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GUIDANCE ON IMPLEMENTATION OF BINGO WP4 – ASSESSMENT OF IMPACTS OF EXTREME WEATHER EVENTS

Establishing the context for the risk management process

Bingo project – Bringing INnovation to onGOing water management – a better future under climate change

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Title

GUIDANCE ON IMPLEMENTATION OF BINGO WP4 – ASSESSMENT OF IMPACTS OF EXTREME WEATHER EVENTS
Establishing the context for the risk management process

Author

HYDRAULICS AND ENVIRONMENT DEPARTMENT

Fernanda Rocha
Assistant Researcher, Water Resources and Hydraulic Structures Unit

AV DO BRASIL 101 • 1700-066 LISBOA
e-mail: lnec@lnec.pt
www.lnec.pt

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GUIDANCE ON IMPLEMENTATION OF BINGO WP4 - ASSESSMENT OF IMPACTS OF EXTREME WEATHER EVENTS

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Abstract

The *main objectives of BINGO* are to provide adaptation strategies for climate change-related challenges, by coproduced tools and methodologies for water and land resources management strategies that are based on an *improved understanding* of future climate and its impact on the hydrological cycle and in human activities, in order to sustain key economic sectors and the environment.

Decision under uncertainty (climate changes evolution) is a risk management process, of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other relevant factors and, if needed, selecting appropriate prevention and control options. The main job of BINGO is to put in practice, in a realistic but scientific way, a comprehensive risk management framework approach, aiming to support efficiently decision-making for sustainable development and improved governance, resulting in the adaptation strategies and policies to be achieved in work package 5 (WP5 - risk treatment).

BINGO WP4 will perform the assessment of impacts of climate change extreme scenarios on human activities, at each research site, based on the risk assessment procedure of ISO 31000:2009, in such a way that its results assist to develop risk validated adaption strategies to cope with climate changes in WP5.

This document aims at providing some guidance to BINGO partners on WP4 implementation, articulating with the remaining project activities. It explains how ISO 31000:2009 needs to be adapted into BINGO project, and addresses in detail the steps required to establish the context for the risk management process at each research site, envisaging as well later results extrapolation for other European regions.

Keywords: BINGO / ISO 31000:2009 / Risk management / Context / Risk assessment / Risk analysis

ORIENTAÇÕES PARA IMPLEMENTAÇÃO DA ATIVIDIDADE 4 DO PROJETO BINGO - WP4: AVALIAÇÃO DOS IMPACTOS DE EVENTOS CLIMÁTICOS EXTREMOS

Estabelecimento do contexto para o processo de gestão de riscos

Resumo

O *projeto BINGO* visa desenvolver estratégias de adaptação aos desafios colocados pelas alterações climáticas, através de ferramentas e metodologias de gestão dos recursos hídricos e do solo, baseando-se em um conhecimento mais aprofundado da evolução climática e dos seus impactos sobre o ciclo hidrológico e sobre as atividades humanas, a fim de sustentar sectores chave da economia e o meio ambiente.

Decisão sob incerteza (evolução das alterações climáticas) é um processo de gestão de risco, que consiste em ponderar alternativas de estratégias e políticas, consultando todas as partes interessadas, tendo em consideração a avaliação dos riscos e outros fatores relevantes e, se necessário, a seleção de opções de prevenção e de controlo adequadas. O BINGO visa desenvolver, de forma realista, mas científica, uma abordagem holística de gestão dos riscos associados a fenómenos meteorológicos extremos, apoiando de forma eficiente o processo de tomada de decisão, orientado para o desenvolvimento sustentável e para uma melhor governança, resultando em estratégias e políticas de adaptação (BINGO WP5 - Tratamento de risco).

BINGO WP4 irá realizar a avaliação dos impactos dos cenários de fenómenos extremos associados às alterações climáticas sobre as atividades humanas, em cada caso de estudo do projeto, com base no processo de avaliação de riscos da ISO 31000: 2009, para que os seus resultados validem as estratégias de adaptação a desenvolver na atividade WP5.

Este documento providencia aos parceiros do BINGO algumas orientações para implementação da WP4, em articulação com as restantes atividades do projeto. Explica como a ISO 31000: 2009 deve ser adaptada para o projeto, e aborda em detalhe os passos necessários para estabelecer o contexto para o processo de gestão de risco em cada caso de estudo, visando, simultaneamente, extrapolação posterior dos resultados obtidos a outras regiões Europeias.

Palavras-chave: BINGO / ISO 31000:2009 / Gestão de risco / Contexto / Análise de risco / Avaliação de risco

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Acronyms

BINGO	Bringing INnovation to onGOing water management
CC	Climate change
EU	European Union
FMR	Framework for Managing the Risk
ISO	International Organization for Standardization
PT	Portugal
RMP	Risk Management Process
RS	Research Sites
WP	Work package

1 | Introduction

1.1 BINGO Objectives and framework

BINGO project (*Bringing INnovation to onGOing water management*) aims at providing practical knowledge and tools to end users, water managers, decision and policy-makers affected by climate change (CC) to better cope with all climate projections, including droughts and floods.

The **main objectives of BINGO** are to provide **adaptation strategies** for **climate change-related challenges**, by coproduced *tools and methodologies* for water and land resources management strategies that are based on an *improved understanding* of future climate and its impact on the hydrological cycle.

BINGO will address *average* and *extreme conditions* of climate change scenarios, focusing on integrated demand-driven solutions for six representative areas across Europe (BINGO research sites).

Key CC adaptation-oriented outcomes of BINGO include:

- Improved and downscaled decadal **climate predictions** and projections of climate variables (e.g. precipitation, radiation, etc.) for the BINGO sites.
- Integrated analysis of the **impacts of climate change scenarios on the water cycle**, using a set of powerful numerical models, producing an increased understanding of the impacts of average and extreme weather conditions on water availability and quality and **their effects on multiple sectors,** including “domino” effects.
- A **portfolio** of **validated risk adaptation strategies** usable by decision makers, underlined by a common standard risk management framework, based on ISO 31 000. In this context, nature-based solutions will be considered as a key element in creating climate resilience.
- A set of **key indicators** to identify scenarios that require the anticipation of specific strategic management measures and, afterwards, to monitor and allow revision of implemented measures.

The key idea is to adapt, managing water and land resources under CC conditions, in order to sustain key economic sectors and the environment. Water is the central resource in BINGO and adaptation strategies must be derived to assure:

- water for ecosystems (nature);
- water for human consumption;
- water for agriculture;
- water for industrial uses: energy; industrial production; tourism (leisure …),

while complying to European (and national) policies and legal framework, as expressed In BINGO proposal (Figure 1.1) (BINGO, 2014).

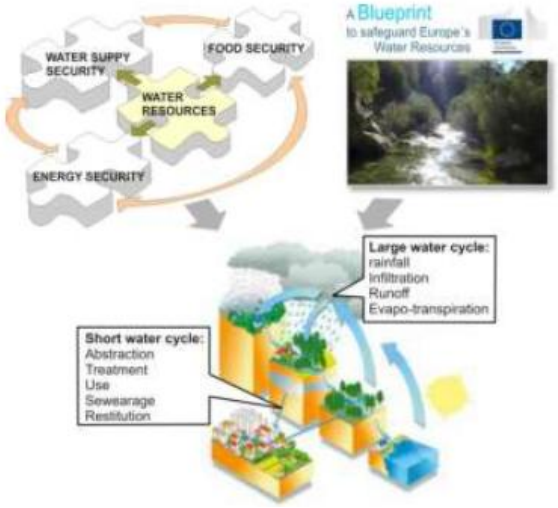


Figure 1.1 – Large and short water cycles dealt within BINGO, under climate change scenarios (Adapted from: Blueprint EU COM 2012, Accompanying Doc.)

BINGO framework has two main interlinked roadmaps contributing to climate change adaptation strategies and policies development (Figure 1.2). One is mainly oriented for knowledge and tools development related with the physical environment. The other, deals with impacts in people and socio-economic activities, and follows a risk management based approach oriented to support validated adaptation strategies.

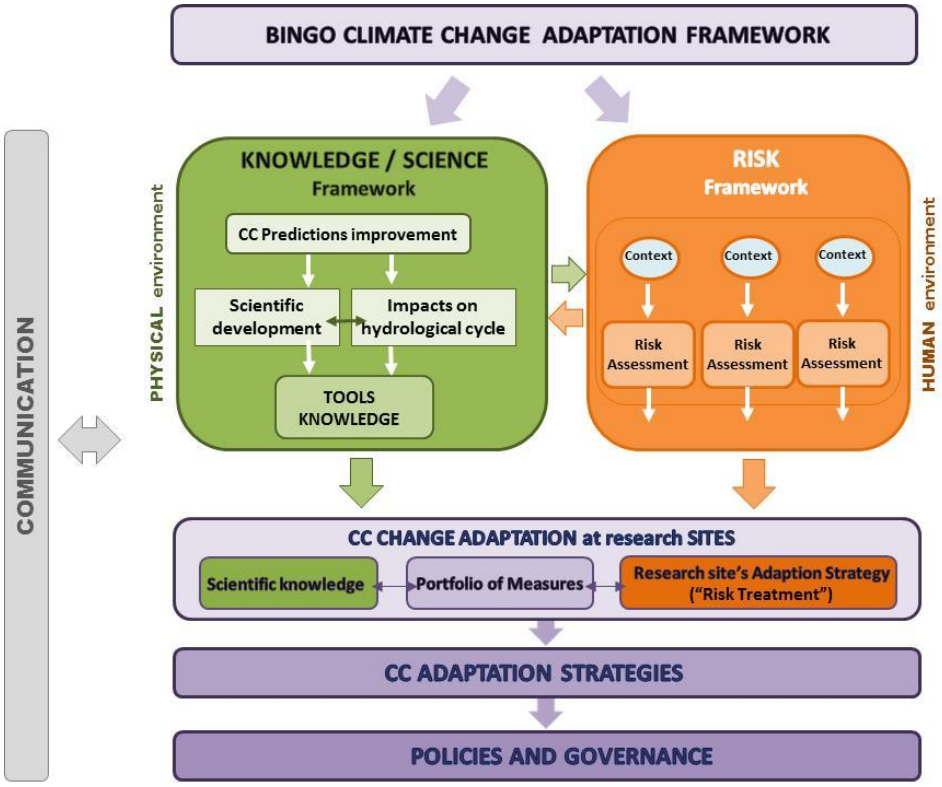


Figure 1.2 –BINGO Framework for Climate Change Adaptation

1.2 Links between WP4 and the other BINGO WP

In BINGO work package 2 (WP2) climate change scenarios will be predicted. These predictions will be used in WP3 to analyse the effect of average trends and extreme weather conditions on the water cycle, both on quantity and quality.

The main objective of WP4 is to perform the assessment of impacts of climate change extreme scenarios on human activities, at each research sites, based on the risk assessment procedure of ISO 31000:2009. WP5 will try to produce risk validated adaptation strategies to cope with climate changes (Figure 1.3).

Communication and consultation (WP6) will be a cross-cut concern all over the project.

Figure 1.3 – Risk management phases in relation to BINGO Work packages (Figure 5 of BINGO, 2014)

The BINGO pert diagram (Figure 1.4) details the links among WP, aligned with the risk management process (RMP).

It is particularly relevant to notice that the way BINGO structure was set up contains a significant interrelation and complementarity between WP4 and WP5. The Risk Management Process (RMP) was split placing the risk assessment in WP4 and the risk treatment in WP5, as part of adaptation strategies definition. As a result, several tasks need to be developed in a cross-complementary way, in order to achieve the envisaged BINGO outputs, with principles and information cross flows that need to be clarified and understood right from the beginning.

