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How to Ensure the European Union Security

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ABSTRACT

Security situation in the world and in each territory continuously changes with time, and therefore, there is necessary to upgrade continuously safety culture based on actual knowledge and experiences with cross-sectional risks among the public assets. According to present knowledge and experiences the level of safety depends on principles of risk management and trade-off with risks. The paper shows the results of assessment of concepts used in practice performed on the basis of evaluation of data published in professional publications and on the real results from real proper research based on the MUT theory. It shows that the best concept for ensuring the European Union security is the work with risk ensuring the system of systems safety.

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1. INTRODUCTION

Present goal of humans in the European Union (the EU) is to live at safe space with development potential. Therefore, the basic function of the EU and its Member States is to provide the protection and development of the human society inside and not to threaten the human society outside. The EU has been realized so-called good governance. Within the 7th framework a lot of research projects have been solved that have been focused on security and sustainable development of the area of interest; the same tendency will continue in the next period. Under these projects it was the FOCUS project in which there were predicted possible disaster scenarios focused on identifying possible situations in the area and on providing a level of prevention, preparedness, response and recovery so that the system of applied actions and activities would not lead to the safety reduction and could be realized in terms of knowledge and in financial and technical terms [1]. After the experiences with several crises of different types in recent years, it is clear that the EU security concept and internal framework must change. They must cover not only the internal market but also other domains supporting the real economy and also systemic ***support for the European population***. One of such aim is to build the safe community with a sufficient sustainability level.

Based on current knowledge of human life it is not enough to meet physiological needs. H. Maslow [2] showed that there are further needs for safety and security, self-realization and social recognition. The fundamental orientation of research and state administration on the issues of security and safety and its management came after major terrorist attacks in the U.S. 11.09.2001, 11.3.2004 in Madrid, 3.9.2004 in Beslan, 7.7.2005 in London, etc., after which the mankind fully realized what security means for it and its development and what represents the highest value for him / her. Current knowledge and experience [3] shows that we know that for achievement the desired state of each system, i.e. including the human system, and for its development, it is important to set goals and procedures for achieving them, which are dependent on the resources, powers and means, which are never enough. Therefore, it is necessary to focus on priorities, and to manage resources, forces and means in time and space. In addition to all above, it is necessary to know the territory and its protected interests, possible disasters that threaten it, a way of threatening, available resources, sources of power and resources [3]. Following paragraphs focus on the facts we need to know about the territory and the scope of details.

A concept is a common feature or characteristic. Concepts are vital to the development of scientific knowledge. Concepts, as abstract units of meaning, play a key role in the development and testing of theories. The paper presents fact for concept of the EU security as a schema containing the both, the items and the data that are taken into account for the EU security, and also the way how to realised it. It contains a vision on the EU security and on its provision, and it also specifies tool for its achievement. On the basis of assessment of data and findings from several hundred professional publications, the list of which is in book [3], the concept is compiled by application of comprehensive approach [4], the aims and principles of which are given in the UN concept HUMAN SYSTEM SAFETY [5] and in the EU concept SAFE COMMUNITY [6]. It respects systemic conception of human space, the co-existence of main subsystems of human system, i.e. the environmental, technological and social, and use of foresighted and proactive behaviour of humans.

The evaluation of collected relevant data shows that the real security concept must specify:

1. Present cognition of problems of safety, security and sustainable development and set of findings on the EU management, i.e.: historical concepts and experiences; management tools (co-ordination and responsibility matrixes, fundamental functions of the EU, Member States, regional and local governments - public affairs management, private organisation affairs management, citizen education, specific education of technical and managerial workers, technical, health, environmental, cyber and other standards, norms and rules, inspections and audits, executive units for emergency situations coping, systems for coping the emergency and critical situations, security, emergency, continuity and crisis planning, research and development, science on safety and on human system security; safety management including the measures and activities for ensuring the security and sustainable development; levels of safety management; data, information and knowledge; decision-making principles (phases, types and methods of decision-making, decision-making on public assets, rules for decision-making and decision support systems); safety management system; programme for safety increasing; golden rules for safety management; groundwork's for application of process management at safety management; strategy and strategic management and strategic engineering disciplines that work with risk.
2. Terms (definition of security, safety, sustainable development, hazard, risk etc.); proposals of definitions are in [1, 3].
3. Human system assets, i.e.: basic public assets; human system characteristics; and conclusions for safety management; details are below.
4. Reality that sources of disasters, i.e. phenomena that from some size can disrupt the EU security, are the results of five different processes in human system [1, 3], Figure 1.

