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RISK MANAGEMENT: A NEW APPROACH TO IMPROVING SAFETY

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ABSTRACT

Risk management is a difficult and complex task with many perspectives.

This paper deals mainly with the aspect of risk management as integrated in the regular governance system in a road transport agency. It draws on experience gathered in the Swedish agency during recent years. There have been increasing requirements for risk management and internal control laid down by the government. It presents and discusses a few practical approaches regarding governance, risk analysis and risk evaluation. Especially risk evaluation is an awkward task for decision makers. It is an issue concerning a wide circle of vested interests in the modern society.

The paper also touches on some philosophical and fundamental aspects of risk and risk management. These aspects have formed the basis for the practical approach. There is nothing as practical as a good theory.

1. RISK, CONTEXT AND MANAGEMENT

1.1. Risk, interest and evaluation

From a philosophical viewpoint risk means the possibility of a negative deviation from whatever is the desire of any human being. This desire, relative to an existing or future state of the world, can also be designated an interest.

As far as we are concerned, risk is a human concept. It does not exist in nature and cannot as such be measured directly with an instrument. What we can measure is the magnitude of phenomena. Whether such phenomena constitute a risk depends on the existence of a vested interest.

An interest may not only be linked to property or finance but also to ideas, attitudes and values. This situation makes risk management really complex. The evaluation of risk depends on who makes it. Different stakeholders or interested parties may have completely different values or perceptions.

1.2. Static and dynamic risks

One dichotomy that originates from the early days of risk management, and still exists, is the philosophical and logical difference between risky situations including and linking together both possible gain or loss on the one hand and situations that only bring possible loss on the other.

So called static risks are inherent everywhere and mean possibilities of loss only, without a specifically linked corresponding balance and with status quo in case of non-occurrence. Here the possible losses have to be balanced against risk control expense in order to find an optimal solution.

The development of an enterprise or activity of any kind has a balance of gain or loss. To an increasing degree, risk management has come to encompass also the management of opportunities rather than “risks”. Opportunities are the opposites of risks. There are possibilities of both gain and loss. The possibility of loss is the so called dynamic risk. Risk

management then deals with assessing and balancing risks against opportunities in a way that would be perceived as most favourable.

Static risks can not be balanced out. A flooded road can not be compensated or “unflooded” by a non-flooded other road. On the other hand, some static risks are insurable.

There is however no philosophical difference. Only the aspects differ. Risk management always deals with the possibility of negative or undesired deviations, either it relates to loss of existing assets or values or non-achievement of plans and efforts.

1.3. Risky decisions in context

All risk management, as well as management in general, more or less, deals basically with options in respect of balancing, limitation or both. But since harm also to other parties could be involved, it is a sensitive issue. The difficulties become apparent in a situation with decision-makers on the one hand and subjects on the other. Whose interest prevails? Who pays? Who gains? Who determines what is a fair balance or profit margin?

If the decision and possible harm only concerns the decision-maker, then it should be her or his sole responsibility. But in the modern society the repercussions go far beyond the primary circle. Media and lobby groups may bring the matter to public attention. Even if the matter is eventually concluded to be acceptable as such, the whole situation brings another type of risk, a critical issues risk, which may result in loss of reputation and failure for the primary party.

Traditional risks for a road transport authority have included anything in relation to infrastructure, personnel and finance. Mostly it has been physical and natural risks, accidents and engineering failures. But road transport authorities are also dealing with matters of public policy, concerning safety, spending, licensing, monitoring, vehicle design, environment and more.

This brings gradually a whole new dimension to the risk environment in the modern society with growing education, awareness, claims consciousness and media attention. That concerns the authority, its management and the political level above.

1.4. Risk definitions and communication

In science and specific applications risk has been given various definitions. They all have a purpose. Anybody can use their own. What we must do is to define our specific terms for clarity, in order to understand each other. Risk communication must however also mean risk dialogue. We have to appreciate also the underlying motives and values and discuss them between parties.

It is dubious whether it is possible to develop one simple common language for all purposes, except those strictly scientific for specific purposes. But even in science, (“truth”), there is room for interpretation. Uncertainty as lack of knowledge in one way or other will always exist. So when decisions are made (by ”power”) there will never be complete knowledge or absolute unanimity about ends and means. Nevertheless “power” should base decisions on “truth” as far as possible.

