RISK MANAGEMENT AT TECHNICAL FACILITIES TYPE AND SITE SELECTION

Dana Prochazkova, Jan Prochazka

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Doc. Ing. Petr Šrytr, CSc.

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LIST OF ABBREVIATIONS

Abbreviation	Title
CBA	Cost Benefit Analysis
ČVUT	Czech Technical University
DSS	Decision Support System
EIA	Environmental Impact Assessment
ESRA	European Safety and Reliability Association
ESREL	European Safety and Reliability Conference
EU	European Union
FEMA	Federal Emergency Management Agency
IAEA	International Atomic Energy Agency
ISO	International Organization for Standardization
IT	Information technologies
OECD	Organisation for Economic Co-operation and Development
SEA	Strategic Environmental Assessment
SMS	Safety Management System
SoS	System of Systems
TA	Technology Assessment
TQM	Total Quality Management
UN	United Nations

ABSTRACT

Technical facilities are created by human activities, and their goal is to provide products or services for the humans´ lives. The technical facilities architecture is the object or the network. Each type of technical facility has its own specifics; e.g. significant differences exist between the control of stable technical facilities and mobile technical facilities. Stable technical facilities affect their surroundings during the whole life cycle, and therefore, their types and locations need to fulfil requirements so they might not seriously damage territory and its inhabitants. The control of object and network technical facilities has also its specifics.

Technical facilities belong to the administration of the various sectors and include physical, cyber, organizational and social systems, i.e. individual devices, machines, components, systems, or the entire production or the service units, and also personnel and way of organization. Large technical facilities represent the systems of systems, i.e. a number of open and mutually interconnected open systems, and therefore, their behaviour is dynamic and depends on a number of factors. The problem-solution way is based on the simultaneously preferred concept, in which the safety is preferred over the reliability.

Management of technical facilities´ safety is not easy and requires the application of specific engineering tools for coping with the expected risks. Due to complex architecture of majority of present technical facilities, their behaviours are sometimes unforeseeable, and therefore, special engineering tools need to be used at their type selection and sitting.

In the past, the attention was not overly given to type selection and location of technical facility. Therefore, some technical facilities projects have not been completed, or after completing their operation have not met the expectations, or even they began to make serious problems, which meant substantial economic losses. Therefore, the book "***Risk management at technical facilities type and site selection***" deals with the problem of specification of the type of technical facilities and their location in the territory. It summarizes results of specific research performed in project "***Řízení rizik a bezpečnost složitých technologických objektů (RIRIZIBE)" CZ.02.2.69/0.0/0.0/16 _018/0002649***". At the request of the CTU Rectorate and the Ministry of Education, Youth and Sports, the submitted version of the book was supplemented in 2022 with data related to the RIRIZIBE project and the format was modified to keep the original pagination.

Since, the deciding body on the subject is the public administration, there are in the book for it produced the tools that will help it to choose the appropriate type of technical facility, which ensures the expected service or products, and to place it in the territory so that, the coexistence of the technical facility with its surroundings may have been during the technical facility life cycle. It goes on the system for decision support and the risk management plan.

Key words: technical facility; sitting; technical facility concept selection; risk; safety; risk sources; risk management; integral risk; risk acceptability.

1. INTRODUCTION

The present monograph is the summary of results of project „Řízení rizik a bezpečnost složitých technologických objektů (Management of risks and safety of complex technological facilities - RIRIZIBE)“ CZ.02.2.69/0.0/0.0/16 _018/0002649. It summarizes the most important present facts. Detail data and lists of all used references are in book [1] and in sources cited in it. The terms used are explain in [2,3]

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1.1. Preface to problem

The goal of every human is to live in a safe world and have development potential. For reaching the target, the humans in addition to a healthy environment and a high quality of human society also need the safe technical systems that are their products. The fundamental problem of the existence of a safe world with regard to the human needs, is the coexistence of these systems in the form, which ensures the human existence, security and the development, Figure 1.

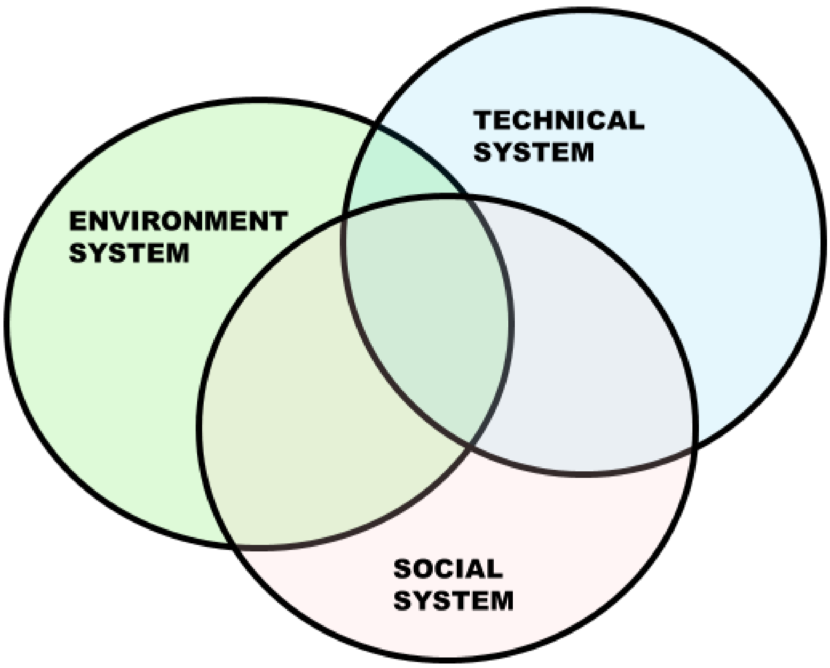

Figure 1. Space for the human life, the human system, it is a system of systems [3] originating by interface of basic three systems which human needs for existence.

Because the humans are only part of the existing world, they can only control their behaviour and actions, so they themselves do not contribute to the distortion of the conditions that are favourable for life. It goes on the concept, which, on the basis of professional knowledge is promoted by both, the progressive professional sphere and the significant institutions such as the UN [4] and the EU [5]. This aspect the authors further pursue by the requirement that the humans, as the creators and operators of complex technical systems, need to ensure so the complex technical systems may be safe, and therefore, they need to avert impacts of disasters: (i.e. adverse phenomena) on themselves and on the technical facilities in order to maintain favourable conditions for their life; and see so they may construct safe systems. Summary of knowledge is in Annex 1 and Annex 2.

1.2. Technical facilities

The work mainly concentrates to complex technical facilities that humans create and operate, i.e. their more descriptive designations are socio-cyber-technical systems. These systems in the form of objects, facilities, fittings, equipment's and infrastructures on the one hand provide to humans the products and services that humans need to quality life and ensure that humans can survive in critical situations, and on the other side they threaten humans by their activities, by hazardous substances that processed, and sometimes also by their products which contain substances that threaten the health of consumers or even the next generation [6-8]. Therefore, it is important the issue of the management of their safety, which is further followed. It is necessary to recognize that complex systems are, de facto, all existing objects and infrastructure around us with the fact that in some time and spatial scales it is possible to neglect the complexity and for solution of several practical tasks to use simple ideas.

The reality is that on the safety of complex technical facilities it is decided on many levels, Figure 2. Effective measures to support the safety are performed on: the technical level and their efficiency are up to 80%; and on the functional level, where their efficiency reaches up to 40% [8]. For the application of effective measures, it should be appropriate situation in human society, because the measures are demanding on the resources, forces and means, i.e. it is necessary support from the management levels.

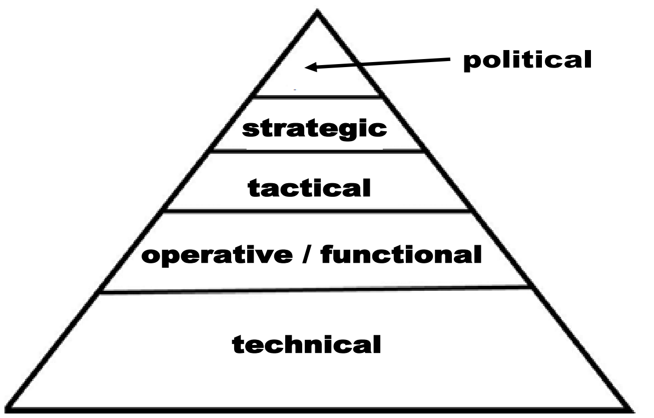

Figure 2. The levels of solving the problems used in the theory and practice of risk management and trade–off with risks.

Technical facilities are created by human activities, and their goal is to provide products or services for the humans´ lives. Their architectures make-up objects or networks, or their interfaces. Each type of technical facility has its own specifics; e.g. significant differences exist between the control of stable technical facilities and mobile technical facilities, and between object and networks technical facilities. Their general form is described by the system of systems - SoS [1-3,6-8]. It goes on an open system that consists of several open systems of different nature and various locations, which are interconnected to ensure certain operations and activities. Interfaces of systems, of course cause the interdependences [7,8].

Some of interdependences only occur at certain conditions [1-3,6-8]. Therefore, of course, it does not hold, that the SoS safety is the aggregation of safeties of subsystems; it needs to respect as well as the cross-cutting risks caused by links and flows across the SoS and with the surroundings. It means that integral safety [2,3] needs to be the management aim for ensuring the coexistence of technical facility with surroundings.

Technical facilities belong to the administration of various sectors and include the physical, cyber, organizational and social systems, i.e. individual devices, machines, components, systems, personnel, organization way or the entire production or the service units. Large technical facilities represent the systems of systems, i.e. a number of open and mutually interconnected systems, and therefore, their behaviour is dynamic and depends on a number of factors. Due to little different aims of safety and reliability [2,8], the problems solution way is based on the simultaneously preferred concept, in which the safety is preferred over the reliability. In the face of complex architecture of technical facilities, their safety mmanagement is not easy and it requires the application of specific engineering tools for coping with the expected risks.

From the present knowledge and the facts set out above, it follows that the safety of complex technical systems, representing the files of open and mutually interconnected systems, which are arranged so as to perform certain tasks in the interval of interoperability, mainly depends on the management of the integral risk, and especially on partial risks associated with links and flows in the system [2,3]. Selecting the appropriate strategy for risk mitigation is very complex and critical task. It does not go on just the reduction of failure occurrence probability, but also on the improvement of the conditions of operating assets, the failure of which can lead to large operating costs [7,8].

Incorrect strategy reduces the productivity and profitability of the technical facility. Selection of strategy for risk mitigation is, therefore, the typical multicriterial decision making problem. The best strategy needs to be selected from the possible alternatives. It needs to be considered the amounts of criterions, some of which are conflicting [2,3,7,8].

To avoid the initiation of major risks that at realisation induce the great losses and damages to both, the humans and the other public and private assets, so the basic aim of control of technical facilities is not just to achieve a large number of products, but also the prevention of losses. On that account, it is looking for a consensus between the risk management and the facility assets management; Figure 3 [7,8].

It goes on finding a way, which will not induce risks that cause losses and damages to public and private assets, which de facto will be greater than the benefits from increased production.

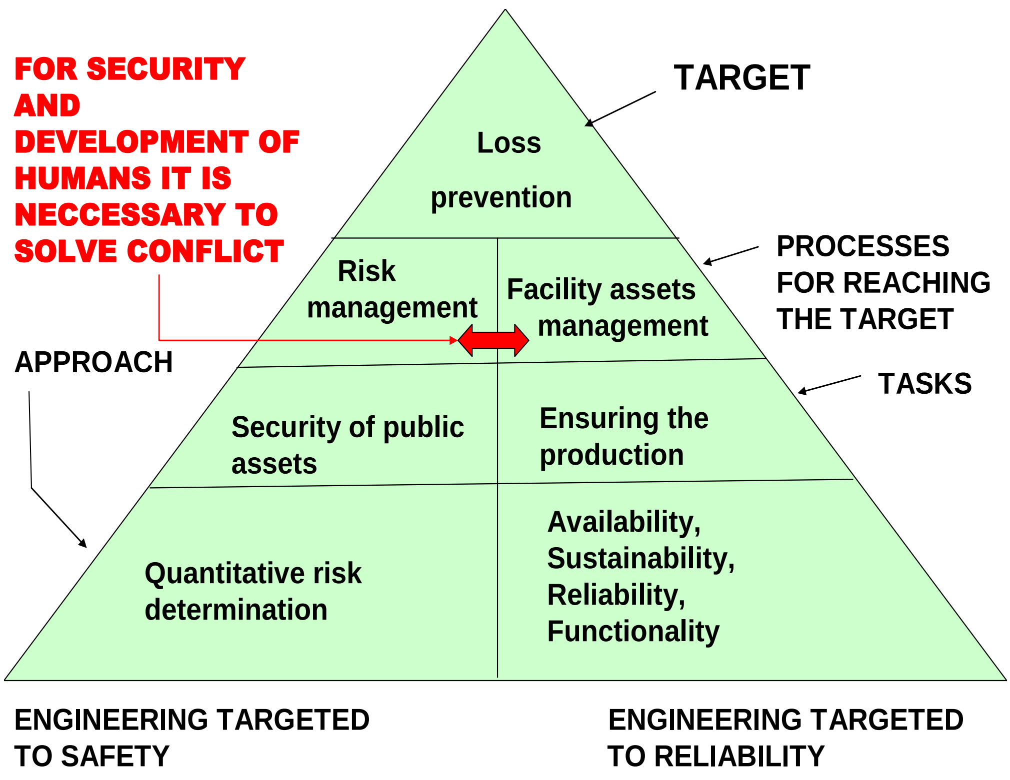

Figure 3. Strategy of technical facility management targeted to human system safety / co-existence of technical facility with surroundings; source idea described in [7].

The further data on technical facilities´ risks, definitions of terms used in risk engineering and their relations are in [2,3].

1.3. Past experiences

In the past, some technical facilities projects have not been completed, or after completing their operation have not met the expectations, or even they began to make serious problems, which meant substantial economic losses. Since, the deciding body on the subject in followed stage of technical facility life cycle is the public administration, the book [1] contains the results of research, which produced the tools that can help public administration to choose the appropriate type of technical facility, which ensures the expected service or products, and to place it in the territory so that, the coexistence of the technical facility with its surroundings may be ensured during the technical facility life cycle. These results are shortly given thereinafter.

Since a technical facility is often required to be placed, where its products or services are needed, one of the possible procedures given in [2,3] cannot be used, i.e. risk cannot be removed by ceasing the technical facility in question. From the point of view of the needs of human society, we have to solve other problems, the solutions of which have their risks. Therefore, to meet the needs of human society, it is necessary to develop several variant solutions and select optimal one, and to prepare principles for such technical facility management directed to safety for future.

Since, there are risks associated with each of the variants, it is then necessary to select a variant that is acceptable from both, the resources, forces and means of human society for its creation and the long-term acceptability of the risks [7,8]. Variants of the proposed technical facility that have a risk lower than the acceptable risk may be accepted, provided that the level of risk will be regularly monitored in the light of the dynamic development of the world. Other variants need either to be excluded from the further decision-making process or their parameters to be adjusted and, if a technical facility is necessary, measures should be taken to mitigate the worst impacts on public assets for the case of a risk realization (it is a real case). According to the data in [1,8], when selecting the optimal variant of a technical facility in a particular case, the following aspects play a role:

- correctly selected technical facility specification,
- achieved level of technical facility safety,
- technical feasibility of measures for ensuring the safe technical facility, considering the suitability of the measures for the given system, i.e. the technical facility and its surroundings,
- material demandingness and energy demandingness of the technical facility,
- speed of implementation of the technical facility,
- claims of the technical facility operation on qualified personnel,
- technical facility demands on transport and information provision, i.e. on communication networks,
- claims of the technical facility for finance during the construction and operation,
- claims of a technical facility for responsibility on safety,
- management / organization requirements in the territory associated with the technical facility.

The publication summarizes the research results in detail described in [1] that show:

- the current state of the section under review at the stage of technical facility preparation (type and location selection),
- real examples of the failure of coexistence of the technical facility and its surroundings, which manifest directly during the type and location selection,
- sources of the risks caused during the type and location selection, which led to the failure of the coexistence of the technical facility and its surroundings at the stage of designing, building or operation,
- appropriate tools from a set of tools that are used in disciplines that work with risks, which will ensure the quality work with the risks associated with coexistence at the technical facility preparation (selection of type and location).

For human security and development ensuring, they are presented two tools that were created by specific research [1]. It goes on:

- the decision support system for the public administration risk management process improvement, the result of which is, that the technical facility gains the capability to be safe for the planned lifetime and its coexistence with vicinity is guaranteed,
- the risk management plan for the public administration, which contains the measures for response to realization of risks expected during the technical facility type and site selection with high potential seriously to damage the technical facility and its surroundings coexistence.

2. FINDINGS ON TECHNICAL FACILITIES TYPE AND SITE SELECTIONS

The detail data on technical facility nature (i.e. system of systems) are summarized in [1-3,7,8]. They show that human system as a model of world in which the humans live, is composed of three basic systems: environmental one; social one, which is related to human society; and technological one, which is represented by technical facilities that humans consistently create for their lives quality improvement. These systems are open and mutually interconnected, and therefore, they are interdependent. Some systems´ interactions are beneficial for humans and other ones adverse and highly unacceptable; some details are in [8,9].

2.1. Risk and safety

The human system safety in the concept based on the UN document [4] is a set of antropogeneous measures and actions by which the humans ensure their security and sustainable development. In this concept, the system safety includes both, the system functionality and the system reliability [1-3,7,8,10-19]. Based on present knowledge and experiences, the system safety can be only reached, if at its management:

- all-important assets are considered,
- the current knowledge in context of system theory is used,
- and the system is forced to perform its activities so that it might not cause phenomena, which would lead to its collapse.

