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SUSTAINABLE DEVELOPMENT AND RISK MANAGEMENT

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ABSTRACT

SECURITY SITUATION IN THE WORLD AND IN EACH TERRITORY CONTINUOUSLY CHANGES WITH TIME, AND THEREFORE, THERE IS FORMED NEW SAFETY CULTURE BASED ON SUSTAINABILITY THAT TAKES INTO ACCOUNT ACTUAL KNOWLEDGE AND EXPERIENCES WITH CROSS-SECTIONAL RISKS AMONG THE PUBLIC ASSETS. ACCORDING TO PRESENT KNOWLEDGE THE SUSTAINABILITY IS NECESSARY FOR ALL HUMAN SYSTEM AND THERE IS NECESSARY TO INVOKE THE SUSTAINABLE DEVELOPMENT PRINCIPLES. THE SUSTAINABILITY IS STRONGLY CONNECTED WITH THE RISK MANAGEMENT PRINCIPLES. THE SUSTAINABLE DEVELOPMENT IS UNDERSTOOD AS THE DEVELOPMENT THAT DOES NOT ERODE ECOLOGICAL, SOCIAL OR POLITIC SYSTEMS ON WHICH IT IS DEPENDENT BUT IT EXPLICITLY APPROVES ECOLOGICAL LIMITATION UNDER THE ECONOMIC ACTIVITY FRAME AND IT HAS FULL COMPREHENSION FOR SUPPORT OF HUMAN NEEDS. IN THE PAPER THERE ARE SUMMARIZED CONDITIONS FOR SUSTAINABLE DEVELOPMENT, TOOLS, METHODS AND TECHNIQUES FOR SOLUTION OF PROBLEMS.

KEY WORDS

Human System. Sustainability. Sustainability Management. Risk Management.

1. INTRODUCTION

Present goal of humans is to live at safe space. In agreement with the EU and UN proclamations and the professional knowledge there is necessary for conservation and sustainable development of the human society to create the safe territory, safe community, safe state, safe Europe and safe world. The safe space is represented by safe open dynamically variable system that we denote in agreement with the UN report from 1994 [1] as the Human System (next only "human system"). In detail the human system is the system of systems (SoS), i.e. several overlapping systems [2].

The human system security and development is disturbed by disasters, i.e. internal or external phenomena that lead or 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, we must negotiate with risks of different origin and kind.

The sustainability (sustainable development) on the basis of recent cognition is not only related to the environment but to the whole human system and it basic assets (i.e. public assets) on which the human lives are dependent. Basis human system assets are: human lives, health and security; environment; property and public welfare; infrastructures and technologies, in particular those that belong among the critical ones [2]. The sustainability assessment in a general sense is the formalised process for identification, prediction and assessment of potential impacts of arbitrary inputs including the variants for society sustainable development (e.g. legal rules, ordinances, regulations, political intent, plan, program, and project). From the viewpoint of present cognition of human system and its assets the mentioned assessment might be performed always at good governance of territory [2].

To understand each other we need clear terminology. The basic terms of system safety management created in professional domain of system disciplines are summarised in work [2]; the most important of which there are:

Security is a state of system at which the occurrence of harm or loss on system assets (protected interests) has an acceptable probability (it is almost sure that harm and loss do not origin). To this there is also belonged a certain sure stability of system in time and space, i.e. a sustainable development in time and space which means that the system is protected against to internal and external disasters.

Safety is a set of human measures and activities for ensuring the security and sustainable development of system and its assets. Its measure is effectiveness size of appropriate measures and activities at ensuring the system assets security and sustainable development.

Secure human system is represented by a territory including the human society that is protected against to internal and external disasters.

Safe human system is represented by a territory including the human society the assets of which (for public assets see Figure 1) are in security and they can sustainable develop. The system is protected against internal and external disasters and the system itself does not threaten its vicinity because the good symbiosis of each system with its vicinity is necessary for system existence. Similarly ***safe organisation*** is the organisation the protected assets of which are in security and they can sustainable develop [2].

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Human system safety management is the management of human system directed to human system safety the product of which is security and sustainable development of all public assets denoted in Figure 1.