However, inside an organisation, an industry or a political field at least, or maybe the global road sector, there should be a need for a common language and criteria for decision making.

This should include the risk management

- terminology
- processes
- organisation, its mission and goals
- objectives

1.5. Risk management emerging - again

Risk management is now a rapidly developing discipline or rather a set of disciplines. The operational, political and social risk environment is in constant change. The aspects of risk management differ considerably between a multitude of applications.

Given the above, the importance of making well supported, transparent decisions has grown, not only for traditional risk decisions but for all decisions. The field of risk management has consequently expanded from traditional safety, security, quality and efficiency into general management. The traditional fields are often labelled safety, security or loss prevention.

The emerging fields are named enterprise risk management (ERM), corporate governance, business continuity planning, corporate responsibility, critical issues management etc. Relative to this development the already widely established risk management discipline is sometimes referred as traditional risk management (TRM).

However, they are simply all part of risk management under the hat of general management.

2. GENERAL APPROACH

2.1. Basic logic and process

There are nearly as many descriptions and definitions of risk management as the number of practitioners. Some of them have been developed by institutions and carry a little more weight. Some are referred to as standards or generally accepted guidelines. They tend to be academic and universal and as such they give frameworks that are needed per se. For the practitioner facing acute problems they may offer little help. They have to be transformed into practicable means of assistance.

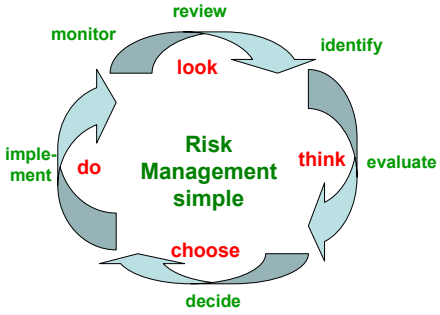

Figure 1 – Simple risk management process

Maybe one could say that there is one universal logic and sequence for management and one for risk management. They form a combination. Risk analysis is the basis for risk management, that normally is understood to be an integral part of general management. Maybe the distinctive features of risk management were overstated in the early days.

Anyway, risk management as a management discipline is not very different, only the subject matter is different. Risk management should in simple terms follow the same process or procedure as any problem solving exercise or science project. The awkward part is the uncertainty, the randomness and the possible harmful effects of making mistakes. Engineering also deals with man-made risks in case of faulty design but is in most cases based on solid and certain scientific knowledge and experience.