In followed case, this goal can be only achieved when the technical facility management:

- knows and considers all possible risks in details and context [6,8,10-20],
- considers the present knowledge, experiences and time variety of processes,
- and properly negotiates with the risks.

Risk management of the complex technical facility is not easy, because of their behaviors and conditions are affected by processes and phenomena that take place inside and outside the system and, moreover, the processes and phenomena impacts are modified by complex networks of links and flows that are inside subsystems, across subsystems, across the whole system and surrounding area [1-3,7,8].

Knowledge and experience show that the technical facilities are put in a certain environment, which in any case react to the located technical facility. It is also the fact that the quality of services provided by the technical facility during its lifetime and the nature of environment reactions to the technical facility significantly depend on the selected technical facility type.

For human security, it is needed, so environment reactions throughout the technical facility lifetime may be adequate. Each technical facility has four basic phases: planning (selection of type and location); designing and building; operation; and demotion from operation and cleaning up the territory for further use; the present work focuses on the first process, details are in [1].

Research, the results of which are given, is based on the system concept, terms and dates of the publications related to the global ESREL conferences, organized by ESRA [10-20] and it uses the list of terms, which is in harmony with the concept of the UN, the OECD, the IAEA, the WB and others that are summarized in [1-3].

Current knowledge indicates that any technical facility is located in the territory, in which it is a number of sources of risks, which can damage both, the technical facility and the technical facility surroundings. The risk size depends on the size of real disaster, which is a source of risk, and on the vulnerabilities of local followed assets. In the strategic management [2,3,7,8], they are defined variables:

- the hazard as the probable size of disaster that occurs in a given location once per defined time interval (called a design disaster),
- the risk as the probable size of the losses, damages and injuries to the followed assets in the given location at the design disaster occurrence rescheduled per unit time (usually 1 year) and a unit of territory,
- the safety as a property on the system level, which is formed by human measures and activities. The system is safe, when at its critical conditions it does not endanger neither itself nor its vicinity. It generally holds that risk and safety are not complementary quantities, because the technical facility vicinity safety and the technical facility safety can be increased by using the organizational measures realized by humans without having to decrease the risk size; the complementary quantity to safety is the criticality.

2.2. Coexistence

Coexistence generally means a common existence. In the reference case, it goes on ensuring such conditions in the human system at sitting the technical facility into the environment that will ensure the common existence of all interconnected systems. The need for and the importance of coexistence is now under consideration in many technical fields, e.g. [14-17,21-25]. These works show that the technical facilities cannot be designed as closed systems, but always it needs to be considered their surroundings; the same one follows from [1-3,6-20].

Figure 4 shows the basic idea of problem understanding, the target of which is the human security and development during the process of the technical facility type specification and its location in the territory. Due ty dynamic development of world, the continuous solution of conflicts between technical facility and its surroundings is necessary.

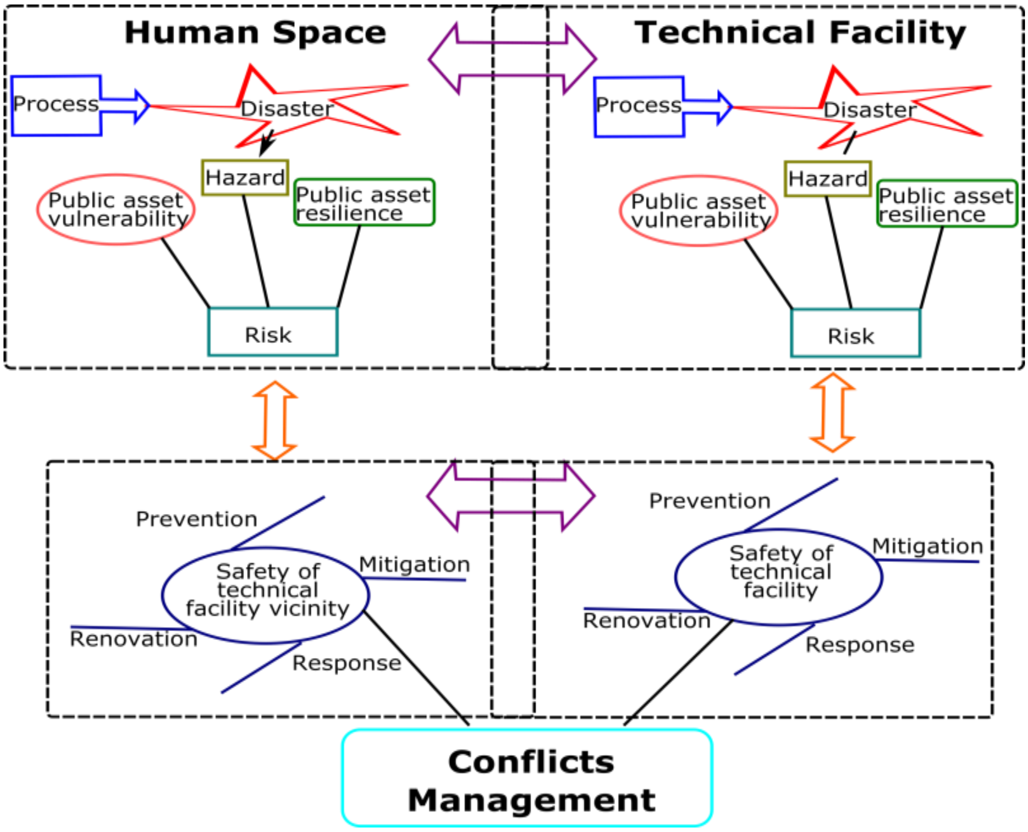

Figure 4. Idea of risk management that needs to be considered during the TF type selection and its location in the territory.

2.3. Requirements on process of technical facility type and site selection

Each technical facility fulfills certain tasks that are necessary for the safety and development of human society, so firstly it is necessary to clarify:

1. Tasks to be performed by the technical facility.
2. Available resources, forces and means for realization of technical facility and its operation.
3. The capability of the planner to ensure the realization and safe operation of the technical facility throughout its lifetime (suitable investor, suitable operator, supervision, acceptability of the impacts of accompanying risks for people, etc.).

Thus, from critical evaluation of the sources of risks, it follows that when selecting the type of technical facility and its sitting in the territory, it is necessary to assess the sources of risks that may significantly affect the safety of people and the environment or disturbed the safety of the technical facility itself. The second case, therefore, concerns the assessment of:

- the safety of the technology, i.e. its reliability and functionality throughout its lifetime; it is necessary to consider maintainability, serviceability, and requirements on service,
- the availability and competitiveness of technology,
- the feasibility of the technology's requirements for knowledge, material, finance, installation and operation of the technology, even in the event of legislative or market changes,
- the ability to ensure the safe operation of the technical facility throughout its lifetime.

The works [3,6-8,26] show that there are many sources of risk. Since there is never enough resources, forces and means, in engineering practice we only focus on critical attributes, i.e. only on unacceptable and conditionally acceptable risks. Therefore, the Total Quality Management (TQM) [27], used in Europe and in the ISO standards, divides the risk sources into three groups:

1. Risk assessment document - all information about the risk is recorded here.
2. Top risks list – set which contains a list of selected risks, the solution of which has the highest demands on resources and time.
3. Retired risk list – it serves as a historical reference for future decision making.

Risks belonging to the second group are identified as priority and need to be monitored. According to the understanding the monitoring in technical and economic disciplines [2,3,7,8], also means that remedial measures are prepared in all aspects in advance. Obviously, this is only possible if we work properly with the risks.

The risk management technique itself, for the sake of cost-effective management of resources, forces and means, formally reviews the risk management and settlement before each stage of risk management in the context of benefits and cost of output; the Coase theorem [28] is used to determine the economic optimum in the cost of risk settlement, Figure 5.

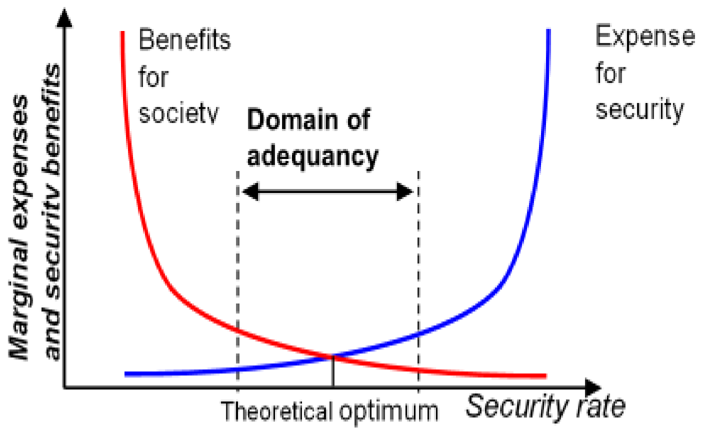

Figure 5. Safety is understood as the optimal interval of acceptable increments of costs for a technical facility; processed according to [28].

From the safety understood by the author of Figure 5, it is clear that benefits from working with risks are for the both, the human society and the technical facility owner, only when the benefits of reducing the risk (providing a higher level of safety) are greater than the costs for reducing the risk.

2.4. Tools used in practice

For the location of a technical facility in the territory, they are used tools that are specified in each country by legislation and they will be briefly characterized. In this context, one should be aware of the current recognition that without standards and legislation we would have been condemned to repeat mistakes from the past, but without putting safety into their improvements and the capability to respond sustainably to unexpected events, we will not be ready for the future [3]. Therefore, the research, the results of which we summarize, monitors risks of all kinds and deals with safety management and settlement tools.

Strategic management of each state, territory or object (i.e. a technical facility) focuses on safety and long-term sustainability [1,6]. In line with current knowledge [2,3,7,8], safety is seen as a system level feature. In this sense, safety is a set of anthropogenic measures and activities by which humans fight back against harmful phenomena of all kinds. In the case of a technical facility, the safety it is a measure of the quality of anthropogenic measures and activities by which humans ensure a safe technical facility.

2.4.1. Strategic planning

Strategic planning includes an identification of problems in the monitored territory, an idea of the goals in this territory in the next 5 to 15 years, an assessment of the feasibility of the goals and the elaboration of tasks into gradual short-term interconnected tasks leading to the fulfilment of the goals; in case of huge technical facilities the time interval is 100 and more years. It is a community tool for making change in territory. Therefore, all local and regional development actors might be involved. Consolidating the interests of these actors is not easy because their goals are often very different. The private sector is primarily profitable because it is the source of its livelihood, and public administration is concerned with the security and development of the territory, in all circumstances, including the emergency and critical situations [29]. The Public Private Partnership (PPP) [30] concept was developed to achieve public-private cooperation.

Security planning is strategic planning [6] that is focused on the safety and development of human society. It includes land-use planning, spatial planning, strategic plans for territorial development, planning in health care, industry, services, agriculture, education, etc. While, the EU and most developed countries are trying to create plans that ensure coordination of requirements and goals of all sectors, so in the Czech Republic, each sector creates its own development plan. This means that conflicts between sectoral development, such as securing the finance, are only resolved when they occur, which often leading to reality that technical facilities are not being carried out as originally intended, or taking a long time to complete or remaining unfinished; examples of induced technical facilities problems are in [1].

2.4.2. Land-use planning

Land-use planning is activity for the purposes of ensuring a safe area and sustainable development of the area. It is about establishing the preventive and mitigating measures against critical disasters and their implementation in practice (it elaborates in detail the development plans of the territory). Land-use planning is a strategic tool that is not designed to deal with immediate problems, where emergency planning and crisis planning have their authorized sites.

In order to save the resources, forces and means of both, the State and the private owners, it is necessary to separate disasters in each territory, based on the risk assessment of disasters [6]. It is necessary to determine disasters for which emergency planning will also be required (i.e. specific disasters) and disasters for which crisis planning will also be required (critical disasters); the crisis planning is significantly exigent on resources, forces and means, namely at all stages of the management, i.e. not only in response (e.g. more in-depth disaster scenarios in territory need to be done, which requires evaluations exigent on data, processing procedures, and evaluators' qualifications).

Risk management [6] creates a certain level of inherent safety for both, the human system and each entity that is part of it, i.e. design disasters should be handled by the project, regulations for land-use planning and construction, operational regulations, emergency management regulations and by instructions for coping with critical situations, and their occurrence should not jeopardize sustainable development [1,2,3,7,8].

Land-use planning is an activity aimed at the mutual arrangement of functionally connected natural and man-made elements / objects / infrastructures in the territory. It comprehensively solves the functional use of the territory, determines the principles of its organization, and coordinates the construction and other activities affecting the development of the territory in terms of time and material. It is a tool for ensuring the security and development of the territory and is specified by the Building Act, related laws and other regulations. In developed countries, spatial planning is common, with the task of addressing not only land but space - high-rise and subsurface objects, which are increasingly being used in practice, and in terms of comprehensive security, rules need to be put in place to ensure that new sources of risk do not exceed a tolerable risk level.

2.4.3. Spatial planning

Spatial planning includes regional policy, strategic planning and spatial planning [29]. It is based on assumption that both, the physical and social environment are constantly changing. It seeks to understand the direction of these changes and looks for possible ways to promote safety and demanded development and to mitigate non-demanded trends in these changes. Spatial planning methods range from exact analysis supported by the GIS to intuition and idea. The aim of spatial planning is the safety and sustainable development of the human system (i.e. the natural, social environment, including the economy and technology). It deals with the organization of population territory, arrangement of human activities and their impacts on environment in the broadest sense (i.e. including the social background). The aim is creation of rational organization of land use and links among types of land use, in order to balance development requirements with environmental protection needs and to achieve social and economic objectives.

Spatial planning is strategic planning that can generally be defined as the process of identifying and achieving long-term goals. Strategic planning is also a tool for building the local community consensus on the future of municipalities. It is a creative and interactive process, involving not only representatives of municipal authorities, but also entrepreneurs and the non-profit sector.

2.4.4. Environment impact assessment, strategic environmental assessment and technology assessment

Environmental Impact Assessment (EIA) is a process of evaluating the probable environmental impacts of proposed project, considering the socio-economic, cultural and human health impacts [31]. It is an auxiliary planning activity aimed at identifying, predicting and assessing the impacts caused by proposed activities such as policy objectives, programs, plans and development projects that may affect the environment.

In order to build a technical facility, the builder needs in most cases to obtain a planning permission from the building authority and then a building permit. However, at some technical facilities building it is the risk, which can unacceptably influence the environment through their impacts (e.g. noise, emissions, waste generation, etc.). In this case, the EIA process needs to be carried out before the planning decision and building permit are issued.

The EIA process assesses the impacts of planned buildings and facilities on public health and the environment, including the impacts on plants, animals, ecosystems, soil, the rock environment, water, air, climate and landscape, natural resources, tangible assets and cultural monuments and their interaction and context. The purpose of the entire EIA process is to obtain an objective professional basis for issuing the subsequent decisions (i.e. mainly planning decision or building permit), and thus contribute to the sustainable development of society.

The EIA process is determined by legislation in each country. The requirement for a variant solution is a key problem in the EIA process. As a variant solution, it is considered to be any suitable solution for meeting the specified objective, i.e.:

- different locations of the construction site and the routing of the transport route,
- various technological processes,
- variant type of activity, e.g. choice of import instead of domestic production,
- different timetable for implementation,
- substitution of raw materials,
- various solutions for waste disposal, emissions, etc.

Generation of variants is understood as a creative model of thinking.

Systematic methods of operational research need to be used for objective solutions. The total risk score is determined for a specified set of risks (brainstorming the experts) and defined variants (scenario fan). The algorithm is based on the application of axiomatic utility theory [32] and AHP methodology [33].

The Strategic Environmental Assessment (SEA) means strategic assessment of impacts on environment [34]. The evaluation in question is perceived as a second generation of the EIA process as a result of the evolution of the EIA process in a changing world. It is strongly integrated with planning, policy intentions, decision-making, the use of sustainable development criteria, all with the participation of the public sector. The influence of internationalization is strongly applied in the field of environmental assessment strategy including the assessment of cumulative effects, biodiversity assessment and formulation of sustainable development principles. The aim of the present effort is to transform foreign internationalized knowledge, recognition and principles into domestic professional literature so as to improve the awareness of experts about the conditions of EIA cooperation within the European institutions and organizations. This transformation concerns methodology, technology and legislation.

As part of the innovation of the problem, new frequent terms have stabilized in the international context, especially SEA and PPP (Politics, Plan, Program):

1. Strategic Environmental Assessment (SEA) is a systematic process of environmental impact assessment of proposed policies, plans and programs. Its task is to ensure their full inclusion and implementation at the appropriate stage of the decision-making process.
2. A policy is a general set of activities or a proposed direction that is declared by the Government and which retroactively directs and influences the Government's decisions. The policy defines objectives and determines steps to achieve them, usually for time horizons of 10 to 20 years (e.g. state concept of transport infrastructure development, energy policy).
3. The plan is a purposeful, forward-looking strategy, often with set priorities, options and measures. Its task is to develop and implement the approved policy, usually for a period of 5 to 10 years (e.g. indicative water management plan).

The program is a coherent, interconnected set of proposals, tools and activities. Its task is to develop and implement the approved policy, usually for a period of one to five years (e.g. waste management program).

Technology assessment (TA) was introduced in the USA in 1972 (The Technology Assessment Act) as a comprehensive interdisciplinary expert assessment of planned technical facilities that considered the current and future impacts on technology, environment, social, social and economic; it began to be used in Europe in the early 1990s [35-46]. The cited publications show that it is not directed against technology. Its aim is to identify problems and prevent damage caused by uncritical application and commercialization of new technologies. The evaluation results are intended for policies that ultimately decide whether to enable the technical facility to be implemented.