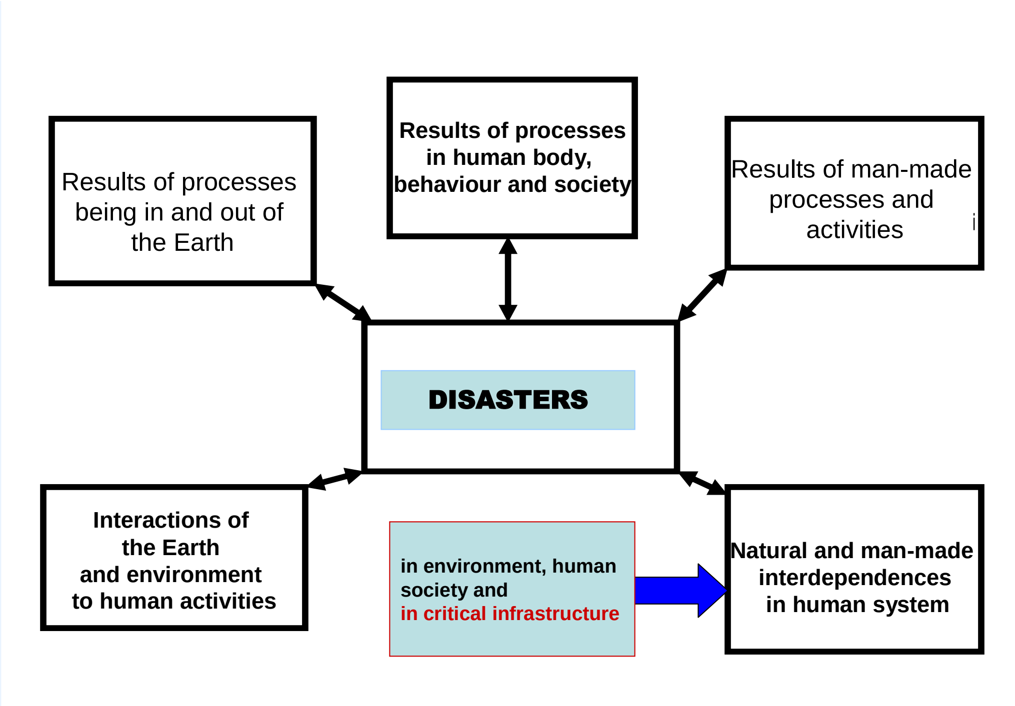

Figure 1. Sources of disasters in the Human system [1, 3]

5. Description of disasters, emergencies and connections linked with management, i.e.: disasters (their causes, types, sizes, characteristics; summary of general findings on disasters; and action of disasters on human system); emergencies (categories, category characteristics); human system vulnerabilities; and emergency defeat principles.
6. Rules for negotiation (trade-off) with risks, i.e.: problems connected with safety of assets; set of knowledge necessary for safety of assets; hazard and risk characteristics and determination; life with risks (partial, integrated and integral risk, analysis and assessment of risks; methods used at analysis and assessment of risks; risk acceptability, qualified procedure for comparison of risks, processing the risk assessment results to form suitable for decision-making, risk assessment); risk management and safety management (risk engineering, security engineering, safety engineering, SoS safety engineering, risk management model, safety management model); details are below.
7. Relevant subsystems of the EU, Member States, regional and local governments for safety management and their support, i.e.: safety management stages; planning (demands, security planning, space planning, land-use planning, emergency, continuity and crisis planning, renewal planning); systems for decision support; and security documentation.
8. Selected aspects connected with safety and crisis management, i.e.: information transfer and communication principles; international co-operation; and humanitarian aid principles.
9. Legislation of the EU and the Members States for safety management, territory development and crisis management, i.e.: basic legislation; special legislation for crisis management; and crisis management bodies.
10. Safety management system of the EU and the Member States, i.e. demands; structure and relevant elements (public administration, police, fire-fighters, army ……, citizens).

2. RESEARCH METHOD

Research method is ***a synthesis***, i.e. method which grounds in a combination of two or more entities that together form something new. The proved facts are combined together by help of logic chain that is confirmed by knowledge and experiences [7] and methods of work with risks [4, 8].

2.1. Description of method for concept criticality judgement

Object of our interest is the human system that is composed of assets: human health, property, welfare, environment, infrastructures and technologies (Figure 2) that are incommensurable and some of their aims are conflicting (e.g. environment vs. technologies – exploitation of natural resources, contamination of air, water and rock). Therefore, for searching the best way of human work with risk the special tool must be used. At present we use five different concepts.

For comparison of concepts used in practice for system risk management and for trade-off with system risk from the viewpoint of their capability to ensure the human system security we use the quantity "criticality" and the procedure based on the Multiatribute Utility Theory (MUT) [9] with the statement "the higher, the worse". The criticality is given by level of integral risk in which the main role is played by level of cross-sectional risks [8].

