RISK MANAGEMENT IN ROAD SECTOR / FRAMEWORK

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ABSTRACT

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

This paper deals mainly with the aspect of risk management as integrated in the regular governance system at a road transport authority and draws on experience gathered from the work of the PIARC Committee for Risk Management (TC 3.2). It is an extract from a report soon to be published by the Committee.

Many governments have stipulated that public authorities must place greater emphasis on risk management and internal control. The paper also presents and discusses a few practical approaches regarding governance, risk analysis and risk evaluation. Risk evaluation is a particularly complex task for decision makers. It is an issue that affects a wide range of key interests in 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. Nothing is as practical as a good theory.

KEYWORDS

RISK MANAGEMENT / RISK ANALYSIS / RISK EVALUATION / HAZARD / GOVERNANCE

1. RISK MANAGEMENT IN THE ROAD SECTOR / FRAMEWORK

1.1 RISK, CONTEXT AND MANAGEMENT

Risk, interest and perception

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

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 risk situations including and linking together both possible gain and loss, and situations that only bring possible loss.

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.

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 what is called dynamic risk. Risk management deals with assessing the risks in comparison with the opportunities.

This is however not a philosophically different kind. 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. Only the aspects differ.

Static risks can not be balanced out. A flooded road can not be compensated or “unflooded” by another road. Dynamic risks can be balanced out in the meaning that one loss can be covered by another gain. On the other hand, some static risks are insurable.

Risk management emerging again
Risk management is now a rapidly developing discipline, or rather 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, in an attempt to distinguish themselves, are called enterprise risk management (ERM), corporate governance, business continuity planning, corporate responsibility, critical issues management etc. They have even invented the term traditional risk management (TRM) for the already widely established management discipline.

As an umbrella concept, the emerging fields could be named Dynamic Risk Management. Traditional risk management is better named Static Risk Management. The same risk management process is used in both fields.
But it is important to remember that they both exist under the umbrella of general management.

2. General approach

2.1 Basic logic and sequence

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 approaches. They tend to

be academic and universal and as such they provide frameworks. For the practitioner facing acute problems they offer little help. In as much as they offer knowledge or bring practicable means of assistance they are much appreciated.

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 the same management. Perhaps this was overstated in the early days. Every decision should be preceded by relevant analysis. Nonetheless, risk management as a management discipline is not different, it is only the subject matter that differs and is more uncertain and possibly more harmful than others.

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 getting involved at all. Retention could mean either residual risk, net post-treatment, or a risk that could not exist or anyway is not treated. Transfer generally means risk financing and sometimes other types of contract. Risk financing used to mean commercial insurance

