RISK UNDERSTANDING AND STANDARDIZATION AS A FACTOR OF DISASTER RISK MANAGEMENT

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Abstract:

Disaster related risk can be categorized as a mainly naturally generated, difficult for prediction and unique in development scenario. Unlike most common large risks which are combined from frequent occurrence and significant losses, high risk index values are mainly due to enormous consequences and risk reduction strategies are mainly related to avoidance of secondary induced hazards or consequences.

Development of safety and protection concept from reactive or ignorance to active approach is following by diverse definitions and approaches in risk definition and practice. Disregarding fact to set of internationally recognized standards for risk management are adopted, in disasters prevention or reduction practice various approaches in definition or methodology are present nowadays.

Key words: Risk, Hazard, Disaster, Reduction, Management, Standardization, ISO31000

1. INTRODUCTION

Safety and being "safe" could be considered as a successful dealing with sources of "unsafe" activities or conditions (E.Delic and E.Nukic, 2014). Disaster risk is continuing to increase, mostly because vulnerable people and assets are located in exposed areas (Tom Mitchell and oth., 2014). Disaster risk level and future predictions are linked to the poverty. This leads to relations between sustainable development and disaster risk reduction, and defined by set of proposed priorities such as: end poverty in all its form anywhere, ensure healthy lives and promote well-being for all at all ages, make cities and human settlements inclusive, safe, resilient and sustainable etc. Journey from definition of abnormal or unlike status, situation or event to final goal to manage evaluated risk could lead to journey which could lead to different directions and make hardly possible to implement previous experience, predict and prepare for potential disasters.

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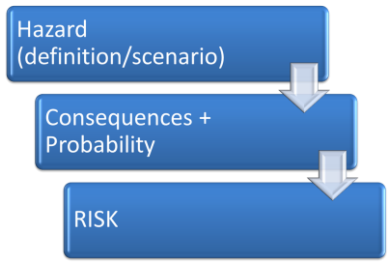


Figure 1: From hazard to risk (E.Delic and E.Nukic, 2014)

Evolution of scientific and systematic approach in risk treatment has several different phases of development, and today is ultimate goal to make possible to "manage risks". Management, as goal, is based on overall identification and evaluation of risk factors, risk levels quantification and comparison to baseline or other way defined criteria. Final goal to manage risks could be defined as attempting to maintain risk levels under desired threshold values.

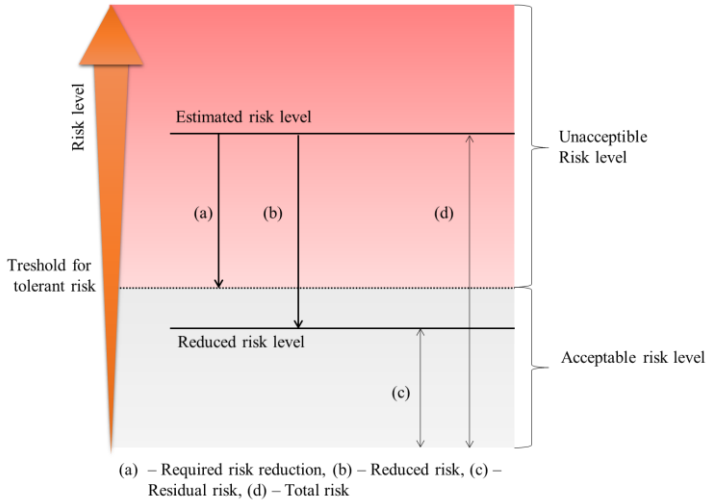


Figure 2: Risk treatment (E.Delic and E.Nukic, 2014)

Risk management should not exclude residual risk levels in any kind of human or natural activity. In order to manage risks different terms, conditions and criteria must be previously precisely defined. Goal for successful risk management is to keep risk levels and indicators in acceptable or tolerable domains.

Disasters related risks are mainly caused by primary natural generated hazards which are difficult to predict or manage. Natural hazards such as volcano eruptions, earthquakes, tsunami, natural forest fires etc. generally are unpredictable, but on the other hand consequences for different events are mainly predictive.