With regard to All Hazard Approach [10] and further disasters caused by internal dependences in system of systems and experiences with similar assessments [4, 8, 11] ***we use for determination of criticality rate of individual concepts of risk management / engineering*** the following criteria:

1-rate of capability of protection of human lives, health and security inside the system
2-rate of capability of protection of human lives, health and security outside the system
3-rate of capability of protection of property inside the system
4-rate of capability of protection of property outside of system
5-rate of capability of protection of welfare inside the system
6-rate of capability of protection of welfare outside of system
7-rate of capability of protection of environment inside the system
8-rate of capability of protection of environment outside the system
9-rate of capability of protection of live-giving infrastructures and technologies inside the system
10-rate of capability of protection of live-giving infrastructures and technologies outside the system
11-rate of capability of protection of human lives and health against disaster impacts caused by interdependences
12-rate of capability of protection of environment against disaster impacts caused by interdependences
13-rate of capability of protection of human society against disaster impacts caused by interdependences

14-rate of capability of protection of live-giving infrastructures and technologies against disaster impacts caused by interdependences

The data for assessment the risk work concepts were obtained from six experts, selected according to criteria used in the EU [11] from domains: public protection; territory protection; environment protection; public administration; protection of technological systems; and first responders (Integrated Rescue System). The experts evaluate 14 criteria given above according to their knowledge and experience with use the following scale that is analogical to that used for risk assessment in many norms and standards [11]:

0 - Criterion ensures extremely high capability of protection (expected damages are lower than 5%, concept application means no significant risk for assets, i.e. negligible concept criticality),
1 - Criterion ensures very high capability of protection (expected damages are in interval 5-25%, concept application means low risk for assets, i.e. low concept criticality),
2 - Criterion ensures high capability of protection (expected damages are in interval 25-45%, concept application means median risk for assets, i.e. median concept criticality),
3 - Criterion ensures median capability of protection (expected damages are in interval 45-70%, concept application means high risk for assets, i.e. high concept criticality),
4 - Criterion ensures low capability of protection (expected damages are in interval 70-95%, concept application means very high risk for assets, i.e. very high concept criticality),
5 - Criterion ensures negligible capability of protection (expected damages are higher than 95%, concept application means extremely high risk for assets, i.e. extremely high concept criticality).
Resultant value for each criterion is determined as the median from data obtained from experts.

2.2. Facts used as input data

The EU security shall lean on the following relevant knowledge and approaches as:

1. There is a set of human system public assets that are mutually dependent, Figure 2 [1, 3].

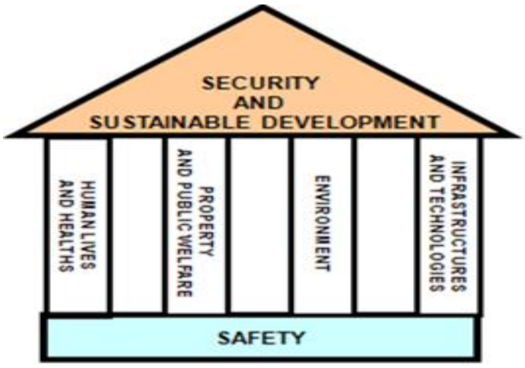

Figure 2. Human system public assets [1, 3]

2. There is a set of documented disasters [1, 3]; about 77 different types.
3. The disasters affect public assets by various ways, and therefore, the protection must be correctly directed [1, 3].
4. At ensuring the human system asset protection it is used the All Hazard Approach [10], it was accepted by the EU [3]; and disasters caused by interdependences in the human system.
5. For safety management there is important the causal relationship „disaster – emergency“, Figure 3 [1, 3].

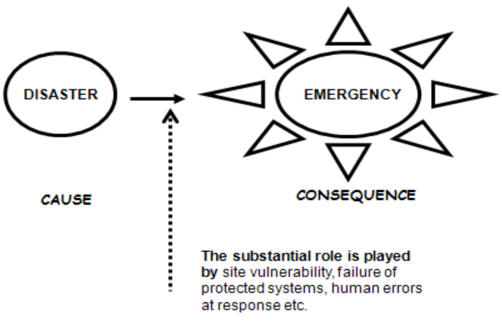

Figure 3. Relationship cause vs. consequence [1, 3]

6. It is the reality that humans have limited possibilities in protection of public assets against to disasters; they only ensure protection to a certain size of disaster level that is marked by term the design disaster (the protection is aimed to impacts of this size for each disaster type). If this level is exceeded the manifestation of interdependences starts, Figure 4 [1, 3, 8, 11]. The special protection during the emergency is only planned and arranged for human lives and health and property (see national legislations).