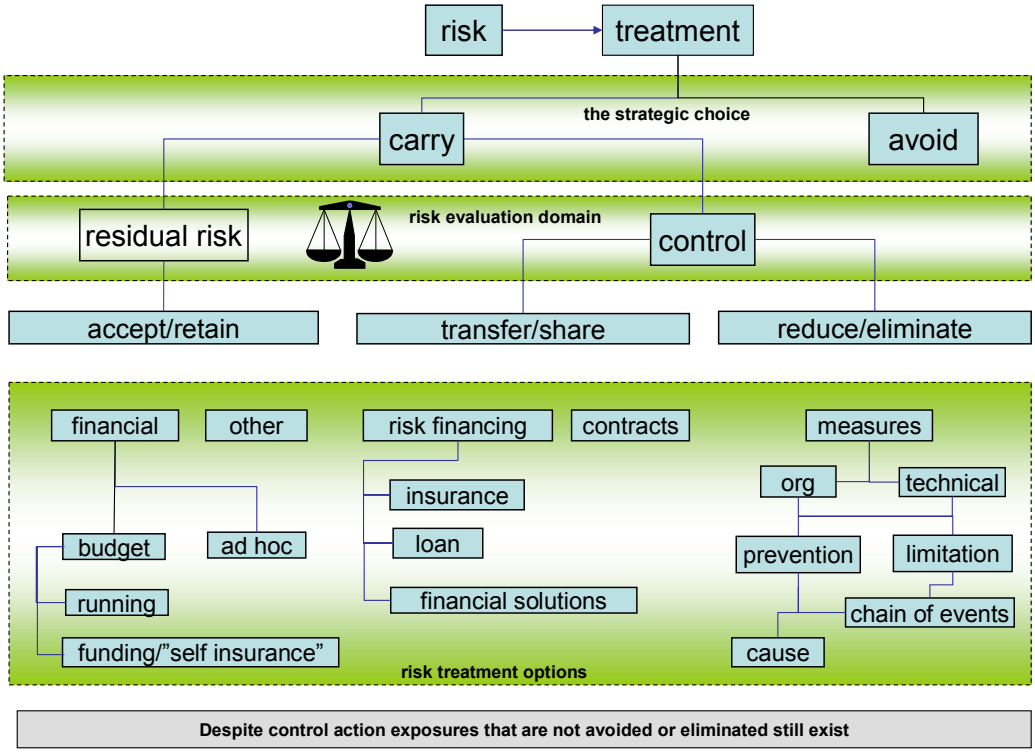


Figure 1 - Risk treatment logic

When risk management developed the number of solutions for risk treatment options also increased. However, public policy insurance is in most cases not a possible option.

2.2 Types of risk

It is self-evident that risks can be categorised. A number of aspects may be involved; e.g., causes, impact, interests and so on. There is no one unambiguous structure for all types.

Therefore, whoever must deal with any kind of risk management will probably devise their own categories as a means of management.
Risks for Static Risk Management can be classified into two categories:

Natural risks – examples	Man-made risks - examples
- Landslides - Earthquakes - Floods - Avalanches - Bushfires / Forest fires - Rock Fall - Snow storm / Ice storm / Heavy Snowfall - Etc.	- Traffic (including trailer, etc.) accidents - IT security risks - Work accidents - Transport of dangerous goods - Overloading (height, weight) - Aeroplane, ship, or train crash - Fire - etc.

Where an organisation has adopted a wider approach to risk management, i.e. covering both dynamic and static risk management, risks can be classified into:

Static risks (attitude preserving) - examples	Dynamic risks (attitude developing) – examples
- **Nature** (flooding, heavy snowfall, landslides, etc) - **Diseases** - **War** - **Accidents** - etc	- Idea - Market - Development - Achieving project goals - Organisational performance - etc

2.3 Risk analysis

Steps

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

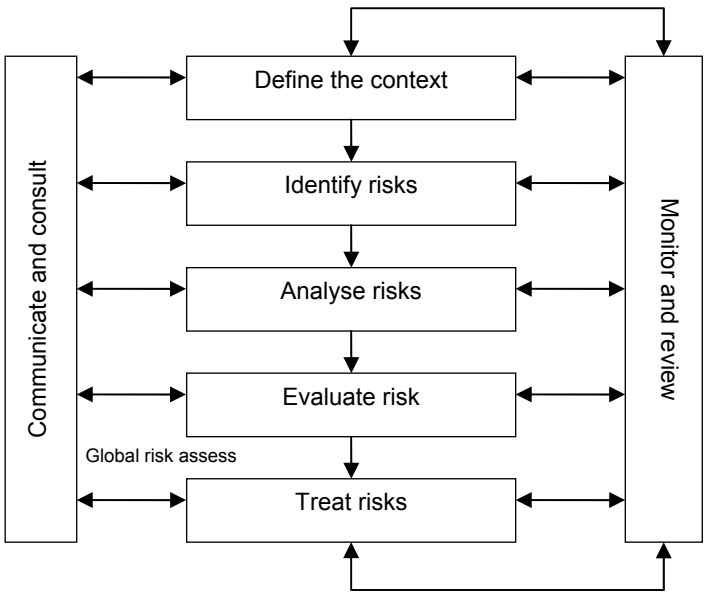


Figure 2 - Risk management process

2.4 Risk evaluation

One of the most difficult tasks in risk analysis is the evaluation of risks including all steps from first assessment over calculation through final assessment.

Risk evaluation will be the ultimate step in understanding a risk and the relevant context with respect to what it might entail in respect of all interests involved, all for making the right decision. This complex of causes and effects will be unique to each decision-maker.

In engineering and business, in many cases fortunately enough, risk needs mostly to be measured in one dimension only. There is a consensus of what constitutes a rational decision or what it should be based on. Risk can be calculated, and by using accepted lines of decision science, a rational decision can be reached. In bold technological projects for example, where political and other aspects appear, it is not so simple to even establish a common rationale.

