

DEFINITION AND UTILIZATION OF SCENARIO

Dana PROCHÁZKOVÁ

Czech Technical University in Prague, Faculty of Transportation Sciences

ABSTRACT

THE SCENARIO AS A TOOL OF PRO-ACTIVE MANAGEMENT IS A HISTORY-SYSTEMIC MODEL THAT DESCRIBES THE DEVELOPMENT OF PROCESS IN ITS DIFFERENT SHAPES (VARIANTS) DEPENDENT ON CONDITIONS OR PERFORMED DECISIONS. IT IMITATES MECHANISMS AND PROCESSES THAT ARE UNDER WAY IN SYSTEM. ITS TARGET IS ABOVE ALL TO DETERMINE CRITICAL PHENOMENA OR CRITICAL ITEMS IN WHICH IT COMES UP TO AFFECTION OF FURTHER DEVELOPMENT, I.E. THERE ARE GIVEN ALTERNATIVE OPTIONS AMONG DIFFERENT TERMINATIVE STAGES. EACH SCENARIO CONTAINS: SEQUENCE OF EVENTS THAT ARE UNDER WAY IN ITS FRAME (INCLUDING THE POSSIBLE VARIANTS); AND DESCRIPTION OF INTERACTION

(COMMUNICATION) BETWEEN USER (ORIGINATOR) AND SYSTEM. FOR NEEDS OF PLANNING AND MANAGEMENT OF SAFETY OF FOLLOWED SYSTEM THE FOLLOWING SCENARIO TYPES ARE PROCESSED IN PRACTICE: SCENARIO OF DISASTER IMPACTS; SCENARIO OF RESPONSE TO DISASTER; MANAGEMENT SCENARIO. FOR SAFETY MANAGEMENT NEEDS THE MOST IMPORTANT ARE SCENARIOS OF DISASTERS BECAUSE ON THE BASIS OF WHICH THE PROPOSALS OF RESPONSE AND RENOVATION ARE PERFORMED. THE PAPER SUMMARIZES DATA OF SCENARIOS OF THE MOST CRITICAL DISASTERS FROM THE VIEWPOINT OF HUMAN THAT WERE COMPILED BY PRESTIGE RESEARCH TEAMS.

Key words

scenario, methodical aspects, scenario for risk management, examples of disaster scenarios

INTRODUCTION

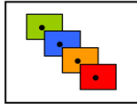
Nowadays, it is possible to find terms such as scenarios, disaster scenarios, scenario management and other in literature and in various strategic documents. The scenario tool is frequently used technique in safety management decisions. Scenarios are compiled on the basis of empirical data or using various simulation techniques, both analytical and heuristic [1]. Because of variability of the world represented by the human system [2] it is necessary to assemble them in variants, as the runs of relevant processes are variable.

Generally, the scenario is a set of isolated and interconnected processes or phenomena in time and space, which takes place at different spatial and temporal scales. Scenarios are used for different purposes. It is de facto succession, a chain of events in time, area, space or space-time. This chain can be deterministically given or stochastically random and the degree of randomness can in some cases be evaluated by statistical methods, by methods based on fuzzy sets and by experts [1]. In terms of present knowledge, we know that there are sets of events that seemingly have no visible internal connection, but the result of which is some specific state of the system. In these cases we talk about so-called deterministic chaos. In systems engineering, there exist methods to describe and understand it [1].

Scenario-as a tool of pro-active management is historical-system model which describes the development of process in its different forms (variants) depending on the conditions or decisions taken. It imitates the mechanisms and processes that take place in the system. Its aim is primarily to identify critical phenomena or points, which affect further development, i.e. which provide alternative choices between different final states. For the purposes of emergency planning and crisis management in practice, we put together the following types of scenarios: disaster impact scenario; response scenario; management scenario.

