Disaster risk assessment model for local authorities

Croatian Crisis Management Association v1.0

METHODOLOGY

The use of scenarios within a standardized model as a tool for identifying threats and adverse events, risk assessment with subsequent evaluation and prioritization. It is an example of a risk assessment and analysis method that may have a wider use as a template. The problem of such models is the human factor, ie the subjectivity and reliability of the obtained results, which is a feature of qualitative analysis. Therefore, a quantified supplement has been added that reduces the subjectivity of the assessment and allows the necessary comparability and significance of the results between municipalities, cities and counties in all-hazard approach. Also, the use of a standardized model allows for a uniform presentation of results. This model is in accordance with all applicable regulations related to the civil protection system, EU guidelines and ISO standards.

This is a hybrid model , made on the basis of semi-quantitative methods *Preliminary Hazard Analysis* with addition of quantified widget and the areas of interest and as such, the first model recommendation for local government in Croatia. Later versions will also include risk management tools for the purpose of the Disaster Risk Reduction Strategy.

The purpose of risk assessment and vulnerability analysis is to create a basis for preventive planning of the analysed area, as well as base for planning in reducing the consequences of an potential event. It also increases knowledge about threats in a particular area, their likelihood of occurrence and the severity of possible effects, and enables their mutual comparison, decision-making base for prioritization and regulation/reduction of assessed risks .

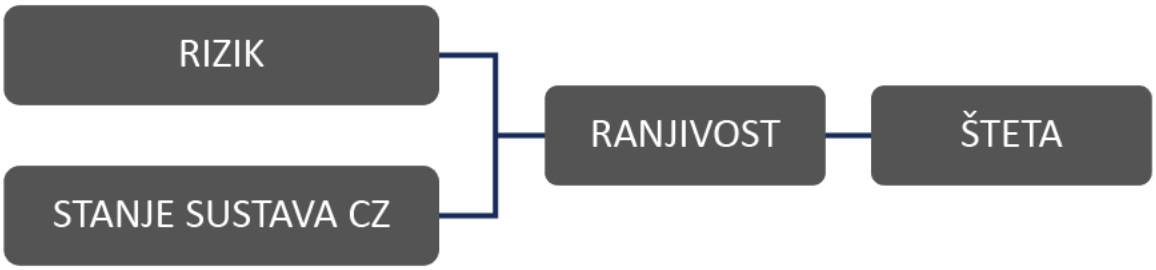


Figure 1 . Simplified crisis modeling scheme

The probability of an event with its consequences are the factors of which the required level of ability and readiness of the system to respond and the required level of preventive measures are determined.

In assessing the probabilities and consequences, it is possible to use domestic or foreign examples of these events, experiences from previous crises, major accidents or disasters (statistical indicators from the past, reports, books, open source, exercises, past events, lessons learned, etc.) .

Risk assessment using this model means assessing each scenario by determining the probability of its occurrence and the potential consequences. The integration of the obtained results is performed in the risk matrix. System vulnerability analysis is performed based on risk assessment and serves to reduce the consequences by strengthening response capacity.

1. IDENTIFICATION THREATS

This model takes as a starting point the analysis of the extraordinary events described in the scenarios . The purpose of identifying threats is to determine possible scenarios of those risks that pose a real threat. The scenario does not cover all potential threats, but only those that meet at least one of the following criteria in terms of the probability of occurrence or the extent of their consequences.

Criteria :

- serious impact on human life and health (dead, injured, sick, evacuated, cared for)
- serious disturbances to social stability and politics
- serious disruption of critical infrastructure
- serious consequences for the economy in the area of responsibility
- consequences with cross-border impact
- high probability of occurrence of the event

The scenario must be as realistic as possible which is why it is good to base it on a real events. It can also be a fictional event that is thought to be possible in the future. It should accurately describe the initial event, the further development of the situation and the extent/severty of the consequences. The description must be sufficiently detailed to allow risk and vulnerability analysis. Previous experience plays an important role in implementing preventive measures, identifying threats, risks and assessing the readiness and ability of the system to respond effectively. When describing scenarios, it is important to consider cascading effects and interdependence.

The scenario is a description of:

- adverse event (its development and consequences) of one or more related events that ultimately have undesirable consequences
- what preceded the event? (cause and trigger)
- the significance of the event, the circumstances that led to the consequences in terms of social value
- consequences of the event and response to the event

Scenario features:

- probable (except *worst case*) and possible event in the near or distant future supported by actual data
- consistently described and as close to real events (recommended that it's based on an actual event)
- must have a time sequence following a given theme
- the initial event must be described in detail to allow for the determination of subsequent preventive measures or operational procedures
- it must contain the actual state of the civil protection system
- in accordance with applicable laws and operating procedures
- it must contain information that enables the assessment of probability and the assessment of consequences
- it must contain the identification of the main triggers of the further development of events

RISK NUMBER		RISK	
SCENARIO NAME			
STAKEHOLDERS			
WORKING GROUP			

SCENARIO
Scenario description:

In Table 1, in the right column, enter the characteristics of the area according to the instructions.

Table 1 .

BASIC CHARACTERISTICS OF THE AREA	
Event location	The place of occurrence of the adverse event
Scope of area	Area of influence of the event (coordinates), area of involvement / areas of responsibility, description and influence of the terrain, form of occurrence (point, spreading in space, etc.)
Cross-border impact	Predicted degree of involvement of communities
Intensity	Event intensity (spread rate)
Warning	Early warning, informing the population, readiness of operational forces, preventive measures (implemented and necessary)
Event time	Hour / day / month / year if possible (or period of increased risk based on statistical monitoring of phenomena, eg spring due to melting snow which causes an increase in water levels, etc.)
Duration	Expected duration of events and direct consequences
Developments	Possible development of further situation, secondary and cascading events, growth rate and potential for early response

The description of the characteristic of significance includes the necessary data, areas / objects whose destruction or incapacitation would lead to extremely serious consequences (eg cultural

monuments whose destruction would lead to a decrease in the tourist value of certain historical sites or areas).

Characteristics of importance	Population
	Budget amount of local community (county)
	Population density
	Number of households in the affected area, list of affected settlements
	Protected areas
	Agricultural land
	Significance for the economy (economic branches in the affected area)
	Water supply infrastructure
	Electricity supply infrastructure
	Petroleum supply infrastructure
	Telecommunication infrastructure
	Cultural goods

Historical examples	Past events and lessons learned, ie implemented risk reduction measures (eg partial construction of embankments in the area ...) since the last event
The peculiarity of the area	Particularities of the area taking into account the economic importance (tourism, industry , critical infrastructure facilities, terrain, climatic conditions, etc.)
Operational forces	List of operational forces involved
Logistics	Accessibility and capacity assessment/self-sufficiency
Administrative complexity and interstate cooperation	Possible obstacles due to the proximity of the border, indication of joint SOPs or joint plans developed with neighboring comunnities/countries on mutual assistance - if any, or indication of the need for cooperation if any

2. PROBABILITY

For each scenario, the probability of its occurrence (realization) is calculated . The use of statistical indicators from the past enables a quantitative calculation of risk in order to ensure the significance and comparability of the assessment itself. Probability must be largely based on quantitative calculation wherever possible and qualitatively as little as possible. The reason is the reduction of the subjectivity of the analysis, ie unreliability , which prevents comparability with other similar analyses and the validity of the obtained results .