The decision has a dilemma: on the one hand, the impacts of a new technical facility cannot be easily predicted until the technical facility is extensively developed and used; and on the other hand, managing or altering a technical facility is difficult once it is widely used. Decision making is difficult because in a specific case:

- it is difficult to estimate the cost of externalities and internals,
- it is not easy to select indicators to assess the benefits and impacts of new technology,
- recalculation of damage and injury to money is not easy,
- there are ethical barriers.

Based on the above quotations, the present evaluation is mainly used in the following areas: information technologies; hydrogen technologies; nuclear technologies; molecular nanotechnologies; pharmacology; organ transplantation; genetic technologies; artificial intelligence; internet etc.

There are many institutions in Europe that conduct technology assessment in this sense and are a member of The European Parliamentary Technology Assessment (EPTA). For example:

1. Centre for Technology Assessment (TA-SWISS), Bern, Switzerland.
2. Institute of Technology Assessment (ITA) of the Austrian Academy of Sciences, Vienna.
3. Institute for Technology Assessment and Systems Analysis, Karlsruhe Institute of Technology, Germany.
4. The Danish Board of Technology Foundation, Copenhagen.
5. Norwegian Board of Technology, Oslo.
6. Parliamentary Office of Science and Technology (POST), London.
7. Rathenau Institute, The Hague.
8. Science and Technology Options Assessment (STOA) Panel of the European Parliament, Brussels.
9. Science and Technology Policy Research (SPRU), Sussex.
10. Department of Science, Technology and Policy Studies, University of Twente.

Some of these organizations are members of a specific panel of the European Parliament and form the European Technology Assessment Group (ETAG), which handles EU research projects in the field. The form of evaluation of technology is determined by legislation in individual countries; the goal is the same, but the form of application differs. The Czech Republic does not have legislation on technology evaluation; however, its representatives participate in EU projects in the relevant field [43].

2.4.5. Resilience

The aim of all human activities is to ensure the coexistence of the technical facility and its surroundings, i.e. the technical facility needs to be safe so that it does not endanger itself or its surroundings under its critical conditions. Today, we say that a technical facility and its surroundings need to have good resilience. In accordance with [2,3,7,8], the resilience means resistance in terms of toughness. This means that the interconnected system needs to have the capability to recover when a major disaster of any kind occurs. It is a fact that the number of disasters is growing rapidly due to the increasing vulnerability of the world (number of people, demanding modern technologies with great destructive potential, people's intolerance…), and therefore, continuous good work with risks over time is required in this interconnected system [3].

Based on data summarized in [1], the resilience is understood as the capability of the system to withstand a major failure with acceptable degradation and to recover at an acceptable time and cost. It is about ensuring the safety of human society, which, as it has been said above, relates to both, the practices and the capacities associated with dealing with disasters of all kinds, i.e. non-demanded phenomena. Therefore, when considering the location of a technical facility and selecting the scenario for its construction and operation, it is necessary to consider the public confidence in public functions and to ensure the reliability of social functions. Evaluation of present knowledge shows that according to engineering disciplines that deal with technical facilities, the resilience is a tool for ensuring the safety of technical facilities and their surroundings.

In the case of a technical facility, consideration should be given to ensuring the technical and organizational resilience, with public administration also having to participate in securing the latter. The organizational resilience according to [47] includes:

- training and readiness,
- situational awareness,
- creating response forces,
- bringing together all organizations and citizens in response and recovery,
- the obligation of both, technical and public administrators to create a safety culture and to build resources for a correct and timely response to disasters,
- and flexibility to adapt to a situation aimed at coping with the emerging emergency.

The cited work also states that obstacles to resilience are:

- lack of time (16%),
- lack of incentives (12%),
- existing hierarchy in management (13%),
- confidentiality and security matters (10%),
- insufficient benefits (12%),
- failure to provide information (11%),
- fear of criticism (9%),
- lack of confidence (9%)
- and technical issues (8%).

Of course, ensuring the resilience is particularly important for complex technical facilities. E.g. work [48] shows its great need for critical infrastructure, especially in identifying the potential emergencies and responding to expected emergencies. Resilience in the present case is understood as the capability of a technical facility to:

- reduce the impacts of disruption of performance and services on the population,
- absorb the consequences of any disruption of operation when they occur,

- quickly recover from a fault and return to normal operation within a reasonable time,
- and adapt the operation to sudden critical conditions.

Of course, this is possible if all the important assets of the technical facility and their interconnections are properly selected based on a thorough analysis of the vulnerabilities in and around the technical facility.

The concept of social provision (security) is defined as the capability of a society to protect and maintain a common or national identity despite potential or real threats. Therefore, the EU demands to build a resilient society, which means building the capacity of human society:

- to prevent the occurrence of disasters, i.e. adverse events, of all kinds,
- to mitigate and deal with the impacts of disasters, i.e. adverse events when they occur,
- to ensure recovery and return to normal after disasters.

In the monitored context, of course, it goes on all the basic subsystems of the human system, i.e. the social, environmental and technological systems, and their interconnections. The key elements of resilience have social and specific elements in all technical facilities.

All the above-mentioned works related to building the resilience of technical facilities and their surroundings show the importance of proper risk management, which is confirmed by the conclusions in the initial monograph [1] on a set of interconnected monographs related to risk management of processes in technical facilities aimed at their safety [3]. This is because increasing the resilience, i.e. the toughness of both, the technical fittings and systems and the human communities, is one of the tools that can be used to increase the integral safety of the human system and its components. All the work used shows that correct risk foresight, robustness of the system, and capability to adapt to disaster-induced conditions are decisive in managing the risks of technical facilities and their surroundings. Proper work with risks needs to be set at the beginning of the preparation of the technical facility, its mission, tasks and security.

2.4.6. Complex tool for technical facility safety management during life cycle

By logical synthesis of the data and experience, there was designed a tool for determining a scenario of area management, which considers the human survival during the critical disasters. Process model of the tool is shown on the Figure 6 [7,8]. The scheme was opposed and recommended by experts from the project FOCUS research team. It was tested in practice by selected experts and students of the safety fields of technical and managerial specialization. For widespread use in practise it is a form of tool, which is understandable, provides professional accuracy and information value results, transparency of getting results, is user friendly and it is possible to set up an IT tool for it, which can provide an access to technical data, their correct processing as well as decision support (criteria, limits, indicators, etc.). The process model contains four main parts called: areas; risks; what to do; and critical interface – a question of survival.

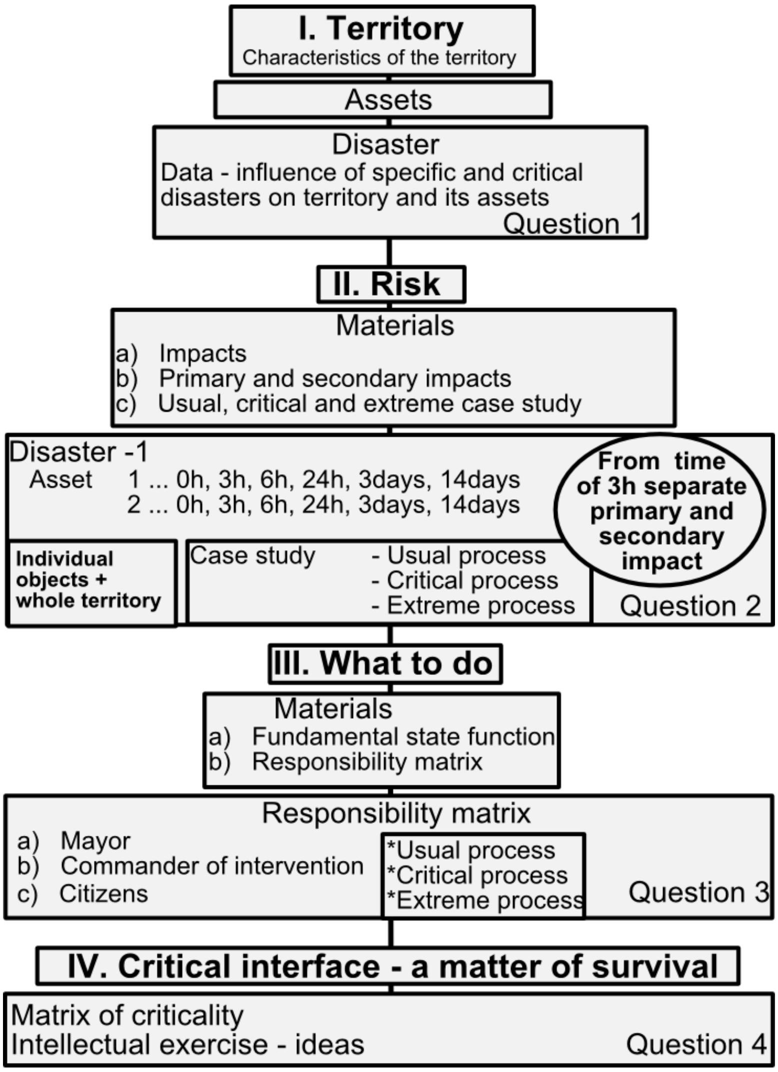

Figure 6. Scenario of territory management that ensures the human survival during the critical disasters.

The objective of the first part “area”, which is connected to technical facility location, is to create a credible scheme and characteristics of an area, both should show the layout of objects important in the terms of protected assets (human lives, health and security; property; public welfare; environment; infrastructures and technologies) and in terms of domino effects resources, which can increase the severity of the situation caused by a disaster. It is necessary to create the list of potential disasters when applied the principle of All Hazard Approach [6,26] and set of data about the impacts of potential disasters on the area, including the data about the vulnerability to specific disasters; the details are in [2,8].

3. RISK ENGINEERING METHODS USED

Both, the logical methods (analysis, synthesis, deduction, evaluation and assessment) ant the specific heuristic methods (described in [2,3,33]) are used to obtain the results which will be in next chapters. At this point we will give only the methods on which the following results are based. These are: fishbone graph; case study; decision support system; and a risk management plan.

3.1. What, If

The What, If method is the most general method for detecting the impacts of a disaster by which the risk of a disaster can be determined. We use it in the form of filling the table; Table 1 [2,3,33] using the data from experts obtained by brainstorming or panel discussion.

Table 1. Standard model for applying the What, If method.

Asset		**The potential impact of a disaster on an asset**
Human lives and health		
Human security		
Property		
Welfare		
Environment		
Infrastructures and technologies		
	Energy supply sector	
	Water supply sector	
	Sewerage sector	
	Transport sector	
	Communication and information sector	
	Bank and finance sector	
	Emergency services	

	Basic territory services (industry, agriculture, supply service, health service, waste management, social services, funereal services)	
	Public administration	
Technical facility: - critical fittings - critical components - critical links - critical infrastructures - critical couplings - critical stocks - critical personnel - critical processes management - ………..		

3.2. Checklist

The checklist is an engineering discipline tool that allows a multi-criteria assessment of the nature of the problem being observed [2,3,33]. Checklists are aimed at risk or safety of a technical facility and they are an essential tool for managers because they clearly identify risks in areas that are well-known and for which the development of knowledge and experience are defined by the limits of individual activities, actions, behaviours, etc. To ensure safety and development, it is necessary to eliminate the immediate, evident and recognizable risks. For their identification, the checklists serves very well. Then, it is necessary to reveal and to cope with the risks that are hidden in the chains of possible events, delayed in time using the specific methods and specific and qualified data.

3.3. Ishikawa (Fishbone) diagram

Fishbone diagram (Ishikawa diagram) is a tool used at causal analysis of the observed problem [2,3,33]. The cause-and-consequences analysis helps to thoroughly understand the nature of the problem by forcing us to address all possible disaster causes. The procedure for its application is:

- identification of the problem (it means to answers to the questions:
    - where does the problem occur?
    - what is the nature of the problem?
    - when did it occur?
    - how often did it occur?,
- enumeration of significant problem factors (factors are fish bones),
- identification of possible causes (small lines on 'fish' bones),
- diagram analysis.

To create a diagram, it is necessary to collect and organize data about the causes that cause the problem and their impacts. This means that the processes associated with the problem to be solved needs to be described in detail by data, while the random and knowledge uncertainties [2,3] need to be clarified. Collecting the data is a first step and is time and knowledge consuming, as many resources need to be used to make the data files representative, i.e.: complete; containing the correct data; have sufficient data number; the data must be spread homogeneously throughout the observed interval and was validated [3].

The tool under review supports the analysis of the causes and consequences of a particular process, phenomenon or object, State and facilitates the search for solutions to the problems that have arisen. The aim of the method is to identify all possible causes or sources of the problem (or areas that affect the problem) and to structure them graphically.

The problem-solving organizer draws a "fish skeleton". In a group discussion, the consequences are placed on the respective skeleton sites according to their kinship and then causal chains of causes and consequences are searched for on the basis of discussion (brainstorming). The method can be used, for example, in the creation of departmental concepts, in identifying the starting state and in defining the starting points. Data that can be detected with considerable effort by routine data collection or measurement can also be quickly obtained. However, the knowledge and experience (i.e. qualifications) of the discussers is a drawback of the method.

3.4. Case study

A case study that relates to a specific decision, is associated with certain work models or simulations of processes that take place over time and territory or in an entity [33]. The case study describes and justifies the real experience gained from life in the subject area, thus broadening the knowledge of the problem and its aspects. The quality of the case study, i.e. the quality of the results presented in the case study, is based on the knowledge and life experience of the case study processor.

The case studies are based on both qualitative and quantitative data. Their result is a qualified locally and time-specific solution to a particular problem / case, and therefore, they are a suitable tool to support decision-making and management at the site. They are used when the knowledge of the problem in the system conception is unstructured, i.e. in connection with the problem in which for a number of elements, links and flows of the assessed system there are not only uncertainties that can be assessed by mathematical statistics, but also vagueness (epistemic / knowledge uncertainties), the estimation of which requires highly qualified data sets and demanding theoretical procedures. In other words, the problem and context data in the system in question do not meet the requirements for a generally valid solution. Therefore, either expert methods or case studies are used in these cases [33].

The case study methodology is, according to the knowledge gathered in [2,3,33], a tool to obtain a set of knowledge about the problem. It combines theory with practice while requiring the practical skills:

- identifying and recognizing the problem,
- understanding and interpreting the data and information,
- distinguishing the facts from the assumptions,
- analytical and critical thinking,
- understanding the random and epistemic uncertainties (data is never complete),
- improving the judgment,
- capability to communicate issues with experts with a different opinion.

It is a problem-solving technique under various conditions (therefore, multi-criteria analysis of the system and its surroundings is important). It allows to solve unstructured problems, which are almost all failures and all complex systems accidents. It does not assume random distribution of solution variants.

It is de facto a historical scenario of a process, i.e. a model of the course of a certain process that takes place under specific conditions, i.e. at a certain place and at a certain time. From a methodological point of view, it is a process model that is compiled on the basis of real data. It is used in project and process management, if the knowledge of the problem in the system conception is unstructured, i.e. in connection with a problem in which many elements, links and flows of the assessed system are not only random uncertainties that can be assessed by mathematical apparatus. statistics, but also knowledge uncertainties, which require highly qualified data sets and demanding theoretical procedures. In other words, the problem and context data in the system in question do not meet the requirements for a generally valid solution.

The processing of a case study, as well as the processing of an expert opinion, requires both, the multidisciplinary and the interdisciplinary theoretical and practical knowledge, at least in the field of management and systems safety management, as well as considerable practical experience. In addition, it teaches justifying decisions to solve a problem.

In original monograph, they are used two forms, evaluation case study and prognostic case study. The evaluation study evaluates the potential risks and their impacts on the safety of the technical facility being prepared in a specific territory. When compiling it, the following questions are used:

1. What is the problem of the proposed technical facility and its surroundings?

2. What are the aspects and impacts of the problem on the conditions and development of the proposed technical work and its surroundings?
3. What is the root cause of the safety damage the proposed technical facility and its surroundings?
4. How could be averted the accident or failure of proposed technical facility and its surroundings?
5. What should be done to prevent a proposed technical facility and its surroundings from occurring safety the damage of during the lifetime?

Process of case study compilation is in Figure 7.

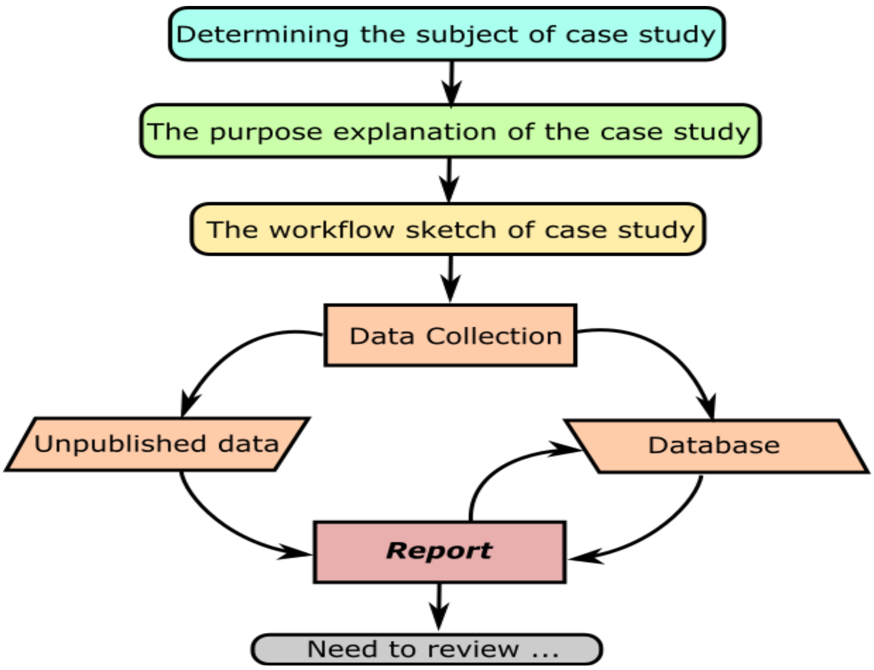

Figure 7. Process of case study compilation.