2. RISK

The term "risk" has origin in the middle Ages. There are different definitions of risk for each of several applications. The widely inconsistent and ambiguous use of the word is one of several current criticisms of the methods to manage risk. Risk is the potential that a chosen action or activity (including the choice of inaction) will lead to a loss (an undesirable outcome). The notion implies that a choice having an influence on the outcome exists (or existed). Potential losses themselves may also

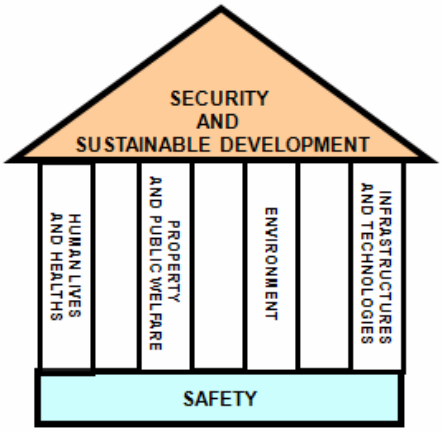

Fig. 1 - Human system safety management process model with presentation of public assets [2].

be called "risks". Almost any human behaviour and endeavour carries some risk, but some are much more risky then other [3, 4].

The present concept has been developed since 50s of last century. In present practice we use three important terms: disaster, hazard and risk [4]. The disaster is a sudden set of phenomena developed by processes, which have inadmissible impacts on human system assets [2]. The hazard expresses the disaster potential to cause at origin losses, detriments and harms on assets in a given site, standardly determined [2]. The risk expresses the probable size of undesirable and unacceptable impacts (losses, harms and detriment) of disasters with size of normative hazard on system assets or subsystems in a given time interval (e.g. 1 year) in a given site, i.e. it is always site specific). The risk partly depends on the hazard and partly on the vulnerability of assets in a given site (i.e. on the sensitivity of each individual asset in a given place against to physical manifestation of the disaster in a given site). It expresses a possibility what it might be happen [5]. From this fact it follows that for each management it is important to know the risk, namely in comprehensible expression. In practice of public administration it is certified the risk expression in a form that by risk analysis and assessment it finds that on specific section:

- there is necessary 5 million a year for remedy of harms caused by existing risk,
- each ten years ten persons die in a consequence of given disaster,
- each five years the property damages caused by disaster exceed 5 billion etc.

Methods for determination of risk size respect both, the nature of phenomena that are their sources (i.e. characteristics and physical nature of disasters) and the parameters of medium in which phenomena affect. There are used methods based on the mathematical statistics, fuzzy sets, approaches of operational analysis etc., that inherently assume the certain model of phenomena occurrence, i.e. they do not permit that these phenomena are extraordinary, and methods based on scenarios that are simulated or empirically obtained [6]. In principle we can split up two basis approaches, namely:

- Determination of hazard from disaster H and return period τ (in years) is performed by methods based on theory of large numbers, theory of extremes, theory of fuzzy sets, theory of chaos, theory of fractals etc. [7]. According to site vulnerability in an investigated land (e.g. around a given site: square 10 x 10 km; circle with radius of 5 km) it is determined the whole damage on all assets for the H denoted by S, usually expressed in money. Risk R connected with the given disaster in a given site is determined by the relation

$$R = \frac{S}{\tau}.$$

The result is very clear: e.g. "the risk from a given disaster in a given site is X EURs and for town it is MX EURs".

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- Determination of disaster scenario for the disaster with size corresponding to maximum expected disaster (there is possible with regard to demands of norms to use the probable size of expected disaster, or the value of standard size of determined disaster or at least unfavourable disaster) is performed; there are used exact scenario compilation methods [7]. According to data for a given land it is determined:
  - the value of whole damage for all assets in affected area ***SS*** (the method for ***SS*** determination is described in [8]) usually expressed in money according to amount of assets and their vulnerability to impacts of a followed disaster in affected area, usually normalised to a certain land unit ***S***,
  - the occurrence frequency of maximum expected disaster normalised to 1 year ***f*** according to the professional data from databases or expert opinions. Risk ***R*** is given by relation

$$R = S * f.$$

The result is in the same form as in the foregoing case. This case is often used for technological and other disasters for which we have not good long-term catalogue (this shortage the EU want to remove by special attention to compilation the MARS database [6]).