Basically risk will be measured in terms of frequency and severity. Actually there seems to be three steps in risk evaluation from the pure quantitative to the assessment and the ultimate evaluation, when all aspects are factored in.

2.5 Matrix tables in risk assessment

Risk matrix tables are probably the most common tools for risk evaluation. Generally the matrices are used for a consistent ranking of risks. A matrix is a stereotyped model. However, there is no universal matrix for all applications. A matrix has to be calibrated within each context.

A risk matrix should be quantitative. Even if the cells of the matrix are given more verbal designations, terms need to be calibrated against the parameters of the context.

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, which seems to be a good general solution, since 3x3 may be too crude. More than 10x10 seems to be totally unnecessary for the applications at hand.

The matrix will not only be used for assessing original (gross) risk but also for assessing residual (net) risk after risk reducing 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.

2.6 Matrix tables as tools for governance

Risk management is basically about how to manage uncertainty. Risk-taking is an unavoidable element in all activities. Traditionally, risk management is focused on preservation, dealing with what is called static risks.

A road transport authority has a tradition of engineering and science. Therefore it could be expected that management could be firmly based on facts and calculations. However, new tasks in administration, such as lobbying, vehicle design, the environment, issuing of licences, etc. has changed its role considerably. The road transport system is also subject to a number of political decisions, some of which might even be in conflict. So there are a number of aspects, interests, etc to deal with: the infrastructure, road users, the general

public, safety, environment, road capacity, regional and industrial interests, more or less open expectations at the political level, etc.

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

Top management must therefore develop a common basis and common criteria for comparing and ranking risks in a holistic view, including both risks and opportunities. This must pertain to both the type of assets or values used to express gains and losses, the "currencies" as well as the frequency and severity/potential of the hazards. These should be categorised and registered in a common data base. Categories can be assigned by a number of factors, of which no specific one is perfect in itself.

It is important that the analysis is performed by the operational or performance units. The analyses should be submitted to executive management once a year. They should focus on a few topics within each area. The analyses should be accompanied by suggestions on how to deal with the issues at hand to bring them in line with the accepted guidelines or criteria.
Executive management should then make an overall assessment of the situation and determine which measures to take considering the availability of funds in relation to risks and opportunities, exposure and level of attractiveness. To support this exercise, a special SWOT analysis (Strength-Weakness-Opportunities-Threats) to consider these aspects could be used.

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

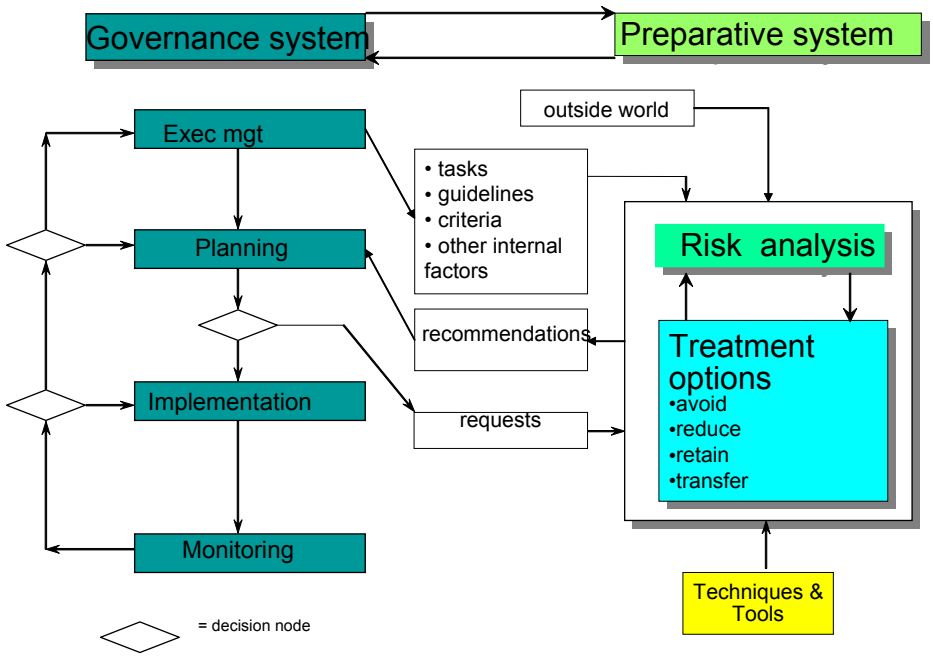


Figure 3 - Risk management for governance

A risk evaluation matrix should be used as a tool in risk management to facilitate measurements, comparisons and governance of an organisation's divisions, activities or situations in order to meet the risk acceptance criteria set by executive management. Different matrices should be developed for different applications.