3.5. Decision Support System

The Decision Support System (DSS) [2,3,33] is a special technique for obtaining data for deciding the complex problems. It generally consists of the following components:

- data management module,
- model of management modules (models´ library),
- module for management of dialogue with user,
- and knowledge core (Knowledge engine).

There are different DSSs, or they have different conceptual starting points:

- model-based DSS (it uses statistical simulations),
- communication DSS (it is for cooperation on a number of decisions),
- document DSS (it uses different types of documents to support decisions),
- knowledge DSS (it contains defined rules).

The decision support system (DSS) helps to solve the problem by supporting an analytical style of decision making against heuristic decision making. This means that:

- it organizes information for decision-making situations,
- it interacts with the decision-maker at various stages of decision-making,
- it extends the information horizon of the decision-making body,
- it facilitates multi-criteria evaluation, because it has built-in multi-criteria methods without the user knowing their mathematical structure.

Decision support systems use a general model for the certain case, reflecting the real situation. When specific parameter variables are substituted, they provide results for the given problem. The aim is to ensure so that the result corresponds to the optimal solution. In their creation and application are used:

- knowledge and data from experts, who know the technical parameters, limits and conditions of the technical facility and the local vulnerabilities,
- the principle of maximum utility theory [32], i.e. "the greater, the better" or "the greater, the worse".

DSSs are divided into special ones that provide support for solving the specific problems; and general, which are based on adaptive and flexible decision-making models. Obviously, the use of a specific DSS is only possible when verification establishes that the conditions for technology transfer are met [3,49]. Otherwise, the method needs to be adapted to local conditions. It should be noted that the adaptation of the method to specific conditions cannot be done by IT specialists, but by technical experts, who know the technical parameters, limits and conditions of the technical facilities and local vulnerabilities.

Applications of sophisticated DSS based on multi-criteria evaluation give good solutions [3]. In our case, we will compile a DSS in the form of a checklist [2,3,33] supplemented by a rule for evaluating questions in terms of [32] and assigning a logical value scale.

DSS application aims are:

- identifying, managing, eliminating or minimizing unforeseen events that have an adverse impacts on critical elements, critical components, critical processes, critical functions, critical infrastructure and critical technologies in the technical facility,
- the process of comparing the estimated risks against the benefit and / or cost of possible countermeasures and establishing an implementation strategy in the context of integral (systemic, overall) safety,

- determining which disasters (harmful phenomena) the technical facility is exposed to, what are the risks from individual harmful phenomena, what damage may arise, which measures will eliminate or minimize the occurrence of harmful events,
- the procedure consists of:
  - the assets are defined and their safety requirements are defined,
  - identification of vulnerabilities, potential impacts and risks,
  - estimation of: the amount of potentially caused damage; and the costs of appropriate safety measures,
  - adequate safety measures selection.

For critical items, limit values (limits) shall be established to ensure acceptable security. This means that the task of their managing is to ensure compliance with the limits, and therefore, the basis is thorough monitoring and qualified DSS.

3.6. Scoring variables using decision matrix

The method of scoring the variables according to [33] makes it possible to classify the problem described by two mutually incommensurable variables into several categories according to established preferences. The method itself does not set or recommend classification criteria. In practice, it is very often used to classify risks into acceptable, conditionally acceptable and unacceptable risk [2,3,33] or to categorize objects according to their criticality [7,8,50]. The method will be further used to assess the benefits and risks of the proposed technical facility.

3.7. Risk management plan

The risk management plan is based on the TQM facility management method [27], i.e. in the monitored facility they are considered priority risks that could not be settled and that have the potential to significantly damage a technical facility at their realization. The plan itself is drawn up in the form of a table [2,3] that considers the risks of:

- technical facility,
- internal sources of risk of the technical facility related to its construction, construction, equipment and operation,
- technical facility personnel,
- external sources of risk of technical facility associated with natural disasters,
- external sources of technical facility risks related to public administration behaviour, competition, market, etc.,
- attacks on technical facility,
- cybernetic risk sources associated with networks,

- war.

For each risk area, the table shall indicate:

- causes of risk,
- the probability of risk realization occurrence frequency and the expected size of the impacts of the risk on the protected assets (basic public assets should also be considered based on legislative requirements),
- risk management measures, or at least for risk mitigation, which are clearly identified, and at each of them it is given responsible person for their implementation.

The risk management plan is also recommended by ISO 31000 [51].

To develop a risk management plan that meets the management requirements required by the TQM, it is necessary to know in detail:

- disasters, i.e. sources of risks,
- local vulnerabilities that determine the severity (criticality, relevance) of critical situations,
- and possibilities of response in critical situations.

As it has been shown [2,3], the risks are associated with itself work with the risks, and therefore, a checklist (Table 2) for assessing the criticality of the risk management plan [7], has been developed and tested in practice; the scale of which was used to assess each item:

0 point - fulfilment of the criterion has negligible shortcomings in the monitored area (less than 5%), i.e. it has negligible criticality,

1 point - fulfilment of the criterion has low deficiencies in the monitored area (5-25%), i.e. it has low criticality,

2 points - fulfilment of the criterion has medium deficiencies in the monitored area (25-45%), i.e. it has medium criticality,

3 points - fulfilment of the criterion has high shortcomings in the monitored area (45-70%), i.e. it has a high criticality,

4 points - fulfilment of the criterion has very high deficiencies in the monitored area (70-95%), i.e. it has a very high criticality,

5 points - fulfilment of the criterion has extremely high deficiencies in the monitored area (higher than 95%), i.e. it has extremely high criticality.

Table 2. Checklist for judgement of quality of risk management plan.

Question	**Rating**
Is the risk management plan guided by a clear vision and the objectives pursued?	

Does the risk management plan apply the principle of integrity (i.e. consideration of the welfare of the social, ecological and economic subsystem; expression of costs and benefits; impacts and benefits of economic activity using the both, the monetary and the non-monetary values)?	
Are substantial elements considered in the risk management plan (e.g. fair distribution of resource use between present and future generations; over-consumption and poverty; human rights; environmental conditions conditional on life; prosperity permitted by economic development and off-market activities)?	
Is the risk management plan adequate in scope (e.g. appropriate time and space measure)?	
Is the risk management plan practically focused (e.g. explicitly defined categories that link the idea with indicators and criteria; a limited number of key objectives; a limited number of indicators; a standardized way of measuring and benchmarking; benchmark values, thresholds, development trends)?	
Is the risk management plan open (e.g. generally accepted methods and databases; explicit plausibility, elimination of uncertainty)?	
Is effective risk management communication included in the risk management plan?	
Is the general public involved in the risk management plan?	
Does the risk management plan provide for a follow-up assessment (e.g. specifying the progressive targets due to system development)?	
Are the institutions' capacities ensured in the risk management plan (e.g. identification of responsibility for meeting the decision-making process objectives, data collection and storage, documentation)?	
TOTAL	

The scale for overall criticality of the risk management plan is determined in analogy to the principles used since the 1980s in standards. The resulting criticality rate, assuming all criteria have the same weight, can range from 0 to 50; the thresholds for the criticality level of the risk management plan corresponding to the scale used are given in Table 3.

Table 3. Value scale to determine the level of criticality of the risk management plan.

Criticality rate of the risk management plan	**Values in %**	**Number of points for all criteria**
Extremely high– 5	Over 95 %	Over 47.5

Very high – 4	70 - 95 %	35 – 47.5
High – 3	45 - 70 %	22.5 – 35
Medium – 2	25 – 45 %	12.5 – 22.5
Low – 1	5 – 25 %	2.5 – 12.5
Negligible – 0	Less than 5 %	Less than 2.5

4. RISK SOURCES

For research need, it was compiled the database of real cases in the world (254 cases) in which the risk management during the process of technical facility type specification and its location selection in the territory failed [52]. Their detail studies based on critical analysis of causes and impacts using the methods: What, I; checklist; and case study, show that in these cases, they were often occurred the high-delay and large financial losses associated with the technical facility [1]. Last cited work contains several detail case studies for documentation.

Failures of type and site selection of technical facilities resulted in reality [1] that they:

- have never been built or completed,
- have been built but has not been put into operation,
- have been completed, put into operation and the operation has ended prematurely because of either high operating costs (costly operation, frequent interruptions requiring costly repairs, etc.) or major conflicts with the surroundings (air contamination with gaseous hazardous substances, noise, waste, etc.),
- were completed, put into operation and a major accident caused by the interactions between the technical part and the surroundings, which were not considered in the project, ended the operation.

From the above sources, the causes of failure of the coexistence of the technical facility with its surroundings, which occurred over time, were found:

1. Technical:
    - the technology used for the technical facility had obvious technical deficiencies (incorrect specification of the technical facility),
    - the type of technical facility, the construction and operation of which were too demanding on the available resources in the area (knowledge; material for manufacturing; raw materials for operation; technical elements, equipment and components; finance; management method; or skill of workers at construction or operation),
    - the technical documentation of the technical facility was incomplete, e.g. it did not contain an accurate description of all the equipment and way how it might be operated,
    - lack of proof of technical feasibility of the technical facility in the territory,
    - there were no measures to reduce the impacts of the technical facility on the territory during its operation,
    - there are no replacement of equipment and components of critical items,
    - there are already technical facilities in the vicinity of the technical facility which caused the technical facility failure or accident,

- the energy performance of the technical facility exceeded the capacity available in the territory,
- the transport demand for the technical facility exceeded the transport possibilities in the territory,
- material demands were not properly valued and caused downtime or shutdown.

2. Financial:
   - claims for the construction of the proposed technical facility were not verified, and therefore, proved to be underestimated,
   - claims for technical facility included only construction costs and did not include operating costs,
   - operating costs do not include maintenance, timely repairs, etc.,
   - the budget did not envisage the occurrence of situations requiring additional costs (e.g. increased tax burden, change in public support, occurrence of natural disasters, etc.).
3. Personnel
   - the underestimation of the technical facility in terms of the amount of staff needed, considering the capacity of the surroundings,
   - underestimated demands on qualified personnel,
   - the working mode set did not include the social needs of the staff.
4. Management of technical facility - organizational causes:
   - the documentation did not contain all the particulars required by the legislation,
   - incorrect timing of construction implementation,
   - incorrect division of the investment unit into stages,
   - incorrectly set operation parameters and operating modes,
   - responsibilities in the construction of the technical facility have not been clearly defined,
   - responsibilities for the processes in the technical facility have not been clearly defined,
   - lack of operational rules for abnormal and possible critical situations and emergency plans,
   - lack of continuity plans for critical components of the technical facility to ensure that they were overcome in the event of beyond design disasters.
5. Management of public administration around the technical facility - organizational causes:
   - incorrect supervision of the public administration over the construction of a technical facility (it does not require so technical facility designer and manufacturer had to work with priority risks that are connected with technical facility location),

- incorrect supervision of the public administration over the operation of the technical facility (it does not require so technical facility operator had to work with priority risks that are connected with technical facility location),
- failure to create tools for the survival of people in the event of a disaster or failure of a technical facility in areas of high population density or highly contaminated.
- unclear means for cooperation with technical facility in emergency situations.

6. Safety of the technical facility:
    - at type and location selection, they were not considered all possible risks during manufacturing and operation inside and outside the technical facility and their impacts on the technical facility and its surroundings,
    - the impacts of external disasters on the technical facility were underestimated,
    - the cross-sectional risks that might be realized through the interconnections of components and systems of the technical facility only under certain conditions, e.g. in case of disasters, were not considered in the safety analyses performed for decision on technology and location,
    - lack of means for security, emergency and crisis plans, or their logical linking,
    - at type and location selection, there are no clearly defined functions relevant to the safety management of the technical facility,
    - the vulnerability of critical assets of the technical facility has not been correctly assessed,
    - the demonstration of the management of possible accidents in the technical facility was insufficient,
    - the mitigation of the environmental impact of construction and operation was insufficient,
    - the safety objective of the technical facility and the means for ensuring it, have not been clearly defined,
    - a safety culture has not been built,
    - a program to maintain and enhance the required safety has not been clearly defined.
7. Other:
    - the technical facility belonged to a category of interest to insiders and terrorists, and the lack of adequate technical and cyber means, human resources and financial costs for its protection,
    - the acceptability of the technical facility by the public was not sufficiently ensured.

The analysis of the data collected on the failure of selection and placement of the technical facility in the territory show the specific causes of failure (unfinished implementation, major problems in operation, and therefore, premature closure), which can be summarized as follows:

- incorrect specification of the technical facility,

- incorrect location of the technical facility,
- high material and energy demands of the technical facility,
- high demands on the operation of the technical facility for qualified personnel,
- high demands on the technical facility on transport and information provision, i.e. communication networks,
- high demands of the technical facility on finance during construction and operation,
- high demands of the technical facility on responsibility for safety ensuring,
- high demands on the management of the technical facility and on the supervision of state authorities over the safety of the technical facility.

Based on these data, there are derived the causes of coexistence failure shown in Figure 8 using the Ishikawa diagram described above.

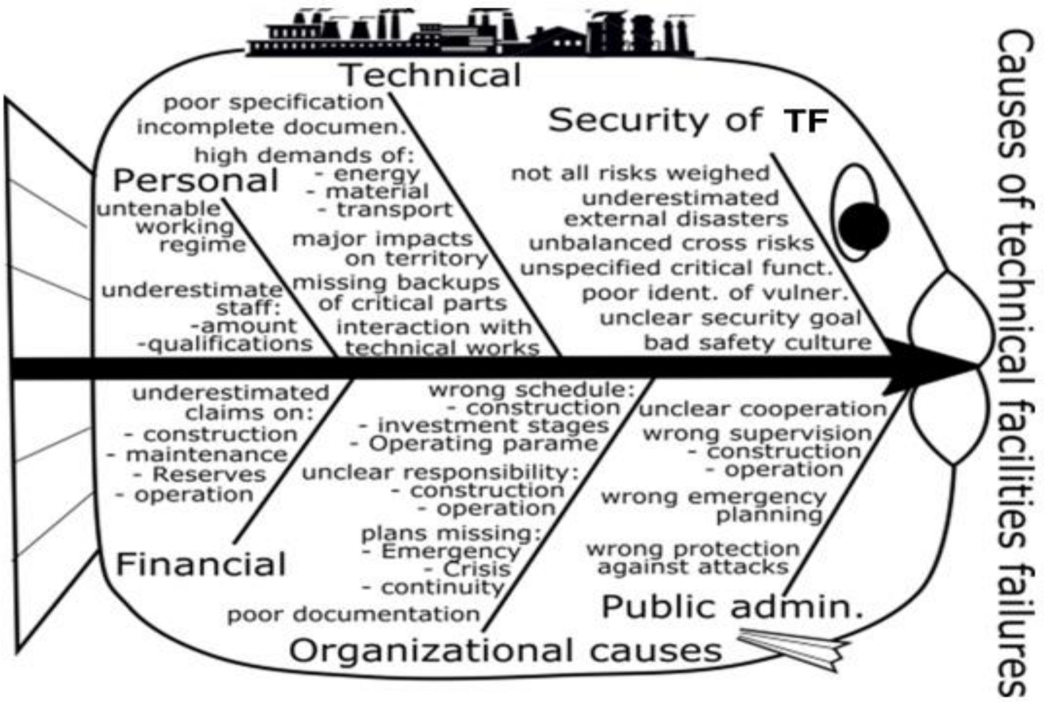

Figure 8. The causes of the coexistence failure of the technical facility (TF) and its vicinity due to a technical facility type bad selection or to a wrong technical facility location in the territory.

The main causes of the coexistence of the technical facility are mainly related to the knowledge and behaviour of the entities managing the territory, permitting and supervising the technical facilities in the area, which is confirmed by the conclusions stated in the works [3,7].

5. TOOL - DECISION SUPPORT SYSTEM FOR ENSURING THE COEXISTENCE AT THE TECHNICAL FACILITY TYPE SELECTION AND ITS SITING IN TERRITORY

Based on the collected knowledge, it was constructed the Decision Support System – DSS for the evaluation of risks associated with the proposed technical facility [1], Table 4. The criterions are evaluated by scale (0-5) with the philosophy "the higher number, the higher risk, i.e. the lower technical facility coexistence with the surroundings" [32]. For the DSS application in practice, two scales are recommended; Table 5 derived in [53] and Table 6 for risk rate assessment from the Technical Standard.

The assessment of Table 4, hereafter given, assumes that all criteria have the same weight. Practical examples [52] show that in many cases some criteria are more important than others, and therefore, it is necessary to assign them higher weight, and to change data in Table 6 by appurtenant way.

Table 4. Checklist for the assessment of risk associated with the co-existence of the proposed technical facility and its surroundings. A- result of assessment (YES / NO) – auxiliary scale is in Table 5, N - note.