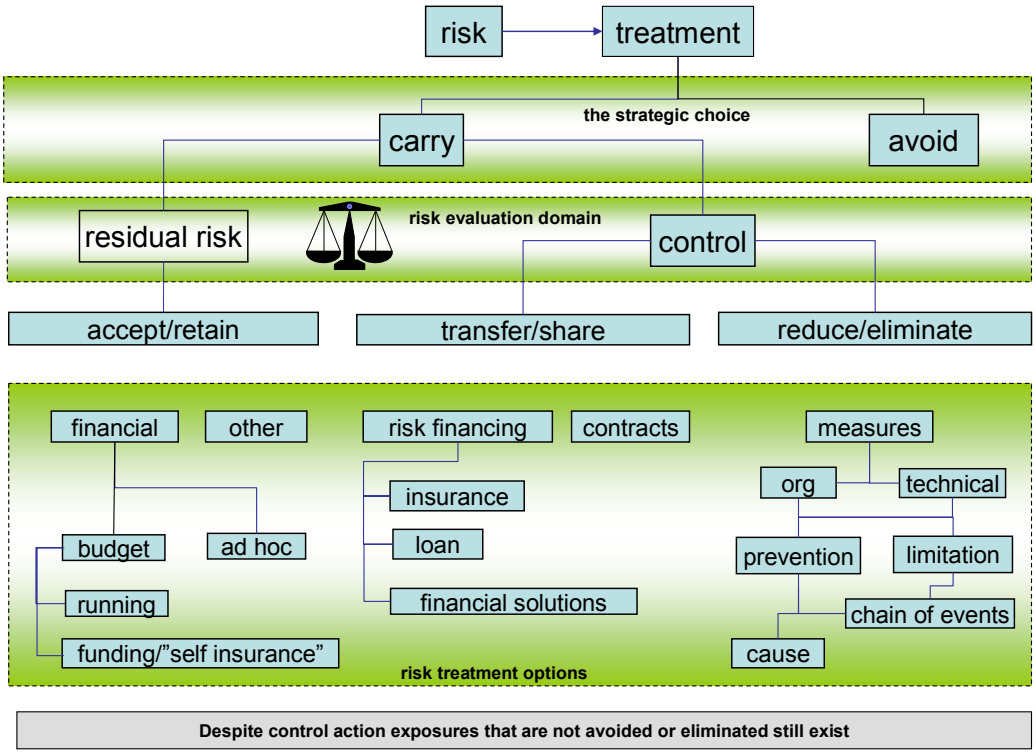

Figure 2 – Risk treatment logic

The normal logic and sequence is usually said to be risk analysis, risk treatment and monitoring. It is also understood that risk treatment only can take four logic options, namely avoidance, reduction with the special case of elimination, retention/acceptance and transfer/sharing.

Avoidance means not to get involved at all. Retention could mean either residual risk, net after treatment, or a risk that could not be or anyway was not treated. Transfer generally means risk financing, sometimes other types of contracts. Risk financing used to mean commercial insurance. Nowadays many organisations and industries have their so called captive insurance companies.

When risk management developed also the number of solutions increased for each option. In many cases of public policy, insurance is of no consequence.

2.2. Integrated risk management

Structure
The basic risk management process has to be applied in various types of organisations. Risk management should be integrated in the regular governance system. Risk analysis should be the foundation for prudent decisions, supporting governance. It should be the main part of what could be called a preparative system. Structure, relations and connections could be depicted as in the figure below.

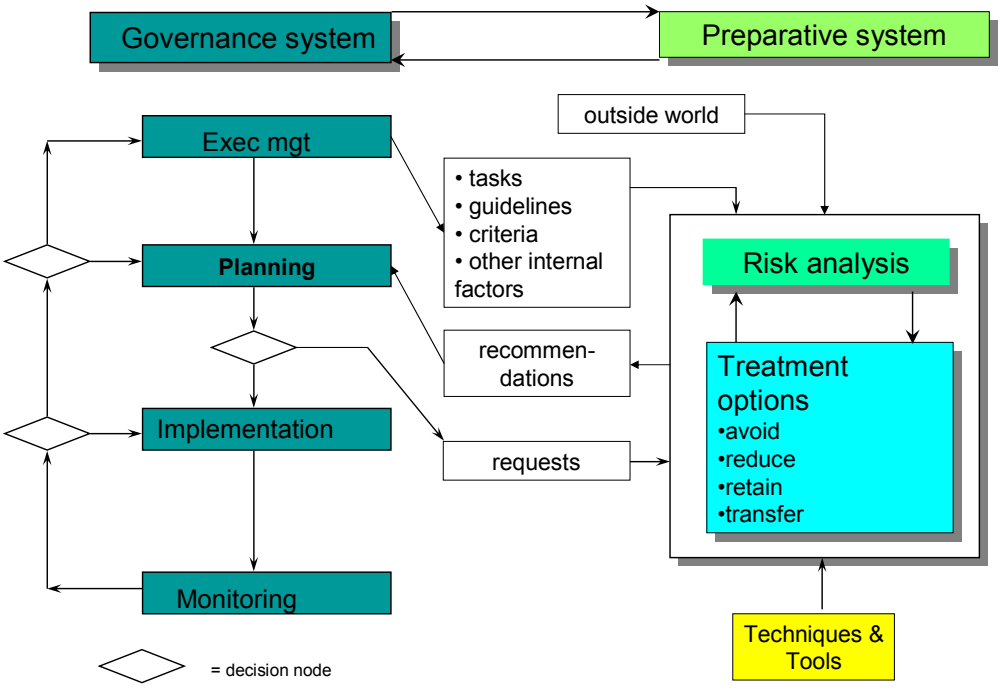

Figure 3 – Integrated risk management

Risks are often categorised. There is no unambiguous structure for all risks. No one can monopolize a structure as universally prevailing. Therefore, whoever has to deal with risks will probably come up with their own categories. A number of aspects may be involved, e.g. causes, impacts, perils, interests and so on.

One way of doing it is to refer risks to organisational areas such as operations, processes, projects, internal security and even executive management. Irrespective of categories the structure above would be applicable.

Steps in risk management
Risk analysis is normally said to include risk identification and risk evaluation. Identification is the scanning of the world for possible perils pertinent to whatever interests might be involved. Evaluation is the more sophisticated step where we expect to use our decision-making science or methodology to help us find the best solutions.