About the analysis:

- the assessment must be based on scientific (statistical) data
- the calculation is clearly structured and transparent
- the assessment is methodologically consistent and can be repeated with the same or very similar results from another working group using the same data and methodology
- an outcome that will support risk determination
- an outcome that will allow for further risk regulation/reduction
- an outcome that will allow comparability of results with other local authorities

Table 2 . Probability estimation

Category	PROBABILITY / FREQUENCY				
	Qualitatively	Probability /year	Select	Quantitative subinterval	Frequency
1	Extremely small	< 1%		-	1 event in 100 years and less
2	Small	1 - 5%		(A) 1-2% (B) 2-3.5% (C) 3.5-5%	1 event in 20 to 100 years
3	Moderate	5 - 50%		(A) 5-10% (B) 10-25% (C) 25-50%	1 event in 2 to 20 years
4	Big	50 - 98%		(A) 50-65% (B) 65-80% (C) 80-98%	1 event in 1 to 2 years
5	Extremely large	98% >		-	1 event per year or more often

Quantitative subinterval[1]	

3. CONSEQUENCES

The consequence assessment is the prediction of direct and indirect negative impacts of the event determined by the scenario. It is advisable to use the national value provisions to assess the damage .

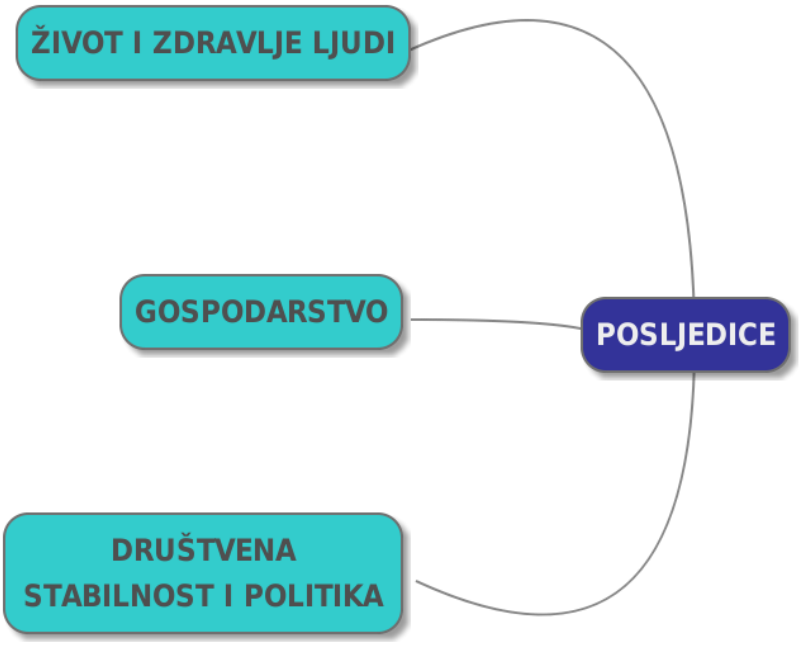


Figure 2 . Criteria (elements) for calculating the consequences

Each scenario is analysed according to the stated criteria of Figure 2 . The criteria of human life and health, economy, social stability and politics make it possible to determine the impact on categories of social values . Individual results within the categories of social values are combined into a common result which is presented in the risk matrix (the calculation of consequences is the average of the calculation of all impacts determined by criteria).

The main feature of consequence assessment is that leads to the assessment of operational forces and other resources (system vulnerabilities), ie whether they are sufficient to effectively eliminate the consequences.

3.1. HUMAN LIFE AND HEALTH

The consequences for human life and health are assessed on the basis of three separate criteria, and the overall consequences are assessed by their common average, ie the total consequences for human life and health. Human life and health should be protected from threats and risks in the greatest possible form. Consequences are described on the basis of a direct impact on life, taking into account the impact on health by the overload of the health system or the occurrence of poorer living conditions after the event.

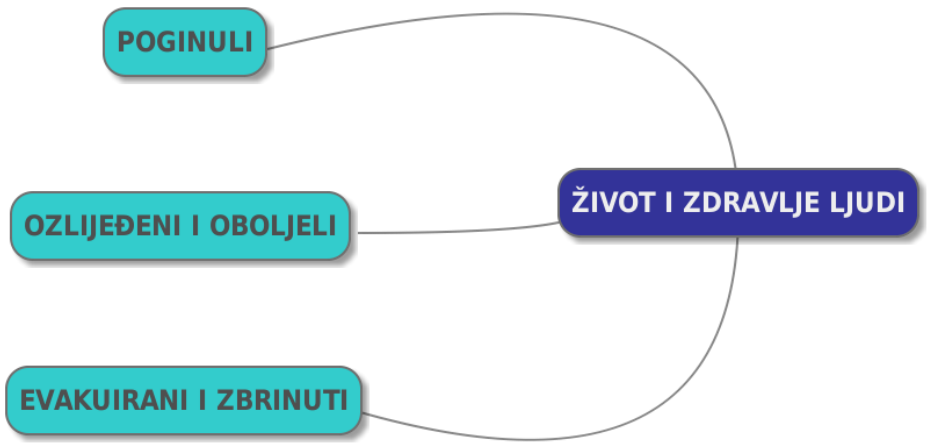


Figure 3 . Schematic representation of elements for the assessment of consequences for human life and health

In Table 3, Table 4 and Table 5 . according to the number of casualties, the category of consequences is determined. In Table 6 . the average value of the categories of the previous tables is calculated and the total category from Table 6 is calculated and used to create a risk matrix.

Table 3 . Categorization - killed

CATEGORY	CONSEQUENCES	SELECT	POPULATION LIFE AND HEALTH (killed)
1	Insignificant		0
2	Small		1 - 5
3	Moderate		6 - 20
4	Significant		21 - 50
5	Catastrophic		51>

Table 4 . Categorization - injured and sick

CATEGORY	CONSEQUENCES	SELECT	POPULATION LIFE AND HEALTH (injured and ill)
1	Insignificant		0 - 10
2	Small		11 - 30
3	Moderate		31 - 100
4	Significant		101 - 400

5	Catastrophic		401>

Table 5 . Categorization - evacuated and taken care of

CATEGORY	CONSEQUENCES	SELECT	POPULATION LIFE AND HEALTH (evacuated and taken care of)
1	Insignificant		0 - 10
2	Small		11 - 50
3	Moderate		51 - 300
4	Significant		301 - 800
5	Catastrophic		800>