Criterion	**A**	**N**
The technical facility design in its documentation contains:		
• impacts of disasters, according to All-Hazard-Approach, that are possible in the territory		
• impacts of disasters on the population in the technical facility vicinity		
• impacts of disasters on the environment in the technical facility vicinity		
• safety analysis, in which there are considered the cross-cutting risks, which are only implemented by interfaces of components and systems of technical facility under certain conditions (at the occurrence of certain disasters), and they may cause cascade failures in the technical facility		
• countermeasures (preventive, mitigating, reactive, and recovery) to cope with the expected emergency situations and possible critical situations; it has the operation rules for normal, abnormal and critical conditions, emergency plans and it contains the obligation to forward information to the public authorities in major accidents, the impacts of which can exceed into the technical facility surroundings; it considers all the essential public assets		

• data that are logically consistent in all conditions and in it they are clearly defined the functions important to safety management of the technical facility		
• information in which it is clearly assessed the vulnerability of critical assets of technical facility and given the proof of coping with possible accidents in the technical facility		
• information, in which there are clearly defined: safety target of the technical facility and the tools for its ensuring; procedure for building the safety culture; program for the maintenance of required safety and for its increase		
• assessment, whether the entire technical facility or some its part may be in the interest of insiders or terrorists. If so, it has given the corresponding technical and cyber resources, human resources and financial costs of protection		
• procedures for cooperation with public administrations in the construction and operation of the technical facility		
• all the elements required by the legislation		
• certified construction schedule		
• realistic division of investment unit into stages.		
• realistically set-up the parameters of operation and operating mode		
• clearly defined responsibilities for the processes associated with the construction of technical facility		
• clearly defined responsibilities for the processes associated with the operation of technical facility		
• realistic operating rules for normal, abnormal, and the possible critical situations, emergency plans, and also business continuity plans for critical components of technical facility that would ensure the renovation of technical facility in case of beyond design disasters		
• clearly defined requirements for necessary technical facility staff and their qualifications		
• judgement of fulfilment of requirements for qualified personnel with regard to the options that are in the vicinity		
• operating modes, which respect the social needs of workers and ensure their safety		
• certified financial demands on the construction of technical facility		
• certified financial demands on the operation of technical facility including the costs on maintenance and timely repair		

• proof that technical facility is feasible for the available resources (knowledge; material on the making; the raw materials for operation; technical elements, fittings, devices and components; finance; the way the process control; or the skill of the staff in the construction or traffic)		
• complete technical documentation, as the precise description of all-important devices and method of their operation		
• list of backups and reserves for critical equipment and critical components		
• information that it uses the technology that has obvious shortcomings		
• information about energy performance and judgement whether surrounding territory has a free appropriate capacity		
• information about water amount and judgement whether surrounding territory has a free appropriate capacity		
• information about construction of other sources of water in event that capacity of territory is insufficient		
• information on claims for transport and judgement whether surrounding territory has a free appropriate capacity		
• information about construction of other transport infrastructures in case that capacity of territory is insufficient		
• information about material and assessment of available potential suppliers		
• information about how to search for other suppliers of material		
• information about consumers and evaluation of available potential consumers		
• measures how technical facility will deal with disorders of the critical components or critical equipment, failure of energy supply, failure of supply of cooling, and countermeasures for cope with emergency situations		
• measures for the management of organizational accidents		
• introduction of a reliable monitoring of all critical processes in technical facility		
• clear concept of operation and clear individual modes of operation targeting to the safety		
• clear limits and conditions for the operation of technical facility and their verification		
• proof of reliability of technical facility for its lifetime and its verification		

• assessment of impacts of technical facility accidents on social area (according to Table 5)		
• assessment of impacts of technical facility accidents on technical and economic area (according to Table 5)		
• assessment of impacts of the technical facility accidents on the environment (according to Table 5)		
• assessment of impacts of technical facility accidents on technical facility and its vicinity goodwill's		
• awards of costs for reconstruction of technical facility and its surrounding area after the great accident and the assessment of recovery capabilities.		

Table 5. Scale for determination of rate of risk that planned technical facility means for its surroundings (rate of coexistence disruption); by analogy to scales in [53]; p – annual insurance, ABT-the annual budget of territory governance.

Domain	**Risk rate**	**Classification criterion**
Social	*By accident or failure of technical facility, it is affected:*	
	0	less than 50 humans
	1	50 - 500 humans
	2	500 - 5000 humans
	3	5 000 – 50 000 humans
	4	50 000 – 500 000 humans
	5	more than 500 000 humans
Technical and Economic	*Accident or failure of technical facility causes damages:*	
	0	less than 0.05 p
	1	equal to p
	2	between p and 0.05 ABT
	3	between 0.05 ABT and 0.075 ABT
	4	between 0.75 ABT and 0.1 ABT.
	5	higher than 0.1 ABT.
Environment	*Accident or failure of technical facility causes:*	
	0	very low damages of environment
	1	damages of environment with which the nature cope during the acceptable time

	2	moderate damages of unrenewable resources of nature and natural reservations.
	3	medium damages of unrenewable resources of nature and natural reservations
	4	unreturnable damages of unrenewable resources of nature and natural reservations
	5	devastation of landscape, unrenewable resources of nature and natural reservations

Table 6. Value scale for determining the rate of the coexistence of the planned technical facility and its surroundings; N = five times the number of criteria in Table 4; N = 270.

The level of coexistence disruption (risk) between technical facility and surrounding	**Values in % N**
Extremely high – 5	More than 95 %
Very high – 4	70 - 95 %
High – 3	45 - 70 %
Medium – 2	25 – 45 %
Negligible – 0	Low than 5 %

The evaluation of real cases according to the Table 4 needs to be performed by a team of specialists from the different fields independently; in practice, according to [53], it works the team consisting of:

- worker of public administration responsible for the land use planning,¨
- worker of public administration responsible for the territory development,
- representative of planned technical facility,
- competent representative of the professional institution for the technical facility safety assessment, for example from the state technical inspection,
- and representative of the Integrated rescue system.

The resulting value is the median for each criterion, and in cases of great variance of the individual values in the one criterion it is necessary, so that the worker of public administration responsible for land use planning may ensure further investigation, on which each assessor shall communicate the grounds for his review in the present case, and on the basis of panel discussions or brainstorming session, the final value is determined.

The appreciation of the benefits of a technical facility for the territory is done again using a checklist. On the basis of the knowledge gathered above, a checklist is drawn up to assess the contribution of the technical facility to the territory [1], Table 7. For application in practice, two scales are assigned to the checklist: one in Table 8 for assessing selected criteria when applying the classification scale (0-5) and the concept 'the higher the value, the higher the contribution of the technical work to the territory"; and the scale for the evaluation of the whole principle-based checklist introduced into Czech Technical Standard, Table 9.

Table 7. Checklist for assessment of the technical facility return for territory. A- result of assessment (YES or NOT).

Planned technical facility	**Criterion**	**A**	**Note**
	It increases education of the population in the territory		
	It increases the possibility of employment of the population in the territory		
	It increases the level of services in the territory		
	It increases welfare in territory		
	It contributes to the development of basic infrastructure in the territory.		
	It raises the prestige of the territory		
	It contributes to the cultural development of the territory		
	It improves the situation in the social sphere in the territory – Table 8		
	It improves situation in technical and economic spheres in territory - Table 8		
	It improves the situation in environment protection and welfares in territory - Table 8		

Table 8. Value scale for determining the rate of benefits that the technical facility means for the territory; it is designed by analogy to the scales set out in the work [52], ABT – the annual budget of the territory.

Domain	**Benefit rate classification**	**Criterion**

	Rate	Technical facility benefits:
	Rate	*Technical facility benefits:*
Social	0	less than 50 humans
	1	50 - 500 humans
	2	500 - 5000 humans
	3	5 000 – 50 000 humans
	4	50 000 – 500 000 humans
	5	more than 500 000 humans
	Rate	*Technical facility gives to territory budget:*
Technical and eco-nomic	0	less than 0.005 ABT
	1	0.005-0.01 ABT
	2	0.01-0.025 ABT
	3	0.026-0.05 ABT
	4	0.05-0.075 ABT
	5	higher than 0.075 ABT
	Rate	Technical facility contributes to environ-ment protection and welfare increase per year by sum of money:
Environment	0	less than 50 EUR
	1	50 – 500 EUR
	2	500 – 5 000 EUR
	3	5 000 – 50 000 EUR
	4	50 000 – 500 000 EUR
	5	more than 500 000 EUR

Table 9. Value scale for determining the rate of return of the technical facility for its surroundings; N is quintuple of criteria in Table 7 (N=50).

Level of technical facility benefits for territory	**Values in % N**
Extremely high – 5	More than 95 %
Very high – 4	70 - 95 %
High – 3	45 - 70 %
Medium – 2	25 – 45 %

Low – 1	5 – 25 %
Negligible – 0	Less than 5 %

At the technical facility risk management based on data in Table 4 we consider the responsibility principle that is general in Europe [54]. It means that in the followed technical facility phase both, the developer and the public administration are responsible for the technical facility safety.

Considering:

- the ALARP principle as in works [55-57],
- the integrated approach as in works [58,59],
- and the assumption that all risk sources have the same occurrence probability, we obtain the requirement for tolerable risk measured by the technical facility maximum annual losses *RZTD*

$$\boldsymbol{RZTD < 0.1 \sum_{i=1}^{n} \frac{k_i\, HTD}{5\, T}} \qquad (1)$$

where *HTD* is the planned technical facility utility value (planned budget for manufacturing and operation), k_i are result evaluations of risk sources in Table 4, *n* is the number of risk sources (in our case 54) and *T* is the technical facility lifetime in years. When this condition is not fulfilled, so the proposed technical facility may not be accepted for realisation because the coexistence will be violated. It means that either a new option or other risk reduction measures should be requested, followed by a further assessment of the proposal. In other case the evaluation process continues.

In order that the losses caused by the technical facility at its operation might be also acceptable for the territory, it is calculated the benefit that the technical facility operation gives rise to territory. Using the data in Tables 7 – 9 and the principles for expected return [60] and the same assumptions on data processing as in the previous case, the expected annual technical facility return caused by the technical facility operation *PRZTD* is

$$\boldsymbol{PRZTD = 0.7 \sum_{i=1}^{n} \frac{k_i\, CPTD}{5\, T}} \qquad (2)$$

where *CPTD* is the total utility technical facility return during the lifetime *T,* k_i are result evaluations of return sources in Table 7 (assessed by experts with help of data in Tables 8 and 9) and *n* is the number of benefit sources (in our case 10). The expected pure annual technical facility return *RPTD* is given by

$$\boldsymbol{RPTD = PRZTD - A - RPNTD} \qquad (3)$$

where *A* is annuity and *RPNTD* is operating costs. Difference *R* of allowed maximum annual TF losses *RZTD,* Eq. (1), and of expected pure annual TF return *RPTD,* Eq. (3)

$$\boldsymbol{R} = \boldsymbol{RZTD} - \boldsymbol{RPTD} \tag{4}$$

is used as the quantitative property for decision-making. They are used the boundaries of acceptability of risk that used the UN and the Swiss Re [6], namely:

- amount of annual premium for protected assets in territory (*PRTD),*
- one-tenth of annual territory budget (*ABT*).

On the basis of results of scoring, they are determined the categories to which in a given case, the risk associated with technical facility belongs:

R is less than PRTD, risk is acceptable,

R is between PRTD and 0.1 ABT, risk is conditionally acceptable,

R is higher than 0.1 ABT, risk is unacceptable.

In the first case, the technical facility benefits will outweigh the technical facility disadvantages, it means the expected losses are acceptable and the coexistence of the technical facility with its vicinity is ensured. It can be done permit for the technical facility realization.

In the second case, the effective technical facility safety management is required; it means to include additional preventive measures in the technical facility design and to ensure the mitigation, reaction and renovation measures for coping with risk realization.

In the latter case, unacceptable risk, it should be thorough reflection on conclusion – either to reject the proposed technical facility variant, or to ask for further measures associated with an increase of technical facility safety (it is necessary to require application of: higher knowledge; a better technical equipment; the higher costs for protective systems; ensuring the greater human resources readiness, etc.) and after this new coexistence judgement.

The tool was tested in five real cases with success. The tests showed that it is pernickety on expert knowledge and moral, however, it ensures the coexistence the technical facility with its vicinity during the technical facility lifetime.

6. TOOL - RISK MANAGEMENT PLAN FOR ENSURING THE COEXISTENCE AT THE TECHNICAL FACILITY TYPE SELECTION AND ITS SITING IN TERRITORY

The facts in works [2,3,6-8,10-20] imply that each technical facility needs to have a plan to increase the safety of the technical facility over time in order to ensure that it fulfils the specified tasks in the required quality and time and it is competitive; on-side plan; data for off-side plan in the event of an accident or failure of the technical facility; a technical facility continuity plan to overcome critical conditions; crisis plan; and a disaster recovery plan. A very effective plan for rapid problem management is the priority risk management plan [51].

The risk management plan is based on identified sources of the causes of accidents or failures of technical facilities, the results of which were losses of human lives, financial and other damage, and therefore, they need to be considered as priority. In the interest of safety, they need to be monitored and timely response and recovery need to be ensured. This plan helps to resolve conflicts because, in the event of an expected conflict of interest, the objectives of addressing the problem caused by the realization of the risk can be agreed in advance. It can be also determined in advance the respective responsibilities and codified the procedures for responding to the problem. The risk management plan contains four basic items, namely:

- domain of risk causes (technical, organizational, internal, external, cyber),
- description of the causes of the risk,
- probability of occurrence and evaluation of risk impacts,
- risk and liability mitigation measures.

Good governance is based on the openness, accountability and efficiency of institutions and public participation in decision-making and other processes. Good governance means transparency, accountability, integrity, the appropriate type of governance, efficient and affordable services, a commitment to partnership and the continuous development of public administration institutions. The adopted territorial management strategies need to have a clear link with the specific activities of the authorities. Good governance has five basic features: openness; public involvement in decision-making; responsibility; efficiency; and the coherence of strategies and real activities. In other words, states, regions or cities, the political and institutional governance of which does not show the five basic features of good governance cannot achieve sustainable development.

Good governance means applying an optimal management system based on problem diagnosis and problem-solving measures. The essence of good governance lies in the combination of different levels of decision-making as opposed to the almost exclusive role of the State. As a result, decision-making shifts to multi-level structures, i.e. to regional structures. Another stage of good governance is the application of project and process management, which is based on the strategic development plan [6].

In book [8] summarizing the principles for managing the risks of complex technical facilities, it is shown that, in addressing tasks in the division of tasks and establishing responsibilities, the account needs to be taken of the possibilities that exist at the management level in question. The possibilities are determined by both, the powers and the availability and amount of available resources, forces and means that needed for problem solution:

- well-structured problems can be successfully solved at the operational level of technical facility management.
- structured and poorly structured problems that are not associated with high risks for the technical facility can be successfully solved at the middle level of technical facility management,
- at the top level of technical facility management, both complex and unstructured problems that have risks that can be controlled using the tools available only to the top management of the technical facility can be successfully addressed,
- only the mutual cooperation of the public administration and the top management of the technical facility can solve complex and unstructured large-scale problems with high risks.

For transnational technical works, international cooperation is still necessary.

In complex world, the technical facility management represents the hierarchical interconnected system. According to [54], the responsibility principle paid in Europe means that for risk management are responsible both, the technical facility management and the public administration that gives permit and supervise the provision of public interest.

Results of research given in [8] has shown that in terms of humans´ safety and development, risk management of complex technical facilities is important in two areas:

A. Domain connecting the public administration and management of complex technical facility.
B. Domain of technical facility dealing with data, methods, material and technical matters, organizational, legal, financial and personnel matters directly in a complex technical work.

The model risk management model plan is drawn up by analogy to the situation in the German Federal Republic, the Republic of Austria, Switzerland and other Western States [1]. When selecting the type of technical facility and location it in the territory, responsibilities are considered for the following functions:

- Mayor of the municipality,
- Chairman of the Building Authority,
- responsible public administration officer for the territory safety,
- responsible public administration officer for the territory development,
- the responsible representative of the investor of the technical facility,
- responsible representative of the future operator,

- responsible representative of the relevant professional institution responsible for the safety of technical facilities (Technical Inspection, Environmental Inspection, Nuclear Inspection, State Office for Occupational Safety, etc.),
- responsible representative of civil protection (the Integrated Rescue System),
- Parliament Chairman.

For the purposes of managing the coexistence of a technical facility with its surroundings, considering the identified sources of coexistence failure referred to in Chapter 4, the model risk management plan is set out in Table 10. There is no distinction between the risk management plan for technical facility of local to regional importance, and for technical facility of national to transnational importance, since building documents in both cases are issued by the locally competent municipal authority, which has the authority of the building authority .

Table 10. Risk management plan for ensuring the technical facility and surroundings coexistence during the process of selection of type and location of technical facility.