Risk treatment should be based on inclusive approach, including experts and methodology from different fields of science and technology, but general framework is necessary in order to insure coherence across different sectors. Since 2009 set of international standards from ISO 31000:2009 and following documents are available as a framework for harmonized approach in risk management.

2. RISK TRATMENT APPROACHES

Dealing with unlike situation and risks is related to any human activity and could be found in many historical documents. Risk and profit are connected and most of "high beneficiary behaviors" are related to associated risks. Challenge on how to benefit avoiding high risk, or survive risky circumstances is life surviving strategy worldwide.

Increased understanding of risk treatment importance and popularity caused diverse definitions and approaches including certain level of confusion in terms what does mean "risk control", "risk reduction", "monitoring of risk", etc.

Under United Nations, in middle of last century, started great debate about future of our planet and environment. First international UN conference in Stockholm 1972 was focused to the anthropogenic environmental degradation and questioning future trends in nature conservation.

First disaster risk reduction international conference was organized in Yokohama in 1994, following environmental internationalization Stockholm UN Conference on the Human Environment (Stockholm 1972), UN Conference on Environment and Development (Rio de Janeiro 1992), and future development of "Agenda 21" for next century. Within 10 Yokohama Strategy principles first one is "Risk assessment is a required step for the adoption of adequate and successful disaster policies and measures". As a part of "Activities at the community and national levels", under paragraph "C" is declared "Develop a risk assessment programme".

Second risk conference was in January 2005 when 168 governments adopted a 10 years plan known as "Hyogo Framework for Action 2005-2015" (HFA) to make world safer from natural hazards (Source: https://www.preventionweb.net). Conference was organized in Japan and named by Hyogo Perfecture in main island Honshu. HFA goal was to substantially reduce disaster losses by 2015 - in lives, and in the social, economic, and environmental assets of communities and countries.

Ending first framework decade, third initiative was organized in 2015 in Sendai, capital city of Miyagi Perfecture located in northern part of Honshu island and close to Tokyo, known as "Sendai Framework for Disaster Risk Reduction 2015-2030" (SFDR). The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) is the first major agreement of the post-2015 development agenda, with seven targets and four priorities for action. It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR).

Sendai Framework for Disaster Risk Reduction includes priorities such as: *understanding disaster risk*, strengthening disaster risk governance to manage disaster risk investing in disaster risk reduction for resilience, enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction. Understanding risk, as priority subject in framework document, is recognition of significance to develop common set of terms and procedures.

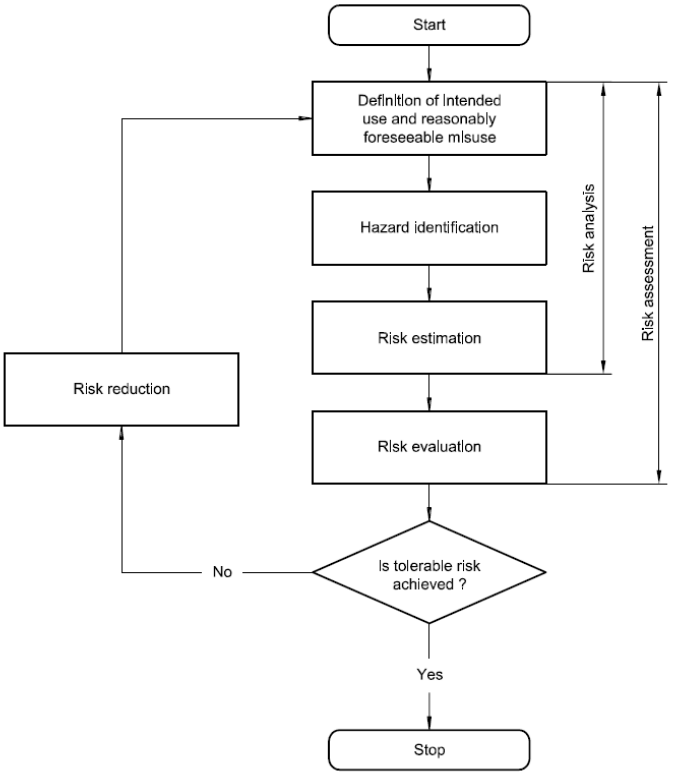


Figure 3: Process of risk assessment and risk reduction (ISO Guide 51:1999)