Hazard scenario / threat scenario is not a mathematical variable. This name is used to describe facts, on which the risk assessment is based. Above all, the source of hazard must be known, and then how it can manifest itself; in military terminology term is replaced with the term threat scenario. In the civil administration [11] the threat is understood as a probability rate of an attack (terrorist or military) in a given location; it is the probability that an event or a set of events occur, that are completely different from the desired state or development of the protected assets in terms of their integrity and functionality; it is determined by attacker capabilities, by vulnerabilities of assets protected and by intent of the attacker. Hazard scenario varies in dependence on time.

Disaster scenarios are an essential matter for safety management purposes, because designs of response and recovery (i.e. response scenarios (plans) and recovery scenarios) are performed on their basis. The term scenario is now widely overused.



SUMMARY OF FINDINGS ABOUT SCENARIOS

However, it is necessary to further consider following views on the scenario: purpose, content, format, and life cycle. At first glance, "intention" is the answer to the question "why scenario has to be used, what are its benefits?" The scenario can be used to project the future (this applies in particular to sustainable development); scenario can serve as decision support (description of activities for emergency response) in a hypothetical situation. The scenario for sustainable development can have three forms:

- predictive (what happens), which is associated with the "What, If" method,
- projective - exploratory (what can happen),
- normative (how to achieve specific development objectives, i.e. to specify the driving force of development).

The task of predictive scenario is to describe future development in its various forms, depending on decisions taken or on expected changes in conditions. This is mainly the identification of critical phenomena and critical points of development in which it is necessary to make major decisions or where a fundamental change can take place, affecting further development. The implications of these decisions are described in scenario as an alternative choice between the final states of the future.

In case of response we speak about planning and implementation scenarios using the techniques of process management. Planning scenario for a given disaster consists of a description of the emergency situation (location, possibility of occurrence, etc.) and from description of consequences of emergency situations, i.e., from estimation of damages and losses, and recommendations for prevention and mitigation of disasters impacts. Response scenario describes procedures for overcoming emergency situations aimed to mitigation of the expected impacts of the disaster, to stabilization of the situation and to start of the recovery. There is an essential difference between disaster scenario and response scenario. Disaster scenario includes distribution of disaster impacts in the territory, i.e. damages and losses to be eliminated by response. The response scenario is a set of measures and actions to be accomplished in order to overcome the disaster impacts. In Czech practice it is known under term emergency plan or flood plan. Both types of plans:

- are based on historical data and assumptions, i.e. the scenarios are only narratives (views on the problem),
- identify differences in capacities and define an action plan for response,
- identify and formalize the response teams,
- identify sources of domino effects.

Security plans include procedures for prevention, preparedness, response and recovery, have a general part which relates to the object or area and site-specific parts which depend on what disasters are important for the followed object or territory, what are territory assets and how those assets are vulnerable in case of expected disasters [2].

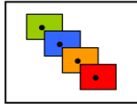
In the second view "content" it is necessary to answer the question: "what knowledge the scenario contains?" which is related to the type of scenario. It is necessary to distinguish whether the scenario is a description or an analytic-synthetic approach to the facts. For the purpose of deciding the second approach is more reliable because it is based on documented facts.

In the third and most important ("format") perspective, it is necessary to answer question "how and what the scenario expresses?" It is necessary to distinguish whether the scenario is a:

- narrative,
- descriptive table,
- logical sequence of events,
- time sequence etc.

The chosen scenario format determines the methods, by which is processed in a particular case. It is difficult to find a scenario in a reasonable format, as e.g. it is shown in a set of scenarios in [3] - the given scenarios are just a list of facts, mostly lacking a description of the algorithm on the basis of which they were compiled. Summary of different formats is for example in [4], where the scenario is seen as a management tool. Other examples of format are in [5], in which scenarios are the basis of different training procedures in response management (but rarely used for training planners). The work also highlights the importance of structure of scenarios, including holistic organization of knowledge. Scenarios are used today in many areas, as documented by the following data:

- article [6] for example provides a case study using software product SEARUMS (Studying the Epidemiology of Avian Influenza Rapidly Using Modeling and Simulation.) with a brief outline of the methodology of modeling the Asian flu epidemic,
- article [7] describes the simulation scenarios of flash floods using the SOBEK model, which specifically monitors the impact of flood on critically endangered elements, such as schools, supermarkets, etc.
- work [8] contains scenarios that were developed in the United States in order to formulate national standards of preparedness for different types of threats considering the principle of "All Hazard Approach" [9]