Risk domain	**Risk description**	**Occurrence probability Impacts**	**Measures for risk mitigation**
Public administration	Wrong supervision	Probability: medium Impacts: great	***Measures:*** Regular professional process review ***Execute:*** Chairman of the Building Authority ***Responsibility:*** Mayor of municipality
	Wrong design	Probability: medium Impacts: great	***Measures:*** Corrections according to legislation in force ***Execute:*** Chairman of the Building Authority ***Responsibility:*** Mayor of municipality
	Incomplete documentation – e.g. missing: considering all disasters set in	Probability: great Impacts: great	***Measures:*** Corrections according to legislation in force ***Execute:***

	territory; no data for off-site plan etc.		Chairman of the Building Authority ***Responsibility:*** Mayor of municipality
Technical facility – technical factors	Proposed technology has serious defects	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority
	Construction and operation are too demanding for available resources in a given territory (knowledge; material for production; raw materials for operation; technical elements, equipment and components; finance; management method; or operator skills in construction or operation)	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority
	Incomplete technical documentation- e.g. missing description of critical fittings and way of their operation.	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority

			Responsibility: Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Missing the proof of technical facility feasibility in a given territory	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Missing the measures to reduce the impacts of a technical facility on the territory during the operation	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection

	Replacement equipment and critical item components are not provided	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	The technical facilities in the vicinity which may cause the technical facility in question failure or accident were not considered	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection Public administration specialist for territory safety
	The energy performance of a technical facility exceeds the capacity available in the territory	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority

			Responsibility: Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Transport claims exceed traffic possibilities in the territory	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	The demands on the production material were not properly appreciated and they could cause downtime until the stop-off operation.	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
Technical facility – finance factors	Construction costs underestimated	Probability: great Impacts: great	***Measures:***

			Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Operating costs were not included in the cost of the technical facility	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Operating costs do not include maintenance and timely repair costs	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority

			Cooperation: Specialist of relevant inspection
	The budget does not foresee situations that would require more costs (e.g. increase in the tax burden, change of support by public administration, occurrence of natural or other disasters, etc.).	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection Civil protection specialist
Technical facility – personnel	Staff shortage	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Public administration for territory development ***Responsibility:*** Mayor od municipality
	Qualified staff shortage	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Public administration for territory development

			Responsibility: Mayor od municipality
	The work regime does not consider the social needs of workers	Probability: medium Impacts: medium	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Public administration for social matters ***Responsibility:*** Mayor od municipality
Technical facility - management	Facility documentation does not contain all the requirements required by the legislation	Probability: medium Impacts: medium	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	The timetable for the construction is incorrect	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority

			Cooperation: Specialist of relevant inspection
	The division of the investment unit into stages is erroneous	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Operating parameters and operating mode are poorly set	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Operating regulations for abnormal and possible critical situations and emergency plans are lacking	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:***

			Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Continuity plans for overcome of beyond design disasters for critical components of the technical facility are missing	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
Technical facility - safety	all possible risks within and outside the technical facility and their impacts on the technical facility and its surroundings have not been considered	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of public administration for territory safety

	The impacts of external disasters on technical facility have been underestimated	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of public administration for territory safety Specialists of Civil protection
	In the carrier out safety analyses, they did not consider the cross-cutting risks that are implemented by interconnection of components and systems of technical facility only under certain conditions, e.g. in the event of beyond design disasters	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	There are no safety, emergency and crisis plans, or they are not logically intertwined.	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority

			Responsibility: Chairman of the Building Authority ***Cooperation:*** Specialist of Civil protection
	Functions important for technical facility safety management are not clearly defined	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	The vulnerabilities of critical assets of a technical facility are not properly assessed	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Insufficient evidence of handling of possible accidents in the technical facility	Probability: great Impacts: great	***Measures:***

			Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	Insufficient mitigation of impacts of the construction and operation of the technical facility on environment	Probability: great Impacts: medium	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	The objective of the technical facility safety and tools for ensuring the safety are unclear	Probability: great Impacts: medium	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority

			Cooperation: Specialist of relevant inspection
	The safety culture is not considered	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
	There is not given programme to maintain the required safety and to their increase	Probability: great Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of relevant inspection
Technical facility - others	Technical facility is in insider or terrorist interest	Probability: low Impacts: great	***Measures:*** Refuse and ask presenter for overwork according to legislation in force - especially object physical and cyber protection, plan for support

			and motivation of employees ***Execute:*** Specialist of Building Authority ***Responsibility:*** Chairman of the Building Authority ***Cooperation:*** Specialist of public administration for territory safety Specialist of public administration for territory development Specialist of Civil protection Municipality mayor
	Technical facility is not acceptable to the public	Probability: medium Impacts: great	***Measures:*** Refuse and ask presenter for cooperation with public and ensuring finances for territory development ***Execute:*** Specialist of public administration ***Responsibility:*** Mayor of municipality ***Cooperation:*** Specialist of public administration for territory safety Specialist of public administration for territory development Specialist of Civil protection
War	Destruction	Probability: low	***Measures:***

		Impacts: great	- peace promotion - negotiation ***Ensure:*** Government Chairman ***Responsibility:*** Parliament Chairman

In order to ensure the security and development of citizens and the whole of the State, it is necessary for the public administration to take proper care of citizens, property, finance and the environment, i.e. correctly fulfil the basic functions of the State. Since this is not a simple matter, as the dynamic evolution of the complex system of the world (the human system) brings more and more sources of risk, it is important not to overlook the risks and to work with them at the level of current knowledge and experience.

Good management of the State, based on quality data, their quality processing, well-established competences and well-fulfilled responsibilities, needs a quality tool for management. One well-proven tool is a well- designed risk management plan.

In order to the risk management plan may fulfil its role, it needs to be based on quality data processed by experts using the quality methods and be backed by legislation that ensures well-divided competences and enforces responsibilities, thereby contributing to building a safety culture in society.

7. CONCLUSION

Human wish is to control the risks, so they may not realize. On the basis of human knowledge, it is partly possible when humans understand the risks and their causes. Therefore, it is very important to understand the great impacts of disasters that have a very low probability of occurrence.

To manage the risks in favour of safety, it is on the basis of current knowledge only possible if it will be introduced in practice the good safety culture and responsibility at all levels of management as they show the results given above and also in works [25,61]. To work with the risks from starting the technical facility planning, it is necessary to carry out so that in all participants it may origin the awareness of the risks and so that appropriate measures for the major risks' management may be introduced.

With regard to current knowledge, all known data and experience need to be considered at selection of technical facility type and its location in the territory. In order for a technical facility to meet the expected tasks or services needed for the development of human society, it is important first to clarify:

- tasks to be performed by the technical facility,
- demands on resources, forces and means necessary for the implementation of the technical facility and its operation,
- the risks associated with the technical facilities at the various stages of its existence, i.e. from construction, through operation to decommissioning,
- demands to build the capability of the human community (State, owner, citizens) to ensure the realization and safe operation of the technical facility throughout its lifetime.

A critical assessment of the sources of risk referred to in Chapters 2 and 4 indicates that when selecting the type of technical facility and its location in the territory, it is necessary to assess the sources of risk that may significantly affect humans´ security and environmental safety or impair the safety of the technical facility itself. The second case, therefore, concerns the assessment of:

- the safety of the technology, i.e. its reliability and functionality, throughout its lifetime; its sustainability, serviceability, and service requirements should be considered,
- the availability and competitiveness of technology,
- the feasibility of the technology's requirements for knowledge, material, finance, installation and operation of the technology, even in the event of legislative or market changes,
- the ability to ensure the safe operation of the technical facility throughout its lifetime.

Given the complexity of the world and its dynamic evolution, the limited ability of people to anticipate future phenomena and the limited knowledge, resources, forces and means of human society, lessons learned from past experience must be applied at the type selection and location stage.

At work [8] it was shown the very important role of situational awareness. In connection with each risk, it is necessary always to remember:

- what can happen,
- where this can happen,
- what can run big losses and damage,
- what assets may be affected,
- and what it is necessary to prepare for the protection of public assets and the coexistence of the technical facility with the surroundings.

In the framework of the State basic functions, it is necessary so the State may supervise the coexistence of all major systems, which are necessary for the life and development of humankind, that include the environment, the technical facilities and the human society. Therefore, for human security ensuring, it is created the decision support system for the public administration risk management process improvement, the result of which is, that the technical facility gains the capability to be safe for the planned lifetime and its coexistence with vicinity is guaranteed.

By use the tested DSS in Table 4, it is possible to reveal the sources of risks of individual variants of the planned technical facility, the oversight of which may disrupt the coexistence of the technical facility and its surroundings, namely today or in the future. The use of risk management plan in Table 10 also ensures the quality of proposal of technical facility (remove of defects). This facilitates the public administration basic decision-making and ensures the first step of coexistence of technical facility with its surrounding.

From the previous attempts to apply the above tools in practice, it shows that due to the diversity of both, the technical facilities and the environment into which technical facilities are placed, a simple template for the process of selecting the type and location cannot be used. In addition to the available knowledge and experience, account should always be taken of local conditions and local options, i.e. to apply site-specific procedure. When setting out proposals to settle risks that cannot be reduced by preventive measures from today's point of view, a sufficient safety reserve should always be considered. It is necessary to prepare for situations where safeguards may fail at the least appropriate time.

With a view to the human security and development, all essential requirements should be specifically included in the legislation and ensure that professional opinions are processed by experts in the public interest. Only in this way, the sustainable development and security of human society can be ensured.

REFERENCES

[1] PROCHÁZKOVÁ, D., PROCHÁZKA, J., ŘÍHA, J., BERAN, V., PROCHÁZKA, Z. *Management of Risks of Processes Connected with Specification and Location of Technical Facility in Territory* (in Czech). ISBN 978-80-01-06467-2. Praha: ČVUT 2018, 134 p., http://hdl.handle.net/10467/78522

[2] PROCHÁZKOVÁ, D., PROCHÁZKA, J. *Analysis, Management and Trade-off with Risks of Technical Facilities.* Praha: ČVUT 2020. *In print.*

[3] PROCHÁZKOVÁ, D. *Analysis, Management and Trade-off with Risks of Technical Facilities* (in Czech)*.* ISBN 978-80-01-06480-1. Praha: ČVUT 2018, 222 p. http://hdl.handle.net/10467/78442

[4] UN. *Human Development Report*. New York 1994, www.un.org

[5] EU. Safe Community. PASR projects. Brussels: EU 2004.

[6] PROCHÁZKOVÁ, D. *Strategic Management of Safety of Territory and Organization* (in Czech). ISBN 978-80-01-04844-3. Praha: ČVUT 2011, 483p.

[7] PROCHAZKOVA, D. *Safety of Complex Technological Facilities.* ISBN 978-3-659-74632-1. Saarbruecken: Lambert Academic Publishing 2015, 244p.

[8] PROCHÁZKOVÁ, D. *Principles of Management od Risks of Complex Technical Facilities* (in Czech). ISBN: 78-80-01-06182-4. Praha: ČVUT 2017, 364p. http://hdl.handle.net/10467/72582

[9] BOSSEL, H., *System, Dynamik, Simulation – Modellbildung, Analyse und Simulation komplexer Systeme.* ISBN 3-8334-0984-3*.* Norderstedt / Germany, 2004, www.libri.de

[10] ALE, B., PAPAZOGLOU, I., ZIO, E. (eds). *Reliability, Risk and Safety.* ISBN 978-0-415-60427-7. London: Taylor & Francis Group 2010, 2448p.

[11] BÉRENGUER, C., GRALL, A., GUEDES SOARES, C. (eds). *Advances in Safety, Reliability and Risk Management*. ISBN 978-0-415-68379-1. London: Taylor & Francis Group 2011, 3035p.

[12] BEER, M., ZIO, E. *Proceedings of the 29th European Safety and Reliability Conference.* ISBN 978-981-11-2724-3. Singapore: ESRA 2019, doi:10.3850/978-981-11-2724-3_0095-cd. e:enquiries@ rpsonline.com.sg

[13] BRIŠ, R., GUEDES SOARES, C. & MARTORELL, S. (eds). *Reliability, Risk and Safety. Theory and Applications.* ISBN 978-0-415-55509-8. London: CRC Press 2009, 2362p.

[14] CEPIN, M., BRIS, R. *Safety and Reliability – Theory and Applications.* ISBN: 978-1-138-62937-0. London: Taylor & Francis Group 2017, 3627p.

[15] HAUGEN, S., VINNEM, J., E., BARROS, A., KONGSVIK, T., VAN GULIJK, C. (eds). *Safe Societies in a Changing World.* ISBN 978-0-8153-8682-7 (Handbook). London: Taylor & Francis Group 2018, 3234p.; ISBN: 978-1-351-17466-4 (eBook); https://www.ntnu.edu/esrel2018

[16] NOWAKOWSKI, T., MLYŇCZAK, M., JODEJKO-PIETRUCZUK, A., WERBIŇSKA-WOJCIECHOWSKA, S. (eds) *Safety and Reliability: Methodology and Application*. ISBN 978-1-138-02681-0. London: Taylor & Francis Group 2014, 2453p.

[17] PODOFILLINI, L., SUDRET, B., STOJADINOVIC, B., ZIO, E., KRÖGER, W. (eds). *Safety and Reliability of Complex Engineered Systems: ESREL 2015.* ISBN 978-1-138-02879-1. London: CRC Press, 4560p.

[18] STEENBERGEN, R., VAN GELDER, P., MIRAGLIA, S., TON VROUWENVELDER, A. (eds). *Safety Reliability and Risk Analysis: Beyond the Horizon*. ISBN 978-1-138-00123-7. London: Taylor & Francis Group 2013, 3387p.

[19] WALLS, L., REVIE, M., BEDFORD, T. (eds). *Risk, Reliability and Safety: Innovating Theory and Practice: Proceedings of ESREL 2016*. ISBN 978-1-315-37498-7. London: CRC Press, 2942p.

[20] IAPSAM (eds). *Probabilistic Safety Assessment and Management Conference. International. 11th 2012. (and Annual European Safety and Reliability Conference).* ISBN 978-1-62276-436-5. Helsinki: IPSAM & ESRA 2012, 6889p.

[21] IYER, A., ROSENBERG, C., KARNIK, A. What is the Right Model for Wireless Channel Interference? *IEEE Transactions on Wireless Communications*, 8 (5), 2009.

[22] KOEPKE, G., YOUNG, W., LADBURY J., CODER, J. *Complexities of Testing Interference and Coexistence of Wireless Systems in Critical Infrastructure,* http://dx.doi.org/10.6028 /NIST .TN.1885.

[23] LADBURY, J. M., KOEPKE, G. H., CAMELL, D. G. Evaluation of the NASA Langley Research Center Mode-Stirred Chamber Facility. *NIST Technical Note 1508*, 1999.

[24] MA, R., MENG, H., CHEN, Y., HUANG, Y. Coexistence of Smart Utility Networks and WLAN/ZigBee in Smart Grid. *IEEE Third Int. Conf. on Smart Grid Communications,* 510-520, 2012.

[25] OECD. Machine-to-Machine Communications: Connecting Billions of Devices. *OECD Digital Economy Papers, No. 192.* OECD, Paris, 2004, http://dx.doi.org /10.1787/5k9gsh2gp043-en.

[26] PROCHAZKOVA, D. *Study of Disasters and Disaster Management. ČVUT study in frame of FOCUS project*. ISBN 978-80-01-05246-4. Praha: ČVUT 2013, 207p.

[27] ZAIRI, M. *Total Quality Management for Engineers.* Cambridge: Woodhead Publishing Ltd, 1991.

[28] COASE, R. H. The Problem of Social Cost. *Journal of Law and Economics,* 3 (1960), pp. 1-44.

[29] BERMAN, N. L. ET AL. Strategic Planning and Economic Development (in Czech). *Moderní obec*, 1999, No. 3, příloha.

[30] PROCHÁZKA, T. Cooperation of Public and Pivate Sectors (in Czech). *Diploma´ Thesis.* Praha: VŠFS 2008, 107p.

[31] MORRIS, P., THERIVEL, R. *Methods of Environmental Impact Assessment.* ISBN 0-415-23958-3. London: UCL Press 1995, 493p.

[32] KEENEY, R. L, RAIFFA, H. *Decision with Multiple Objectives*. Cambridge: Cambridge University Press 1976, 1993, 569p.

[33] PROCHÁZKOVÁ, D. *Methods, Tools and Techniques of Risk Engineering* (in Czech). ISBN: 978-80-01-04842-9. Praha: ČVUT 2011, 369p.

[34] THERIVEL, R. *Strategic Environmental Assessment in Action.* ISBN 978-020307-2561. London: Roulledge 2010, 384p.

[35] http://ota.fas.org

[36] VAN EIJNDHOVEN. Technology Assessment: Product or Process? *Technological Forecasting and Social Change* 54 (1997), pp. 269–286.

[37] SCHOT, M., RIP, A. The Past and Future of Constructive Technology Assessment. *Technological Forecasting & Social Change* 54 (1997), pp. 251–268.

[38] RIP, A. STS in Europe. *Science, Technology and Society* 4(1999), 1, pp. 73-80.

[39] RIP, A., MISA, T., SCHOT, J. (eds). *Managing Technology in Society: the Approach of Constructive Technology Assessment*. London: Pinter 1995.

[40] SCHOT, J. Towards New Forms of Participatory Technology Development. *Technology Analysis and Strategic Management* 13(2001), 1, pp. 39–52.

[41] TARR, J. A. (ed.). *Retrospective Technology Assessment – 1976.* San Francisco: The San Francisco Press 1977.

[42] GENUS, A., COLES, A. On Constructive Technology Assessment and Limitations on Public Participation in Technology Assessment. *Technology Analysis and Strategic Management,* 17(2005), 4, pp. 433-443

[43] MACHLEIDT, P. Technology Assessment or how to Handle with Technical Risks (in Czech). In: *Člověk a rozhodování - rizika a nejistoty*. Praha: ČVUT, 2005.

[44] MACHLEIDT, P. New Democratic Forms of Technology Assessment wit Public Participation (in Czech). In: *Teorie vědy* 3 (1994), 1-2.

[45] http:eptaproject.eu

[46] http://www.eptanetwork.org/EPTA/

[47] GIMENEZ, R., LABAKA, L., HERNANTES, J. Enhancing Organizational Resilience through Virtual Communities of Practice. In: *Safety and Reliability of Complex Systems.* ISBN 978-1-138-02879-1. London: Taylor &Francis Group 2015.

[48] KOZINE, I. ANDERSEN, H. B. Integration of Resilience Capabilities for Critical Infrastructures into the Emergency Management Set-up. In: *Safety and Reliability of Complex Systems.* London: Taylor &Francis Group 2015. ISBN:978-1-138-02879-1 (Hbk+CD-ROM), ISBN:978-1-315-64841-5 (eBook pdf) www.crcpress.com – www.tayloeandfrancis.com

[49] AZADEH, A., GHADERI, S. F., ANVARI, M., IZADBAKHSH, H. R., REZAEE, M. J., RAOOFI, Z. An Integrated Decision Support System for Performance Assessment and Optimization of Decision-Making Units. *The International Journal of Advanced Manufacturing Technology*, 66(2013), 5-8, pp. 1031–1045.

[50] PROCHÁZKOVÁ, D. ET AL. *Risk of Processes and Their Management* (in Czech). ISBN: 978-80-01-06144-2; e- ISBN 978-80-01-06186-2. Praha: ČVUT 2017, 295p.