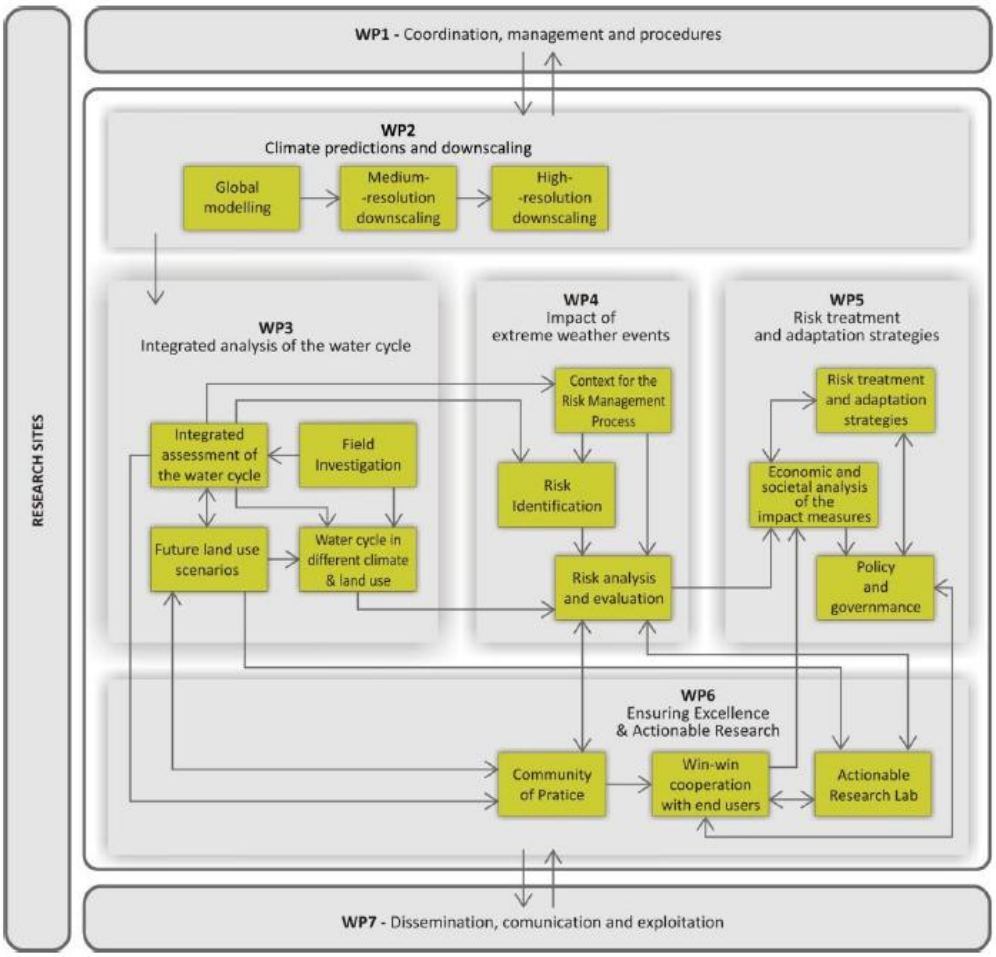


Figure 1.4 – Risk management phases in relation to BINGO Work packages (Figure 7 of BINGO, 2014)

It is essential to clarify, right from the beginning, how the BINGO framework will incorporate risk assessment into climate change adaptation strategy development or, it put in other words, how Figure 1.2 will be put in practice. This clarification should be provided by WP5, clearly stating their objectives (see 2.2).

The job of WP4 is to perform the risk assessment, aligning its goals and objectives with the risk management objectives established in the BINGO framework. WP4 results will provide ranked and prioritized risks per research site, to be then used by WP5 to establish risk based adaption strategies.

Internal and external communication procedures are quite important within this framework, therefore a close link between WP4/WP5 and WP6 exist.

1.3 Purpose of this supporting document

There are several risk management approaches; several techniques; several ISO. Those that have already worked with risk evaluation and management have experienced how different scientific communities have different risk definitions and concepts.

The main first difference is between hydrologists, that consider risk as the probability of occurrence of an extreme event, and those that manage the consequences of those events. The concept of risk differs significantly and, therefore, the methodologies to address it.

Furthermore, it is necessary to understand that BINGO project follows a risk approach methodology, but it is not a real organization managing its own risk. The ultimate aim of BINGO project is not the development of a risk management/safety plan (main output of a risk management process) but is rather the development of climate change adaptation strategies, based on a risk approach. This makes all the difference. Therefore, it is useful to be aware, right from the beginning, that it is necessary to adapt many concepts, approaches and methodologies of a risk management process into BINGO project.

This document aims at providing some guidance to BINGO partners on implementing WP4 (risk assessment associated with extreme weather events), articulating with the remaining projects activities, in such a way that its outputs are useful to WP5 (risk treatment), where adaptation strategies will be developed. In this document it is addressed, in particular, the definition of the context for the risk management process. Context is relevant not only for risk assessment and management but for further results extrapolation to other European regions.

This document is a first draft version of a methodological approach that should be nourished by partner’s contributions, till final methodologies are agreed and implemented.

2 | BINGO risk approach

2.1 BINGO General Approach

2.1.1 ISO 31000:2009 based

Water is the central resource in BINGO. Climate change is the driving force for adaptation. Deviations from average lead to two main types of extreme conditions scenarios - droughts and inundations (either by river flooding or by marine origin as storm surges, spring tides and sea level rise), with different time scale of events and different types of adaptation strategies (Figure 2.1).

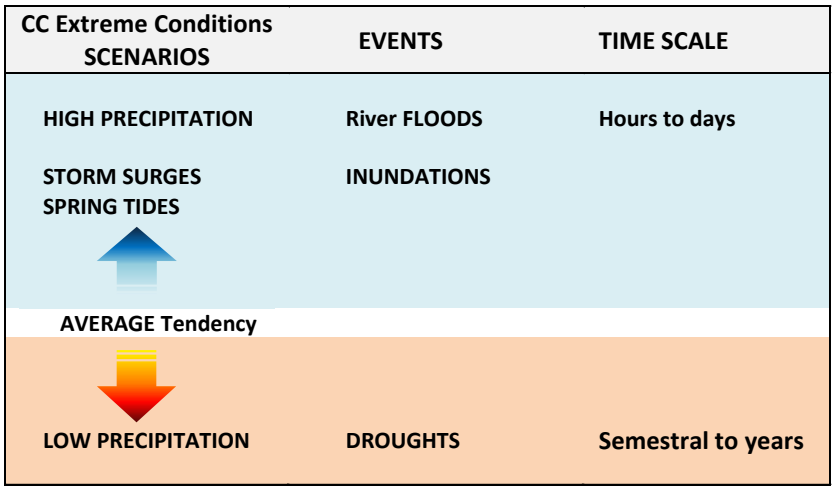


Figure 2.1 – BINGO extreme weather conditions scenarios

The based risk management approach acts in BINGO as a conducting line, from the climate scenarios predictions and projections to CC adaptation strategies set up, aiming at helping to sustain key economic sectors and the environment and protect people and property.

Risk is defined as the effect of uncertainty on objectives therefore, risk management is decision under uncertain. The first unknown in climate change adaptation is how climate change (CC) will really occur, no matter all possible predictions. As a consequence, CC adaptation strategies need to cope with large uncertainty.

Many entities, organizations and scientific studies have already identified and listed enormous amount of climate change adaptation measures, related with water resources management and sectors adaptation.

In order to make a difference, BINGO project will attempt to incorporate already known adaptation measures, as well as new BINGO produced ones, into CC risk based validated adaptation strategies

for six research sites and try to extrapolate the results achieved at research sites level to European policies.

Therefore, risks must not only be identified, but also analysed and evaluated, allowing for risk prioritization, to support decision making in adaptation strategies definition. Economic, social and political values will be determinant for strategy decision. They will have influence in risk evaluation criteria definition, consequently in risks prioritization, and finally in adaptation strategy setting up.

Defining such strategies also involves the definition of objectives, the identification of actors responsible for taking action, clarification of their responsibilities in the process (accountability), the interdependence among these intervenient, establishment of coordinated activities, how the activities of one intervenient trigger the action of another, how conflicts will be dealt with, set the internal and external communication procedure, etc.

The main job of BINGO is to put into practice, in a realistic but scientific way, a comprehensive risk management framework approach, aiming to support efficiently decision-making for sustainable development and improved governance, resulting in the adaptation strategies and policies to be achieved in WP5.

The risk management approach proposed in BINGO is *based* on ISO 31000:2009, comprehending a general Framework for Managing Risk (FMR) that supports and frames the specific categories of risk to be managed through a Risk Management Process (Figure 2.2).

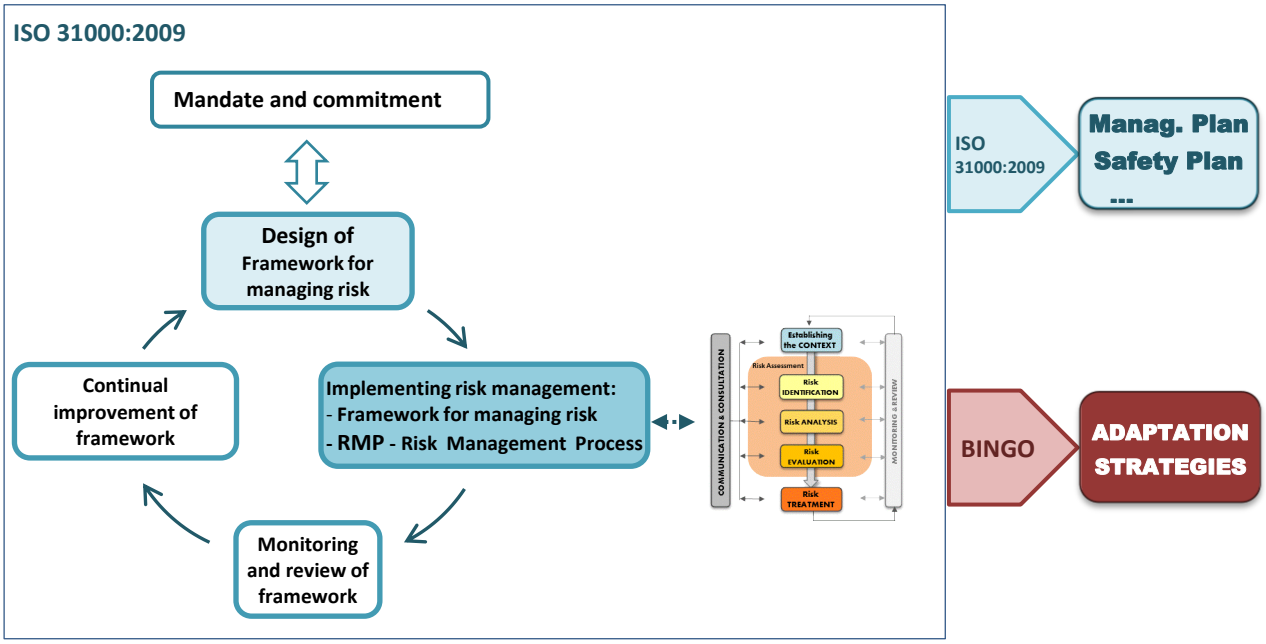


Figure 2.2 – Relationships between the risk framework and process (Adapted from ISO 31000:2009)

It is naturally obvious that BINGO project is not suitable for a full risk management framework implementation. Methodologies, tools, strategies and policies are envisaged outputs of BINGO, not compatible with a complete implementation of an ISO risk management framework, structured and oriented for *an organization* (comprehending one or more entities, persons, government …).

When applying such a framework to an organization the outputs are risk management or safety plans or other sets of activities. The output of BINGO will be CC adaptation strategies (Figure 2.2).

When is stated that the approach used in BINGO is based on a risk management framework (ISO 31000 in this case) means essentially that it uses a framework that:

1. Provides the foundations necessary to assist **integrating risk assessment into CC adaptation**, by providing means to evaluate and prioritize risks to support decision-making, strategies definition and inter-sectorial conflicts management;
2. Assists to establish internal and external **reporting and communication mechanisms** to facilitate communication among risk managers, stakeholders, technicians, scientists, decision-makers and all other intervenient in the process.

Each component of the framework will be adapted into bingo CC adaptation strategies definitions as much as possible (Figure 2.3), bearing in mind the similarities and differences between strategy definition for organizations and effective organization implementation.

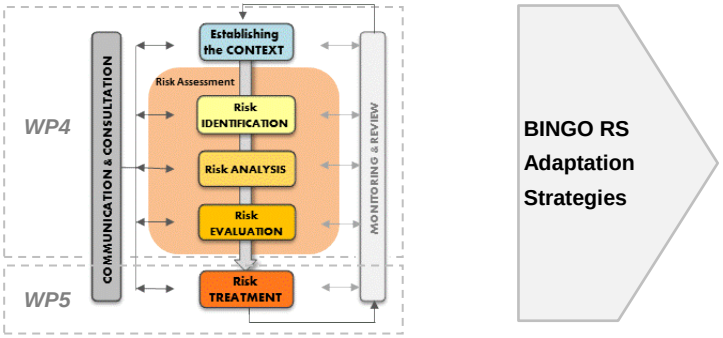
ISO 31000:2009	BINGO Adaptation for each Research Site (RS)
FMR - Design of Framework for Managing Risk	• *If a FMR is existent*: Understand FMR of each Research site' Organization responsible for managing risks under study • *If a FMR is not existent*: Understand the external and internal context of the Research site' Organization responsible for dealing with risks under study
RMP - Risk Management Process	At each BINGO research site: 
Monitoring and review of framework	BINGO project duration is not compatible with outputs implementation. Nevertheless some indicators and guidelines will be produced for later application.
Continual improvement of framework	

Figure 2.3 – ISO 31000:2009 adaptation into BINGO at research site level

RISK (ISO Guide 73:2009, definition nº 1.1)

Effect of uncertainty on objectives.