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)

A normal way to select solutions according to accepted quantitative decision theory is to find the optimal solution. Depending on whether the focus is on static or dynamic risks one could either attempt to find the minimum cost of the risk or the maximum benefit. These solutions are highly attractive but elusive, since it will be almost impossible to demonstrate the evidence through calculations. A more realistic goal is to look for satisfactory rather than optimal solutions.

3. Examples in practice

3.1 Risk analysis by scenario - (RAS) light version

The risk analysis by scenario as described here is a basic universal methodology 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 accordingly.

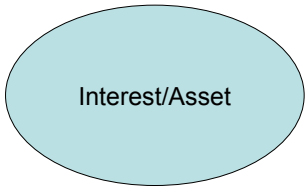
What is RAS?
A scenario in general is a description of a future situation based on the present situation and a presumed path of transition from the present into the future.

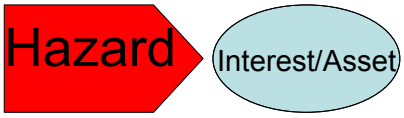
- ***Here each set of interest, hazard and risk factors comprises one scenario.***
- ***One interest at a time is in focus for analysis.***

What this means and how the analysis is done is briefly described here

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. its real resources, operations and performance, to deviations or harm.





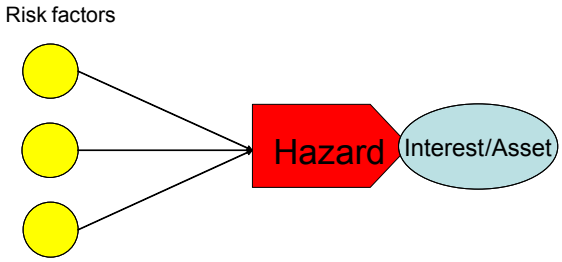
Hazard

The force that is potentially harmful to an interest is here called a ***Hazard.*** Instead of Hazard sometimes Peril or Event is used in the literature.

A hazard is to be taken in the broadest possible sense. What makes a hazard varies depending on the nature of the interest.

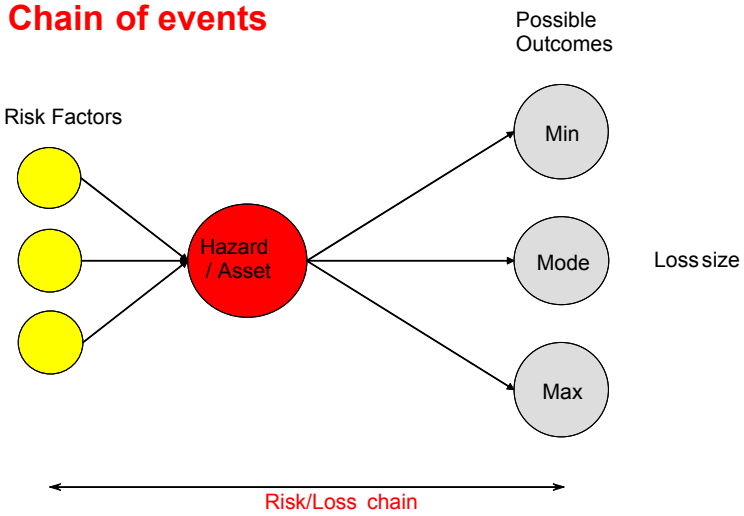
Risk factors

Causes of hazard are here called risk factors. Risk factors are seen as contributors. The causation of a hazard may depend on one or more risk factors. Some risk factors may have to be present in combination to trigger the hazard. The appearance of risk factors can be reduced 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 hazard 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 beginning to 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).

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

as 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.