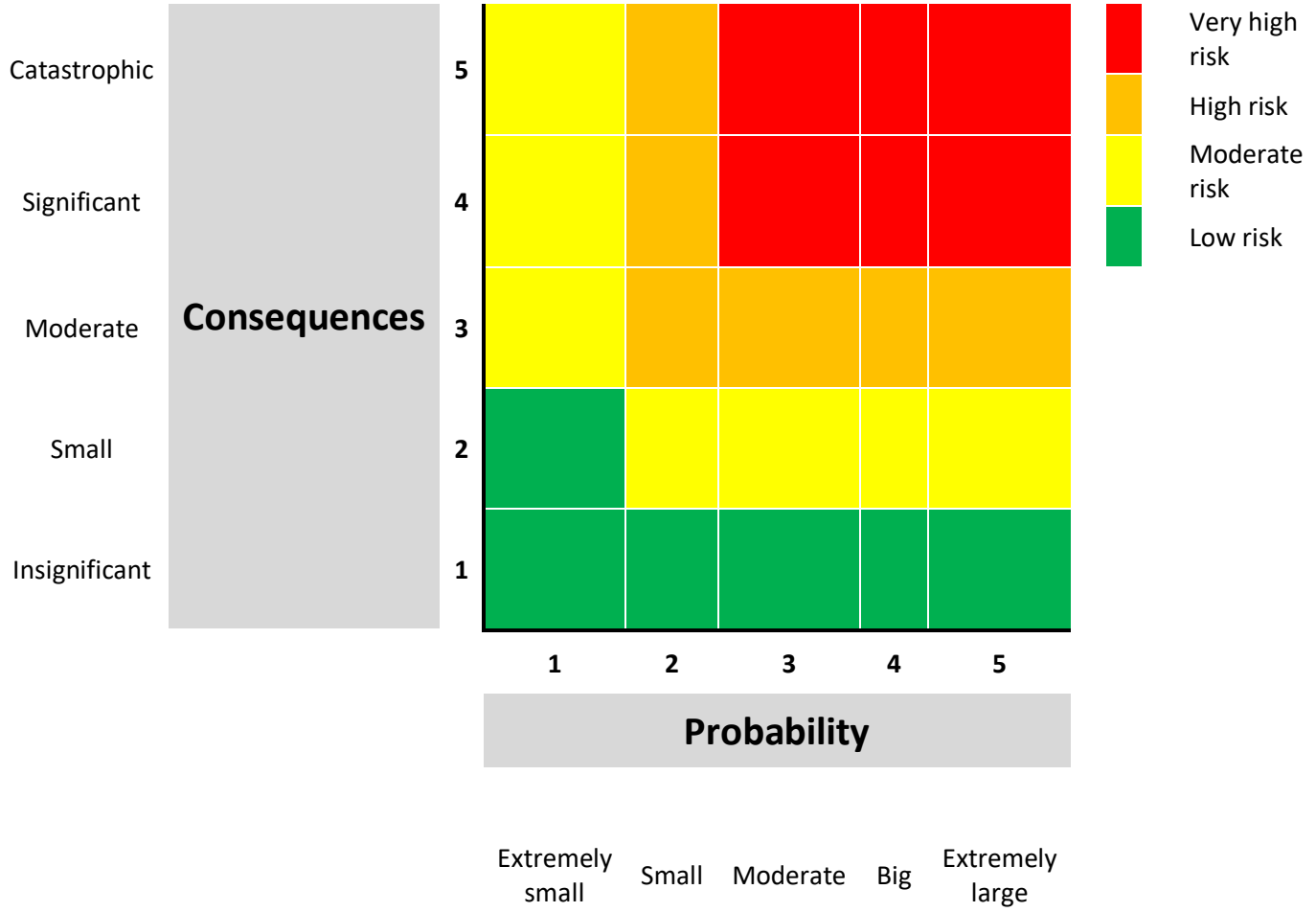
Table 6 . Categorization - total

CATEGORY	CONSEQUENCES	ODAB RATI	POPULATION LIFE AND HEALTH (total)
1	Insignificant		Average value of the categories of Table 2, Table 3 and Table 4.
2	Small		
3	Moderate		
4	Significant		
5	Catastrophic		

Total number of casualties		% of the total population of Local area	

3.1.1 RISK MATRIX - LIFE AND HEALTH

The risk matrix includes the category of probabilities in Table 2 and the category of consequences for human health. More on the risk matrix is covered in Chapter 4.



3.2. ECONOMY

The consequences for the economy are a negative impact on the efficiency and ability of the economy. Impact on ECONOMY in (total damage) determines the in monetary value and refers to the damage, the additional costs and loss of income. The damage is expressed in the monetary value necessary to bring the damaged or destroyed property to the condition before the occurrence of the event , ie the value required to procure these goods in the quantity and quality they had immediately before the occurrence of the event. Environmental damage assessment refers to the direct damage caused by the event and the cost of returning the environment to the state before the event if such return is possible, or the cost of reducing/eliminating the consequences of damage to the environment.

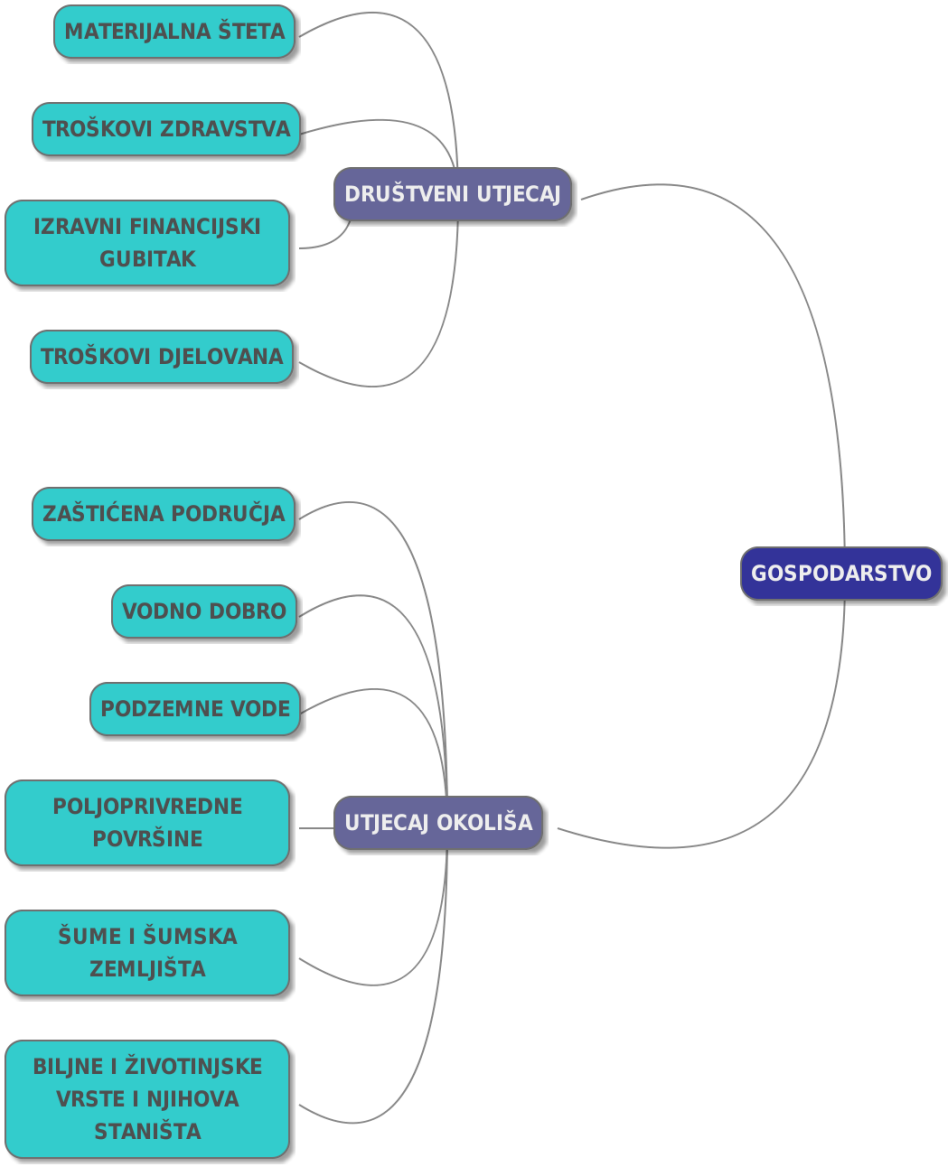


Figure 4 . Schematic representation of the elements of impact on the economy

3.2.1. SOCIAL IMPACT

The following tables describe the negative impact according to the given criteria and estimate the damage / loss of revenue / costs. Under the negative impact column, impacts are described within the criteria. Table 11 calculates the total material damage by summing the amounts of the previous tables. Table 11 is used when calculating the total material damage to the economy in Table 14. In Table 15 the category of total impact on the economy is used in the risk matrix.

Table 7 . Material damage

MATERIAL DAMAGE	NEGATIVE INFLUENCE	DAMAGE (euro)
Buildings and infrastructure, inventory and inventories, machinery, vehicles , damage to communication and information systems , etc.		