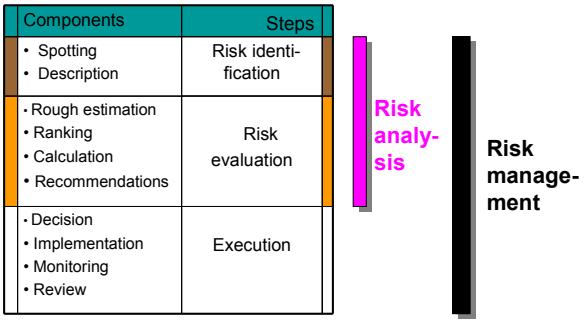

Figure 4 – Steps in risk management

The solutions may differ for static and dynamic risks as well as the criteria. The perhaps most important step is however to execute the decisions made and not wait for the perfect solution. A more realistic ambition is to go for a satisfactory rather than an optimal solution.

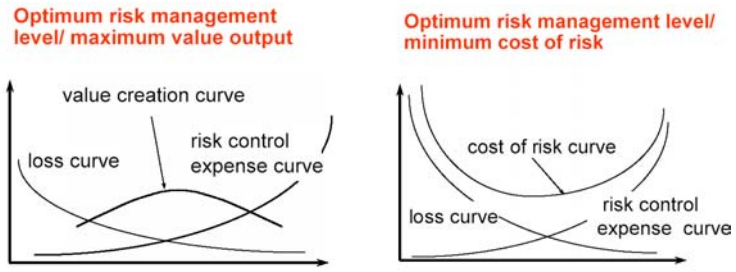

Figure 5 – Risk management targets

The first evaluation is often performed by means of a simple risk evaluation matrix. A matrix may very well be used also for the final assessment. Hopefully the latter is more detailed. At least the input at that time should be more qualified.

2.3. Risk evaluation. Matrices

Risk matrix tables are probably the most common tools for risk evaluation. Generally the matrices are used for a consistent ranking of risks. However, there is no universal matrix for all applications. A risk matrix should be quantitative. Even if the cells of the matrix are given verbal designations, these need to be calibrated against the parameters of the context.

Risk matrices help to reach decisions and to establish priorities but are not models for making predictions about what will actually happen in the real world.

The matrix will not only be used for assessing original (gross) risk but also for residual (net) risk after risk control action. In a risk matrix risk reduction will be represented by moving “south” or “west”. Not only will the residual risk position be evaluated but also the specific power or efficiency of alternative solutions or the efforts of an organisational unit.

There are various views on the number of cells in a matrix. The determining factor should be the need for nuances in decisions. The minimum number of cells is 3x3, given the need for “low”, “medium” and “high” for both axes. Higher need for detail may lead to 5x5.

The combinations of cells in a matrix represent averages (means). The matrix does not account for the uncertainty in each cell. Generally speaking, the credibility from a statistical viewpoint is low or very low, especially in cells combined from high severity and low frequency. However, a way of avoiding this problem is to stipulate for each cell what action is to be taken. For cells with a large severity, action could be demanded, regardless of the frequency (likelihood). This would be an example of embedded risk aversion against large losses.

Accuracy and validity in underlying methods, calculations and valuations should be in line with the matrix and not more detailed than is called for. On the other hand, if precise methods are available at no extra cost, they should be utilized.

2.4. Matrix tables as tools for governance

Although a road transport authority does not act commercially, there are dynamic risks to consider. Non-performance or bad quality in the operation or development projects may very well end up with loss of public confidence. New regulations that are ill-devised is an example. Non-compliance with goals set up by the ministry is another one and also underdelivery of services.

Top management must therefore develop a common basis and common criteria for comparing and ranking risks in a holistic view.