From above given facts there is evident that risk value determined is related to certain land unit and time unit. We say that the risk is a site specific quantity. If we could negotiate with risk we must know the risk size and at its determination we must respect all assets and their interfaces as they are shown in [2]. Because the human system is the SoS, we must respect this character and to consider also cross-section risks, i.e. we must determine the integral risk. For such risk form we have not yet simple formula respecting all human system public assets because interdependences that cause cross-section risks are site specific [6].

3. RISK MANAGEMENT

Strategy of management for ensuring the security and sustainable development of managed subject consists in negotiation with risks [6, 8]. In its frame according to present possibilities of human society we apply several ways of deal with risk:

- part of risk is reduced, i.e. by preventive measures the risk realisation is averted,
- part of risk is mitigated, i.e. by preventive measures, activities and by preparedness (warning systems and another measures of emergency and crisis management) there are reduced or averted non-acceptable impacts,
- part of risk is re-insured,
- part of risk for which there are prepared resources for response and renovation,
- part of risk for which there is prepared contingency plan, i.e. it is used for part of risk that is non-controllable or too expensive or low frequent.

To this it is joined the distribution of risk defeating among all stakeholders [6]. The distribution in good governance is performed according to rule that all stakeholders have responsibility for risk defeat and that the defeat of real risk is assigned to a subject the preparedness of whom is the best.
In practice there are usually used two risk management models: classical risk management; and safety management, i.e. risk governance for security and sustainable development [5-7].

4. SUSTAINABILITY

From the system viewpoint the sustainable system has attributes as productivity, resilience, adaptability and vulnerability, and therefore, sometimes it is not easy to find suitable reference state / conditions:

- The reference point of sustainability is demanded future state (scenarios techniques and foresight).
- The reference points are on the one hand inputs and on the other hands outputs of system processes (ecological trace, product life times etc.).

It means that we can assume the context given in Figure 2. Because the followed attributes are mutually tied up so in the relation to existence of system there is on the peak the sustainability. The decision-making on system adaptive capacity is then given by help of decision matrix [9]. The sustainability that is also connected with sustainable existence is often erroneously understood as the goal on which all strive. In reality the sustainability is not achievable final state / conditions because it is more the basic characteristics of dynamically developed system. It means that the ***sustainability is permanent adoption to changing conditions***. It is only question of education to introduce the adaptive procedures to the public administration decision-making on human, i.e. socio-ecologic-technical system [9]. For the realisation in practice it holds several pieces of knowledge:

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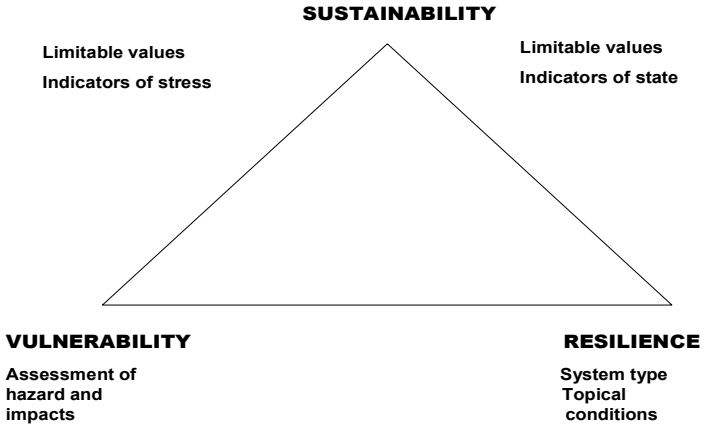

Fig. 2 - Relation among sustainability, vulnerability and resilience.

- The criticality is directed to failures and hazards, the sustainability deals with the existence. Therefore, more and more there are important approaches and procedures that deal with the sustainable infrastructure, namely both, the grey (set up by humans) one and the green (natural) one. The procedure for searching the sustainable elements is the following:
  - list of activities,
  - key impacts induced by human activities,
  - identification of receptors,
  - identification of ways of impacts spread,
  - identification of secondary and further order impacts on main and other receptors.

  This approach is possible to use only for grey infrastructure, whereas the green one cannot be investigated by the way that their clear-cut parts are separately analysed since landscape with ecosystems create complex super system, i.e. system of systems [10].
- The landscape sustainability is also connected with its sensitivity; the assessment is done by scoring, i.e. also by help of decision matrix.
- The human needs, however, depends in broad rate on functions of ecosystems, and therefore, it is necessary to understand the ecosystem functions, because:
  - the ecosystem functions varies and with this reality there is variable their influence on human health,
  - responses of ecosystems to human activity (intended or non-intended) are not always immediate, they can cumulate, affect vicariously or retrospectively and through the retrogressive links to create emergency up to critical situations.