[51] ISO. *Risk Management – Principles and Guidelines*, ISO 31000:2009.

[52] CVUT. Czech Technical University archives.

[53] PROCHÁZKOVÁ, D. *Principles of Management of Safety of Critical Infrastructure* (in Czech). ISBN 978-80-01-05245-7. Praha: ČVUT 2013, 223p.

[52] PROCHÁZKOVÁ, D. *Principles of Management of Safety of Critical Infrastructure* (in Czech). ISBN 978-80-01-05245-7. Praha: ČVUT 2013, 223p.[53]

[54] DELONGU, B. *Risk Analysis and Governance in EU Policy Making and Regulation.* ISBN 978-3-319-30822-1. Springer 2016, 288p.

[55] ALE, B. Tolerable or Acceptable. A Comparison of Risk Regulation in the United Kingdom and in the Netherlands. *Risk Analysis*, 25 (2005),2, pp. 231-242.

[56] BOULDER, F., SLAVIN, D., RAGNAR, E. *The Tolerability of Risk: A New Framework for Risk Management.* ISBN 978-1-84407-398-6. London: Taylor & Francis 2007, 160p.

[57] EU. *Land Use Planning Guidelines in the Context of Article 12 of the SEVESO II DIRECTIVE 96/82/EC as Amended by DIRECTIVE 105/2003/EC*. Brussels: Joint Research Centre 2006.

[58] CUI, T., OUYANG, Y., SHEN, Z. J. M. Reliable Facility Location Design under the Risk of Disruptions. *Operations Research,* 58 (2010),1, pp.998-1011.

[59] LEVITT, R. E., LOGCHER, R. D., QUADDUMI, N. H. Impact of Owner-Engineer Risk Sharing on Design Conservatism. *ASCE Journal of Professional Issue in Engineering.* 110 (1984), pp. 157-167.

[60] BRUCE, J. F. *Investment Performance Measurement.* ISBN 0-471-26849-9. New York: Wiley 2003, 748p.

[61] HUDSON, P., HUDSON, T. *Possibility Space: Understanding Risk.* https://www.ntnu.edu/esrel2018

ANNEX 1 – Disasters and their selected quantities

The human system security and development are disturbed by disasters, i.e. internal or external phenomena that lead or from a certain size can lead to damages, harms and losses on system assets. It means that human system safety is affected by both, the processes, actions and phenomena that are under way in human society, environment, planet system, galaxy and other higher systems, and the human management acts. Therefore, for safety reasons we need to negotiate with risks of a different origin and kind.

Among the disasters, we classify the phenomena that cause damage, losses and harms to humans and other public assets on which the humans are dependent. These phenomena are the results of five different processes in the human system that represents the world [1]. The results of processes:

- running in and out of the Earth are: *natural disasters* (earthquake, floods, drought, strong wind, volcanic activity, land slide, rock slide etc.); *epiphyte; epizootic; land erosion; desertification; fundament liquefaction; sea floor spreading etc*.
- running in the human body and in human society are: *unintentional:* illnesses; epidemic; involuntary human errors etc.; and *intentional*: robbery; killing; victimization; religious and other intolerance; criminal acts; terrorist attacks; local and other armed conflicts, bullying; religious and other intolerance; criminal acts such as: vandalism and illegal business, robbery and attacking, illegal entry, unauthorized use of property or services, theft and fraud, intimidation and blackmail, sabotage and destruction, intentional disuse of technologies, such as: improper application of CBRNE substances; data mining from social networks and other cyber networks used for psychological pressure on a human individual etc.
- connected with the human activities are: *incidents; near misses; accidents; infrastructure failures; technology failures; loss of utilities; etc*.
- that are reactions of the Planet or environment to the human activities are: man-made earthquakes; disruption of ozone level / layer; greenhouse effect; fast climate variations; contaminations of air, water, soil and rock; desertification caused by human bad river regulation; drop of the diversity of flora and fauna (animal and vegetal) variety; fast human population explosion; migration of great human groups; fast drawing off the renewable sources; erosion of soil and rock; land uniformity etc.
- connected with inside dependences in the human society and its surrounding separated to: *natural*: changes in stress and movements of territorial plates; changes in water circulation in the nature (environment); changes in substance circulation in the nature (environment); changes in the human food chain; changes in the planet processes; changes in the interactions of solar and galactic processes; *and human established*: the failure of human society management (organizational accidents caused by: mutual improper behaviour of an individual or groups of individuals as illegal migration of great groups of people; incorrect governance of public affairs - as: corruption, abuse of authority, the disintegration of human society into intolerant

communities; and failures in organization of education and upbringing etc.); the failure of correct flows of raw materials and products; the failure of correct flows of energies (harmful is e.g. blackout); the failure of correct flows of information; the failure of correct flows of finances etc.;*{word "correct" means the way in benefit of human interest, i.e. given by legislation}*.

The disaster list shows that disasters, according to the process, the product of which they are, have very mixed physical, chemical, economical, biological, social or cybernetic nature/basis. This mentioned fact is a clincher from the view of safety, because the preventive measures need to be targeted to the nature of disaster for the sake of being effective. Definitions, features and impacts of disasters are listed in the works [1-4]. Generally, it stands that the disasters have certain characteristic features, which are the origin of impacts causing the damages, losses and harms to the important assets, links or flows and that from the human point of view, because this is de facto the only thing in which a human is interested (human aim is to make human to survive). Among the impacts it belongs e.g. vibration; directed fast air, water or soil flow; damage to a stability and cohesiveness of rocks and soil; displacements of materials; outburst of liquids; anomalies in the temperature etc.

The impacts effect directly or vicariously through links and flows of human system. Humans, thanks to their intellect, deliberately create the resilience of areas, buildings, infrastructures and technologies against disasters. They do with a help of both, the choice of elements, links and flows and their interconnection; and the specific preventive measures and activities until the specific disaster extent (which is given by human knowledge, abilities, financial and technical possibilities etc.) [1]. It makes why the impacts of interconnections in the system (interdependences) appear only with beyond design disasters, which by their extent lays above the border size of disaster against which the humans systematically provide resilience [3]. Understandably, there is a big difference - rich technically developed and quality managed countries or organizations (generally entities) have the threshold of assets resilience set higher that the counties with a lower standard.

Disasters cause or from certain extend cause damage, loss and harm on assets, i.e. they are the reasons of situations falling on a human and that is why human has to handle with them. By the reason of big variety of disasters, the arising situations classified as "the emergency situations" have either the same or highly specified impacts. The relation between a disaster and an emergency situation is the relation *"cause-consequence"* [1]. This relation is not simple because the intensity (destructiveness, severity, criticality, cruelty) of emergency situation in a given place is predetermined not only by the size of disaster but also by the local vulnerability of assets, failure of implemented protective systems (e.g. the system of warning in the area, security mechanism etc.) which were created for increasing the assets resilience, the humans' mistakes during the response etc. [1,2,5].

In domain connected with the disaster management, there are three terms that are by given way interconnected. They are not often distinguished in spoken language, which leads to misunderstanding at critical moments, and by this to huge harms. In professional terminology they have exactly the given sense, and therefore, we here deal with them; it goes on terms: danger, hazard and risk.

Danger marks the conditions of human system at which the origin of harms on protected assets has the high probability (it is almost sure that the harm will origin) [6], i.e. the term marks the rate of conditions. It means that it goes on mark of possibility of origin of harm, loss or damage of one or more assets. The danger is predetermined by substance properties that are in facility, object or territory and by properties of processes that are running in facility, object or territory. It is immediate, if the course uncontrollably goes to the disaster origin that causes the emergency situation; and it is creeping, if the course goes to disaster origin inconspicuously and without clear-cut precursors [6]. The danger for human means both, the big phenomena (e.g. natural disasters, industrial accidents, environmental or social disasters) and the seemingly small phenomena from the daily life (slump of snow, icicle or roofing from roof, rough pavement etc.) [6].

Hazard marks the disaster potential to cause the harms, losses and damages on protected assets in a given site that is prescriptively determined. It goes on prescriptive measure of danger that is connected with the given disaster. For the strategic planning needs, the centennial disaster is often considered, i.e. the hazard is size of disaster that occurs once in hundred years, or professionally exactly, the disaster size that has return period 100 years; at special buildings and facilities it is considered from safety reasons the hazard, which is connected with thousand years' disaster or ten thousand years' disaster [6].

Risk connected with a given disaster is the probable size of damages, harms or losses on protected assets that originate in given place at origin of disaster with size of normatively determined hazard, which is normalized to the certain territory unit or number of individuals and the time unit [6]. The difference between risk and danger is the following: the danger is specific (it denotes the topical conditions) and the risk is only expected opportunity.

The humans ensure the protection of human society and populated territory against the risks by the way that for each disaster they determine the certain size (so called design disaster). They perform the preventive measures to design disasters and by which they ensure so the possible risk size may be acceptable. The problem arises if disasters with size greater than design disaster occur, because great damages, harms and losses origin as the consequence of failure of man-made technological systems [1,4-6].

References

[1] PROCHÁZKOVÁ, D. *Strategic Management of Safety of Territory and Organisation* (in Czech). ISBN 978-80-01-04844-3. Praha: ČVUT 2011, 483p.

[2] PROCHÁZKOVÁ, D. Principles of Mitigating and Managing Human System Risks. *Information & Security*, 28 (2012), No 1, 21-36, ISSN 0861-5160, e-ISSN 1314-2119, http://infosec.procon.bg

[3] CVUT. Czech Technical University archives.

[4] PROCHÁZKOVÁ, D. *Risks Connected with Disasters and Engineering Procedures for Their Control* (in Czech). ISBN 978-80-01-05479-6. Praha: ČVUT 2014, 234p.

[5] PROCHÁZKOVÁ, D. *Safety of Complex Technological Facilities.* ISBN 978-3-659-74632-1. Saarbruecken: Lambert Academic Publishing, 2015 244p.

[6] PROCHÁZKOVÁ, D. *Risk Analysis and Risk Management* (in Czech). ISBN: 978-80-01-04841-2. Praha: ČVUT 2011, 405p.

ANNEX 2 – Disaster management

Result of special research, the results of which are summarized in [1,2], created for public administration tool for disaster management. It consists in:

1. To separate disaster types into groups: disaster with no impacts in a given territory; relevant disasters – disasters that have only the acceptable impacts on public assets in a given territory; specific disasters – disasters that have from a certain size have significant and unacceptable impacts on public assets in a given territory; critical disasters – disasters that have from a certain size have the highly unacceptable impacts on public assets in a given territory. For each disaster type ranked into category "specific disaster" to determine marginal size from which this disaster type has unacceptable impacts on public assets in a given territory**.**
2. For each disaster type ranked into category "specific disaster" to determine effective:
   - preventive, mitigation, response and renewal measures and activities by considering whole set of specific disasters and by selecting measures and activities respecting the given territory properties and vulnerabilities in order that the measures and activities against one disaster type might not substantially increase territory vulnerability to other disaster type,
   - emergency management including the special trained forces and procedures for response.
3. For each disaster type ranked into category "critical disaster" to determine effective:
   - mitigation, response and renewal measures, activities and procedures of their implementation,
   - crisis management including the standard and beyond standard reserves in forces, sources and means and special legislation for the enforcement of needy measures and activities from all stakeholders,
   - learning from disaster and its implementation into territorial management.

In the tool we have concentrated the public administration to, it is necessary to:

- distinguish correctly measures and activities against disasters and their consequences, i.e. emergency situations. There is a different focus of struggle: against disasters it is the prevention; and against emergency situations it is qualified fast response at which we consider site vulnerabilities, failure of protected systems, human errors at response,
- realize in practice that all citizens must build the territory safety and that their tasks at emergencies follows from ranking the emergency situations into categories: 0: negligible from the human life viewpoint; 1: unimportant from the human life viewpoint; 2: important from the human life viewpoint; 3: relevant from the human society viewpoint; 4: very relevant from the human society viewpoint; and 5: threatening the existence or nature of the human society. I.e. the situations 0-2 are solved by

individuals and for the further ones the public administration has special management types, i.e. emergency management, crisis management including technical, material, finance and personal support,

- pay special attention to critical (extreme) disasters because they usually cause the extent failure of infrastructures and technologies. Example in Figure 1 shows cascade chains that invoke secondary and other impacts on public assets and they can lead to social crises,
- respect legislation, the principles of daily support of inhabitants and of crisis management such as responsibility, prompt and correct reaction, warning etc.

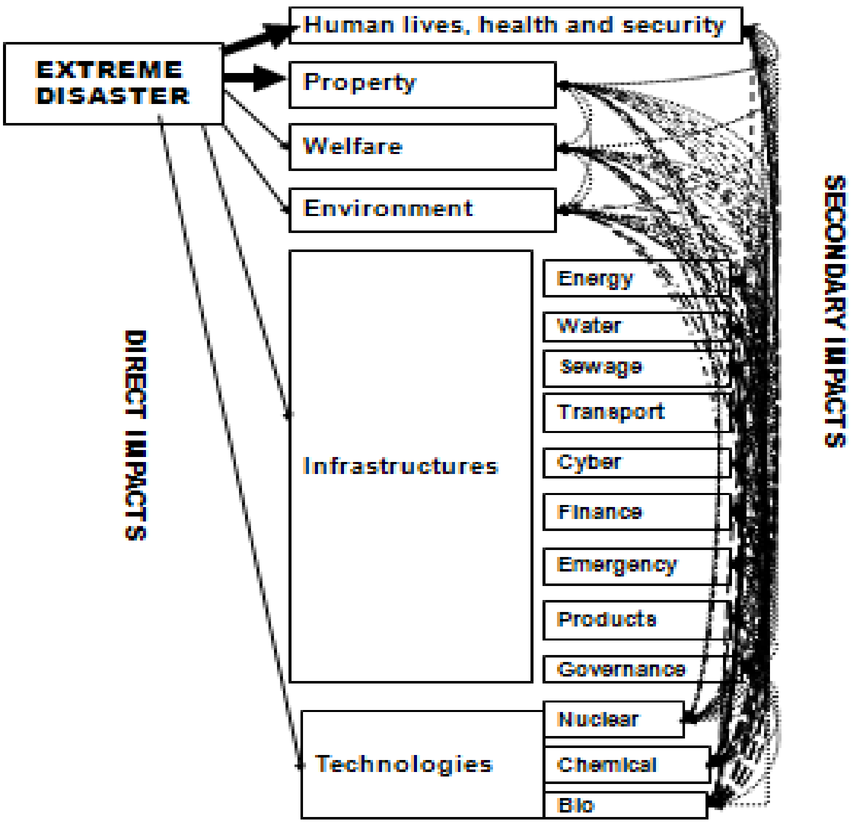

Figure 1. Extreme (beyond design) disaster impacts on public assets. Protection measures and activities are prepared only for impacts denoted by bold arrow. Secondary impacts are caused by cascade failures of infrastructures; details are in [2].

There is a set of twelve method for public administration [1] that contains the exact procedures how the public administration needs to act (what materials from what institution it must require; how to process materials; how to interpret and what to do) in negotiation with real disasters in order that its management is effective in this domain. Application of methods enables the public administration to use correct data for decision-making in the frame of territory management directed to human system safety including the human security and the EU security. The methods were tested in five real territories (town, village, forest country, agriculture region, industry region) with the result of a significant upgrade of the territory management. However, it was found that these methods are still too complex for the present public administration management officers and about a half of them had problems with the separation of measures and activities against the cause (disaster) and consequences (emergency situation). The investigation of these realities revealed that most of the present public administration officers´ problems resided in lack of knowledge on the dynamic behaviour of human system and on dynamic territory management (e.g. when and how to use the special types of territory management as emergency or crisis one) and that they had no knowledge of the current methods, tools and techniques for decision making because methods based on the top knowledge that were / such as cluster analysis and time series were not enough. Therefore, we started an education in given domains.

With regard to the above given facts, knowledge and experiences summarized for decision support systems in [1] we propose in table 1 the tool for the quality determination of quality of public administration territory management with regard to disasters and protection of public assets; the form of a checklist was selected.

Table 1. Check list for judgement of the level of public administration negotiation with disasters

Question	**Judgement*)**	**Note**
Does territory public administration know all expected relevant disasters and the extent of their impacts on public assets?		
Does territory public administration effectively negotiate with all expected relevant disasters?		
Does territory public administration respect in territory management the knowledge of conditions of specific disaster origin in territory and conditions causing the escalation of disaster impacts?		
Does territory public administration respect in territory management the knowledge of specific disaster occurrence frequencies?		
Does territory public administration respect in territory management the knowledge of sizes of specific disasters from which they have unacceptable impacts that cause losses, harm and damages on public assets?		
Does territory public administration respect in territory management the knowledge of maximum expected specific disaster sizes?		
Does territory public administration respect in territory management the knowledge of harms and losses that can cause		

maximum possible specific disasters on a specified credibility level?		
Does territory public administration respect in territory management the knowledge of preventive, mitigation, response and renovation measures and activities against specific disasters?		
Does territory public administration implement in territory management the suitable measures and activities of technical, organisational, financial, social, legal, education and training domains?		
Does territory public administration implement in territory management the knowledge of unacceptable and residual risks with regard to critical disasters and ensure response in the technical, organisational, financial, social, legal, education and training domains?		
Does territory public administration implement in territory management the knowledge of qualified response to critical disasters with aim to stabilize the territory conditions and to start the renovation?		
Does territory public administration implement in territory management the knowledge of qualified renovation of public assets after critical disasters?		
Does territory public administration prepare in territory management the renovation plan after critical disasters respecting the logical rules for territory renovation?		
Does territory public administration create in territory management the financial reserve for the performance of the territory renovation after critical disasters?		