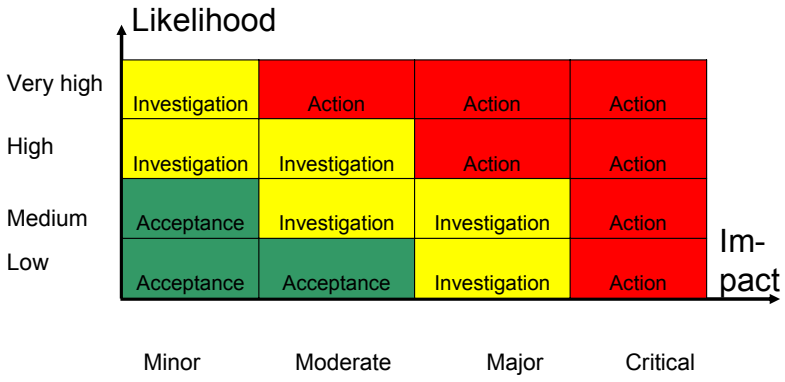

Figure 6 – Standard risk matrix/Response

It is important that risk analyses are performed by the concerned operating or functional units. The analyses should be submitted to the executive management once a year. They should focus on a few topics within each area. The analyses should be accompanied by suggestions how to deal with the issues at hand to bring them in line with the accepted guidelines or criteria.

Normally the matrices should lead to decisions in three categories or priorities:

- Action to be taken (risk not accepted)
- Further investigation (risk accepted after consideration)
- No action needed (risk accepted)

2.5. Specimen executive risk matrix and profile

Table 1 – Consolidated risk matrix and profile

					Risk response			
Likelihoos/frequncy	Very high	Event occurs several times per year within the realm of the organisation		4	Investigation	Action	Action	Action
	High	Event has occurred within the realm of the organisation		3	Investigation	Investigation	Action	Action
	Medium	Event has occurred in the country		2	Acceptance	Investigation	Investigation	Action
	Low	Event never occurred in the country		1	Acceptance	Acceptance	Acceptance	Investigation
		Aspect			**1**	**2**	**3**	**4**
Type of asset	Intangibles	Confidence/reputation	Media neg. coverage and attention		Single column	Local	Regional	National
			Mgt time and effort/ neg. attention		Unit	Unit mgt	Exec top mgt	Board/investors/ministry
	Property	Damage	Infrastructure/Equipment/Buil-dings etc.		≤ 1 million €	≤ 50 million €	≤ 200 million €	> 200 million €
	Personal	Road users	Increased accident rate		Minor injuries	Multiple injuries	Single death or multiple serious injuries	Multiple deaths and serious injuries
		Employees						
	Finance	Operations	Downtime		Short down-time	Single unit down for short period	Single unit down more than 50% for more than 1 day	Single governing unit down more than 50% for more than 1 day
		Transport capacity	Reduced transport capacity		Secondary road shut down for a few hours or one area shut down	Main road shut down or secondary road shut down for > 12 hrs or one area for a few hrs	Main road shut down for several hrs or secondary road for > 24 hrs or one area for > 12 hrs	Main road shut down for > 24 hrs or one area for > 48 hrs
	Environ-ment	Impairment	Single occur-rence/gradual		Temporary minor	Temporary serious	Permanent minor	Permanent serious
					Minor	Moderate	Major	Critical
					Impact			

A risk evaluation matrix could be used as a tool in risk management that facilitates measuring, comparing and governing an organisation´s units, activities or situations in order to meet the risk acceptance criteria by the executive management.

An example of a consolidated enterprise risk matrix is given below. Descriptions and criteria are included. It could be used at board level for evaluation of top risks reported from the organisational units.

In order not to lose sight of the major issues, a top twenty list could be introduced at executive level, presenting the top current issues for implementation and monitoring during the next year.

The impact should be reported in some given terms or dimensions. This facilitates risk ranking and comparison. Generally it is preferred to use monetary terms.

The Swedish Road Transport Agency has selected the following types of assets for reporting: Property (own and other), Finance (own and public), Human (all personal injury), Intangibles and Environment. Pure economic terms are used but also other dimensions.

3. EXAMPLES OF PRACTICE

3.1. Concept of risk analysis by scenario (RAS)

The risk analysis by scenario as described here is a basic universal methodology or template for risk analyses. For obvious reasons a universal methodology must be adjusted, adapted or amended for special applications. Input from various other specially developed methods or models could and should therefore be utilised as a support or, if used separately, be structured or presented afterwards in accordance with the template.

A scenario in general is a description of a future situation based on the present situation and a presumed path of transition from the present into the future. Here each set of interest, peril and risk factors make one scenario. One interest at a time is in focus for analysis. What this means and how the analysis is done is briefly described below.

Focus
The focal point is a specific “interest” that is to be either created or preserved through the activities performed by an organisation. Here an interest could be a target, a prerequisite, a budget, a compliance area, a plan or an asset of any kind, physical or intangible.