NOTE 1 An effect is a deviation from the expected — positive and/or negative.

NOTE 2 Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process).

NOTE 3 Risk is often characterized by reference to potential events and consequences, or a combination of these.

NOTE 4 Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence.

NOTE 5 Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood.

RISK MANAGEMENT (ISO Guide 73:2009, definition nº 2.1)

Coordinated activities to direct and control an organization with regard to Systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analysing, evaluating, treating, monitoring and reviewing risk.

RISK MANAGEMENT FRAMEWORK (ISO Guide 73:2009, definition nº 2.1.1)

Set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization.

NOTE 1 The foundations include the policy, objectives, mandate and commitment to manage risk

NOTE 2 The organizational arrangements include plans, relationships, accountabilities, resources, processes and activities.

NOTE 3 The risk management framework is embedded within the organization's overall strategic and operational policies and practices.

RISK MANAGEMENT PROCESS (ISO Guide 73:2009, definition nº 3.1)

Systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analysing, evaluating, treating, monitoring and reviewing risk.

2.1.2 The Risk Management Process (RMP)

The Risk Management Process consists of a series of steps that, when undertaken in sequence, enable continual improvement in decision-making.

The Framework for Managing the Risk (FMR) expresses the risk objectives and policy of an Entity (Organization). Aiming to achieve its objectives, an Organization can perform a risk management process (RMP) covering all possible risks able of compromising the achievement of its objectives or, can isolate certain particular types of risks or sectors, and perform a RMP oriented for those specific cases.

The risk management process (ISO 31 000:2009) includes several key steps (Figure 2.4), each of them with a significant purpose (Figure 3.1):

- Establishment of the **context** for the risk management process (RMP);
- **Risk assessment,** comprehending:
    - risk identification;
    - risk analysis and
    - risk evaluation
- Risk **treatment;**
- **Communication** and **consultation;**
- **Monitoring** and **review.**

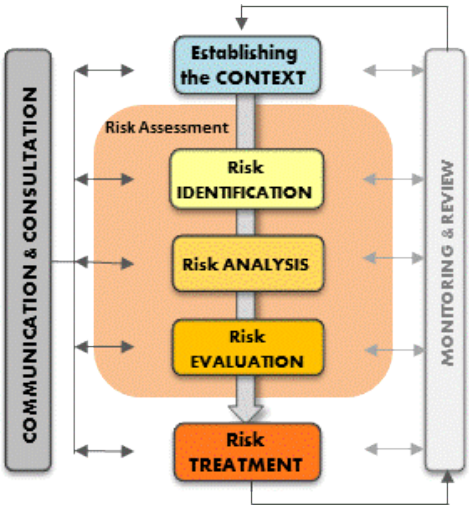


Figure 2.4 – Steps of the Risk Management Process (ISO 31000:2009)

2.1.3 BINGO Common language

Different scientific groups have different risk definition concepts. A common difference is observed between hydrologists, that consider risk as the probability of occurrence of an extreme event, and those that manage the consequences of those events. The concept of risk differs significantly and, therefore, the methodologies to address it.

In order to assure a common language, definitions and vocabulary from ISO Guide 73:2009 will be used, always possible. Clarification of some terms can be agreed among partners. Complementary terms will be defined when considered necessary. This information is reverted into BINGO GLOSSARY presented in Annex I.

In this document the most relevant definitions are presented in the chapters when considered useful to facilitate interpretation.

2.1.4 RISK definition

Under ISO 31 000:2009 **RISK** is defined as being the **effect** of uncertainty on objectives (ISO Guide 73:2009, definition nº 1.1).

The third edition, published in 2004, of AS/NZS 4360 (the embryo of ISO 31000:2009) defined risk as "*The chance of something happening that will have an impact on objectives*". There is a shift of the emphasis from "the event" (something happening) to the "the effect" (Broadleaf, 2012).

Risk is associated with the interaction between environmental phenomena, communities and the surrounding environment. ***Risk(r)*** is expressed in terms of a combination of the ***consequences (c)*** of an event or a change in circumstances, and the associated ***likelihood of occurrence (p)***.

$$r = p \; x \; c \tag{1}$$

The ways consequences are addressed have been evolving along the years and also changes with different scientific communities. In order to assure the referred common language it is important to assume a BINGO concept. According to ISO Guide 73:2009 definitions (see end of chapter) it is proposed to assume the following risk definition:

$$r = p \; x \; c \quad \Leftrightarrow \quad r = p \; x \; c \quad (f \text{ (exposure, susceptibility, resilience)}) \tag{2}$$

Exposure and vulnerabilities (leading to susceptibilities) contribute to increase the harm or consequences. On the other hand, resilience (adaptive capacity) decreases the potential damaging effects.

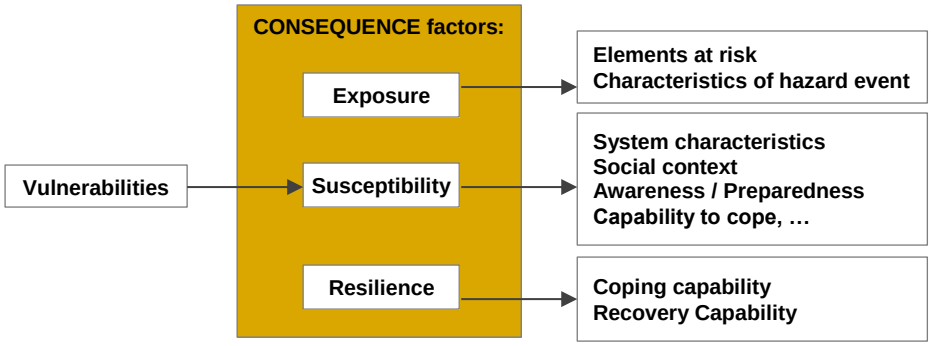


Figure 2.5 – Factors affecting consequences of an event

In more colloquial terms is possible to say (UNESCO-IHE):

Consequence: considered as the extent of harm, which can be expected under certain conditions of exposure, susceptibilities and resilience.

Exposure: considered as the predisposition of a system to be disrupted by a hazardous event (floods or other) due to its location in the same area of influence.

Exposure can be understood as the values that are present at the location where a hazardous event (floods or other) can occur. These values can be goods, infrastructure, cultural heritage, agricultural fields or mostly people. The indicators for this component can be separated in two categories; the first one covers the exposure of different elements at risk and the second one give details on the general characteristics of the hazardous event.

Susceptibility: considered as the elements exposed within the system, which influence the probabilities of being harmed at times of hazardous event (due to their vulnerabilities).

Susceptibility relates to system characteristics, including the social context of hazardous event damage formation. For floods, for instance, especially the awareness and preparedness of affected people regarding the risk they live with (before the flood), the institutions that are involved in

mitigating and reducing the effects of the hazards and the existence of possible measures, like evacuation routes to be used during the floods.

Resilience: considered as the capacity of a system to endure any perturbation, like floods, droughts or other hazardous event, maintaining significant levels of efficiency in its social, economic, environmental and physical components.

Resilience to a hazardous event damages can be considered only in places with past events, since the main focus is on the experiences encountered during and after the events.

EVENT (ISO Guide 73:2009, definition nº 3.5.1.3)

Occurrence or change of a particular set of circumstances

NOTE 1 An event can be one or more occurrences, and can have several causes.

NOTE 2 An event can consist of something not happening.

NOTE 3 An event can sometimes be referred to as an “incident” or “accident”.

NOTE 4 An event without consequences can also be referred to as a “near miss”, “incident”, “near hit” or “close call”.

PROBABILITY (ISO Guide 73:2009, definition nº 3.6.1.4)

Measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is impossibility and 1 is absolute certainty.

EXPOSURE (ISO Guide 73:2009, definition nº 3.6.1.2)

Extent to which an organization or individual is subject to an event.

VULNERABILITY (ISO Guide 73:2009, definition nº 3.6.1.6)

Intrinsic properties of something resulting in **susceptibility** to a risk source that can lead to an event with a consequence.

CONSEQUENCE (ISO Guide 73:2009, definition nº 3.6.1.3)

Outcome of an event affecting objectives.

NOTE 1 An event can lead to a range of consequences.

NOTE 2 A consequence can be certain or uncertain and can have positive or negative effects on objectives.

HAZARD (PREPARED project)

Source of potential harm. A hazard can be a risk source.

HAZARDOUS EVENT (PREPARED project)

An event which can cause harm, e.g. a situation that leads to the presence or release of a hazard (Beuken, 2008). The hazardous event is part of the event pathway.

2.2 BINGO Risk Framework within BINGO CC Adaptation Framework

BINGO Climate Change Adaptation Framework has two main interlinked roadmaps contributing to adaptation strategies and policies development (Figure 1.2), as already referred. Easily said, more difficultly put into practice at this starting stage.

It is important to provide, right from the beginning, the foundations and arrangements that should be embed throughout the BINGO project, at all levels, in order to understand and implement:

1. How BINGO RISK Framework will be enclosed by BINGO Climate Change Adaptation Framework;
2. How results from BINGO RISK and SCIENCE/KNOWLEDGE frameworks will be linked to support CC adaptation and policies development.

Regarding the first issue, an analogy may be useful at this point. The ***design of a framework for managing risk*** at an organization or entity (Figure 2.2) establishes the way policies (risk management) are linked with risk assessment (science based) and how communication supports these processes (Figure 2.6).

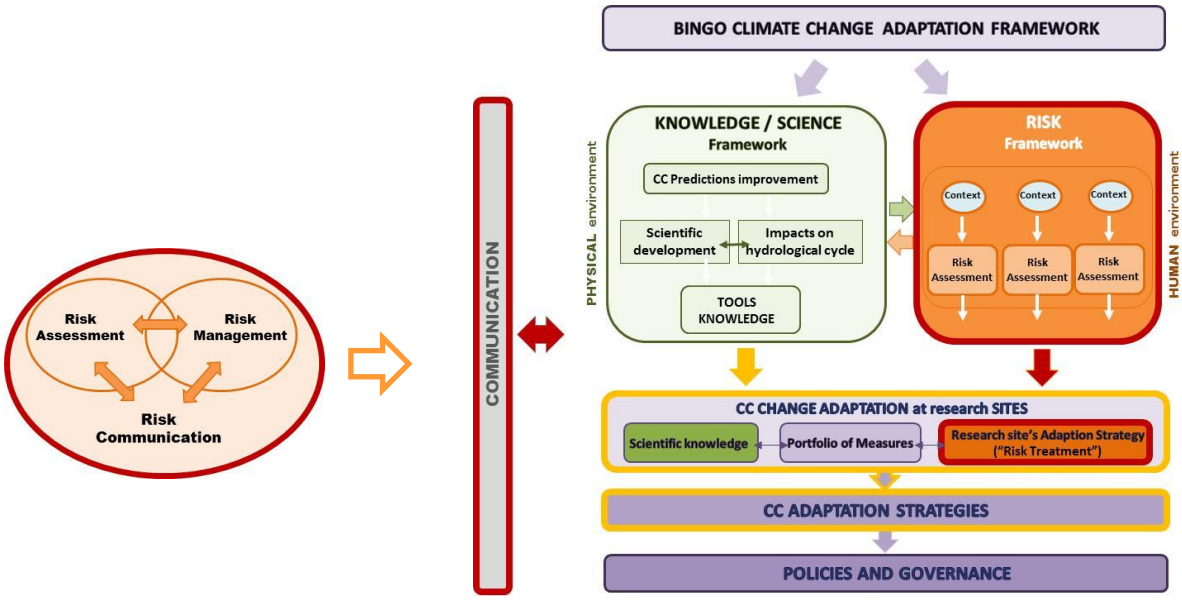
Figure 2.6 – Risk Analysis Framework (WHO, 2010)

As analogy it can be said that a BINGO "*Framework for Managing the Risk"* needs to be established:

1. To provide the underlying policy and foundations necessary for integrating risk assessment into CC adaptation strategy definition, including the clear definition and articulation of objectives for a risk management approach conducting to CC adaptation strategies, in order to assist, for example:
    - identification and understanding of similarities and particularities of contexts;
    - identification of the chain of management actors and respective accountabilities;
    - establishment of performance measurement indicators;
    - application of the Risk Management Process (RMP) at varying levels and within specific contexts, providing means to evaluate and prioritize risks to support inter-sectorial conflicts management, decision-making and efficient strategies definition;

2. To assist establishing internal and external communication and reporting mechanisms:
   - ensuring that information derived from the risk management process is adequately reported and used as a basis for decision making and accountability;
   - facilitating communication among risk managers, stakeholders, technicians, scientists, decision-makers and all other intervenient in the process. Communications is a component of this risk framework considered crucial in BINGO.