Table 8 . Healthcare costs

HEALTH COSTS	NEGATIVE INFLUENCE	COSTS (euro)
Cost of deaths, costs of health care, costs of hospital treatment, additional costs of response activities in the event of a major accident or disaster		

Table 9 . Direct financial loss

DIRECT FINANCIAL LOSS	NEGATIVE INFLUENCE	LOSS OF INCOME (euro)
Losses in business interruption related to property damage or lack of manpower, consequences of disruption of communications or transport infrastructure, lack of supply and demand		

Table 10 . Operating costs

OPERATING COSTS	NEGATIVE INFLUENCE	COSTS (euro)
Costs of operational forces, provision of assistance, accommodation, costs of evacuation and care of the vulnerable population, costs of recovery		

Table 11 . Consequence assessment - social impact

SOCIAL IMPACT	TOTAL DAMAGE (euro)
Sum of damages / loss of income / expenses of social impact	

3.2.2.	ENVIRONMENTAL IMPACT

Criteria:

- negative impact on protected areas
  protected area affected by the event (strict reserve, national park, special reserve, nature park, regional park, natural monument, significant landscape, park-forest, monument of park architecture), km / ha
- negative impact on water well
  surface (inland) water and sea water affected by the event, km / ha
- negative impact on groundwater
  water below the soil surface and in direct contact with the soil surface or underground layer affected by the event , ha
- negative impact on agricultural land
  agricultural areas affected by the event, ha
- negative impact on forests and forest lands
  forests and forest lands affected by the event, ha
- negative impact on plant and animal species and their habitats
  habitats of plant and animal species affected by the event, ha

The assessment of the consequences of the negative impact on the environment is categorized by the total material damage of the negative impact of the event , ie change in natural resources or direct or indirect measurable disturbance in the functioning of natural assets (measurable harmful effect) . Total material damage refers to the sum of all damages caused by the event.

Table 12 . Elements (criteria) of environmental impact

	Impact on protected areas		Impact on water well
	Impact on groundwater		Impact on agricultural land
	Impact on forests and forest lands		Impact on plant and animal species and their habitats

Table 13 . Environmental impact assessment

ORDINAL NUMBER	CRITERIA FOR ENVIRONMENTAL IMPACT	NEGATIVE INFLUENCE	AFFECTED AREA (ha, km)	MATERIAL DAMAGE (kn)	
1.					
2.					
3.					
4.					
5.					
6.					
			TOTAL MATERIAL DAMAGE (euro)		
			TOTAL AREA AREA	Ha	km

3.2.3. IMPACT ON THE ECONOMY

The total impact on the economy is calculated by summing the damage of social impact and the damage of environmental impact in Table 14.

Table 14 . Total material damage - economy

TOTAL MATERIAL DAMAGE TO THE ECONOMY	euro
The sum of the damage of social impact and environmental impact	

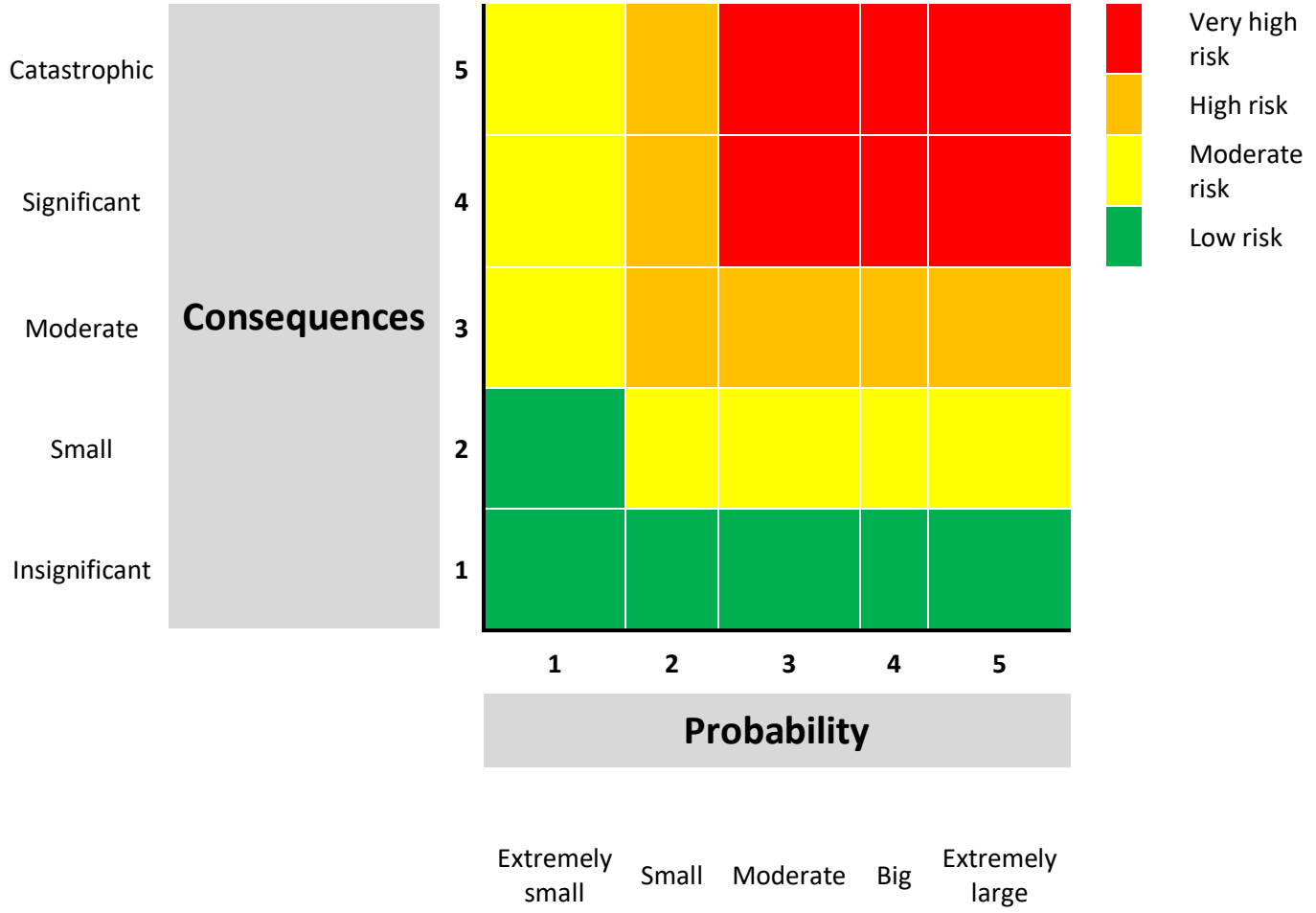
Table 15 . it is used to determine the overall category of impact on the economy and is used to create a risk matrix.

Table 15 . Consequence assessment - economy

CATEGORY	CONSEQUENCES	% BUDGET LOCAL	SELECT	IMPACT ON THE ECONOMY
1	Insignificant	<1%		Total material damage - number of damage to material goods, health care costs, direct financial loss and operating costs in relation to the Local budget
2	Small	1 - 5%		
3	Moderate	5 - 15%		
4	Significant	15 - 25%		
5	Catastrophic	25%>		

3.2.3.1. RISK MATRIX - ECONOMY

The risk matrix includes the category of probabilities in Table 2 and the category of consequences impact on the economy - total material damage. More on the risk matrix is covered in Chapter 4.