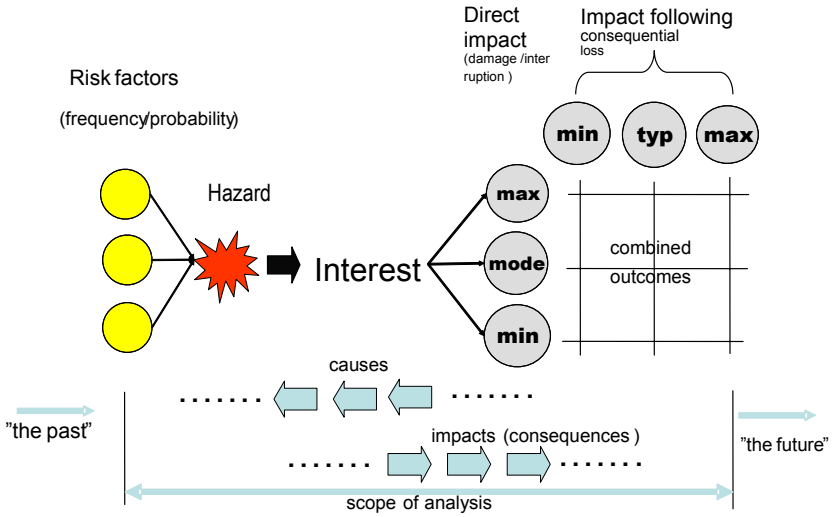


Figure 4 - The scenario methodology in overview

Routine

How the analysis is done is depicted in the following diagram (Figure 12). The essential part is to decide on an action plan for serious-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 matrix table, indicated in the diagram. The matrix table is however to be determined (calibrated) by the relevant stakeholder.

3.2 Universal risk matrix

A risk matrix must be calibrated in its own context with its dimensions. A universal matrix should preferably be dimensionless and designed in such a way that it would be applicable in any context.

The matrix here is based on percentages along both axes. However, the cells state, according to the principles above what kind of response is required rather than stating numbers. The response is also represented by the popular traffic light system, green, yellow and red.

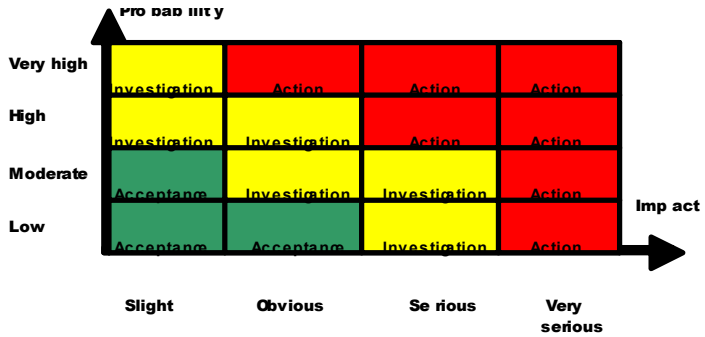


Figure 5- Risk assessment matrix/Response prioritied

3.3 Basic risk analysis for scorecard targets

This method is a much simplified application of basic risk management principles and the scenario approach. It is intended to be used as part of the annual planning process in respect of the scorecard targets set. The aim is to assure a systematic overall planning process.

In addition there are three questions to be answered concerning a broad view of the risk. This kind of analysis produces assessments based on knowledge, experience and an open mind. A brainstorming session could facilitate the identification of prerequisites and risk factors.

This is the procedure. Each step is described in more detail further on.