- work [10] describes the results of the Floris project in which probability of occurrence of floods and their consequences were estimated based on processing of historical data. At determining the risk, the risk is defined as degree of expected damages [11]. The consequences are categorized according to types of damages, and according to them protective measures such as dikes, are proposed,
- work [12] contains processing the scenario based on the results of the SWOT analysis, aimed to establish a process for sustainable development of the region with emphasis on transport infrastructure. It is a mere description, since for the script to be projective, it lacks the driving force of development,
- work [13] focuses on creating the scenarios that are considered as a tool for examining the differences in capacities of authorities responding to various types of disasters, but lacks the methodology of scenario production.

In the fourth "life cycle" it is necessary to answer the question of "how to handle the scenario? ", i.e. how to understand, interpret, and evaluate it. E. g. at decisions based on disaster scenarios, it is necessary to know whether isolines represent the mean observed values, or some of its limit value, see, e.g. scenarios for earthquakes which are in the works [14, 15] and are used to ensure seismic safety of buildings and infrastructures.

From all of the above it follows that the scenario is generally a set of isolated and interconnected of processes or phenomena in time and space, which takes place at different spatial and temporal scales, and that the scenarios are used for different purposes. Development of scenarios from the perspective of strategic management [2] requires:

- Ensuring permanent monitoring of the situation in the human system from the point of view of occurrence of disasters and critical situations resulting from them.
- Creating tools for disaster management and detection of critical situations approaching
- Creating tools that lead to the removal of critical situations.
- Creating tools to manage critical situations and to avert protracted critical situations.
- Creating tools to ensure recovery after critical situations and to ensure the continued stable development.

Complex scenarios for territory management must have 4 separate parts, namely: the disaster scenario, an emergency scenario, scenario for management of response to an emergency, scenario of security management and sustainable development of the territory [16].

METHODOLOGICAL ASPECTS RELATED TO THE CREATION OF SCENARIOS

Following steps are important when creating scenarios:

- to identify the key assumptions or factors that affect the form of scenarios,
- to focus on factors that have a high potential impact on the shape, size, scope, etc.
- to identify factors with an uncertain nature and to try to produce alternative solution of the scenario.

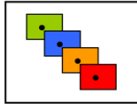
A prerequisite, however, is a relatively small number of factors that could be incorporated into the possible variants.

Development of scenarios as in [1] consists of:

- gathering the prognostic information about the system and its surroundings,
- identification of targets of studied system,
- identification of internal factors, or barriers to development of the system,
- identification of external factors, or barriers to development of the system,
- identification of alternative management strategies for the system (it is necessary to take into account existing management mechanism and its variants, which can be realized in future periods, simultaneously it is necessary to formulate a strategy for development of the system - which direction is desirable),
- proper compilation of scenario,
- interpretation of scenario.

In all the steps above it is necessary to consider:

- assessment of current state and current decisions in terms of future development,
- qualitative factors and strategies of various participants,
- the fact that the future is uncertain and multidimensional,
- the fact that each system must be examined globally and systemically,
- the fact that the information and strategies are not neutral, but biased,
- more approaches that are complementary,
- the fact that there are biases in strategies of people and prevent them.



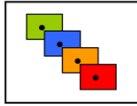
Management scenarios can have different forms, depending on the use intended.

Based on the scenarios in a variant version there are created decision support systems that help to manage the safety of monitored system [11, 16].

Table 1 briefly describes the differences of two categories of scenarios: gaming scenarios for disaster management and strategic scenarios for conception management [16]. The function of both scenarios is to face the unexpected events and test organizational readiness in state of uncertainty and vagueness. A comparison with data shows that the gambling scenario is suitable for the type of reactive management and strategic scenario is suitable for the type of proactive management.

Tab. 1 - Comparison of application of gaming scenario for disaster defeat and strategic scenario for strategic management.