A crucial part of a risk analysis is to assess the sensitivity of an organisation, i.e. really its resources, operation and performance, to deviations or harm.

Peril
The force that is potentially harmful to an interest is here called a “peril”. A peril is to be taken in the broadest possible sense. What makes a peril varies depending on the nature of the interest.

Risk factors
Causes of perils are here called risk factors. Risk factors are seen as contributors. The causation of a peril may depend on one or more risk factors. Some risk factors may have

to be present in combination to trigger the peril. The appearance of risk factors can be impacted by preventive measures.

Chain of events
The reference to the scenario concept lies in that the methodology analyses a chain of events starting with the emergence of a peril and an interest being in harm's way and ends with an evaluation of the resulting total harm. It is therefore necessary to describe, accurately enough for the analysis at hand, what happens from the start to the end.

The scenario could and should include relevant estimations and calculations and can also be repeated with a number of variations to form a space of outcomes (lucky case=min; typical case=mode; worst case=max).

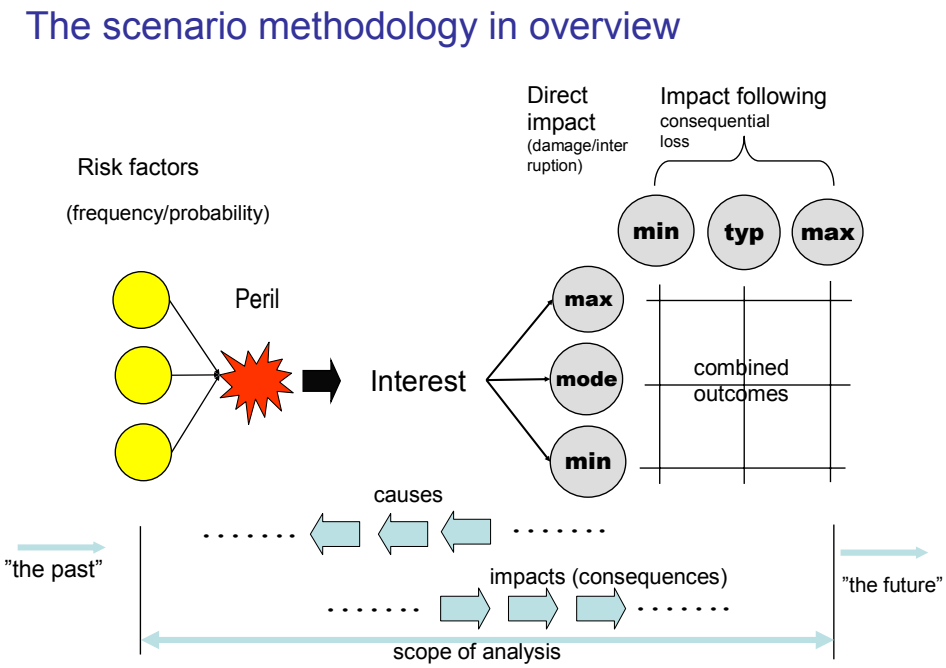

Figure 7 – Scenario analysis concept

A chain of events is a representation of a cause and effect theory. In a chain of events everything upstream of a specific point is considered causes and everything downstream effects or consequences. It all depends on which point is selected. Often the term consequence is used for impact or size, which is another aspect per se.

Process
The analysis process is depicted in the above diagram. The essential part is to decide on an action plan for high level ranking risks and to monitor that the plan is executed. In order to facilitate the analysis there are some guidelines included, among others regarding ranking of risks by a given universal matrix table, indicated in the diagram. The matrix table is however to be determined (calibrated) by the relevant stakeholder.