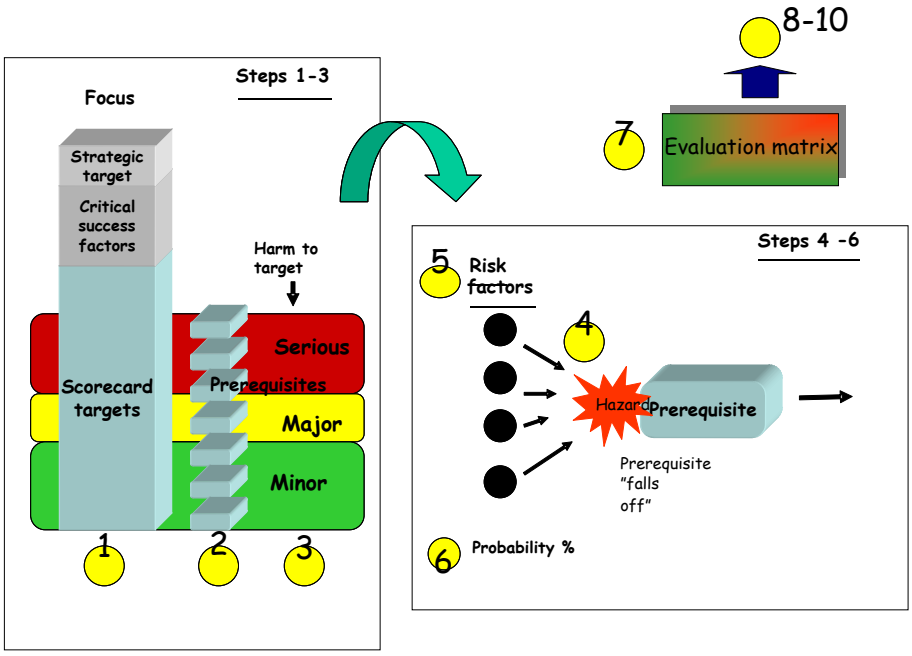


Figure 6 - Risk analysis of scorecard targets

3.4 Procedure step by step

These are all the steps:
1. Identification of the prerequisites for the annual target at hand.
2. Ranking of the prerequisites.
3. Specific hazard.
4. Identification of risk factors.
5. Estimation of the probability of a specific risk factor.
6. Choice of action.
7. Overall assessment.
8. Assignment of responsibility.
9. Action plan proposals.
10. Monitoring and review.

3.5 Consolidated top risk profile

An example of an enterprise “top twenty” risk matrix is given below, in total and in parts. Descriptions and criteria are included for the risk matrix. For the opportunity matrix criteria is still to be developed.

					Risk response		
Probability/frequency							
	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	Negative media coverage and attention	Single column	Local	Regional	National
			Management time and effort/ negative attention	Unit	Unit management	Executive top management	Board/ investors /ministry
	Property	Damage	Infrastructure/ Equipment/ Buildings etc.	= 1 million US Dollar	= 50 million US Dollar	= 200 million Us Dollar	> 200 million Us Dollar
	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			

Figure 7 – Risk matrix, executive level

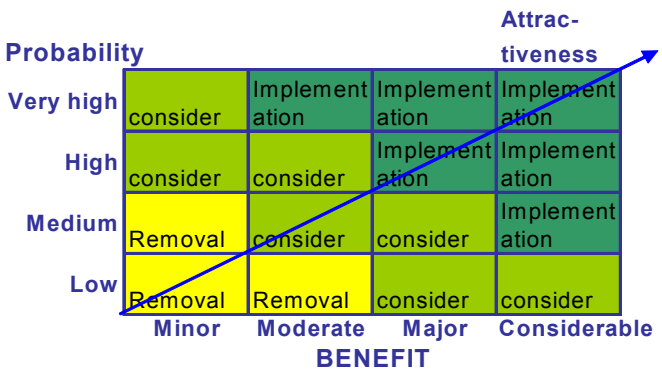


Figure 8 – Opportunity matrix

4. Internal Security (Personnel – Facilities – Information Technology)

4.1 General

Internal Security deals with the security of personnel, facilities (e.g. buildings) and information technology (IT).

The risks are:

- Natural risks
  See chapter 3.2
- Anthropogenic risks
  - Force majeure: fire, explosion, strikes, breakdown of technical systems, technical disaster (e.g., accident in atomic power plant)
  - Organisational deficiencies: unauthorized access, lack of regulation, lack of control, lack of training, etc
  - Human error: non-respect of regulations, negligence, etc
  - Technical failure: blackout of security system, blackout of technical systems, loss of data, blackout of supply
  - Malicious acts: vandalism, sabotage, theft, demonstration, sit-in, aggression, amok, hostage-taking, bomb threat, wiretapping, attack against software (hacker, viruses, etc), etc

The risks mentioned above have to be treated according to the generic risk management process: define the context, identify the risks, analyse the risk, evaluate the risks, treat the risks. The objectives of countermeasures are protecting human lives, ensuring the operational capacity of the organisation and its systems. There are two groups of countermeasures: prevention and emergency plans. This chapter addresses both aspects.

The security of personnel is the first priority. They are key to the operation, maintenance and construction of the road network. The security level needed for facilities and IT is determined by their relevance for the management processes.

Most countries have regulations regarding internal security. They are often divided into two parts: one related to personnel and facilities and the other related to information technology. This subdivision will be adopted in this chapter.

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