Characteristic	Gambling scenario for disaster management	Strategic scenario for conception management
Source	Job training in preparation for incidental situation as a military incident, natural disaster, industrial accident.	Long-term forecast in the frame of the policy / decision-making concepts and major investments.
Initial targets	Test of operational skills and systems aimed to create a predictable behavior in unpredictable situations.	Notify senior managers of organizations about changes in the environment.
The nature of the scenarios and uncertainties	A simple description of the emergency event or situation with which were not previously experienced. Training for a predictable event.	Multiple descriptions of future variants (2-4) in terms of modification of social, economic and political environment. Training of mental flexibility in decision-making in an uncertain event.
The main participants	1. Entity describing the event, design and cope of risk (simulation team). 2. Participants in the field testing the crisis restrain (target audience).	1. Body forming and presenting a description of scenarios (scenario team of authors). 2. Leading managers who use and make strategic decisions according to created scenarios (target audience).
Methodological steps, including public participation	1. Persuasion of senior managers about the importance of used scenarios (simulation team). 2. Decisions about the purpose of simulation: the organizational skills to be tested? (Mutual simulation team meeting and the target audience). 3. Construction and credibility proof of disaster or emergency situation scenarios (simulation team). 4. Design of simulation exercise aimed to determine the response of the target groups to scenario (simulation team). 5. "Playing games "(Simulation Team + target audience). 6. Hearing the players and assessment of experience gained during the game (Simulation Team + target audience).	1. Persuasion of senior managers about the importance of used scenarios (team of scenario authors). 2. Identification of existing assumptions (thinking), especially of senior managers. 3. Identification of important trends, uncertainties, and suggestions of the outside world that challenges the current mindset of managers (team of scenario authors). 4. The arrangement of factors for a small number of scenarios (2-4) for the purpose of illustrating future variants (team of scenario authors). 5. Convincing presentation of the facts to leading managers (team of scenario authors). 6. Work with managers on conceptual management and investment decisions for each scenario (team of scenario authors + target audience).
Presentation of philosophy	Exercise and cooperation for the preparation of specific abnormal situations.	Exercise and cooperation aimed to prepare for future large uncertainty.
Presentation of objectives	Improvement of activities during a disaster or emergency situation.	Improved decision-making in policy and strategy.
Common objectives	Facing the unexpected.	Test of assumptions and organizational readiness.



APPLICATION OF SCENARIOS IN RISK MANAGEMENT

Processing Model Framework for logical model of risk management in the territory is according to [11] as follows:

- description of the process,
- defining the objectives (criteria for measuring goals, verification, hierarchy and priority objectives),
- generating the system structure (in a simple directed graph format, including features and links),
- determination of critical points of the process,
- defining the parameters of critical points,
- determining the relative importance (weight) of each parameter,
- aggregation of survey results and allowed simplification,
- interpretation of results and acceptable risk of decision-making process,
- definition of countermeasures in the form of response scenarios to disasters in variants,
- generating the response management scenarios for the superior version, which was evaluated (selected) for the realization as socially most advantageous.

Most of these tasks are managed by standard methods of operational analysis and systems engineering, i.e. by:

- screening the potential risks in the territory,
- generating the criteria to security and sustainable development,
- modeling the integral risk
- risk management model,
- catalog of criteria
- methodical processing of results of initial screening,
- acceptability of risk,
- application of the precautionary principle.

When screening potential risks in the territory, the rating algorithm is happening in the background of a conceptual scheme for sustainable development. The system concept determines the basic paradigm, which reflects the gradual steps for the systematic risk analysis of the system, see diagrams from theoretical modeling the integral risk [11].

EXAMPLES OF CRITICAL DISASTER SCENARIOS

A number of scenarios processed in the U.S. for safety management are found in [17]. For example, scenario for outbreak of influenza epidemics is generated based on pragmatic experience of mankind, according to which a flu pandemic occurs regularly every 10 to 60 years, with three such occurrences in the 20th century (1918, 1957-8, and 1967-8). Influenza viruses cause annual epidemics regularly, which passes across the world. Usually it comes to mild forms of disease that rarely kills - and if so, usually only the old and weak people, in magnitude of tens of thousands of victims worldwide. Occasionally, however, wide epidemic caused by a dangerous variant (mutations, strain) virus can appear, characterized not only by unusually high virulence, but also by a high mortality rate.