3.3. SOCIAL STABILITY AND POLICY

The impact on social stability and politics is easiest to describe as disturbances in everyday life, disruption of the democratic system with significant socio-psychological impact.
The impact is divided into three parts:

- **disruptions in the operation of critical infrastructures**
- **damage to public and public buildings**
- **negative impact on critical functions of social stability**

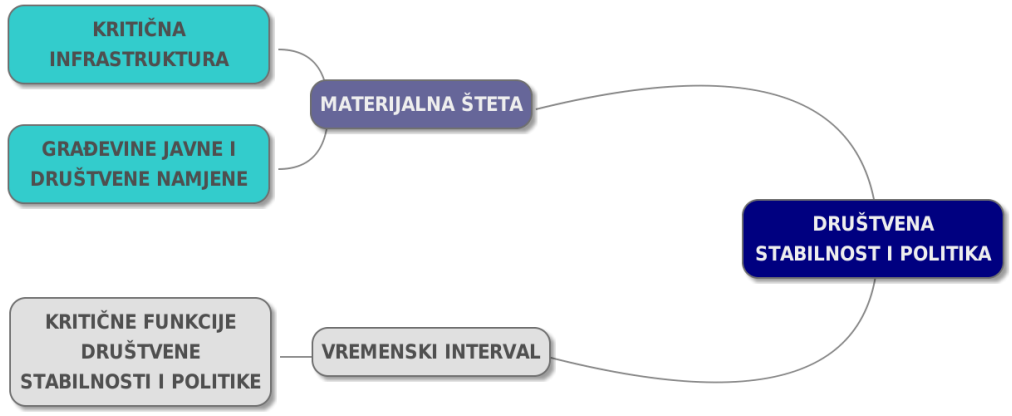


Figure 5 . Elements (criteria) of influence on social stability and policy

3.3.1. CRITICAL INFRASTRUCTURE

In Table 16 . each sector of critical infrastructure under the negative impact of the event shall be identified, taking into account both interdependence and cascading effects and shall be entered in Table 17 .
In Table 17 the negative impact describes all the negative impacts of events by sector elements, the damage and the time interval of the disturbance duration are estimated . The section total material damage summarizes the damage of all sectors of critical infrastructure under the influence of events. In Table 18 the category of consequences for critical infrastructure is estimated by the ratio of total material damage and local budget.

Table 16 . Critical Infrastructure Sectors

	energy (production, including reservoirs and dams, transmission, storage, transport of energy and energy, distribution systems)		communication and information technology (electronic communications, data transmission, information systems, provision of audio and audiovisual media services)
	traffic (road, rail, air, sea and inland waterway transport)		health (health care, production, trade and supervision of medicines)
	water management (regulatory and protective water structures and communal water structures)		food (food production and supply and food safety system, inventories)
	finance (banking, stock exchanges, investments, insurance and payment systems)		production, storage and transport of hazardous substances (chemical, biological, radiological and nuclear materials)
	public services (ensuring public order and peace, protection and rescue capacity, emergency medical care)		national monuments and values

Table 17 . Impact assessment by critical infrastructure sectors

ORDINAL NUMBER	CRITICAL INFRASTRUCTURE SECTOR	NEGATIVE INFLUENCE	DURATION OF THE DISORDER (days)	MATERIAL DAMAGE (euro)
1.				
2.				
3.				
4.				
5.				
6.				
			TOTAL MATERIAL DAMAGE (euro)	

Table 18 . Impact assessment for critical infrastructure

CATEGORY	CONSEQUENCES	% OF LOCAL BUDGET	SELECT	DAMAGED CRITICAL INFRASTRUCTURE
1	Insignificant	<1%		Total material damage in area of responsibility (local)
2	Small	1 - 5%		
3	Moderate	5 - 15%		
4	Significant	15 - 25%		
5	Catastrophic	25%>		

3.3.2. PUBLIC BUILDINGS

Public buildings are buildings intended for carrying out activities in the field of social services (training, education, science, culture, sports, health and social welfare), the work of state bodies and organizations, bodies and organizations of local and regional (regional) governments , legal entities with public authority and associations of citizens and religious communities .
In Table 19 . buildings under the influence of an event are listed and the negative impact is described and material damage is assessed . The section total material damage summarizes all damage to public buildings .

Table 19 . Assessment of the consequences of public and social buildings

ORDINAL NUMBER	PUBLIC AND SOCIAL PURPOSE	NEGATIVE INFLUENCE	MATERIAL DAMAGE (euro)
1.			
2.			
3.			
4.			
5.			
6.			
		TOTAL MATERIAL DAMAGE (euro)	

3.3.3. SOCIETAL CRITICAL FUNCTIONS

Each area of critical social functions is denoted by the influence of events (Table 20). Each marked social function is individually categorized by time interval in Table 20 with a description of the negative impact . Table 21 assesses the overall category of consequences for the societal critical functions by calculating the averages and categorizations included in Table 22 . and the stated data is not used to create averall risk matrix.

Table 20 . Elements of critical functions of social stability and politics

	Telecommunications (fixed and mobile, Internet)		Oil, gasoline, fuel oil
	Electricity		Natural gas
	Postal services		Drinking water supply
	Television and radio broadcasting (terrestrial infrastructure)		Quality and quantity control of drinking water and/or air
	Public order and peace		Food availability and quality assurance
	Business opportunity		Availability of medicines and hospital care
	Use of roads and public transport		Storage and transport of hazardous substances
	Possibility to go to school and/or work		Territorial integrity
	Distrust in public power and the emergence of fear		Disruption in the work of public bodies and services
	Occurrence of infectious diseases and epidemics		Institutions of public importance

Table 21 . Assess the consequences of the negative impact on the societal critical functions

ORDINAL NUMBER	CRITICAL FUNCTION	NEGATIVE INFLUENCE	DISRUPTION TIME INTERVAL (days)
1.			
2.			
3.			
4.			
5.			
6.			
		AVERAGE VALUE OF DISRUPTION DURATION (days)	

Table 22 . Categorization of consequences of time interval of critical functions of social stability and policies

CATEGORY	CONSEQUENCES	TIME INTERVAL OF NEGATIVE IMPACT (days)	SELECT	SOCIETAL CRITICAL FUNCTIONS
1	Insignificant	0 - 2		The average value of the duration of the disruption
2	Small	3 - 10		
3	Moderate	11 - 20		
4	Significant	21 - 30		
5	Catastrophic	30 >		

This categorization of Table 22 is not used in the development of the risk matrix of social stability and policy, but the data is used for the development of planning documents given the importance of the time component of the negative impact on societal critical functions.

3.3.4 IMPACT ON SOCIAL STABILITY AND POLICY

Table 23 summarizes the total damage to social stability and policy, and Table 24 assesses the category of consequences for social stability and policy.