  Therefore, it is necessary to alert that the procedure in which we define firstly the grey / engineering infrastructure for human settlements and after this the proposal is transformed into the landscape is incorrect because it completely ignores possible cumulative, long-term and delayed impacts on environment sources and ecosystems services. Therefore, it is necessary to search for solution that is suitable for local conditions; i.e. it is site specific.
- The orientation to the interface of grey and green infrastructures relays on technologies that might solve present and future problems. New technologies, however, carry into green infrastructure uncertainty and vagueness because the technology impacts on environment are hardly forecast. Therefore, it is necessary to use and to process the methodology foresight not only on technological level but also on society level, i.e. societal foresight that is aimed to trends of behaviour of grey infrastructure (i.e. theory of normal accident, high reliable organisation, industrial ecology) and green infrastructure (adaptive environmental management, industrial ecology etc.) [9].

5. TOOLS, METHODS AND TECHNIQUES FOR SOLUTION OF PROBLEMS

The humans did not come with intent to subvert the nature. They wanted to transform it for their needs. The conflicts have started in time when they tried to separate from the nature and between them and the nature they placed technology / engineering. Initially, it did not too display, the biosphere had and till now it has its reserves and it contrived to equilibrate with a range of activities. However, the human activity progressively took on the intensity and in some directions the biosphere has been globally affected [11, 12]. The present global nature of worldwide problems is given by reality that it

goes on questions that are mutually connected and their solution is connected with solution of other ones. Apart from environment contamination there are considered as global problems the questions of peace and war, overcoming the differences between developed and developing countries, ensuring the food for future population, energy accessibility, lack of water, soil, sources, and the questions of care on health, culture and education. THEREFORE, it is necessary to introduce STRATEGIC, SYSTEM AND PROACTIVE MANAGEMENT [13, 14], which is based on realistic, systemic and proactive view on human system and its problems; i.e. existing risks. The given view is necessary from the following reasons:

- Humans have been getting to a certain life standard that they do not repudiate; this standard is conditioned by interventions to nature.
- The human system is the system that is adaptable. During their development the humans have been accumulated much knowledge and experiences, and therefore, it is possible to believe that there are ways by which it is possible to limit interventions to a system so that the system development might be ensured in direction that should support the mankind development.
- The environment today for many humans creates a stylish stalking horse by which they also cover actions that have nothing common with the environment (e.g. the reality that the soil is left unexploited does not prosper to environment).

For decision-making the states of their organisational parts there has been used from intelligible reasons the model of environment that is restricted to human medium because the aim of human strive is to ensure the human society development, i.e. by recent words said the such development trajectory of whole environment system that onward enables humankind development.

On the basis of present knowledge [13, 14] each quality management, i.e. also human system management must respect the need to carry out the decision-making with the aim:

- to prevent emergency situations and to localize emergency situations (the accidents can origin in the frame of both, the individual components and the more components or even in the frame of whole environment system),
- to ensure the healthful development of human society,
- to realise ecological programmes in the socio-economic sphere.

According to principles of advanced management of human society the *TASKS HAVE ALL PARTICIPATED IN* [13, 14]. The management of state include in the most general concept the managing, government, control and office hearing the public affairs. It represents the conscious activity that is directed to determination and control of course of topical processes for achievement of appointed goals. It puts in harmony individual activities and it fulfils general functions of the whole, i.e. the state / territory / object / organisation etc. The governance is the form of activity of authorities, particularly executive ones that consists in organizing and practical implementation of tasks given by managing team / state management / territory / object / organisation in harmony with laws and the other legal rules.

The basic tools of state for management, i.e. also for production and protection of environment according to [13, 14] there are:

- management (strategic, tactical, operational) based on qualified data, knowledge, professional assessments, qualified decision-making methods, land-use planning, correct sitting, designing, building, operation, maintenance, reparation and renovation of buildings, technologies and infrastructures,
- citizen's education, schooling and training,
- specific education of technical and management workers,
- technical, health, ecological, cyber and other standards, norms and rules including the best practice procedures, i.e. tools for control / regulation of processes that may or might lead to disaster occurrence or to its impact increase,
- inspections and audits,
- executive security forces for qualified response to emergency and critical situations,
- systems for critical situations defeating,
- security (land-use and spatial), emergency, continuity, crisis and contingency planning,
- specific system for defeating the critical situations - safety, emergency, continuity and crisis management.