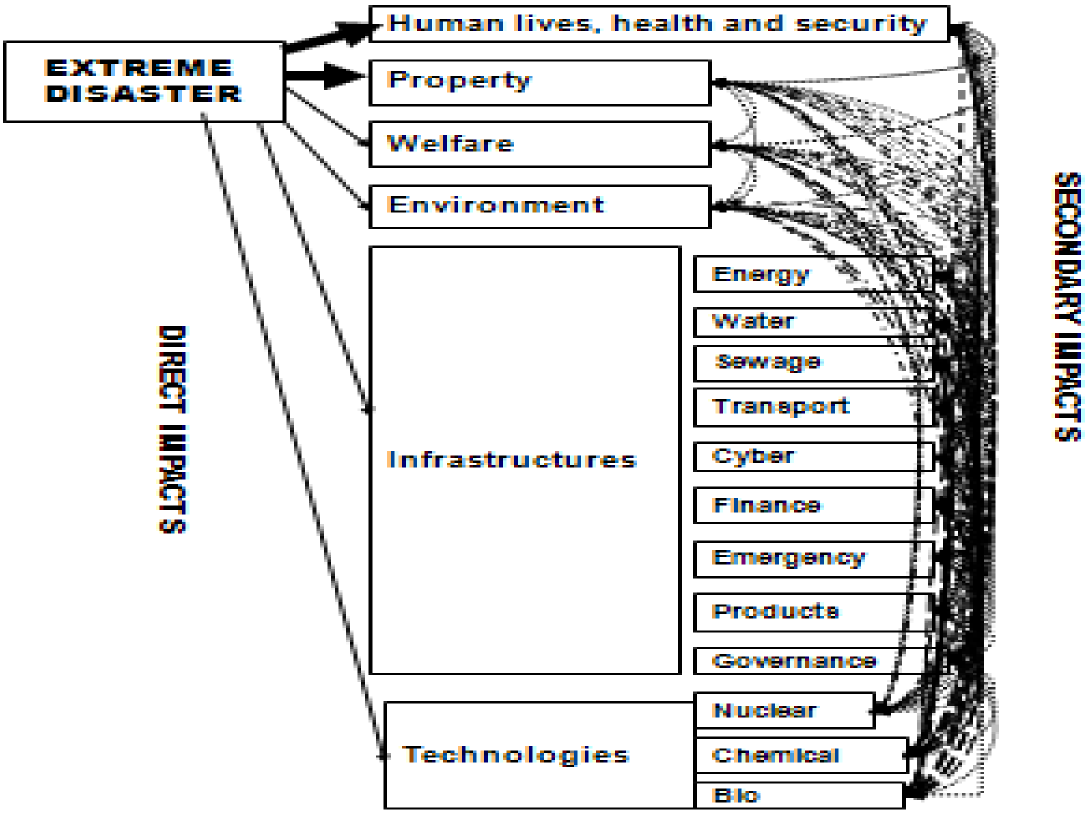

Figure 4. Extreme (beyond design) disaster impacts on public assets. Protection measures and activities are prepared only for impacts denoted by bold arrow. Secondary impacts are caused by cascade failures of infrastructures [1, 3]

7. The humans perform different measures and activities with aim to cope the disasters, Figure 5 [1, 3].
8. The EU security can be reached only by systematic, proactive and permanent effort correctly directed to important targets [3].
9. The EU and its Member States have management of state (i.e. human system) with three levels, Figure 6 [1, 3].
10. The EU and its Member States have special legislation for safety management; example is in Figure 7 [1, 3].
11. The methods of risk identification, risk analysis, risk management and of risk engineering depend on requirements that are followed (there are distinguished the methods for: risk reduction in closed system only considering the technical causes of risks; risk reduction in closed system considering technical and human factor causes of risks; ensuring the system security without respecting the system vicinity security; ensuring the system safety – system and its vicinity are safe; ensuring the system of systems (SoS) safety – overlapping systems and their vicinity are safe) [1, 8, 11].
12. The EU can be the global security actor only if it respects principals of SoS safety in management of risks and in engineering disciplines implementing the measures and activities keeping the risk on acceptable level.