Table 23 . Total damage - social stability and politics

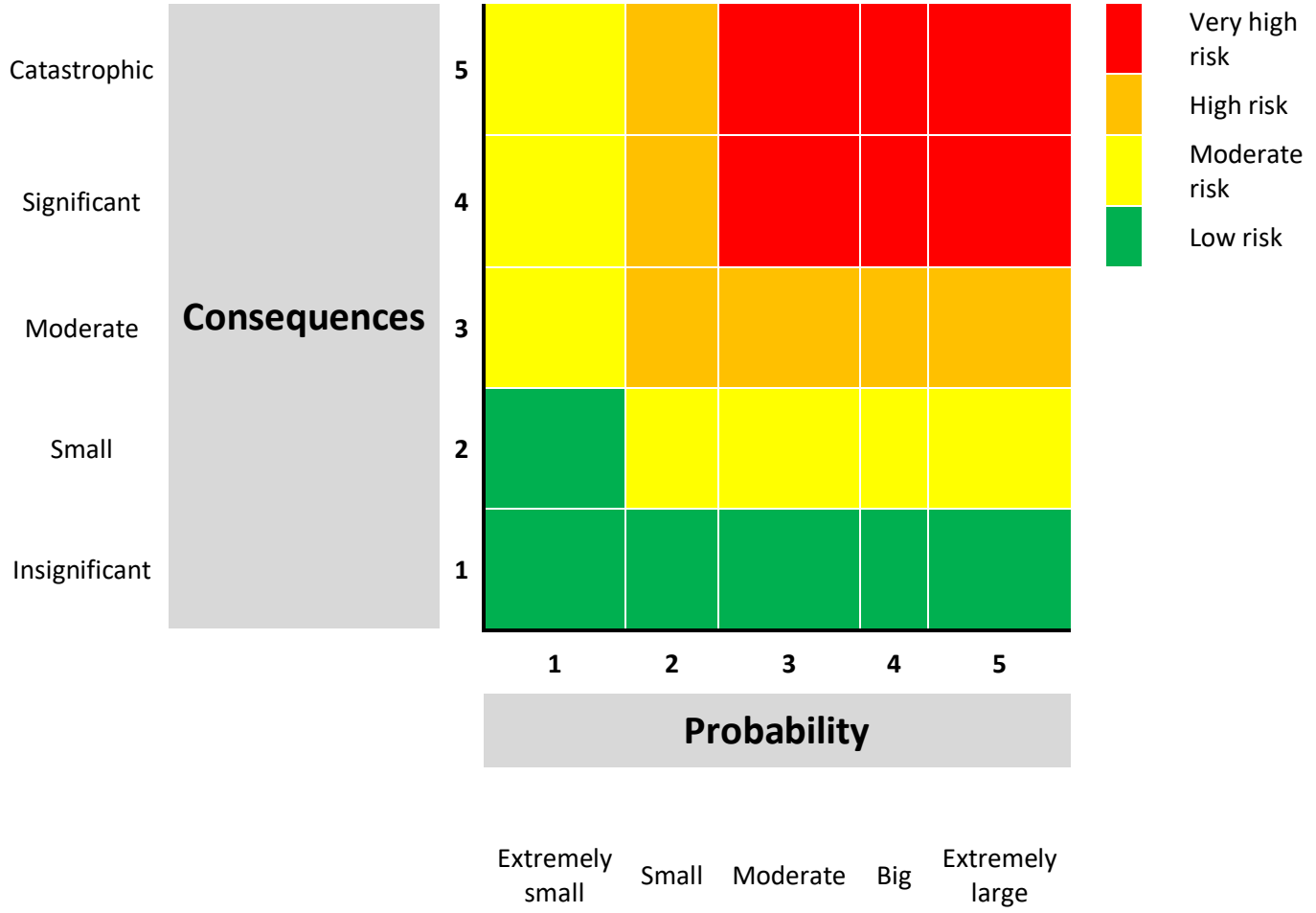
TOTAL DAMAGE TO SOCIAL STABILITY AND POLICY	euro
Sum of critical infrastructure damage (Table 17) and buildings of public importance (Table 19)	

Table 24 . Categorization of consequences on social stability and politics

CATEGORY	CONSEQUENCES	% OF LOCAL BUDGET	SELECT	SOCIAL STABILITY AND POLICY
1	Insignificant	<1%		Total material damage - Sum of damage to critical infrastructure and buildings of public importance in relation to the Local budget
2	Small	1 - 5%		
3	Moderate	5 - 15%		
4	Significant	15 - 25%		
5	Catastrophic	25%>		

3.3.4.1. RISK MATRIX - SOCIAL STABILITY AND POLICY

The probability matrix of the probability category of Table 2 and the category of consequences of social stability and policy - total material damage are entered . More on the risk matrix is covered in Chapter 4.



4. RISK MATRIX

The risk matrix is a way of determining the level of risk, taking into account two dimensions of the classical definition of risk - the probability of its occurrence and the extent of the consequences of its realization.
It consists of a vertical (consequence) and a horizontal (probability) axis, divided into five value categories and a matrix of twenty-five fields (green - low risk, yellow - moderate risk, orange - high risk, red - very high risk).
The risk matrix is intended to evaluate and prioritize assessed risks based on probability and consequences. Using a risk matrix to display the obtained results is a simple way to show their relationship.

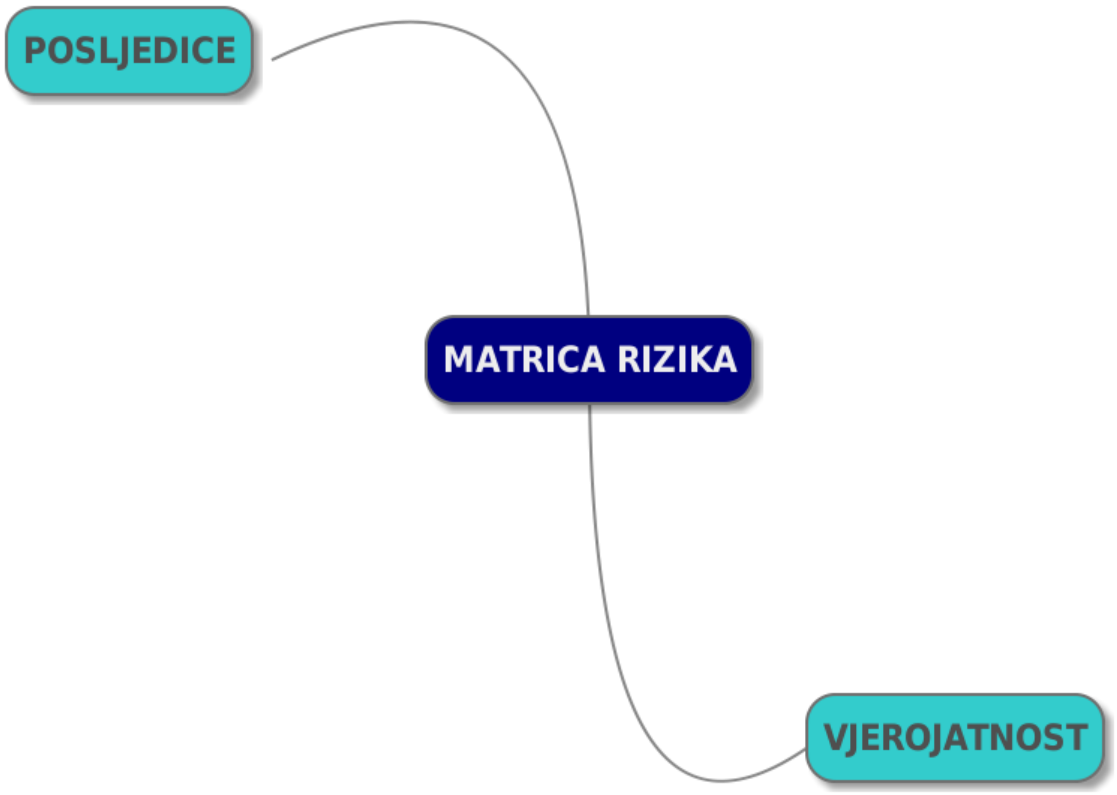


Figure 6 . Elements of risk matrix calculation

4.1. RISK MATRIX - TOTAL RISK

Risk is calculated by the ratio of probability categories and assessed consequences. The average value of the categories human life and health, economy and social stability and politics is taken as the category of consequences. The probability estimate of Table 2 is used for the probability category.