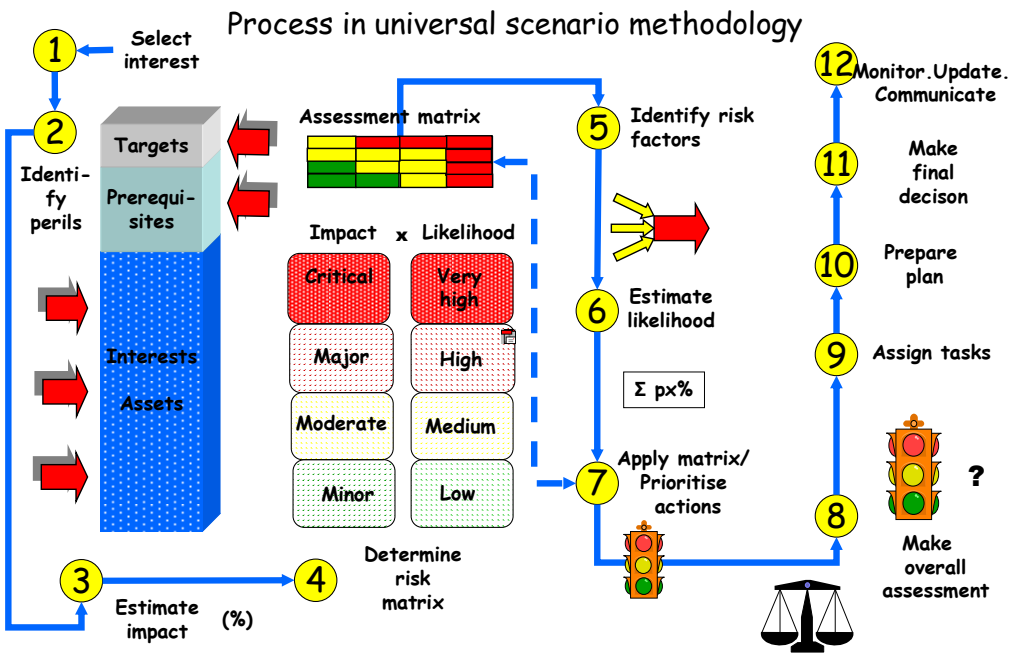

Figure 8 – Process for scenario analysis

3.2. The scenario analysis step by step

1 Select interest

Which interest in our business or operation is to be analyzed? Is it "everything" in a geographical area, IT security, a specific building or workplace safety in a specific room? Is it a business target or an asset in the financial report or a functional, physical or intangible asset?

Pin-point the interest to be analyzed. The better it is done, the better the relevance and accuracy of the analysis will be.

2 Identify perils

Which are the possible perils to the selected interest? The task is to find which external and internal "circumstances" may hit the interest. What lies in harm's way? The ability to discover all relevant perils is of course a crucial factor.

It could be just as important to determine dependencies and interdependencies. An interest might be totally depending on other assets, processes or performance factors. These other parameters constitute "prerequisites" for the interest at hand.

The situation that a prerequisite is impaired or ultimately taken out would then be perceived as a peril to the interest. This may be seen as a virtual peril but is nevertheless relevant in analyses regarding e.g. process targets or project planning.

An interest may serve as a prerequisite for another interest. There are often hierarchies or structures where means and ends shift. In this method each peril is studied separately. Perils should be independent of one another.

3 Estimate impact

Estimate the impact on the interest (loss/damage/impairment) by the selected peril.

What would be the expected impact on the interest by a specific peril? It is important to arrive at both a worst case and the most typical outcome (mode). Both results are factors in the risk assessment to come. The maximum usually has to be estimated from existing knowledge and a number of assumptions, since it has usually never occurred. The mode can more likely be gathered from previous occurrences or statistics. If not it has to be estimated in a similar way.

Generally it is necessary to assess the total consequences, meaning also the indirect or secondary impact following. Otherwise there will be no complete picture. There are various indirect impacts such as business interruption or loss of public confidence.

4 Determine risk matrix

The matrix recommended below is a 4*4 matrix with given designations and intervals for both impact and frequency. It may be adjusted for specific applications by the management in charge and responsible for the analysis.

It is recommended as a first approach to express both impact and likelihood as percentages. Thus the assessment appears as a key ratio, a dimensionless indicator. It is easy to reason in terms of a percentage when it comes to evaluation. The axis for impact should be divided into percentage bands or intervals with an associated verbal designation.

However, in the matrix here the cells state what kind of response be required rather than stating numbers. The response is also represented by the popular traffic light system, green, yellow and red.

Evaluation of impact

Since risk management is a part of a governance system it is important to use quantitative measures that are already used by the management. Percentages can be helpful to reflect the degree of impact to an interest. Since it is dimensionless it facilitates reporting, comparison and ranking. It can easily be evaluated and translated into verbal designations for bands in a matrix.

The following standard designations and intervals are recommended.