*) Scale for the judgement of individual questions is: 5 = measure of demand fulfilment is > 95%; 4 = measure of demand fulfilment is 70-95%; 3 = measure of demand fulfilment is 45-70%; 2 = measure of demand fulfilment is 20-45%; 1 = measure of demand fulfilment is 5-25%; 0 = measure of demand fulfilment is < 5%.

The whole check list judgement is proposed in the same form as the judgement of individual questions. With regard to results derived in [1] the normalized value determining the optimum territory management is 3.165 (calculated as probable mean value). It can show that in real cases other scales can be more useful.

The aim of each territory management is public interest. From this reason, a good governance of public affairs has five principal features, namely the openness, the public participation in a decision-making process, the responsibility, the effectiveness and the continuity of strategies and real activities, and from the viewpoint of present knowledge it needs to respect basic principles of sustainable development [3,4]. The good governance of public affairs is the project and process management of safety in which the basic role is played by negotiation with risks [4]. The good governance of public affairs has in reality three levels (Figure 2), namely:

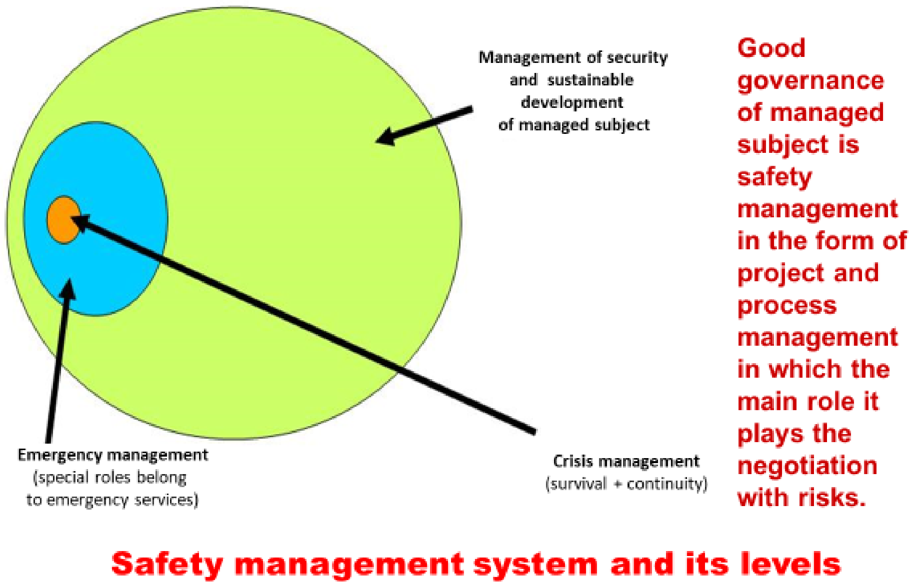

Figure 2. Three level state (i.e. human system) management.

- directed safety management which concentrates to ensuring the security and sustainable development of human system, i.e. to ensuring the security and sustainable development of assets of human system. Its main aim is to perform the human activities by the way in order that the human system changes may not result in unacceptable disruption of human system and in order that they may result in prevention of possible phenomena that disrupt security and sustainable development of human system,
- emergency management that is used in the cases in which serious problems occurred and it is necessary to carry out measures in order that the originated losses, damages and harms on basic assets might be acceptable at using standard sources, forces and means,
- crisis management that is used in the cases in which critical problems occurred and it is necessary to carry out measures in order that the originated losses, damages and harms on basic assets might be acceptable at using both, the standard and the beyond standard sources, forces and means (main attention is devoted to human lives and health and environment).

Rights on good governance of public affairs are guaranteed by the European Charter [5]. The good governance of public affairs is impossible without knowledge of risks and their effective management. From the general viewpoint the risks are connected with:

- disasters,
- disaster impacts,

- vulnerabilities of territory and assets being in the given territory,
- domino effects that might happen in certain site,
- human factor,
- errors and failures at management and governance of territory, namely at measures and activities of response and renovation that being usually performed under the time pressure,
- random combinations of possible phenomena in a site.

Public affairs governance is based on qualified planning and it systematically interconnects all living sectors important for ensuring the security and sustainable development [1]. The same holds for a private sector that is dependent on profit, and therefore, it has specific risks as:

- risk of profit loss,
- risk of expiration of concord with requirements of public administration in a given territory.

Tools of public administration ensuring the security and development of system, by other worlds the preservation or protection and development of assets [1,3] are the following:

- management (strategic, tactic and reactive) based on qualified data, professional evaluations and correct methods for decision-making,
- education and training of citizens,
- science, research and system TSO (Technical Support Organizations) organisations providing the professional support to public and private sector,
- specific education and training of technical and managerial workers,
- technical, medical, ecological, social, cyber and other standards, norms and rules, i.e. the tools for regulation of processes that might lead to origination of disasters or to intensification of their impacts,
- inspections,
- executive units for overcome of emergency situations,
- systems for overcome of critical situations,
- land-use, emergency and crisis planning,
- specific systems for overcome of critical situations (in the CR this type of management is denoted as a crisis management; in many countries there is talked about a response management or on a management of disasters with catastrophic impacts).

The inherent part of conception there are the financial expenses that are necessary for ensuring the security and sustainable development of human system. The mentioned expenses need to be properly distributed, because the good governance includes the segments as the prevention, the preparedness, the response and the renovation. It is now generally known that reactive management directed only to response is not the best tool for ensuring the specified targets, but that there is necessary to apply the proactive, systemic and strategic management based on obtained knowledge and experience. It means that it is not sufficient to create only conditions for rescue at emergencies but it is necessary by directed prevention to create the safe territory and the safe community.

In present privilege concept there is considered that the security has also dimension to future, i.e. it is not sufficient only to ensure the present required human system state but also its required state in near future and as long as in far future, i.e. the security inherently includes such system development in which the security is also guaranteed in future, i.e. it goes on sustainable development (i.e. the development supporting the development of human and human society in require direction in time) [1,6,7]. It is necessary to consider that in all considerations on security and sustainable development there is necessary also to consider the surroundings of human system because the human system is open.

The sustainability / sustainable development of human system is from the professional viewpoint the concept that is anchored in time and is related to the system as a whole. The human seat sustainability, mainly towns goes from so called the Aalborg Charter (1994) [8] that formulated further given main goals:

1. Determination and sharing the principles for town sustainability.
2. Support to local strategies for sustainability.
3. Sustainable use of land for development.
4. Prevention of ecosystem intoxication.
5. Search for tools for sustainability management.

With the Aalborg Charter it is indirectly connected the concept of so-called sustainable community. In connection with these documents there is necessary to mention the new view on sustainability, that talks that for support of live in community there is necessary the sustainable area budget. This way for search of a balance reflects the fact that present economic grow does not include the mechanisms for long-term survival (especially, it has not a sufficient resilience).

From the system viewpoint the sustainable system must have such attributes as productivity, resilience, adaptability and vulnerability of system. It means that it is possible to suppose the coherences given in Figure 3. Because followed attributes are mutually interconnected so in relation to system existence the sustainability is on the vertex. The decision-making on system adaptive capacity is so given by relation expressed in decision-making matrix in Table 2.

The goal of management of human communities' sustainability through the risk management or through the higher management type, i.e. through the safety management there is to preclude in order that the system could not reach inconvenient, i.e. unacceptable states and arrangement. The sustainability management needs to go out from the resilience management [9,10] that has two targets:

1. To preclude in order that the system might reach inconvenient states as a consequence of external defects and outer load.
2. To preserve elements activating the system re-organisation and renovation in consequence of massive changes.

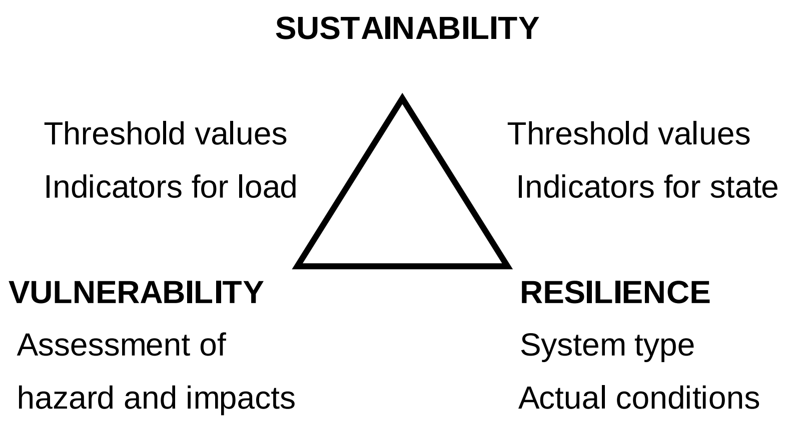

Figure 3. The relation among the sustainability, vulnerability and resilience.

Table 2. Adaptive capacity of system.

Impacts	**Adaptive Capacity**	
	Low	***High***
High	*Vulnerability*	Opportunities for development
Low	Residual risks	*Sustainability*

From the viewpoint of risk management [11] there is necessary to concentrate to suppress the system vulnerability because ***the sustainability is a permanent system adaptation to changing conditions***. It means that the sustainable object needs to be the nature system (so called green infrastructure), the system created by humans (so called grey infrastructure) and their interconnections. The concentration to interconnections of grey and green infrastructures leans on technologies that the might be resolved actual and future problems. New technologies, however, bring into green infrastructure the uncertainties and indefiniteness, because technology impacts into environment are heavily predicted. Therefore, it is necessary to use and to process the methodology of foresight not only for technological level but also for societal level that is directed to trends of behaviour of grey infrastructure (e.g. theory of normality of accident, high reliable organisation, industrial ecology) and of green infrastructure (e.g. theory of adaptive environmental management, industrial ecology etc.).

From the above given facts, it follows that the target would not be only enumerative determination of critical elements, critical phenomena etc., but the goal would be the monitoring the sustainable livelihoods because in it there are accumulated all influences of green and grey infrastructures. The methods suitable for analysis of sustainable existence need to specify parameters for different system sustainability, i.e. for sustainable:

- economic and technological system, i.e. for diversity of sectors, qualified labour force, innovation, robust infrastructures, expedient movement of goods and services, accessibility of technologies, ecological effectiveness,
- social system, i.e. for community solidarity, social capital, protection, safety and safe environ, relation to a site, preservation of culture heritage, mobility, equality of chances, green infrastructure and recreation possibilities,
- environmental system, i.e. for sound and quality soil, biodiversity, functional green infrastructure, bio-corridors and interlinked bio-localities, environmental flows, quality of water and air, the landscape character.

Ensuring the sustainability of all systems, however, needs the quality public administration, i.e. the transparency and responsibility in decision-making, competency, capability to anticipate the future situations.

Because the security and sustainable development depend on way by which we negotiate with risks, i.e. firstly on the fact if we correctly find, understand and evaluate the risks in human system and if we optimally get over them. The negotiation with risks consists in correct estimation of size of possible disasters of all kinds that are risk sources in the human system.

With regard to above mentioned facts the expenses for ensuring the security and sustainable development are the sum expenses exerted into negotiation with risks. I.e. they are expenses for measures and actions of prevention, preparedness, response and renovation, expenses for insurance and reserve expenses for unforeseen situations caused e.g. by low probable accumulation of unfavourable phenomena. From the effectiveness viewpoint the most effective there are expenses for prevention [12]. These are, however, challenged for knowledge, sources, forces and means, their outputs are not immediately visible and are evident after time, i.e. after disaster, and therefore, for their application the public administration and other stakeholders are usually accelerated for their use only after the huge disaster. For ensuring the assets protection and sustainable development there is necessary legally to promote the enforceability of basic preventive measures by legal rules.

At ensuring the acceptable level of human system security containing inherently the sufficient level of sustainable development we cannot ignore the reality that human sources are limited and that each activity and measure need sources, forces and means. Therefore, a possible level of security corresponds to the human system state in which marginal expenses for prevention are equal to marginal expenses for removing the damages (i.e. expenses for response and renovation). It is possible to note that such defined security level is the economic optimum for human system [13], Figure 4. The theoretical optimum is not of course generally valid, it is only valid for real territory or community because conditions and sources, forces and means of territories and communities are variable. The domain of adequacy is determined by the public administration that directly in its authority or through the legal rules requires from other stakeholders the realisation of certain activities and measures leading to the ensuring the security including the sustainable development. Naturally, the good governance may be only performed by qualified public administration and only on basis of sources that are to disposal.

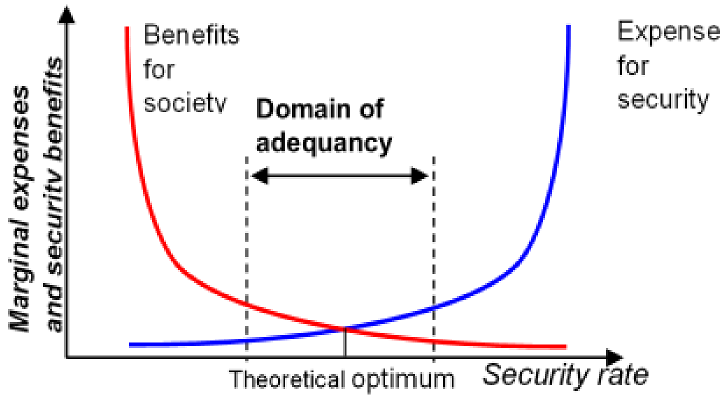

Figure 4. Security understand as economic optimum for human system [13].

At present there are known qualified procedures for identification of damages, possible losses and possible harms in a given territory at individual disasters (methodologies used by Swiss Re, Munich Re and further ones described in work [1,12]) in dependence on assets being in a given territory and vulnerabilities of real given territory. There are also procedures for quantification of expenses on activities connected with negotiation with risks, and therefore, it is possible with regard to possible sources, forces and means of real community to predetermine the level of security including the sustainable development that is situated in vicinity of theoretical optimum. From this it is evident that reach regions or states have a predisposition to ensure the higher level of security including the sustainable development than poor regions and states among which also belong regions and states being economically reach but only concentrating to economic grow and marginalizing the other needs of humans and human society today and in future.

Above given data show the real look at world, i.e. even if we have effort to ensure the security including the sustainable development we need correctly to spend sources, forces and means because our possibilities are limited. The negotiation with each risk is connected with increase of expenses, with shortage of knowledge, technical means, qualified humans etc. Therefore, in practice there is searched for a boundary to which it is acceptable to reduce the risk in order that the expenses might be reasonable. Optimally it is necessary at negotiation with risks to select site specific approaches because availability of sources, forces and means is distributed in a territory an in a time. Risk reduction rate (certain optimisation) is mostly a subject of top management and political decision-making at which there are used present scientific and technical findings and considered economic, social and other conditions.

Basic turn in human system management with regard to required goals cannot be reached by individual measures but only by complex approach regarding the site conditions. The complicated division of competences leads in practice to serious difficulties and in the whole, it does not cover the complete domain. To ensure the security and sustainable development of human system there is necessary to use co-ordinated and purposeful approach. It enables step by step and in harmony with their importance and urgency to solve the set of tasks in all sectors and parts and to achieve the required state of human system in a real territory. The solution of problems consists in domain of investment, technology, organisation, governance and management, science, research, education etc. The effective output of problems cannot be ensured without the strategic and conceptual management for which detail, objective and systematic data must be prepared by a specific research. The reactive approach at problem solving without linking to the strategic plans is not usually the correct solution at medium-term and long-term prospect.

References

[1] PROCHAZKOVA, D. *Strategic Safety Management of Territory and Organisation* (in Czech). ISBN 978-80-01-04844-3. Praha: ČVUT 2011, 483p.

[2] PROCHÁZKOVÁ, D. *Challenges connected with critical infrastructure safety.* ISBN: 978-3-659-54930-4. Saarbruecken: Lambert Academic Publishing 2014, 218p.

[3] EU. *FOCUS Project Study – FOCUS*. http://www.focusproject.eu/documents /14976/-5d763378-1198-4dc9-86ff-c46959712f8a

[4] PROCHÁZKOVÁ, D. *Risks Connected with Disasters and Engineering Procedures for Their Control* (in Czech). ISBN 978-80-01-05479-6. Praha: ČVUT 2014, 234p.

[5] ECHR. *European Convention on Human Rights.* Brussels: EU 1950.

[6] UN. *Human Development Report*. New York: UN 1994, www.un.org

[7] EU. *Safe Community*. PASR projects. Brussels: EU 2004.

[8] EU. *Charter of Fundamental Rights of the European Union*. Nice: EU 2000.

[9] REES, W. E. Economic, Ecolog, and the Role of Environmental Assessment in Achieving Sustainable Development. In: P. Jacobs, B. Sadler (eds): *Sustainable Development and Environmental Assessment: Perspectives on Planning for a Common Future*. CEARC, Ottawa1989, pp 123-141.

[10] NEEFJES, K. *Environments and Livelihoods - Strategies for Sustainability*. Development Guidelines, Oxfam Publication, Oxford 2000.

[11] PROCHÁZKOVÁ, D. *Risk Analysis and Management* (in Czech). ISBN 978-80-01-04841-2. Praha: ČVUT 2011, 405p.

[12] PROCHÁZKOVÁ, D. *Methodology for Estimation of Costs for Renovation of Property in Territories Affected by Natural and Other Disasters* (in Czech). ISBN 978-80-86634-98-2. Ostrava: SPBI SPEKTRUM XI 2007, 251p.

[13] COASE, R. H. The Problem of Social Cost. *Journal of Law and Economics,* 3 (1960), pp. 1-44.

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Autorský kolektiv:	Doc. RNDr. Dana Procházková, DrSc., RNDr. Jan Procházka, Ph.D.
Recenzenti:	Doc. Ing. Petr Šrytr, CSc.
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