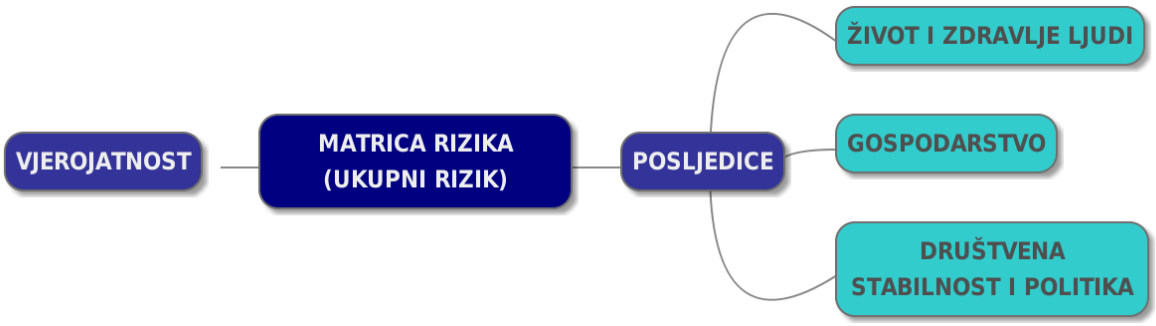
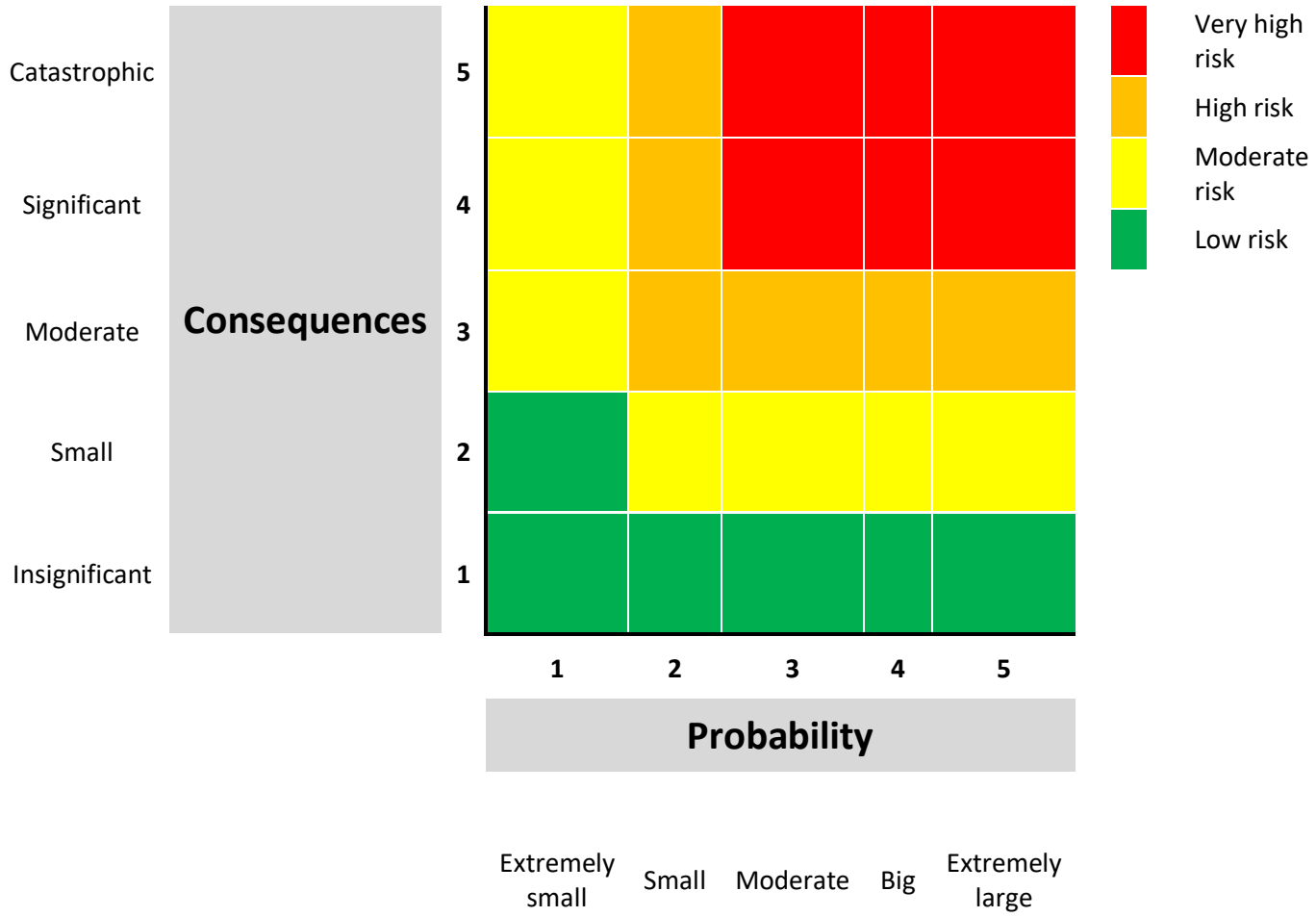


Figure 7 . Elements of risk matrix calculation - total risk

Table 25 . Categorization of total risk

	CATEGORY REPERCUSSIONS
LIFE AND HEALTH OF PEOPLE	
ECONOMY	
SOCIAL STABILITY AND POLICY	
CONSEQUENCES (total)	
The category of total consequences is determined by the average value of the categories of consequences life and health of people, economy, social stability and politics and is used in the risk matrix of total risk	

	CATEGORY
PROBABILITY	
CONSEQUENCES (total)	
These categories are used to create a risk matrix of total risk	



EFFICIENCY OF CURRENT RISK REGULATION MEASURES VISIBLE FROM THE RISK MATRIX

Extremely small
Small
Medium
High

5. RISK EVALUATION

Risk evaluation is the classification of assessed risks using the risk level determined by the risk matrix and is performed using the ALARP principle (As Low As Reasonably Practical). Risks are classified into three classes:

1. **Acceptable**
   Acceptable risks are all low, for which it is not necessary to plan additional measures in addition to the usual ones .
2. **Tolerated**
   Tolerated risks (socially acceptable and) all:
   - **moderate that can be accepted because the cost of risk reduction exceeds the benefit**
   - **high that can be accepted because their reduction is impractical or the costs far outweigh the benefit**
3. **Unacceptable**
   Unacceptable risks are all very high that cannot be accepted, except in exceptional situations

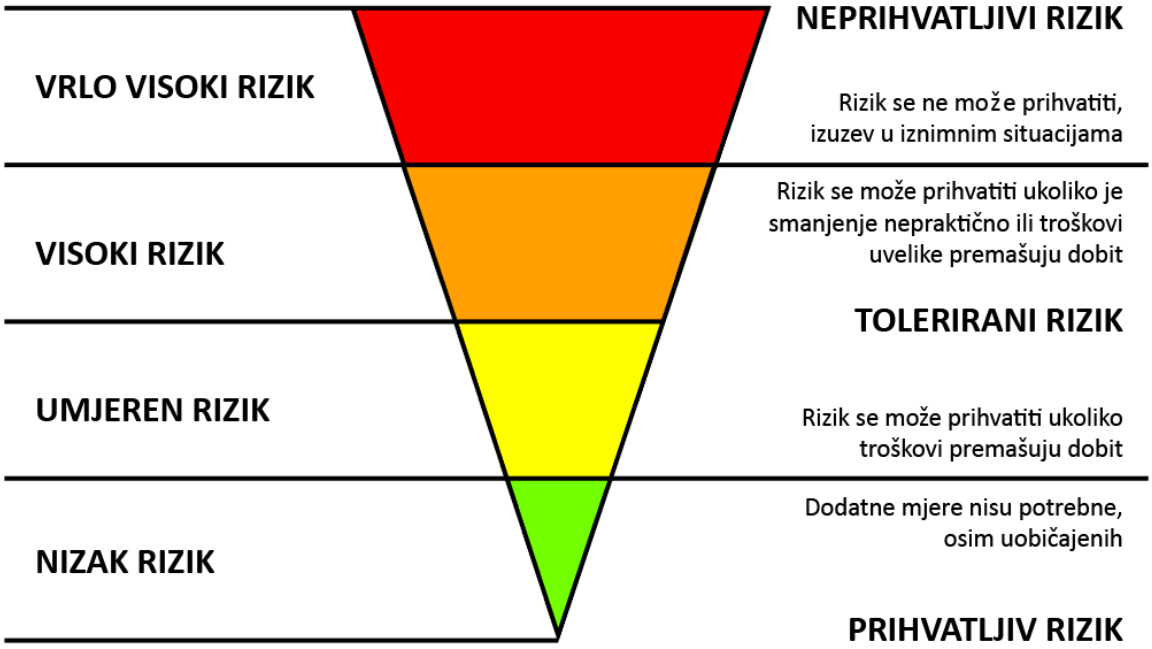


Figure 8 . Risk matrix risk assessment scheme (left), according to the ALARP principle (right)

In Table 26, risks are classified by ordinal number by marking the corresponding class.