6. CONCLUSION

The analysis of development of both, the environment and the political, social and economic situation worldwide shows that it is necessary to prepare for solving the cases and actions that by their intensity induce the critical situations that can lead to relevant crises of type denoted as humanitarian catastrophe / social crisis. Therefore, from the viewpoint of human security, human system development, conservation of quality environment, existence, stability and development of

state there must be safety concept and with it connected concepts of development codified and implemented by safety management into practice [2]. In basic (usual) level of management the target are security and sustainable development, and on this level connect emergency and crisis management.

The goal of human society management is at each situation to ensure the protection of: human lives, health and security; property, welfare; environment; infrastructures and technologies, which are inevitable for human survival, i.e. the mobilisation and co-ordination of utilization of national sources (energy, labour force, production capability, food and agriculture, resources, telecommunications etc.), the co-ordination of such activities as they are notification system, rescue system and medical services that reduce impacts of natural or other disasters and ensures the continuity of activity of public administration, the adherence of legislation and also generate the conditions for start of development [11-15]. The land and regional development manifest by construction of industrial regions that approach to residential zones and vice versa. By this the possibility of harm origin increases and society (community) has not been willing to accept all risks. This is reason for origination of risk management discipline and consecutively risk engineering that include risk assessment, risk reduction and harm explanation. In short meaning the risk engineering is connected with technical systems (only in advanced forms there is considered the human factor influence on complex process safety) and in the broader one it is possible to generalize it to renewal of landscape with utilization of engineering approaches. Therefore, the risk engineering holds so important role and its target is on the one hand the optimum protection of humans, property and environment and on the other hand the optimum renewal of damaged landscape with utilization of engineering procedures and findings [6]. Both concepts require structured system approach and qualified utilization of planning the scenarios for decision-making support.

The measures for benefit in environment protection have been performed in frame of:

- land-use planning connected with technology assessment [2],
- construction of security and protection systems,
- different recommendations, e.g. smog regulation.

The territory management understand as strategic and proactive territory safety management differs from normal environment management in the following items:

- It is directed to the long-term sustainability.
- The aim is the system integrity because services/utilities promote live supporting functions.
- It considers the human as an element of system and it integrates human activity with environment protection.
- It sentient reacts to human needs in the system contexts.

From the viewpoint of society needs there is necessary to ensure on the one hand the further development of economy and on the other hand to reduce the environment contamination and to ensure the environment protection. It particularly consists in the following:

- The detection of objective human system conditions and of direction of their development in future, resp. in the nearest period.
- The determination of priority questions for protection and production of human system and their solutions in frame of programmes and tasks (it is necessary the concept solution).
- The elaboration of proposal of regulative, protective and corrective measures for reduction or remove of negative influences of human activities on environment and human.
- The elaboration of methods of prevention against to excessive contamination of environment in the next period.
- The determination of development trend and prognoses of reflection of development in science and technology in human system main/sector.

The artistic creation is the high degree of proficiency. The complex problems of relation of human to nature lean on certain philosophical foundations in each historical era. The present period is possible to characterize as the era in which the humans incessantly start turning the higher merry-go-round of substances and energies for satisfaction of their needs, with reality that the bulk of these substances grows much faster than the human needs. On one side it displays deficiencies of resources and energy (resource stocks have been stretched) and on the other side it wastes with resources and with energy. There is necessary to consider that in effort on sustainability it does not go on founding the conciliation or utopian harmony with nature how it found in several philosophical works of 60s years of last century or on understanding the nature as hard-hearted element in which it has been under way heartless and nonsensical fight against to all presenting. But it goes on realistic view that is represented by understanding the nature and human from the viewpoint of optimum development of the whole biosphere. The ecological behaviour is impossible to reduce on riotous discussions around the nuclear power plants, water structures or industrial complexes. We must plan and build big structures. At the same time we must consider the impacts of these constructions on environment and human health.

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