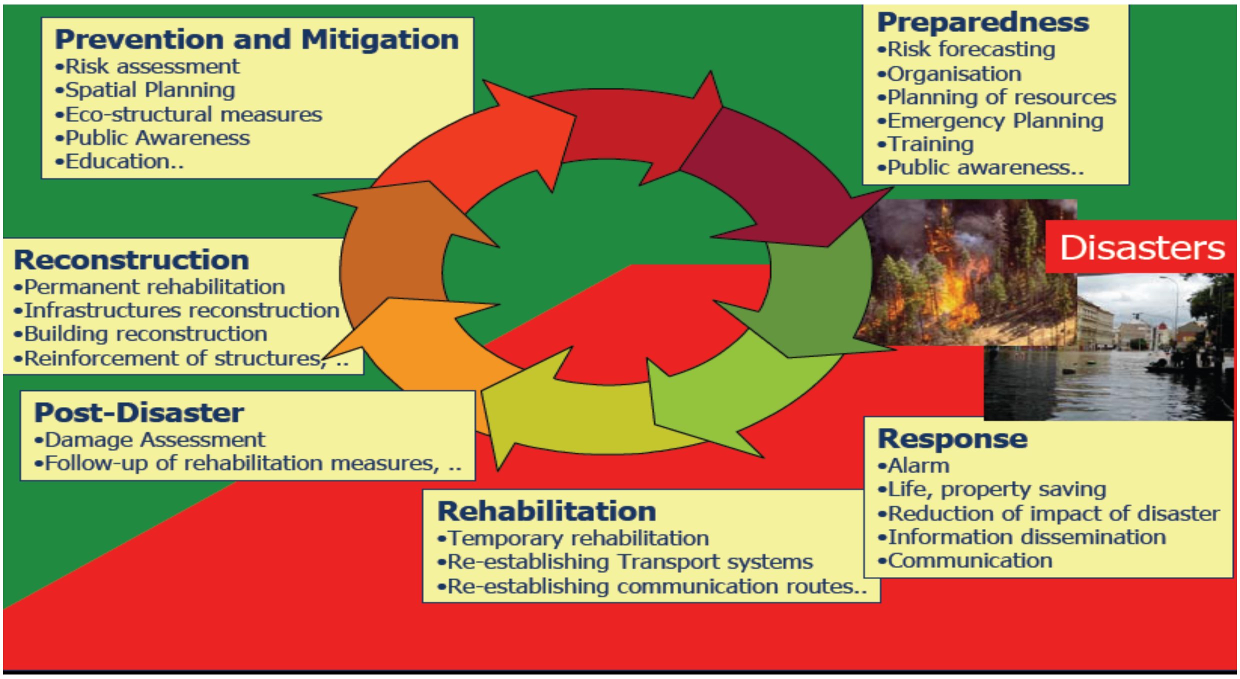

Figure 5. Different measures and activities performed by humans with aim to cope the disasters [1, 3]

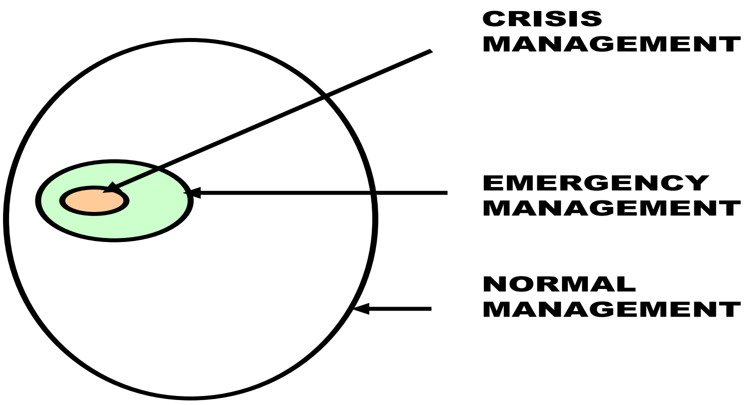

Figure 6. Three level state (i.e. human system) management [1, 3]

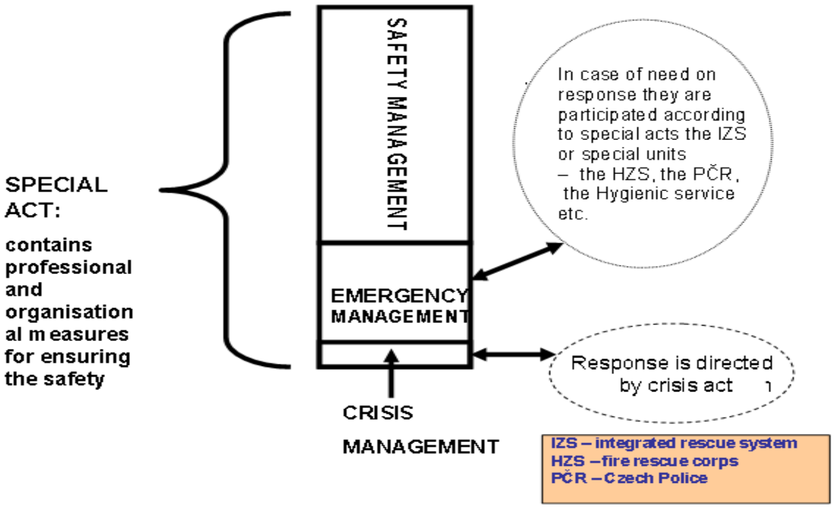

Figure 7. Example of legislation structure for ensuring the safety in various situations that is usually in force [1, 3]

3. WORK WITH RISK

Work with risk is expressed by model shown in Figure 8 [11]. Feedbacks denoted in this Figure are used if risk level is not on required level [11]. For human safety and for human system safety (i.e. territory, organisation, plant) we must manage the integral risk including the human factor, i.e. to find the way of cross-section risks management and to concentrate the investigation on interdependences and critical spots with a potential to start the system cascade failures, domino effects, strange behaviour etc., and on the basis of such site knowledge to prepare measures and activities ensuring the continuity of limited infrastructure operation and of the human survival.