Significant progress in harmonization of risk assessment and management across different fields of science and technology was insured adopting new international standards for Risk management (ISO 31000:2009[2]), as an evolution from previously adopted standards in Canada (1997), Australia and New Zeeland (1999), USA (2000) and Japan (2001). Standard ISO 31000 is coherent to most of previously mentioned national standards, and it is not excluding or replacing any previously defined standard. It is general "framework for harmonization". New standard defined many significant terms and

[2] ISO 31000: Risk Management - Principles and Guidelines on Implementation

process in risk treatment, such as risk altitude, risk appetite, owner of risk, tolerance and risk aversion. ISO 31000:2009 is not developed for any specific science field or industry use and can be applied to any type of risk, without intention to generate uniform approach. Risk management should be further developed for specific fields, introducing general framework, definitions and processes. Risk management policy is required as an integral part of management and decision making process.

UN Resolution number 72/218 "Disaster Risk Reduction" was adopted on the 22nd session of the UN General Assembly (December 20, 2017), where central point is reduction of disaster related risks. Resolution recognizes that disaster risk reduction requires a multi-hazard, multisectoral and inclusive risk-informed decision-making. Resilience and poverty are focused related to the Sendai framework priorities, especially mentioning healthy ecosystem, ***development of risk baselines***. It also "encourages countries to conduct a disaster risk assessment of existing critical infrastructure, to make disaster risk assessments a prerequisite for infrastructure and housing investments and to strengthen regulatory frameworks". One of key messages is to "welcomes the report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction, 19 and the establishment of common indicators and shared data sets to measure the Sendai Framework global targets and the disaster risk reduction targets of Sustainable Development Goals 1, 11 and 13 as an important contribution to ensure coherence, feasibility and consistency in implementation, collection of data and reporting, and also welcomes efforts to develop coherent metrics for reporting under the Sendai Framework, the Sustainable Development Goals and other relevant instruments".

Risk management terms, conditions and procedures

Initial foundation for standardized approach in risk management is definition of key factors for risk management. Hazard and risk definition are starting point for any further harmonized development.

According to ISO 31000:2009 **hazard** is identified as "***source of harm***", ***missing opportunity or danger situations***. In hazard identification specific approach for different kind of problems is necessary to define specific methodology, depending of nature of hazard and required procedures.

In area of Landslide geotechnical analysis in urban planning common approach for many years is analysis of "landslides hazard and risk" and mapping (L.Cascini and oth. 2005). Landslide hazard map is defined as document which should provide "information concerning the spatial probabilities and frequencies of all anticipated landslide types", expanding concept to frequency classes, landslide intensity. Landslide risk analysis factors are "vulnerability of the elements at risk".

W.J. Ammann (2006) define risk related to natural hazards as the product of: frequency or probability of a "catastrophic" event/disaster; scale of the damage, as measured by the number of people and the value of the material damage caused at the moment of the actual

causal event and accounting for the susceptibility of the affected people and assets. Amman define "Integral Risk Management" as identification and analysis of risk, risk assessment and measures and discuss one of base principles for Risk Concept: "*To compare different types of natural hazards and their related risks and to design adequate risk reduction measures a consistent and systematic approach has to be established*".

As example of many different definitions and approaches, example of RMI index could be mentioned. Risk management index (RMI) is suggested as a complex estimation of four public policies (risk identification index, risk reduction index, disaster management risk index, governance and financial protection index) consisted six indicators for each of them (M.L.Caren and oth., 2007). RMI is generic approach consisting numerous of different risk assessment or management.

United Nations Office for Disaster Risk Reduction define hazard as "A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards)" (UN/ISDR, Geneva 2004).