Table 2 – Evaluation of impact

Designation/Ranking	% interval
Critical	75 - 100
Major	50 - 75
Moderate	25 – 50
Minor	0 - 25

Evaluation of likelihood

Frequency is the number of occurrences during a period. Likelihood means the degree of certainty associated with the occurrence of a peril during the period of time studied in the risk analysis. The period could apply to a project, a planning process, the life of a built structure etc., relevant to the interest.

The following standard designations and intervals are recommended. A ”period” is the relevant time frame for the analysis, e.g. a project during three weeks or a series of hydrologic 30-year studies.

5 Identify risk factors

Risk factors are the underlying causes or drivers of the emergence of a peril. They can appear single or in combination and they have to be both necessary and sufficient for the emergence.

Start with the most severe perils, i.e. those with a critical direct or indirect impact on the interest. What can trigger the peril? Identify as many risk factors as possible for each peril.

The risk factors should be independent of each other.

6 Estimate likelihood

The likelihood for each peril will be estimated starting from the minimum set of risk factors required for the emergence of the peril at hand. The likelihood will be determined by the number of necessary risk factors and their frequencies. If the risk factors are independent the combined frequency is calculated by multiplication of the single frequencies.

Table 3 – Evaluation of likelihood

Designation/Ranking	% interval	Average no. of occurrences/period
Very high	75-100	>1
High	50 - 75	0,5- 0,75 i.e. >1 occ. per 2 periods
Medium	25 - 50	0,25 - 0,5, i.e. 1 occ. per 2 - 4 periods
Low	0 - 25	0 – 0,25, < 1 occ. per 4 periods

Risk control action will reduce the frequency of a necessary risk factor. In the best case it will be reduced to zero, meaning that the risk is eliminated.

The estimation will be based on the collective knowledge and experience. Consideration will be given to risk control actions already taken or other existing favourable circumstances. They will be properly noted and documented.

Are there comparisons with other situations to be made? Is there a track record of frequency (e.g. the occurrence of a risk factor under similar circumstances)?
It is obvious that the likelihood of a maximum impact is smaller than that of a mode impact. That would be explained by the fact that the maximum would require one or more additional risk factors.

7 Apply matrix/Prioritise action

Use the recommended universal matrix or an adjusted case matrix. The plotting of likelihood and impact in the matrix results in a demand for risk control action, further investigation or acceptance of the risk situation. The matrix defines a given acceptable risk level.

Control action may be required even for minor impact if the risk factors are frequent, i.e. likely to occur. Action will generally be demanded for critical impact irrespective of the likelihood. These deliberations represent the parameter called risk aversion. The matrix should be designed to mark the risk policy of the management.

At this point the analysis moves on to the next scenario until all have been processed. Finally they are all put together in a portfolio for ultimate assessment and treatment.

8 Make overall assessment

Finally an overall assessment will be made of each scenario. The management in charge will on basis of the risk analysis determine whether to

- accept the situation (combination of residual risk and control measures)
- consider a more detailed analysis
- review the situation and possibly introduce a new approach and analyse again.

One specific interest may be exposed to a number of perils, no one of which demanding control action. However, if one might perceive that the resulting situation is too exposed and the final assessment is should be fins other solutions. On the other hand, one single peril may impact a number of important interests, which could mean that there is a common vulnerability emanating out of a single peril.

Scenarios that are not accepted have to be run through a second analysis to show that the variations undertaken has taken the scenario out of the red. The most cost effective action should be selected, satisfying a minimum cost of risk.

9 Assign tasks

When appropriate risk treatment options have been selected pertinent to each scenario, the accumulated analyses will serve as a basis for the continued risk management. Officers in charge are to be appointed for each scenario. The next important step will be to prepare plans for the implementation.

10 Prepare plan for recommended action

For each scenario the officer in charge will prepare a proposal for risk treatment. Risk control measures may reduce the likelihood for the emergence of perils or the impact by the peril to the interest. All activities are to be compiled in a comprehensive budget linked risk control plan.

11 Make final decision

Management in charge makes the final decision for the execution of the plan.

12 Monitor and update plan. Pass on information and knowledge.

The risk analysis and action plan are to be updated as needed. The implementation is to be monitored and the efficiency evaluated in due time.

Summaries and current assessments should be reported to all concerned units or operations. It should be the responsibility of anyone who first gets aware of a risk situation. In sequential processes or projects this can be seen as a relay of intelligence from one step to the next, as a baton. It is important that assessments and other data are explicit in order to be comprehensible to others. One way of achieving this is to develop templates that are recognizable throughout the organisation.