The Scourge of "Spanish flu" (type H1N1) that struck the world at the end of the First World War (it was also one of the main reasons for the end of the war) had infected around 500 million people worldwide. (At the same time not even 2 billion people did live on Earth), so that about every third person on the planet contracted it. 40-50 million people fell victim to it. The last major epidemic, Hong Kong flu" H3N2 virus, was in 1968 and about one million people died.

Virtual scenario expects emergence of a pandemic without prior planned preparation. As the source of outbreak small village in southern China in the number of 25 cases is considered, followed after two months with infection breaking out in Hong Kong, Singapore, South Korea and Japan; mortality rate reaches 5%. After several weeks, the first cases occur in four major cities in the U.S... Pandemic continues.

The threat is reinforced by the timeline. The spread of the pandemic is rapid, so it is not enough time to develop, test and produce an effective antidote, and vaccination is not possible to sufficiently "significant" number of persons.

Secondary effects are dramatic - closure of sites, services, schools; healthcare facilities are overcrowded. Transport and possibility to travel is limited.

Figure 1 shows the scenario to ensure a safe food chain for defined threats, i.e. marks places where the real threat (i.e. the risk associated with human intent to harm the food chain) and points at which it is necessary to apply relevant security measures [18]. The figure shows that the real threats are on the farm, in processing and transportation, wholesale trade and in transport to retailer. It also shows that countermeasures must be performed by public administration, food processor and supranational institutions.

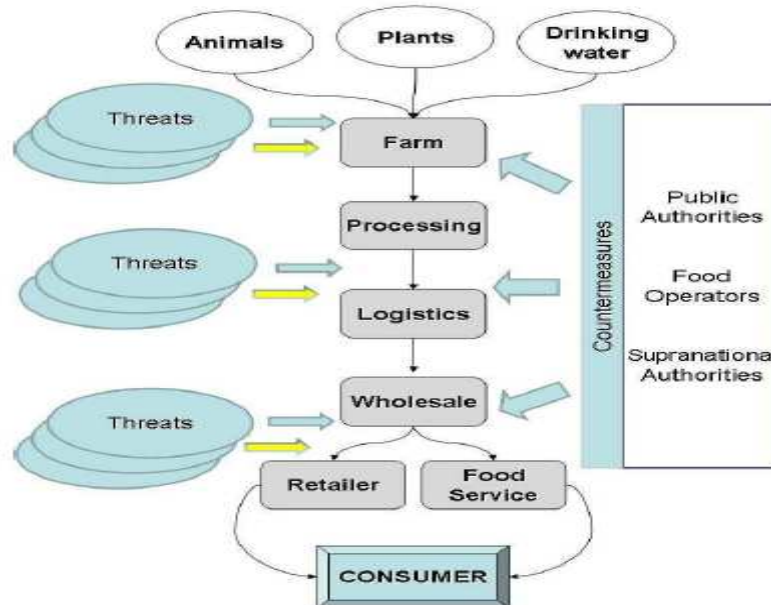
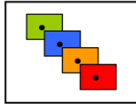


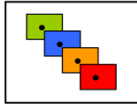
Fig.1 - Scenario for ensuring a safe food chain [18]

CONCLUSION

Development of scenarios suitable for practice requires the databases available for the respective problem and a multidisciplinary team of experts, application of suitable team expert method such as brainstorming, Delphi, panel discussion etc. From the perspective of protection of it is necessary to handle both optimistic and pessimistic scenarios, as, e.g., the conclusions drawn from work [19].

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CONTACT ADDRESS

Author: Assoc. prof. RNDr. Dana PROCHÁZKOVÁ, PhD., DrSc.,
Workplace: Czech Technical University in Prague, Faculty of Transportation Sciences
Address: Konviktská 20, 110 00 Prague 1, Czech Republic
E-mail: prochazkova@fd.cvut.cz