UN General Assembly session on June 3, 2015 adopted report "*Establishment of an open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*". Group is consisted from comprising experts nominated by States and supported by the United Nations Office for Disaster Risk Reduction, for the development of a set of possible indicators to measure global progress in the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. On seventy-first session of UN General Assembly (December 1, 2016), adopted "*Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction*", which addresses importance of proper understanding and coherent methodology in "disaster risk treatment".

Between goals of group is and to "develop minimum standards and metadata for disaster-related data, statistics and analysis", and recommendations of the open-ended intergovernmental expert working group on terminology relating to disaster risk reduction

UN define hazard as a *process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation* (General Assembly 2015).

Disaster is recognized as *serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts and disaster risk is potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a*

community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.

Disaster risk governance is recognized as *system of institutions, mechanisms, policy and legal frameworks and other arrangements to guide, coordinate and oversee disaster risk reduction and related areas of policy*.

Disaster risk management is defined as *application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses*.

Obviously, UN definitions are broader and more complex compared to ISO 31000:2009 standards, but also less precise and specific. Beside risk management new area of "risk governance" is defined. It is not certain why UN initiatives did not take in account significant effort and success in risk management standardization announced 6 years before in ISO 31000:2009 standard and following documents. Definitions and approach are completely applicable to disaster risk management or reduction process, and disaster risk management could benefit from fact that all involved subjects are obliged in countries which adopted ISO 31000:2009 to harmonize their practice to international standards.

According to ISO Guide 51:1999 risk is defined as combination of the probability of occurrence of harm and the severity of that harm. Harm is described as physical injury or damage to the health of people, or damage to property or the environment. Hazard is defined as potential source of harm. Risk is slightly differently defined in ISO GUIDE 73:2009 as "effect of uncertainty on objectives" and "characterized by reference to potential events and consequences", but such definitions could be considered as more precise and completely compatible description.

Risk is considered as generic indicator derived from three major factors: identified hazard, frequency or probability of occurrence and consequences. After hazard identification, statistical estimation of occurrence and estimation of consequences, it is possible to move to next level: to estimate level of risk, as a combined indicator of mentioned factors. Risk could be treated on several different approaches, such as: risk monitoring, risk control, risk reduction, risk managing etc. Risk reduction is frequently mentioned in disaster decision making as "DRR-disaster risk reduction". Frameworks for disaster risk reduction at the international level and risk terms are not completely coherent to the ISO standards. Recently broadly used term DRR appears as narrow set of ISO risk treatment methods related to 3k family of standards.

Before "launching" of ISO 31000 standard (2009) it was acceptable to expect various approaches and different definitions of key terms. Main purpose of "risk framework standardization" is to establish necessity connection between different risk treatment efforts. Risk management standard is evolutionary derived from several national standards in developed countries. Selected definitions and methodology could be easy adopted in

any kind of previous risk treatment methodologies. Benefits from harmonization are enormous, because implementation of ISO 31000 gives better possibility to understand different risk managing areas, to measure, compare and to treat risk on a more systematic way.

Regardless many different approaches in theory and practice, all of them could be adopted and harmonized to ISO 31000:2009 procedures. Risk management is becoming responsibility to all subjects in process and hazard situations are expanded to "missed opportunities", "unlike events or potentially harmful situations" etc. Implementation of ISO 31000:2009 requires development of "risk register" and owners for any particular risk. For risk owners, which are also responsible for status of given risk, is essential to have precisely defined criteria and procedures for any expected scenario. Beside estimated risk level in process, significant is to define acceptable risk level, because many potential risks are unavoidable, area of reduction of such risks should be precisely defined for many reasons. If level of residual risk is under broadly accepted level, no any further risk reduction is required, but in case of higher risk levels different risk treatment strategies should be considered.