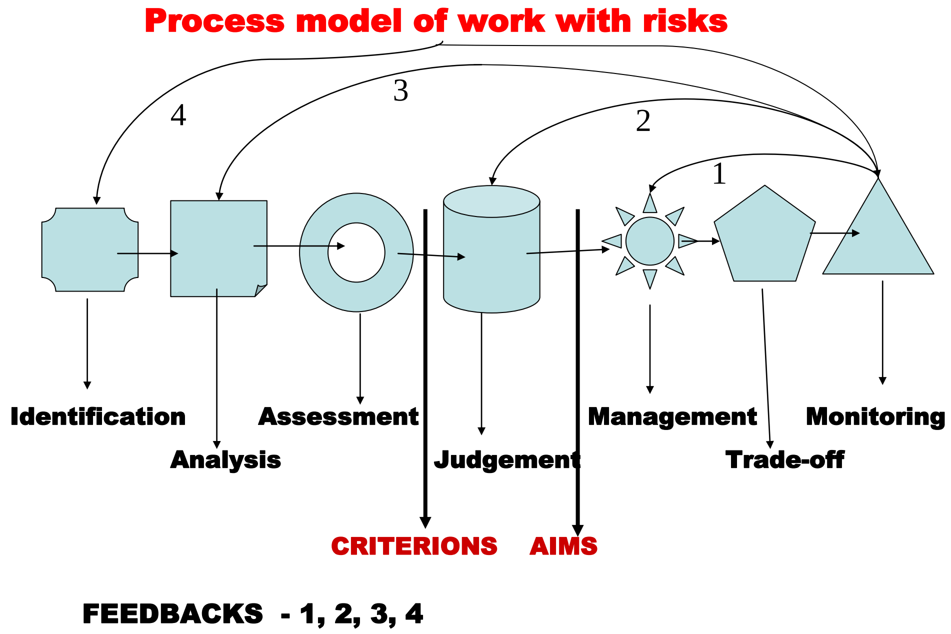

Figure 8. Process model of work with risks, numbers 1, 2, 3 and 4 denote feedbacks [11]

Considering the critical present knowledge evaluation, we recognised that one from the many causes of interdependences, inducing the failure cascades in the human system or in its parts, is the human error (intentional or unintentional) in management. Therefore, in both, the management activities and the engineering activities we must do all the procuration with the aim to avert a human failure, especially at the decision-making. Because consequences of errors caused at decision making are often huge, the human failure causes at management level, are now under a big attention at work with risk [12]. I.e. in work with risk we also consider the disasters triggered by human failure at decision-making.

Strategy of management for ensuring the security and sustainable development of managed subject consists of the negotiation with risks. We apply several ways of dealing with risk [8]:

- part of the risk is reduced, i.e. by preventive measures and activities the risk realisation is averted,
- part of the risk is mitigated, i.e. by prepared measures and activities (as warning systems and another measures of emergency and crisis management) non-acceptable impacts of risk realisation are reduced or averted,
- part of the risk is re-insured,
- part of the risk is covered by reactive and renovation measures and actions, i.e. there are prepared resources, forces and means for response and renovation,
- and residual part of risk remaining without human attention, i.e. it is a part of the risk that is non-controllable or too expensive at its averting or low frequent – in very advanced risk management it is prepared contingency plan and continuity plan for case of it realisation (see actions after the extreme disasters, e.g. Fuku-shima accident in 2011).

It is necessary to give that management of risks has not been uniformly understood yet [8]. In our research we consider the interpretation given in Figure 8 that is consistent with definition of the FERMA (Federation of European Risk Management Associations), EMA (Emergency Management Office of Australia), UK Cabinet Office, USA Presidential / Congressional Commission on Risk Assessment and Risk Management, OECD, IAEA etc.

Types of risk management / engineering and their characteristics summarized in work are given in Table 1 that was constructed according to results of critical analysis of basic publications the lists of which other ones are in [8, 11 and 13]. Table 1 and Figure 9 show concepts of management and trade-off with risks and their targets; they are arranged chronologically according to introduction time in practice.