This analogy can be summarised in Figure 2.7.



Legend:

Issues to be defined for the BINGO "*Framework for Managing the Risk*"

Issues to be clarified on how to integrate results from both Risk and Science/ Knowledge frameworks

Figure 2.7 – Issues to be defined for the BINGO "*Framework for Managing the Risk*"

The underlying policy and foundations necessary for integrating risk management into CC adaptation strategy definition needs to be clarified in WP5 in order to effectively fulfil risk assessment in WP4.

Facilitating communication, reporting and consult among risk managers, stakeholders, technicians, scientists, decision-makers and all other intervenient in the process is the job of BINGO WP6, but it requires previous identification of issues to be communicated or consulted with stakeholders and all the remaining Communities of Practice for every steps of risk management.

The establishment of BINGO "*Framework for Managing the Risk*" is, in summary, an important step to be performed prior to WP4 implementation, requiring filling of Table 2.1, where main issues are listed.

Table 2.1 – Establishment of BINGO "*Framework for Managing the Risk*"

1. How to integrate risk management into CC adaptation strategy definition in BINGO (WP5)	
Provide the underlying policy/foundation:	
Articulate objectives for a risk management approach conducting to CC adaptation strategies:	
How to link policies (risk management) with risk assessment (how to ensure that information derived from the risk management process is adequately reported and used as a basis for decision making and accountability):	
Other issues:	
2. How to integrate results from KNOWLEDGE/SCIENCE and RISK ASSESSMENT in WP5	
How to link results from the 2 BINGO road maps, Risk and Knowledge/Science frameworks:	
3. WHAT to consult or communicate (WP4 & WP5)	
Assemble Team (WP4) – Identify and understand Stakeholders	Who are the Stakeholders? What is the Stakeholders' perception of risk? What are their objectives?
Establish the context (WP4):	
Identify the risks (WP4):	
Analyse the risks (WP4):	
Evaluate the risks (WP4):	
Treat the risks (WP5):	
4. HOW to consult or communicate (WP6)	
Understand Stakeholders	How shall they be involved? …

3 | Guidance on BINGO WP4 implementation

3.1 Objectives, steps and outputs of WP4

BINGO framework has two main interlinked roadmaps contributing to climate change adaptation strategies and policies development (Figure 1.2). One is mainly oriented for knowledge/science development, mainly related with the physical environment, whiles the other deals with impacts on people and socio-economic activities, and follows a risk based approach to support validated adaptation strategies.

It is opportune to remind that the risk approach proposed in BINGO is an adaptation of ISO 31000:2009, which is oriented for an organization. The objective of BINGO risk framework it is not to produce an entity risk management plan for each research site but rather to perform risk assessment of overall or part of the entity activities (or functions, processes…) in order to embed the results in climate change adaptation strategies. Therefore, steps of the risk management activities, as presented in ISO 31000:2009, can't be implemented in its full extension.

Also, in some research sites the risk owner is not a full BINGO partner, being its involvement voluntary. Therefore, only the issues relevant to perform risk assessment will try to be put in practice in BINGO, in a pragmatic way, without compromising the outcomes.

Objectives of WP4

The main objective of WP4 is to perform the assessment of impacts of climate change extreme scenarios on human activities, at each research site, based on the risk assessment procedure of ISO 31000:2009. WP4 results will be used by WP5 to establish risk validated adaption strategies.

Steps of the risk management process

Figure 3.1 summarizes the main steps (Broadleaf, 2012):

Step 1. Communicate and consult.

Step 2. Establish the context for the risk management process (RMP)

Step 3. Identify the risks.

Step 4. Analyse the risks.

Step 5. Evaluate the risks.

Step 6. Treat the risks.

Step 7. Monitor and review.

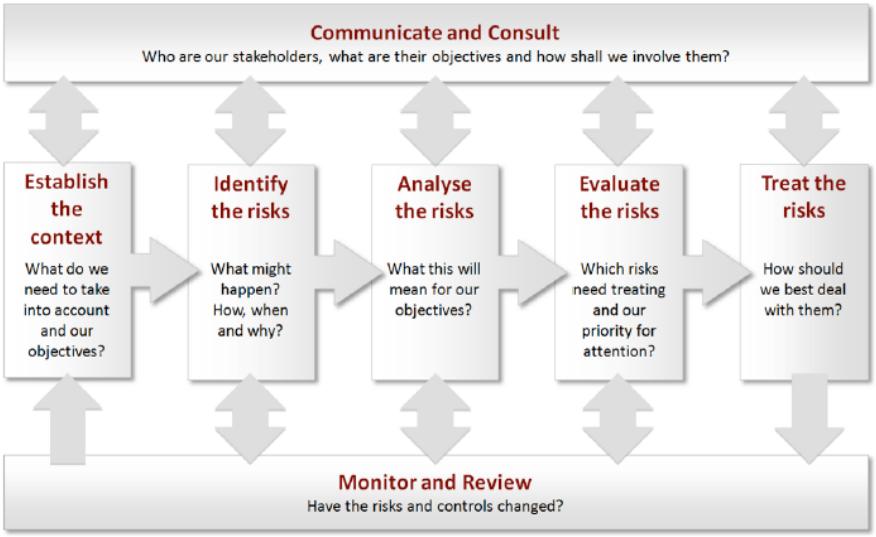


Figure 3.1 – Steps of the Risk Management Process (Broadleaf, 2012)

Steps to be performed in WP4 (Figure 3.2)

At each research site:

Step 1. Communicate and consult.

- Assemble Team → Identify external and internal Stakeholders and relevant Community of Practice;
- Identify relevant issues to communicate to and consult Stakeholders, within BINGO WP6 Communication framework.

Step 2. Establish the context for the risk management process (RMP)

Perform risk assessment:

Step 3. Identify the risks.

Step 4. Analyse the risks.

Step 5. Evaluate the risks.

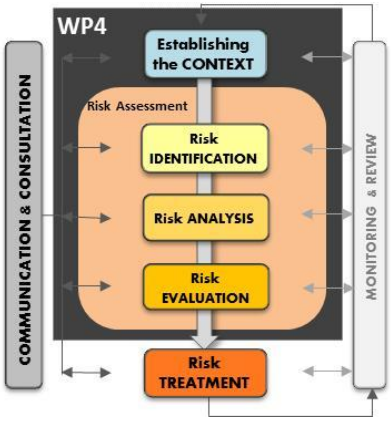


Figure 3.2 – Steps of WP4

For later generalization and extrapolation:

Perform an analysis, comparison and harmonization of key relevant issues among case-studies, detecting trends, common conditioning factors, perceptions of risk and level of acceptance of risk, as well as other contextual factors considered relevant for CC adaptation strategies definition.

Main outputs of WP4 (Figure 3.3)

For each research site:

- Understanding of the context for the risk management process;
- Ranked risks by level of magnitude;
- Level of risk acceptance.

Figure 3.3 – Main outputs of WP4 for each research site

For BINGO in general:

- Understanding of the European context for CC adaptation;
- Factors affecting the level of risk acceptance;
- Ranked risks by level of magnitude.

3.2 Oversight and accountability for the risk assessment process

3.2.1 Identification of Risk Owners

RISK OWNER (ISO Guide 73:2009, definition nº 3.2.1.1)
Person or entity with the accountability and authority to manage a **risk**.

STAKEHOLDER (ISO Guide 73:2009, definition nº 3.5.1.5)
Person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity.
NOTE: A decision maker can be a stakeholder.

1st Key principle for effective and efficient risk assessments:

Governance over the risk assessment process must be clearly established.

Oversight and accountability for the risk assessment process is critical to ensure that the necessary commitment and resources are secured, the risk assessment occurs at the right level in the organization, the full range of relevant risks is considered, these risks are evaluated through a rigorous and ongoing process, and requisite actions are taken, as appropriate (PricewaterhouseCoopers, 2008).

When seeking adaptation for climate change impacts, actions/ measures must be taken at different levels: governmental level (water resources management; legislation…); private/ public sector level (water supply, agriculture, energy …). Several intervenient can contribute and have accountabilities at different stages.

Each BINGO research site is different. It can address one or more climate change drives (low/ high precipitation, storm surges …), or it can address all or only some of the referred levels of the chain. Each research site can have one or several intervenient entities, with different objectives while pursuing CC adaptation. It is important to distinguish which ones fall under BINGO scope. It is also likely that only some of those entities are suitable of performing a risk approach within BINGO.

Therefore, in order to implement WP4, it is necessary to start by identifying which of the intervenient entities of each research site will perform a risk approach. Only those will be considered as **Risk Owners in WP4**. The remaining can be considered as **Stakeholders**.

Measures at governmental level, will affect sectors activities competing for the same resources that will need to develop their own global adaptation strategies. Stakeholders become now the risk owners in their own adaptation process, needing to deal with their own "stakeholders", and so on (Figure 3.4). This sequential chain is present in some BINGO research sites. It is necessary to identify if different entities will perform a risk approach in BINGO at each research site. It is the useful to understand the interlinkage and complementary of risk owners.

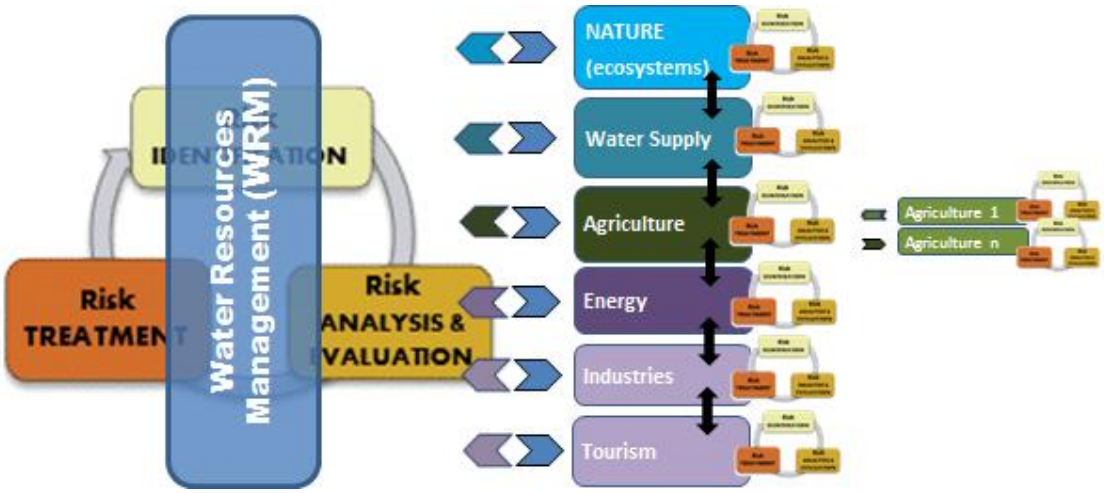
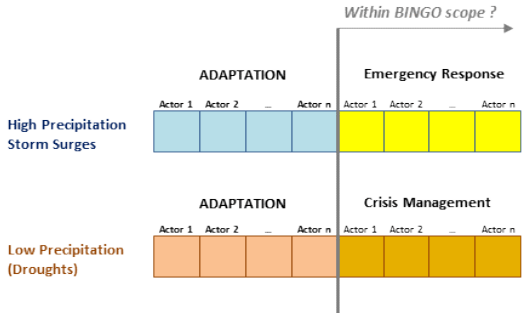
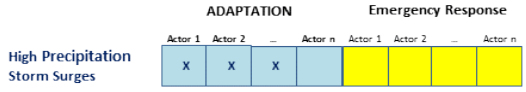
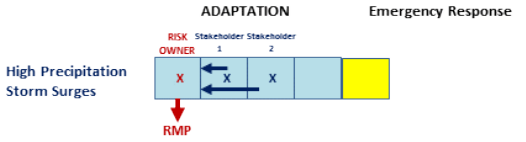


Figure 3.4 – Example of CC adaptation chain

It would be suitable that both risk owners and most relevant stakeholders were BINGO partners, but that may not be the case. It is important to clarify the way they are involved in BINGO project. Table 3.1 summarises the main steps to identify Risk Owners within WP4 as well as relevant stakeholders.