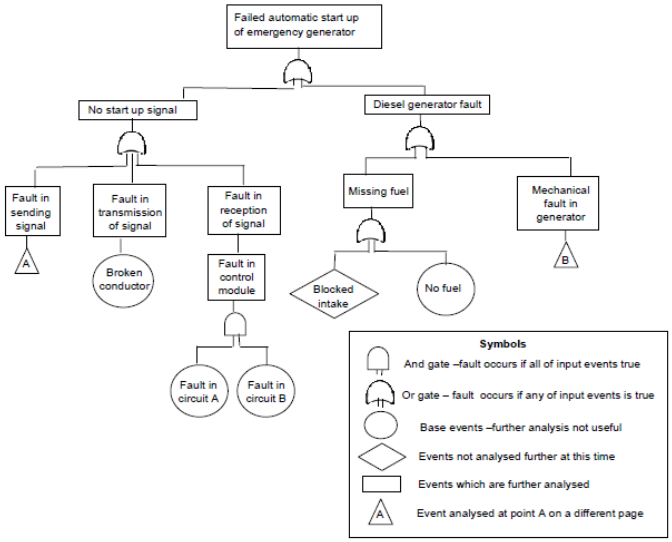


Figure 4: Example of an FTA (IEC 60300-3-9)

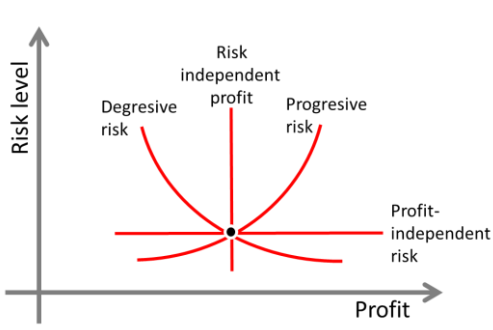
For purpose of hazard identification, risk evaluation and other procedures, various standardized methods are explained and proposed for use, but concept could be even more adjusted for different purposes. Within explained and proposed methods it is possible to find almost any of risk related methodology, or adopt to some of following: Brainstorming, Interviews, Barrier Analysis, Checklists, PHA – Preliminary Hazard Analysis, TA – Task Analysis, HAZOP – Hazard and Operability Study, SWIFT (Structured "What If" Technique), Scenario Analysis, BIA-Business Impact Analysis, LOPA-Layers of Protection Analysis, FMEA – Failure Mode and Effect Analysis,

FMECA - Failure Modes and Effects and Criticality Analysis, ETA/FTA – Event and Failure Tree Analysis, JHA – Job Hazard Analysis, QRA – Quantitative Risk Analysis, HEI – Human Effect Identification HRA-Human Reliability Analysis, Cause-Consequence Analysis, Case and Effect Analysis, Ishikawa Fishbone Diagram, Markov Analysis, Delphy technique, Monte Carlo Simulation, CBA - Cost and Benefit Analysis, Secret Analysis and etc.

Disaster Risk Reduction, monitoring and treatment paradigm

Disasters is rare appear to be alone (Understanding Risks, 2018). Domino effects follows other unlike events, which sometimes overcome initial consequences scale – especially in areas characterized by poverty and infrastructural under development. Within numerous hazard or risk characterization, one of essential is "genetic" classification, which divide all of them in two major families: (1) naturally induced hazards and (2) anthropogenic "manmade" hazards. Disaster hazards are mainly linked to the naturally caused hazards, but many secondary induced hazardous situations in disasters are anthropogenic, such as hazards caused by poverty, bad or missing infrastructure, pure disasters management and etc. Risk managing in disasters prevention should be closely connected to any other risk treatment in industry, governmental on non-governmental and international organizations. To create interface between different areas, minimal set of common definitions and procedures should be respected.

"Risk reduction" appears in title of main disaster risk treatment international frameworks (Hyogo and Sendai frameworks). Risk reduction is just one part of broad risk treatment procedures. Family of ISO 31k standards defines risk management as *"coordinated activities to direct and control an organization with regard to risk"*. Management is much more than monitoring, estimation or control. Risk treatment is defined as "process to modify risk", with regard to risk treatments that deal with negative consequences are sometimes referred to as "risk mitigation", "risk elimination", "risk prevention" and "***risk reduction***".