Table 1. Types of risk management / engineering and their characteristics

Type of risk management / engineering	**Concept characteristics**	**Aim of risk management / engineering**
Classical risk management / engineering	Object (plant, territory, organisational unit) is a closed system. Risk sources are internal technological phenomena in buildings. Formation in 30s of last century.	The target is to reduce the technological risks of a system to a certain level, given by standards and norms. The risk is determined after the design of the system, and therefore, there is no possibility to reduce risks connected with an inappropriate solution for a given site and a system. The reduction of risks connected with an inappropriate solution for a given site and system may be removed only by organisational measures, the effectiveness of which is lower than effectiveness of technical ones [13].
Classical risk management / engineering considering the human factor	Object (plant, territory, organisational unit) is a closed system. Risk sources are internal technological phenomena and human factor in buildings. Formation at the end of 70s of last century.	The target is to reduce: the technological risks of a system to a certain level given by standards and norms; and to reduce risks connected with a human factor – safety instructions for danger works. The risk is determined after the design of the system, and therefore, for reduction of risks connected with an inappropriate solution for a given site and system may be removed only by organisational measures, the effectiveness of which is lower than effectiveness of technical ones [13].
System security management / engineering	Object (plant, territory, organisational unit) is an open system. Risk sources are external and internal phenomena including the human factor. Formation at the first half of 80s of last century. As risk sources also failures of decision-makings at risk management / engineering were included [13].	The target is to reduce risks for a system: from external and internal phenomena and a human factor, to a certain level given by standards and norms; i.e. to ensure the security of a system and its assets. No interest on system vicinity. Unacceptable impacts on vicinity can be only mitigated by special off-site emergency plans [13], i.e. by organisational measures and activities if state enforces such legislation.
System safety management / engineering	Object (plant, territory, organizational unit) is an open system. Risk sources are given by all hazards approach. Formation at the second half of 80s of last century. The advanced safety engineering uses at risk determination the following principles: - risk is determined during the given system whole life cycle, i.e. at sitting, designing, building, operation and putting out of operation, and eventually at territory bringing in original condition, - the risk determination is directed to user's demands and to the level of provided services, - risk is determined according to the criticality of impacts on processes, provided services and on assets that are determined by public interest, - unacceptable risks are mitigated by tool for risk management, i.e. according to technical and organisational proposals, by standardisation of operating procedures or by automatable check-up. To prepare groundwork, it is necessary to	The target is to ensure the security of a system and its assets and the security of system vicinity. The target is the safety, i.e. it is also necessary to trade-off with risks having low occurrence frequency if their impacts are unacceptable, and i.e. precaution principle is applied. The set of standards and norms exist especially for nuclear and chemical domain. Except of technical measures respecting the precaution principle, special technical problems solution there are continuity plans containing the procedures for overcoming the critical conditions in system and system vicinity, emergency plans and crisis plans. The risk management viewpoint by these characters: sitting – designing – construction – project with risk reduction; operation with the integration of early warning systems and of procedures for the management of the acceptable level of risks; and defeating the abnormal, emergency and critical conditions at the operation and at putting out of the operation [3, 11, 13].

	combine analytical methods with expert judgement by which we remove vagueness (epistemic uncertainties) in data [13].	
System of systems safety management / engineering	Object (plant, territory, organizational unit) is an open system of systems. Risk sources are given by all hazards approach and by interdependences among the partial systems and by those with vicinity. Formation at the beginning of third millennium [13].	Target is to ensure: the security of both, the system of systems including its assets and the system of systems vicinity; and the co-existence of individual systems creating the system of systems. It considers interdependences of many kinds and promotes precaution principle [13]. The set of standards and norms are under discussion and preparation.

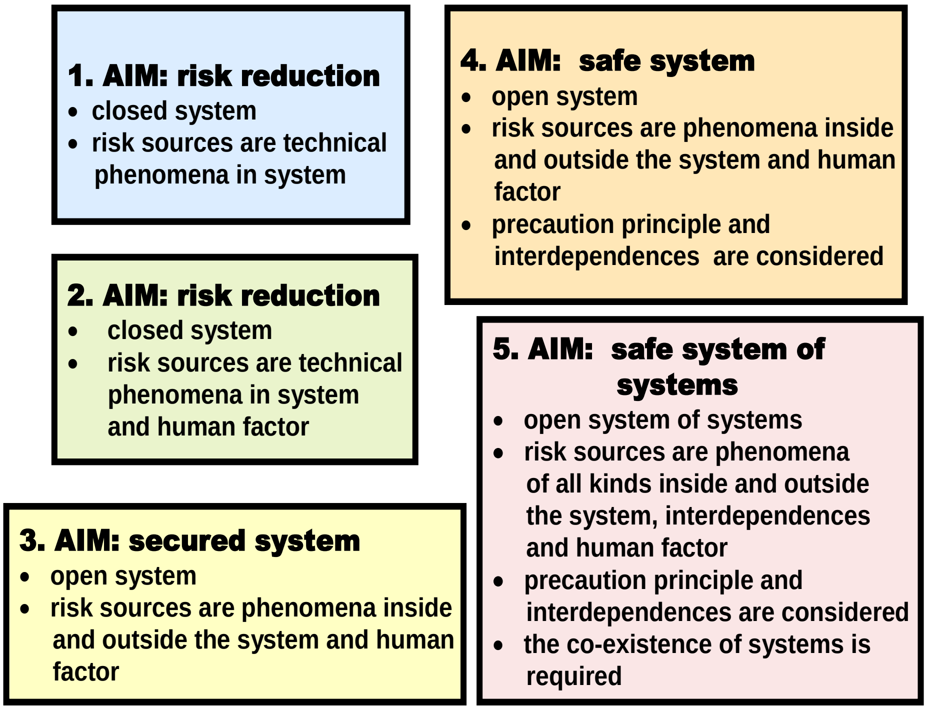

Figure 9. Concepts of management and trade-off with risks and their targets arranged chronologically according to introduction in practice

4. CRITICALITIES OF RISK MANAGEMENT AND TRADE-OFF WITH RISK

As it was shown above the five various concepts of risk management / engineering are used in practice. They were the subject of our research because we can show which one is capable to ensure the EU security well. As it was said above they are assessed by methods described above and by help of data obtained from 6 experts. The resultant assessment representing the median from data obtained from experts described in foregoing paragraph is given in Table 2.