Table 3.1 – Steps to identify the Risk Owners and relevant Stakeholders of each research site within WP4

STEPS for each research site	
1 – Identify all the intervenient Actors (persons or entities) for each type of event (inundations, droughts; storm surges …). Identify accountabilities - According to the type of problem being addressed one or more entities can have accountabilities over the problem being addressed; and: Decide which of the Actors fall within BINGO scope	
2 – Identify which of those Actors will be addressed in BINGO (either by undertaking risk assessment or by measures being produced)	
3 – Identify which of the intervenient Actors addressed in BINGO will implement a risk approach (doesn't need to be a full one) → Those are the **RISK OWNERS**. The remaining Actors can be considered as **STAKEHOLDERS**, according to risk vocabulary. Note: the Risk Management Process (RMP) is performed by an entity (or person). Different Risk Owners can be placed at different levels of a chain. Each one will perform its own RMP. Identify as many risk owners as necessary.	
4 – Identify the way Risk Owners are involved in BINGO project : i) as partners; ii) other formal involvement; iii) voluntarily, with no formal involvement; iv) other …	

3.2.2 Identification of key Stakeholders

Communication and consultation aims to identify who should be involved in assessment of risk (including identification, analysis and evaluation). It should engage as well those who will be involved in the treatment, monitoring and review of risk (Figure 3.5). It may (ISO 31000:2009):

- help establish the context appropriately;
- ensure that the interests of stakeholders are understood and considered;
- help ensure that risks are adequately identified;
- bring different areas of expertise together for analysing risks;
- ensure that different views are appropriately considered when defining risk criteria;
- secure endorsement and support for a treatment plan;
- enhance appropriate change management during the risk management process; and
- develop an appropriate external and internal communication and consultation plan.

As such, communication and consultation will be reflected in each step of the process. How best to engage and communicate with stakeholders in BINGO is the scope of WP6.

For WP4, the identification of Stakeholders for initial phase of the RMP (communication and consult), aims essentially:

- ➔ **Eliciting risk information** – Who hold the information needed to identify the risks? It is important to identify the range of stakeholders who will assist in making this information complete;
- ➔ Understand their **perception of risk** and what their **objectives** are. As initial step this is particularly relevant to assist on the definition of the objectives to perform risk assessment at each research site (WP4).

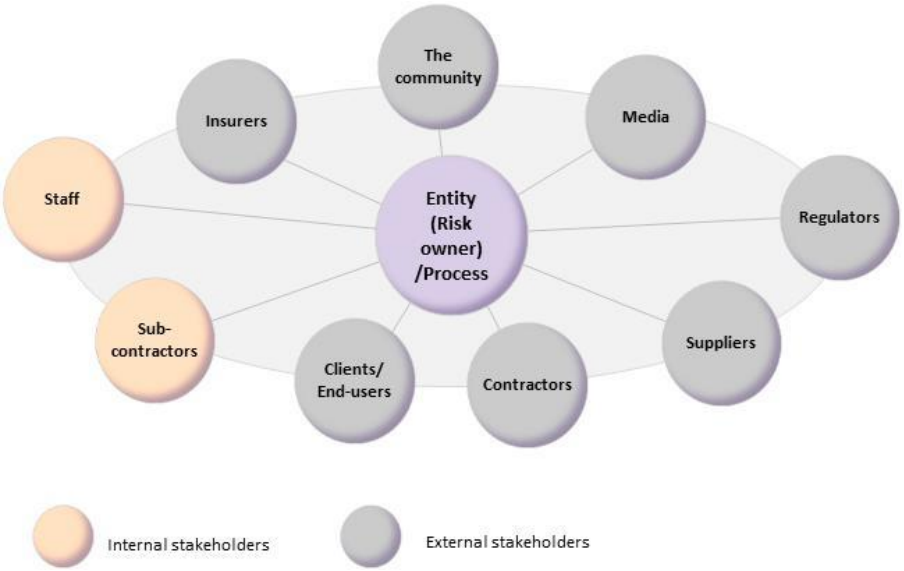


Figure 3.5 – Risk owner and stakeholders (Adapted from Kanona, 2007)

For BINGO_WP4 initial stage the relevant steps are:

1. Identify Stakeholders of the organization (both internal and external)

   Identify the key stakeholders (people or entities) that are affected by the risk owner work, who have influence or power over it their actions, or have an interest in its successful or unsuccessful accomplishment.

   Several studies consider being very useful to grade the stakeholders by their influence and interest. In Stakeholder Analysis and Management Strategy (dsc, 2015) it is suggested to plot their position on a grid (Figure 3.6). When plotting stakeholder's position on the grid, it is also suggested to use colour coding to identify which stakeholders are expected to be blockers or critics, and which are likely to be advocates and supporters or your project. .e.g advocates and supporters in green, blockers and critics in red, and others who are neutral in blue.

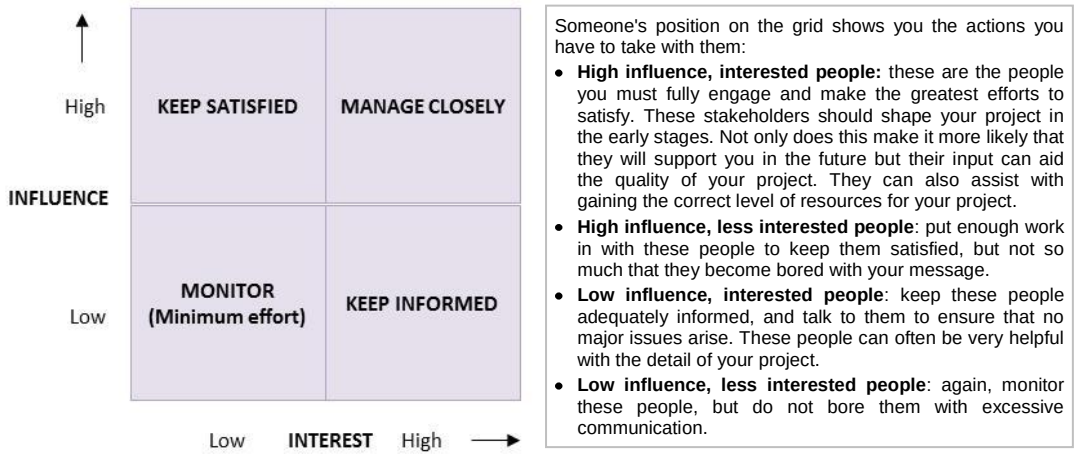


Figure 3.6 – Grid of Stakeholders according to their influence and interest (dsc, 2015)

2. Identify the Stakeholders to be listened/involved in BINGO

   From the above identified universe decide those whose influence or interest are going to be addressed in BINGO. Refer if they are BINGO partners, if they belong to the Advisory Board, to the Community of Practice or if they are not involved at all.

3. Understand the Stakeholders:

   - What is the Stakeholders perception of risk?
   - What are their objectives?

3.2.3 Description of the research site form the WP4 point of view

In order to understand each research site, what is at state in BINGO, and also to allow comparison among them, it is necessary to provide some information regarding the following issues:

- *Geographical location*: situate geographically the research site in Europe, indicating the latitudes and longitudes of an imaginary rectangle containing the site;
- *Climate*: Refer type of climate, mean present annual precipitation, mean monthly temperature;
- *Climate change driver*: Identify the cc driver to be analysed (high/ low precipitation, sea level rise, storm surges, …);
- *Risks to be addressed*: identify which type of risks are going to be analysed in WP4 (associated them with the CC driver - if necessary, refer impacts of past extreme events);
- *Areas of impact*: identify inundation or drought prone areas to be studied…;
- *Elements at risk*: refer special economic sectors being affected; relevant vulnerabilities or other concerns;

- *Physical system characterization*: provide succinctly a description of the system, relevant from the risk assessment point of view:
    - Ex: PT_Sorraia agriculture case study: in the areas prone to droughts describe water sources for irrigation, type of cultures, irrigation practices, protection structures against salt water intrusion …
    - Ex: PT_Castelo do Bode case study for water supply: identify main EPAL water sources and other strategic reserve water sources and describe the main features relevant to the RMP;
- *Risk owners and Stakeholders*:
    - Identify which intervenient entity will implement a risk approach within WP4, as well as the main stakeholders involved in BINGO and how they are linked among them, referring as well if they are governmental, national or regional authorities, if they are private or public sectors (indicate which)…;
    - Refer if the entity that is going to implement a risk approach in WP4 will address risk from the point of view of factors affecting the *probability of an event happening* (ex: reduce probability of inundations) or factors *reducing the impact* (ex: reduce elements at risk or vulnerabilities, etc.) – see equation 2.

And if appropriate to the case study:

- Frame the entity/ process(es) that will be submitted to risk decision within the research site general big picture.

3.3 Framework for Managing the Risk (FMR)

3.3.1 Understanding framework for managing the risk

Risk management is supposed to be a continuous process to support internal changes and decisions as well as respond to external changes. This is only possible if an organization (entity) has embedded risk management in its processes. The Framework for Managing Risk (FMR) sets how an Organization includes risk management within its context. It states the policies, arrangements and organizational structures to implement assist and improve the risk management process (RMP), management as summarised in Table 3.2. The ***design of a framework for managing risk*** of an organization also establishes the way policies (risk management) are linked with risk assessment (science based) and how communication supports these processes (Figure 2.6).

Table 3.2 – What to consider when designing a Framework for Managing Risk (FMR) at an Organization

Design of FMR - Framework for Managing the Risk	
ORGANIZATION 'S CONTEXT	**Understanding of the ORGANIZATION and its Context.**
EXTERNAL Context	External environment in which the **organization** seeks to achieve its objectives. Includes: a) the social and cultural, political, legal, regulatory, financial, technological, economic, natural and competitive environment, whether international, national, regional or local; b) key drivers and trends having impact on the objectives of the organization; and c) relationships with, and perceptions and values of, external stakeholders; …
INTERNAL Context	Internal environment in which the **organization** seeks to achieve its objectives. Includes: – governance, organizational structure, roles and accountabilities; – policies, objectives, and the strategies that are in place to achieve them; – capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, processes, systems and technologies); – information systems, information flows and decision making processes (both formal and informal); – relationships with, and perceptions and values of, internal stakeholders; – the organization's culture; – standards, guidelines and models adopted by the organization; and – the form and extent of contractual relationships; …
RISK MANAGEMENT POLICY	The risk management policy should clearly state the organization's objectives for, and commitment to, risk management: – the organization's rationale for managing risk; – links between the organization's objectives and policies and the risk management policy; – accountabilities and responsibilities for managing risk; – the way in which conflicting interests are dealt with; – commitment to make the necessary resources available to assist those accountable and responsible for managing risk; – the way in which risk management performance will be measured and reported; and – commitment to review and improve the risk management
ACCOUNTABILITY	Assign accountabilities, authority and competence for managing risk at appropriate levels - **identify risk owners that have the accountability and authority to manage risks;** - identify who is accountable for the development, implementation and maintenance of the FMR - identify other responsibilities of people at all levels in the organization for the RMP - establish performance measurement and external and/or internal reporting and escalation processes: - assure appropriate levels of recognition
INTEGRATION INTO ORGANIZATIONAL PROCESSES:	Risk management should be embedded in all the organization's practices and processes in a way that it is relevant, effective and efficient.
RESOURCES	Ensure the necessary resources available to assist those accountable and responsible for managing risk (human, financial, technological, …)
Establishing INTERNAL COMMUNICATION and REPORTING mechanisms	The organization should establish internal communication and reporting mechanisms in order to support and encourage accountability and ownership of risk.
Establishing EXTERNAL COMMUNICATION and REPORTING mechanisms	The **organization** should develop and implement a **plan** as to how it will **communicate with external stakeholders**. This should involve: – engaging appropriate external stakeholders and ensuring an effective exchange of information; – external reporting to comply with legal, regulatory, and governance requirements; – providing feedback and reporting on communication and consultation; – using communication to build confidence in the organization; and – communicating with stakeholders in the event of a crisis or contingency. These mechanisms should, where appropriate, include processes to consolidate risk information from a variety of sources, and may need to consider the sensitivity of the information

3.3.2 How to address the Framework for Managing the Risk at BINGO research sites

It was already noticed (2.1.1) that a risk approach based on ISO 31000:2009 is oriented for an Organization, and needs to be adapted for BINGO project.