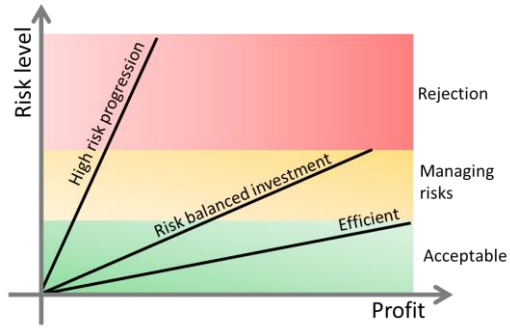


Figure 5: Risk and profit profile of different hazards and development policies

Any kind of risk treatment or reduction is connected to assets engagement and economical costs. Proper investments in good risk reduction strategy could be considered as "savings" or investments in better economical efficiency, because it saves lives and property. On the other hand, over-dimensioned risk reduction policy could lead to economic losses and loosing focus from main sources of risk.

In order to understand meaning of "risk reduction", when and how to do it, what will be final goal of reduction, how will we recognize final goal and steps to reach it, previously is required definition of criteria for estimation and decision. Moreover, in case of acceptable level of risks no any reduction is required, but sometimes high risk could be hidden for analysis in case of missing or unproper estimation of consequences and risk probability.

Avoiding to implement framework of ISO 31000:2009 standardization concept, in best case, will reduce potential of collaborating in risk management with organizations, institutions or companies which will utilize this concept in near future as integral part of management and decision making process.

"*Risk reduction*" is mentioned only once in ISO Guide 73:2009, in definition of "*risk treatment*", which is "*process to modify risk*". Risk treatment can involve: risk avoiding, risk taking, removing risk source, changing likehood, changing consequences, risk transfer or financing and retaining the risk. In explanation "note 2" is defined how "Risk treatments that deal with negative consequences are sometimes referred to as "risk mitigation", "risk elimination", "risk prevention" and "*risk reduction*". Focus to "risk reduction", without taking in account whole concept, is basically concentration to one part of risk treatment potentials, but also and limitations in understanding and practice for whole other procedures: starting from hazard identification, risk assessment and estimation, risk decision making, estimation of necessity for particular risk treatment, and post-risk treatment managing procedures.

Defining and accepting of "risk estimation criteria" is essential for efficient decision making process in risk management. Criteria could be not very precise, such as ALARP (As Low As is Reasonably Practicable). Such criteria is potentially acceptable in any case or situation, but main challenge is how to define what is reasonably? Risk reduction programs could require major investments and be unreasonable economic burden if "reasonably" is not properly defined.

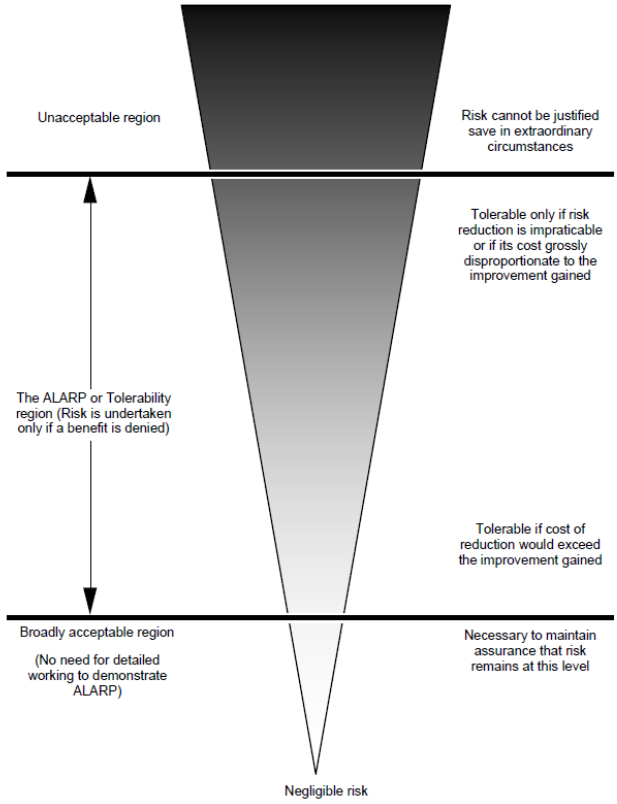


Figure 6: ALARP (As Low As Reasonably Practicable) concept (ISO 31010:2009)

International cooperation, sharing information and seek for harmonized approaches in risk treatment are some of goals of international organization "Understanding Risk Community" where participate more than 8000 different experts nowadays. Organization is active since 2010. In publication "Understanding risk" Organization is emphasizing understanding significance of risk management and requirements for methodology which "***will cut across sectors and industries***" (Understanding Risk, 2018).