Table 26 . Classification according to the ALARP principle

ORDER NUMBER OF A RISKS AND NAME	ACCEPTABLE	TOLERATED	UNACCEPTABLE

5.1. PRIORITIZATION OF RISK

Risk prioritization is the basis for the selection of risk management measures, ie it leads to the development of the Disaster Risk Reduction measures. For example, the risk matrix does not offer the possibility of prioritizing between categories 3*4 and 4*3, which is why the following table is used to help determine risk prioritization.
In the table, the risks are compared with each other according to the importance of their regulation, where in the comparison with each other, the risk of greater importance of regulating is entered in the empty field (eg R1 is entered in the empty field between R1 and R2). Prioritization is determined by the number of entries of an individual risk in the fields in such a way that the risk with the most entries has the greatest importance of regulation . If there is more risk with the same number of entries, the prioritization must be repeated.

Table 27 . Prioritization by rank

	R1	R2	R3	R4	R5
R1					
R2					
R3					
R4					
R5					

Figure 9 . Forms of risk regulation (reduction)

6. RELIABILITY OF RISK ASSESSMENT

Determining the unreliability category of the risk assessment is a self-assessment of the performed analysis according to the criteria shown in Table 28, and the corresponding category is selected .

Table 28 . Reliability assessment

CATEGORY	RELIABILITY LEVEL	SELECT	CRITERION
1	low unreliability		The assessment is supported by reliable experience, statistics and other data. Likelihood of possible inaccuracy of the assessment
2	medium unreliability		Partial availability of statistical and other data. The estimate is acceptable with possible errors
3	high unreliability		Lack of statistical and other data sources necessary for making the assessment. The probability of error is high

7. SYSTEM VULNERABILITY ANALYSIS

System vulnerability analysis is assessed based on two criteria: capability and preparedness. System capability is the ability of a system to respond to an event, while system readiness is the level of preventive and operational preparedness for an event.

7.1. ABILITY

For the general perception of the ability to respond to an event, the total response ability of all system participants in their area of responsibility is analysed.

Table 29 . System capability analysis

CATEGORY	RESPONSE LEVEL	SELECT	DESCRIPTION
1	full ability		routine response
2	good ability		the existing capacities are to a greater extent sufficient for timely response and elimination of the consequences of the event
3	moderate ability		the existing capacities contain certain shortcomings for timely response and elimination of the consequences of the event
4	insufficient ability		there is a certain ability to respond, but the capacities are overall insufficient to cope with the situation (higher level help needed)
5	inability to respond to an event		due to the nature of the event, the capacities are not sufficient to respond from the very beginning (automatic activation of a higher level of the system)
DESCRIPTION OF ABILITIES AND DEFECTS			

7. 2 . CAPABILITY

The system readiness analysis is based on 2 criteria : preventive readiness and operational preparedness. The numerical value of the criteria is entered in the tables under the category.

CRITERION	
Very low preparedness	4
Low preparedness	3
High preparedness	2
Very high preparedness	1

Table 30 . Capability analysis

CAPABILITY		
TERRITORY	ELEMENT	CATEGORY
Coordination	Existence of planning documents	
	Qualification and training	
	Robustness of the communication system (including alternative forms of communication)	
	Level of coordination	
	Informing the public	
	Mutual coordination at the local level and with higher levels	

Warning	Early warning system (allows early information and rapid dissemination to required parties)	
Regulations	Clear legal definition	
	The state of spatial planning, development of spatial and urban plans	
	Clear response plans and operational procedures	
	Clear contracts that apply in the stated situation	
	Fiscal situation and its perspective for the needs of preventive action	
	Clearly defined competencies	
Experience	Similarity with events that happened in the past	
	Implementation of exercises on the mentioned topic	
	The state of awareness of individuals, members of vulnerable groups, management and responsible bodies about risk awareness	
	AVERAGE VALUE	

Table 31 . Operational preparedness analysis

OPERATIONAL PREPAREDNESS		
TERRITORY	ELEMENT	CATEGORY
General characteristics	Event alert	
	Standby and activation	
	Efficacy in eliminating side effects	
	Material resources	
	Assistance to the injured and endangered population	
	Psychological help	
Leadership and command of responsible and managerial capacities	Ability to manage the response in carrying out the responsibilities within their competence	
	A clear and reliable communication system	
	Preparedness at all levels of an organization	
Resources	Necessary resources for elimination of consequences (material and technical means)	
	Rapid availability in the initial phase of event	

	Logistic support of at least a week	
	Ability to distribute relief and receive additional relief	
Human factor	Competence and training of operational forces	
	Reaction rate	
	Possibility of replenishment with additional forces	
	Implementation of exercises on the mentioned topic	
	AVERAGE VALUE	

The following table determines the system preparedness level by the average value of each of the categories

Table 32 . System readiness level

CAPABILITY		
Very low readiness	4	
Low readiness	3	
High readiness	2	
Very high readiness	1	

OPERATIONAL PREPAREDNESS		
Very low readiness	4	
Low readiness	3	
High readiness	2	
Very high readiness	1	

8. QUANTIFICATION

The information referred to in this section are designed to ensure the comparability of the results obtained pursuant to Article 3 of the Ordinance on guidelines for the preparation of disaster and major-accident risk assessments for the territory of the Republic of Croatia (Croatian inlaw)

Table 33 . Data relevant to the comparability of risk assessments and analyzes

LOCAL AUTHORITY			
ORDINARY NUMBER AND RISK			
PROBABILITY			
	QUANTIFIED SUBINTERVAL		
CONSEQUENCES			
LIFE AND HEALTH OF PEOPLE			
	TOTAL NUMBER OF PERSONS INJURED		
	% OF THE TOTAL POPULATION		
ECONOMY			
	TOTAL MATERIAL DAMAGE TO THE ECONOMY		
	TOTAL AFFECTED AREA OF ENVIRONMENTAL IMPACT	Ha	km
SOCIAL STABILITY AND POLICY			
	TOTAL DAMAGE TO SOCIAL STABILITY AND POLICY		
	DURATION OF THE LONGEST DISORDER OF THE CRITICAL INFRASTRUCTURE SECTOR	days	
	CATEGORY OF TIME INTERVAL OF SOCIETAL CRITICAL FUNCTIONS		

9 . SUPPLEMENT

Preventive measures (list existing preventive measures)

Response measures (list existing response measures)

List of possible events which, due to their intensity and destructiveness, require automatic activation of higher-level CP forces (necessary in case the lowest level cannot request more help due to circumstances, so automatic activation of higher-level forces without wasting time on administrative obstacles is ordered

Description of measures to reduce the risk of disasters from existing planning documents or strategies of institutions in charge of monitoring occurrences and actions in case of threat or occurrence of adverse events
EXPLANATION: Description of the necessary (or planned) risk reduction measures that are scattered in several different documents and strategies at the local and national level. In this way, there is a list of all planned measures / interventions to reduce risk in a specific geographical area and makes it easier to plan financial resources and detect priorities, according to the size of the endangered area, population density, number of critical infrastructure facilities in endangered areas, etc.

Possible limitations and problems when making the assessment and analysis