Within BINGO, at each research site, it is particularly relevant:

- To know if the research site' Organization responsible for managing risks under study (risk owner) has a risk management framework or not.

  Its existence reveals they have a risk management approach embedded in their procedures, what that can be quite beneficial for BINGO risk assessment implementation. On the other hand, its inexistence will certainly mean that risk owner will require more assistance from BINGO team to perform risk assessment;

- To understand the most relevant issues of the Organization's FMR within BINGO, essentially:
  - *Context* of the Organization (Entity) - The external and internal context of the Organization responsible for dealing with risks under study at the research site. This will not only help to perform risk assessment but also to assist on extrapolating results later on in BINGO;
  - *Accountability* - Governance over the risk management process at the research site must be clearly identified.
  - *Communication and consult* plan of the Organization – How to communicate and consult will be reflected in each step of the RMP. The organization's communication plan, if existent, can be boosted in BINGO. How communication is going to be put in practice in the project falls within the scope of WP6, nevertheless it is the job of WP4 to identify the issues to be communicated or consulted.

The Organization external and internal context will be addressed in the sub-chapter 3.4.2.

3.4 Establishment of the Context for the RMP

3.4.1 Relevance of the Context

Before beginning a risk identification exercise, it is important to define the limits, objectives and scope of the activity or issue under examination. The context concerns what is needed to be taken into account and the objectives.

The context is established in three stages: **external context; internal context** and **context for risk management process.** Table 3.3 helps to understand each concept and what each one involves.

Table 3.3 – Three stages of the Context

CONTEXT	Understanding the concept:	Involves:
1 - EXTERNAL Context of the Organization (Risk Owner) ➔ **Organization oriented** *It is part of the risk management framework (FMR)*	(ISO Guide 73:2009, definition nº 3.3.1.1) External environment in which the organization seeks to achieve its objectives. Concerns the crucial elements which might support or impair its ability to manage the risks associated with its operation	Can include, but is no limited to: - the cultural, social, political, legal, regulatory, financial, technological, economic, natural and competitive environment, whether international, national, regional or local; - key drivers and trends having impact on the objectives of the organization; and - relationships with, and perceptions and values of external stakeholders.
2 - INTERNAL Context of the Organization (Risk Owner) ➔ **Organization oriented** *It is part of the risk management framework (FMR)*	(ISO Guide 73:2009, definition nº 3.3.1.2) Internal environment in which the organization seeks to achieve its objectives. The purpose of this stage is to develop an understanding of the organization and its capabilities, as well as its goals and objectives and the strategies that are in place to achieve them.	Can include, but is no limited to: - governance, organizational structure, roles and accountabilities; - policies, objectives, and the strategies that are in place to achieve them; - the capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, processes, systems and technologies); - information systems, information flows and decision-making processes (both formal and informal); - relationships with, and perceptions and values of, internal stakeholders; - the organization's culture; - standards, guidelines and models adopted by the organization; and - form and extent of contractual relationships.
3 - Context for the RISK MANAGEMENT PROCESS ➔ **Activity/ Process … oriented** *It is related to particular process, activity … that will be the object of the RMP (risk management process)*	Concerns what needs to be taken into account **when managing risk**: - Objectives, scope, responsibilities, methods - Risk criteria: measures, tolerance levels, views of stakeholders	- articulates **goals** and **objectives** of the risk management activities; - defines the **external** and **internal** parameters to be taken into account when managing risk (*external and internal context for the RMP*); - sets the **scope** and **risk criteria** for the remaining process. - **Structure of analysis** While many of these parameters are similar to those considered in the design of the risk management framework (see 3.3.1), but when **establishing the context for the risk management process**, they need to be **considered in greater detail and particularly how they relate to the scope of the particular risk management process.**

The establishment of the context for the risk management process influences directly the formulation of the problem (scope) as well as the structure of risk analysis and risk evaluation (Figure 3.7). In fact,

it determines the success of the process (Figure 3.8). Unsatisfactory results on risks evaluation may require the reformulation of the context.

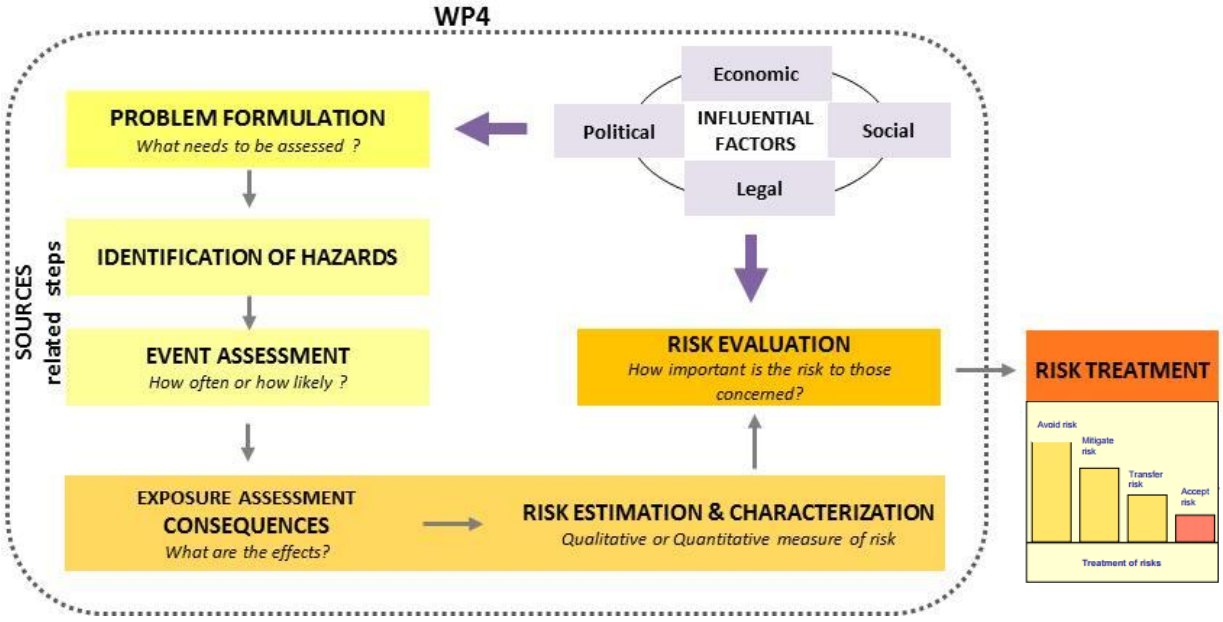


Figure 3.7 – Impact of context establishment on RMP (Adapted from Csaba and Nikolett, 2008 and Heinz, 2010)

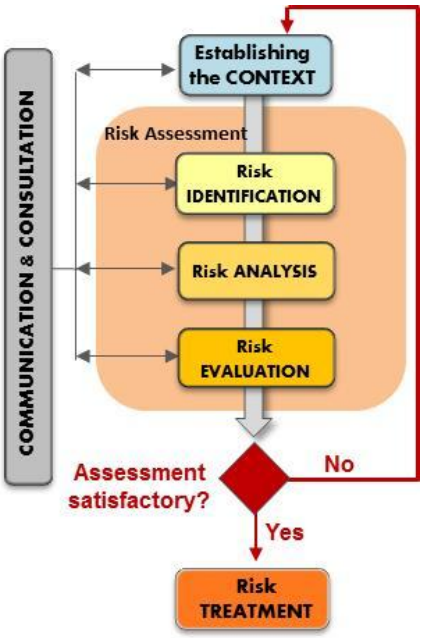


Figure 3.8 – Reformulation of context in case of unsatisfactory risk assessment

3.4.2 Tips and methodologies to establish the context for the risk management activities in BINGO

3.4.2.1 Define the External context

Understanding the external context

The external context defines the external environment in which the organization seeks to achieve its objectives. Understanding the external context is important in order to ensure that the objectives and concerns of external stakeholders are considered when developing risk criteria. It is based on the organization-wide context, but with specific details of legal and regulatory requirements, stakeholder perceptions and other aspects of risks specific to the scope of the risk management process (Table 3.3).

The external context is established in two levels:

- External context of the organization (risk owner), as part of the framework for managing the risk (FMR);
- External context for the risk management process (RMP).

Between both (1st Context of the organization (FMR) → 2nd Context for RMP) vary:

- Scope;
- level of detail;
- Context for FMR is more comprehensive, is organization oriented (risk owner);
- Context for RMP is process oriented.

Tips to define the external context at BINGO research sites

- Be as **synthetic** and focused as possible;
- **Merge Context of the risk owner (FMR) with the Context for RMP as much as possible**: In order to implement BINGO in a practical way, define the external context of the risk owner at your research site already oriented to the scope of the risk management process addressed in BINGO.

  Justification: As already stated, BINGO risk framework is based on ISO 31000:2009, undertaking risk assessment to assist adaptation strategies development for each research site and further extrapolation for Europe. Nevertheless, it is clear that BINGO doesn't provide the adequate frame for a full ISO implementation. Therefore, within BINGO it may not be possible or suitable to establish a full external context of the risk owner entity, because their field of action may be broad or because they may not be totally committed to the project.

- **External environment** (international, national, regional or local): Use **PESTLE analysis** to structure the information and allow for comparison. See Figure 3.9 and Table 3.4. An analysis of these factors may also identify the strengths, weaknesses, opportunities and

threats to the field of action of the entity in the external environment. A **SWOT analysis** can be applied, if considered relevant (Figure 3.10).

Figure 3.9 – PESTLE analysis for external context definition (Sources: FME, 2013 and Manek, 2016)

POLITICAL - What are the key political drivers of relevance?

Worldwide, European and Government directives, funding council policies, national and local organizations' requirements, institutional policy.

ECONOMIC - What are the important economic factors?

Funding mechanisms and streams, business and enterprise directives, internal funding models, budgetary restrictions, income generation targets.

SOCIAL - What are the main societal and cultural aspects?

Societal attitudes to education, particularly in relation to government directives and employment opportunities. Also general lifestyle changes, changes in populations, distributions and demographics and the impact of different mixes of cultures.

TECHNOLOGICAL - What are current technology imperatives, changes and innovations?

Major current and emerging technologies of relevance for teaching, research or administration.

LEGAL - Current and impending legislation affecting the role

European and national proposed and passed legislation.

ENVIRONMENTAL - What are the environmental considerations, locally and further afield?

Local, national and international environmental impacts, outcomes of political and social factors.

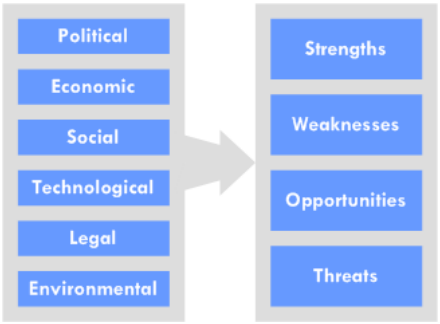
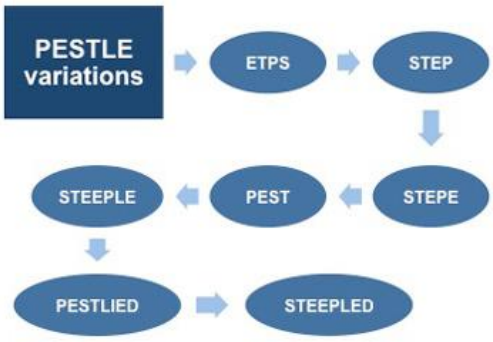


Figure 3.10 – PESTLE and SWOT analysis (Source: Jisc, 2016)

For some BINGO case studies a variation of PESTLE may be suitable. The most common variations are shown in the diagram of Figure 3.11. The important thing to note is that these are all just variations of the one analysis tool; the underlying method is the same in all cases.