UR forum addressed also and "The Disaster Imagination Game (DIG)" approach. It is clear that "gaming about disasters" does not sound nice, but it proves how important is to "unleash creativity" to gaming level in order to predict what can go wrong. From systematic approach to disaster gaming is essential to establish good understanding and coherent procedures, oriented more to harmonization then to uniform approach. But harmonization does not mean that any field of science, technology or governance seeking for its own definitions and procedures.

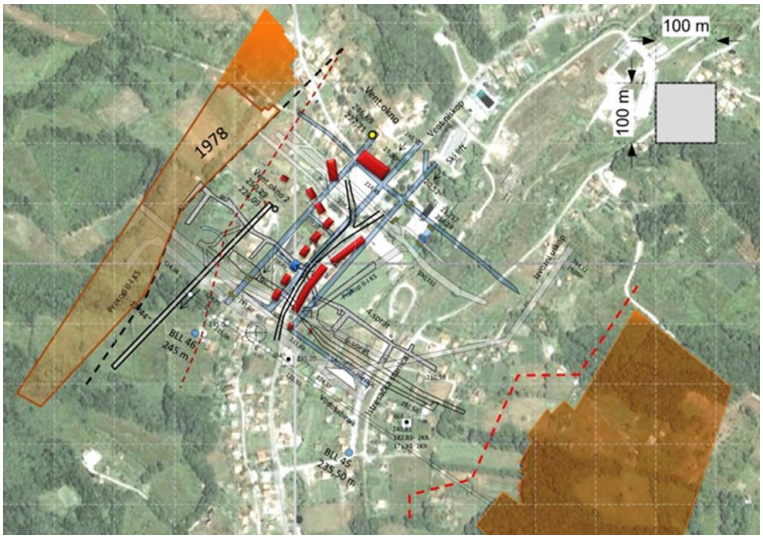


Figure 7: Example ilustration of combined risk assesment from past and existing mining/industrial activities and settlement conditions in ex-miner area Lipnica near by Tuzla (E.Delic and A.Softic, 2014)

To deal with major disasters is necessary to look for common points, specific and narrow definitions, measurable and comparable indicators, cross-field recognized methodology and criteria.

Risk level and related factors could be expresses as descriptive, categorized values, absolute or relative numeric value. Description and categorization of hazard is always first broad analysis, but in order to manage risks is necessary to estimate more specific value of risk indicators, limitations and borders, goals and criteria. Two essential values to estimate risk level are: (1) probability of occurrence and (2) expected consequences. As much is possible to estimate two factors in common indexes and units, result will be more applicable to different kind of analysis, comparison, implementation of previous experience in different situations and create baseline for further decision making process. As an example of applicable estimation of probability and consequences statistical probability and economical or human loses could be used for risk level estimation.

Simplified inclusive definition allows rapid risk estimation based on preliminary hazard analysis, potentially applicable in almost any imagined situation. Common understanding of risk concept will be great tool to make world safer for humans in future.

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QUESTIONS

1. Hazard and Risk: definition, factors, meaning and overall objective?
2. Risk treatment approaches and methodology?
3. Historical development of disaster risk reduction concept?
4. United nations international efforts in disasters risk reduction?
5. Risk management terms, conditions and procedures?
6. ISO 31000:2009 Risk management standard: overview, purpose and connection to other standards?
7. Risk treatment, management and reduction: meaning and practice?
8. Role of risk base level and criteria in risk management?
9. Significance of harmonized and standardized set of definitions and procedures in risk management?