Table 2. Rate of criticality of followed concepts of risk management / engineering

Criterion	Classical system risk management / engineering	Classical system risk management / engineering considering the human factor	System security management / engineering	System safety management / engineering	System of systems safety management / engineering
1	4	3	1	1	1
2	5	5	5	1	1
3	4	3	1	1	1
4	5	5	5	1	1

5	5	3	1	1	1
6	5	5	5	2	1
7	4	3	1	1	1
8	5	5	5	1	1
9	4	3	1	1	1
10	5	5	5	1	1
11	5	5	4	5	1
12	5	5	4	5	1
13	5	5	4	5	1
14	5	5	4	5	1
All	66	60	41	31	14
criteria	5	4	3	2	1

From Table 2 it follows that the criticality is:

- extremely high for the classical system risk management / engineering,
- very high for the classical system risk management / engineering considering the human factor,
- high for system security management / engineering,
- median for system safety management / engineering,
- low for system of systems safety management / engineering.

It means that the system of systems safety management / engineering is the most effective concept of work with risk with regard to our present knowledge and experience directed to human system safety from the viewpoint of ensuring the human security and sustainable development. Taking into account the reality that the use of various concepts are differ by requirements on knowledge, data, personal qualification, material, finance and technical solutions, it is evident that the most effective concept is the most challenging. Therefore, it is necessary and important for strategic level of problems´ solution. For tactical and functional levels of problems´ solution is sufficient the concept ensuring the system safety management / engineering. The concept called as system security management / engineering is only suitable for technical level of problems´ solution, i.e. in cases in which high damage on system vicinity are not probable.

It is also evident that at emergency management or at crisis management we have not time to determine the most suitable strategic solution, i.e. at emergency at simple case the risk management / engineering principles are sufficient, but at most of real cases the security management / engineering principles are applied if we *only* protect object under account and not its vicinity, ***otherwise*** the safety management / engineering principles or SoS management / engineering principles must be applied.

Because the system safety is complementary quantity to system criticality, i.e. safety + criticality = 1, we obtain from Table 2 the following values for safety rate: 0, 1, 2, 3, 4 and statement "the higher, the better". To obtain the optimum concept for our aim we use the way used in the engineering disciplines, i.e. the theory of margin assessment [11, 14]. By this way we obtain for safety rate the values: median $\mu = 2$ and standard deviation $\sigma = 0.63$, $\mu + \sigma = 2.63$, $\mu + 2\sigma = 3.26$, $\mu + 3\sigma = 4.89$. From this it follows that the concept for system of systems safety management / engineering is the optimal for ensuring the EU security.

5. CONCLUSION

The results given above show that the system of systems safety management / engineering fulfils demands of social engineers, technical engineers and environmental engineers because it ensures well the protection of humans in the EU that is the ground for the EU security. In research described in a great detail [1] there were revealed the main EU problems, i.e. the EU vulnerabilities:

- all hazard approach is not systemically applied,
- some disasters are underestimated (especially in social domain and in organisation of public affairs),
- systemic, strategic and proactive management is not implemented into practice as a fundamental tool,
- gaps in risk management, risk engineering and in trade-off with risks,
- research does not determine priority orientations, its targets are influenced by politicians or lobbies,
- application procedures and orientation of strategies are not regularly verified,
- reasonable strategy for disaster management is missing,
- the disaster management does not often respect disaster life cycle,
- accent to problem solving is missing, still only a lot of discussions on problems,
- lack of resources,
- lack of instrument for ensuring the EU finance stability,
- lack of management supporting the public protection and sustainable development.

It is necessary to improve education in the domain of work with risk (often defect is reliance on results of analytical functions without respect to data uncertainties, especially epistemic ones) and at least of strategic level to promote professional solutions without political dreams.

For improvement the EU security it is necessary to remove the mentioned vulnerabilities and mainly to work with risk by the way determined by the concept “system of systems safety management / engineering”. According to good practice principles only systematic, permanent and well directed measures and activities guarantee the procuration of good EU role in the world now and in future.

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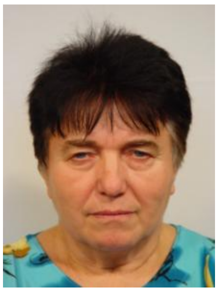
BIOGRAPHY OF AUTHOR



Assoc. Prof., Dr. Dana Prochazkova, PhD., DrSc. studied the Faculty of Mathematics and Physics, Charles University at Praha, worked in research and in governmental institutions: in Czechoslovak Academy of Sciences, Ministry of the State Control of the Czech Republic, State Office for Nuclear Safety, Ministry of Interior – Fire and Rescue Service of the Czech Republic, and in Czech Technical University in Praha. The whole work life she has been lectured in the Czech and Slovak Universities. The objectives of professional works have been seismicity, seismic engineering, seismotectonic relations, responses of constructions and their equipment to the earthquakes, evaluation of soil conditions to the construction behaviour, nuclear engineering, disasters, crisis management, emergency management, risk and safety management, engineering, legal and technical measures etc. She published 25 professional books and more than 500 professional papers in the English, in the Czech, in the Russian, in German and in the Chinese.