ETPS - Economic, Technical, Political, and Social

STEP - Strategic Trend Evaluation Process

STEPE - Social, Technological, Economic, Political, and Ecological

PEST - Political, Economic, Social, and Technological

STEEPLE - Social, Technological, Economic, Ethical, Political, Legal, and Environmental

PESTLIED - Political, Economic, Social, Technological, Legal, International, Environmental, and Demographic

STEEPLED - Social, Technological, Economic, Environmental, Political, Legal, Educational, and Demographic

Figure 3.11 – PESTLE analysis variations (Source: FME, 2013)

- **Key drivers and trends having impact on the objectives of the organization:** Climate changes are key drivers that can have direct impact over the risk owner or impact on some clients/ stakeholders that changes the way they relate with risk owner. Identify trends that can affect your risk assessment;
- **Relationships with, and perceptions and values of external stakeholders:**
  - Understand external stakeholders accountabilities;
  - Understand external stakeholders perceptions of risk;
  - Understand external stakeholder objectives.

For BINGO definition of the context of the organization managing the risk will allow understanding of the European and national research sites contexts for CC adaptation.

It will allow distinguishing among technical, political and other constraining issues, as well as allowing comparison among Member-States, detecting the main similarities and differences that will need to be taken in account in adaptation strategies development and later extrapolation.

3.4.2.2 Define the Internal context

Understanding the internal context

Internal context is anything within the organization that can influence the way in which an organization will manage risk. The purpose of this stage is to develop an understanding of the organization and its capabilities, as well as its goals and objectives and the strategies that are in place to achieve them.

As with the external context the internal context is established in two levels: 1st Context of the organization → 2nd Context for RMP, varying the scope, level of detail, being the later oriented for the RMP.

Tips to define the internal context at BINGO research sites

- Be synthetic and focused;
- Merge Context of the risk owner (FMR) with the Context for RMP as far as possible;
- Determine the significance of the activity in achieving the organization's goals and objectives;
- Identify internal stakeholders and their accountabilities;
- Decide on the **depth and breadth** of risk assessment and allocate resources accordingly (3.4.2.3.2). It might not be necessary a full entity resources description;
- Use Table 3.5 to establish the internal context, but bear in mind to focus it to the RMP

Table 3.4 – PESTLE analysis for establishing the External Context

Research Site (RS): _____
Risk Owner: _____
SECTOR (of risk owner): _____
SCOPE of RMP: _____

	Some explanation	Key questions (types of questions we should ask)	Factors here might include:
POLITICAL	These are the aspects of the political environment in which you operate, which have the potential to impact on your plans.	***• What are the key political factors?***	--> Government type and policies --> Funding, grants and initiatives These might include political stability, Worldwide, European and Government Directives, national and local organization's requirements, institutional policy, tax policy, trade restrictions and reform.)
ECONOMIC	These are factors relating to the local, national or global economy	***• What are the important economic factors?***	--> Funding mechanisms --> Labour and energy costs ? --> Liability --> Inflation and interest rates ? (Funding mechanisms/streams; business/enterprise directives, internal funding models, budgetary restrictions, income generation targets; liability costs, s growth/decline, interest rates, exchange and inflation rates, credit availability, unemployment rate, cost of living.)
SOCIOLOGICAL	Consider what is occurring socially in the "markets" in which you currently operate or plan to operate.	***What are the important sociological factors?***	--> Population, education, media --> Lifestyle, fashion, culture (General lifestyle changes, demographic trends, population distribution, migrations, age distribution, education, cultural norms, fashions and trends and social expectations …)
TECHNOLOGICAL	The rate of change in new technologies is increasing.	***• What technological innovations are likely to occur?***	--> Emerging technologies; WEB, .. --> Information & Communication (Major current and emergency technologies of relevance for the sector/ goals, for instance, rapid developments in mobile phone technology and greater use of social networking sites may impact on your products and services)
LEGAL	These could be things like changes in legislation relevant to the sector/ company. What legal structures must your company operate within? Are there compliance requirements?	***• What current and impending legislation may affect the sector?***	--> Regulations and standard --> Other binding laws (Employment law?, ..) (Worldwide and national proposed and passed legislation, aspects relating imports/exports, taxation, access to materials, quotas, professional practice, …,)
ENVIRONMENTAL	This refers to what is happening with respect to ecological and environmental issues. Some of the environmental factors, however, may also be economic or social in nature.	***• What are the environmental considerations?***	--> Climate, weather --> Pollution, --> Ethical issues (Local, national and international environmental impacts, outcomes of political and social factors)

Table 3.5 – Establishment of the internal context

Research Site (RS): _____
Risk Owner: _____
SECTOR (of risk owner): _____
SCOPE of RMP: _____

	Some explanation	**Key questions (types of questions we should ask)**	**Might include:**
GOVERNANCE & INTERNAL STAKEHOLDERS	Intend to identify the decision chain and services structure, and identify the person or sectors within the organization crucial for assisting in information gathering and risk management	What are the relevant Organization's Governance issues?	--> Decision chain within the organization --> Services structure, person or staff groups crucial for assisting in information gathering and risk management
GOALS & OBJECTIVES	Intend to articulate the organizational **objectives** and planned **results** of the end user activity	What are the objectives and specific goals?	--> Clear objectives identification --> Determine the significance of the activity in achieving the organization's goals and objectives --> What metrics could be used to define success or failure of the activity/objectives?
STRATEGIES	Identify strategies that are in place to achieve the goals/ objectives	What are the **strategies** that are already in place to achieve the organizational objectives?	a. Strategies that are successful; b. Strategies that are not (so) successful c. Strategies that are planned for the future
RESOURCES	Description of **resources available to the risk owner** (that are needed to support the organizational objectives) *(Such as, staff; information sources; funding; infrastructures; technologies; equipment…);* Decide on the **depth and breadth** of analysis and allocate resources accordingly.	What capabilities does the organization have in terms of people, systems, processes, equipment and other resources to achieve the objectives?	--> staff; --> existing Risk Management expertise and practices --> information sources; --> funding; --> infrastructures; --> technologies; --> equipment…
INTERNAL CULTURE	Intends to identify inside organization resistance to adaptation	Is there an internal culture that needs to be considered?	--> Is there staff resistant to change? / professional culture that might create unnecessary risks ?

3.4.2.3 Context for the RMP

3.4.2.3.1 General

Before beginning a risk identification exercise, it is important to define the limits, objectives and scope of the activity or issue under examination.

The **context of the risk assessment** process will vary according to the needs of an organization. It can involve, but is not limited to:

- define the ***goals and objectives*** of the risk management activities;
- define the **external** and **interna**l parameters to be taken into account when managing risk (*external and internal context for the RM).* For example, *legislation, regulations, policies, standards and operating procedures that need to be complied with;* views of stakeholders; *responsibilities* for and within the risk management process; etc.
- defining the ***scope,*** as well as the ***depth and breadth*** of the risk management activities to be carried out, including specific inclusions and exclusions;
- defining the *activity, process, function, project, product, service or asset in* ***terms of time and location*****;**
- defining the ***risk assessment methodologies***: risk criteria (measures, tolerance levels,) and risk analysis

It is also useful in the context for the RMP :

- Decide what the output of the process will be (last purpose), e.g. a risk assessment, safety analysis or a board presentation. The output will determine the most appropriate structure and type of documentation.

Tips for the establishment of the external and internal context were already provided in the former sub-chapters. Tips for the remaining topics will be provided now.

3.4.2.3.2 Extent of RMP development at each research site

For the time being ***depth and breadth*** of the risk management activities will be seen at BINGO project as the extent of implementation of the risk management process.

Decide what the last purpose of analysis (output of the process) will be, e.g. a risk assessment, safety analysis, management plan or any other option.

For WP4 implementation, it is necessary to clearly identify the extent of RMP development at each BINGO research site and particularly, how far risk assessment will be performed (how many steps will be carried out).

In fact, although all research sites contribute to CC adaptation strategies definition, not all of them will go through a complete RMP, which is structured and oriented for an organization or an economic

sector. Some case studies will not even go through a partial or full risk assessment process. This distinction is relevant in order to distinguish how to address them in WP4.

Several possibilities can take place regarding the extent of RMP development at each BINGO research site (Figure 3.12):

i. Case studies where the main objective is to increase the scientific knowledge, for example the study of evapotranspiration effect in water availability;

ii. Case studies where the main objective is to produce a knowledge for latter decision making, as for example the identification of the elements at risk under some CC scenarios; in this case research site does not go through a RMP;

iii. systems where the objective is to perform the three steps of CC risk assessment (risk identification, analysis and evaluation) and, in some cases, to provide a list of CC adaptation measures, but do not persecute an economic validation analysis for risk treatment;

iv. systems that will go through a full risk assessment treatment processes, developing risk based climate-change challenges adaptation measures and strategies, oriented either to the governmental level (legislation, for example), or to the river basin district level (structural, such as dams, dykes, etc., and non-structural solutions, such as water safety plans, land-use alterations, reservoir management, flood emergency plans, warning systems etc.) or even to private sectorial level (ex: agriculture CC adaptation).

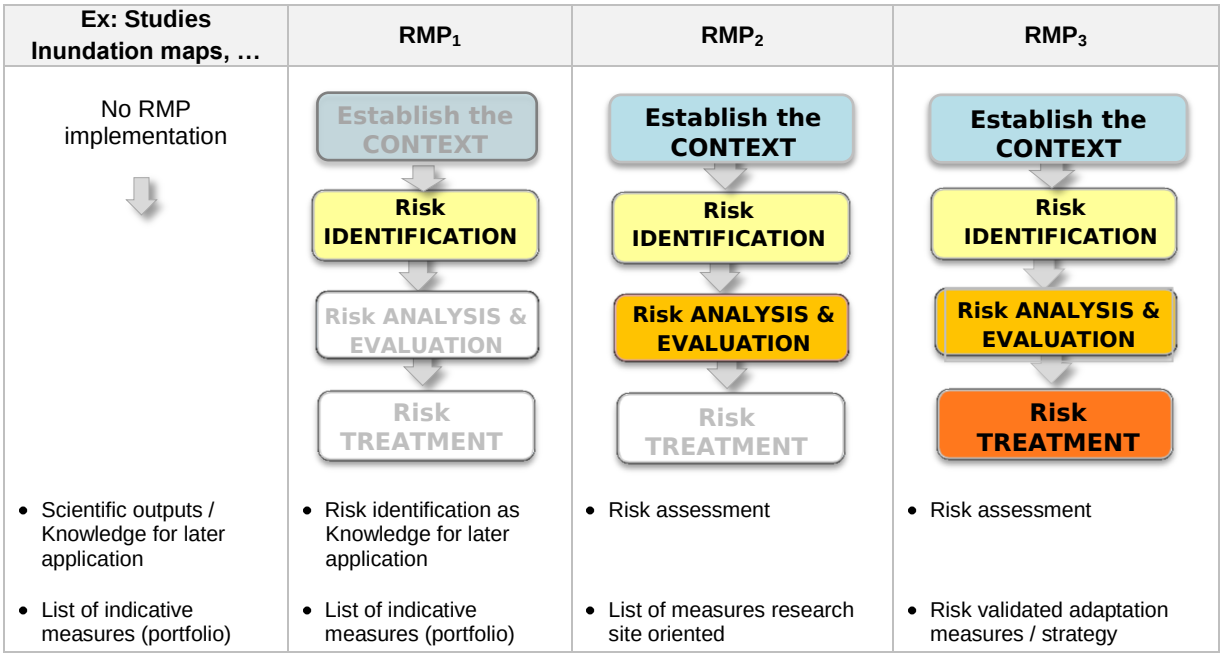


Figure 3.12 – Possibilities of extent of RMP implementation at research sites

Finally, decide what the output of the process will be, e.g. a risk assessment, safety analysis, management plan or any other option.

3.4.2.3.3 Goals and objectives of the risk management activities

***Understand objectives** of the risk management activities*

Risks can impact an organisation in the short, medium and long term. These risks are related to operations, tactics and strategy, respectively. *Strategy* sets out the long-term aims of the organisation, and the strategic planning horizon for an organisation will typically be 3, 5 or more years. *Tactics* define how an organisation intends to achieve change. Therefore, tactical risks are typically associated with projects, mergers, acquisitions and product developments. *Operations* are the routine activities of the organisation (ISO, 2009a).

The articulation of the objectives of an organization risk management policy integrates the Framework for Managing the risk (FMR).

For performing a risk management process (RMP) the organization *objectives* can be broad (e.g. *strategic, operational or compliance)* or can be narrow relating to a product, process, or function (e.g. supply chain, new product sales, or regulatory compliance). Likewise, *possible risks* may span many categories or only a few if the discussion is more narrowly focused (ISO, 2009a). Articulation of the **organization's goals and objectives for the RMP** is essential for the process.

Some examples of frequently performed risk assessments are: the already referred *strategic*; *operational*; *compliance*; or others as *internal audit*; *financial statement*; *fraud*; *market*; *credit; customer*; *supply chain*; *product; security*; *information technology*; *project* risk assessment (ISO, 2009a)..

Risk assessment is intended to provide management with a view of **events** that could **impact** the achievement of those **objectives**. Understanding both the nature of the **organization's objectives** and the **types of possible risks** under consideration is key to determining the scope of the risk assessment and, afterwards, to perform risk assessment.

Based on the organization's objectives, the designated owners of the risk assessment should develop a preliminary inventory of events that could impact the achievement of the organization's objectives. "Events" refers to prior and potential incidents occurring within or outside the organization that can have an effect, either positive or negative, upon the achievement of the organization's stated objectives or the implementation of its strategy and objectives.

Various taxonomies or libraries of common event types or, alternatively, risk types can help initiate the identification process (ISO, 2009a). An example is provided in Figure 3.13.

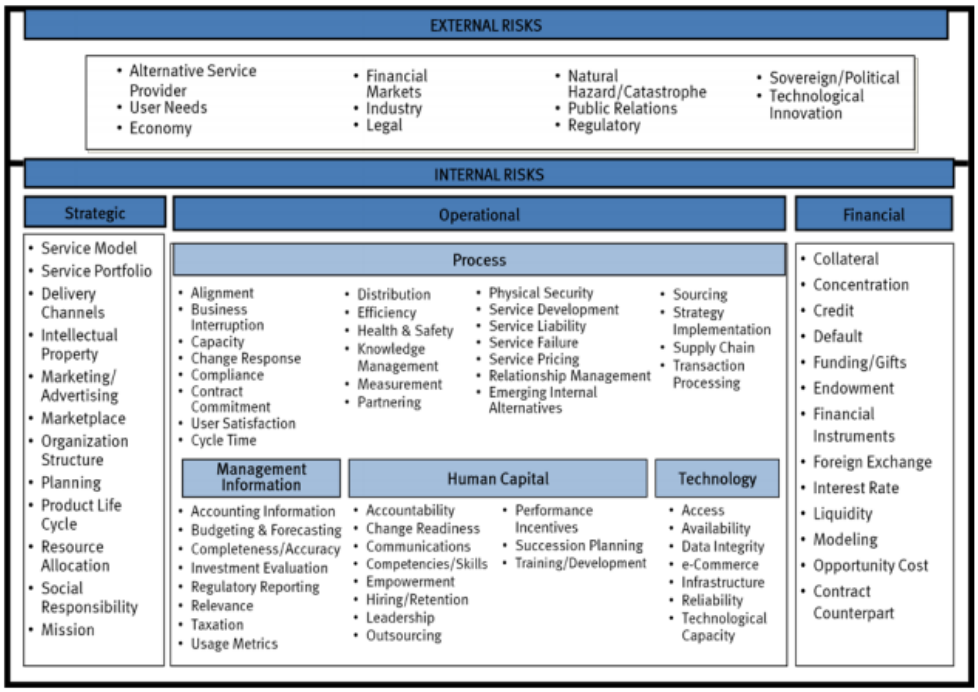


Figure 3.13 – Example of library of types of external and internal risks affecting an organization's objectives (Michalko; Malpas; Arcolio., 2010)

Tips for BINGO implementation

1 –Objectives of the organization for the RMP

The articulation of the objectives of an organization risk management policy integrates the Framework for Managing the risk (FMR). In BINGO, risk owners may or may not have already designed a FMR. It could be useful and efficient to start by identifying the entity objectives of risk management policy, if existent.

State and articulate clear objectives of the activity, task or function that will undertake a risk management approach in BINGO. Assure that:

- the activity, task or function is appropriate for the organization's mission;
- the objectives are aligned with objectives of the risk management policy, if existent;
- the objectives are adequate for the depth and breadth of analysis that you intend to develop;
- the organization has the resources and the skills to create and manage it.

2. Identify events that could affect the achievement of objectives

From all the events that could impact the achievement of the organization's objectives, within BINGO "events" refers to potential incidents associated with climate change induced extreme events (incidents occurring outside the organization), that can have an effect, either positive or negative, upon the achievement of the organization's stated objectives or the implementation of its strategy and objectives. Examples: droughts, inundations; sea level rise; storm surges.

3.4.2.3.4 Scope of the RMP

Understanding the Scope and its Specific objectives

Defining the scope corresponds to defining the activity, process, function, project, product, service or asset in terms of time and location. It is the primary aim of the risk owner.

The scope may be organization-wide or limited to an organization unit or business unit or a particular geographical area. The scope of the particular risk assessment that management chooses to perform depends upon priorities and objectives of the risk owner.

The objectives and events under consideration determine the scope of the risk assessment to be undertaken.

The scope of risk management addresses the parts of the organizations (activities, processes, functions, projects, products, services or assets) where the risk management process will be applied.

Risk assessment begins and ends with specific objectives. Risks are identified and measured in relation to an organization's objectives or, more specifically, to the objectives in scope for the risk assessment (ISO, 2009a).

For the scope, defining **objectives that are specific and measurable** at various levels of the organization is crucial to a successful risk assessment. Evaluating the risks relative to such objectives facilitates the reallocation of resources as necessary to manage these risks and best achieve stated objectives.

Scope and specific objectives and criteria for risk evaluation need to be aligned between them to allow completion of risk assessment (Figure 3.8).

PREPARED Project (Almeida; Vieira; Smeets, 20103) provides some examples of scopes for water utilities. Overall, guidance and other stakeholders included in the ISO and EN standards (ISO 24511:2007; ISO, 2007a, ISO 24512:2007; ISO 2007b and EN 752:2008; CEN, 2008) cover aspects such as:

- protection of public health;
- safeguard public safety;
- protection of surface and groundwater;
- sustainable use of resources (water, energy, etc.);
- continuity of service;
- fulfil needs and expectations of consumers and other users;
- sustainability of the service.

Many others can be considered according to the type of entity.

Tips for setting the Scope and its Specific objectives within BINGO

When setting the scope and its specific objectives remember that you are within BINGO project. Set scopes at your research site aligned with BINGO objectives and framework as well as aligned with risk owner's objectives:

- Isolate the categories of risk that you want to manage (*related to extreme climatic events to stay within BINGO);*
- **Define the activity, process, function, project, product, service or asset that the risk owner wants to manage**. Define it in terms of time and location;
- Take into consideration the depth and breadth of the risk management activities to be carried out (extent of risk assessment/ management being undertaken) and the resources available to accomplish it (*think of the risk owner's resources but also the research site BINGO team's resources*);
- Take in consideration stakeholder's objectives and perceptions of risk (in case of several existing attend to stakeholders analysis (3.2.2);
- Set the **scope** according to all referred above and define **its specific objectives**, assuring they are mensurable, either qualitatively or quantitatively. Remember that these objectives will guide all the remaining RMP;
- Set the specific objectives of the scope simultaneously with risk criteria definition (3.4.2.3.5), to assure successful accomplishment of risk assessment.

3.4.2.3.5 Risk criteria

Understanding risk criteria

Risk criteria are the terms of reference against which the *significance of a risk is evaluated*. Risk criteria allow risk owner to clearly define unacceptable levels of risk. Conversely, risk criteria may include the acceptable level of risk for a *specific activity or event*.

The criteria should reflect the organization's values, objectives and resources and should be consistent with the organization's risk management policy be defined at the beginning of any risk management process and be continually reviewed.

Some criteria can be imposed by, or derived from, legal and regulatory requirements and other requirements to which the organization subscribes.

When defining risk criteria, factors to be considered should include the following (ISO Guide 73:2009, definition 3.3.1.3):

- structure of the risk analysis:
  - the nature and types of causes and consequences that can occur and how they will be measured;
  - how likelihood will be defined;

- the timeframe(s) of the likelihood and/or consequence(s);
- how the level of risk is to be determined;

- the views of the stakeholders;
- the level at which risk becomes acceptable or tolerable; and
- whether combinations of multiple risks should be taken into account and, if so, how and which combinations should be considered.

Tips for defining risk criteria

Risk criteria establish measures of risk significance; tolerance levels and views of stakeholders.

- Decide or define the acceptable level of risk for each activity;
- Determine what is unacceptable;
- Clearly identify who is responsible for accepting risk and at what level.

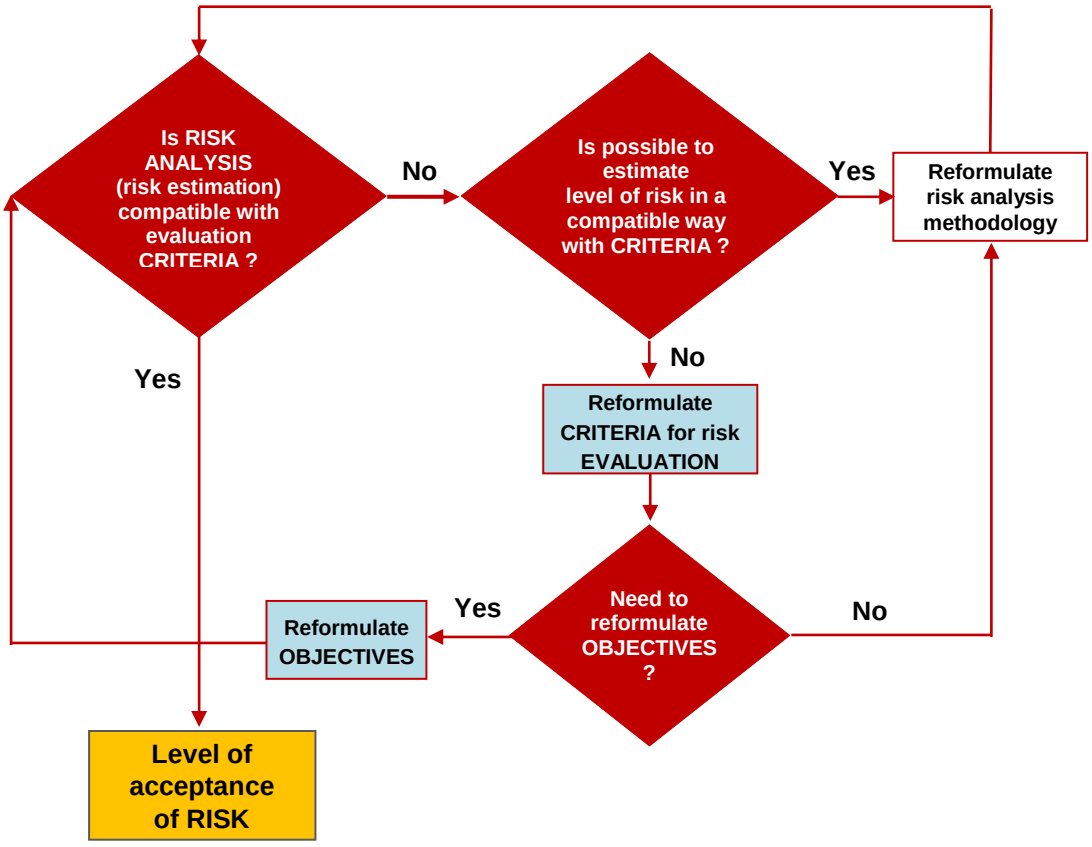


Figure 3.14 – Steps to perform in case risk assessment cannot be achieved

When doing so, remember:

- Do not define risk criteria that are not aligned with organization values and RMP objectives and context (external and internal);
- Define risk criteria simultaneously with scope's specific objectives;
- Align with the structure of risk analysis - for instance, do not provide qualitative levels of risk (risk analysis) and then have quantitative evaluation criteria (risk criteria) – see Figure 3.14;
- Risk criteria can be derived from standards, laws, policies and other requirements;
- At the initial step the risk criteria may be broadly defined and then further refined later in the risk management process.

If risk criteria are not aligned with the scope and risk analysis structure it will not be possible to achieve the level of acceptance of risks (Figure 3.14).

3.4.2.3.6 Risk analysis methods

Risk analysis can be undertaken with varying degrees of detail, depending on the risk, the purpose of the analysis (and the decision-making needs of the organization), and the information, data and resources available (ISO, 2009b).

At 1st stage the **structure** of risk analysis needs to be defined. The 2nd stage requires setting the **methods** for risk analysis.

Tips to define structure of risk analysis:

- Isolate the categories of risk that you want to manage. This will provide greater depth and accuracy in identifying significant risks;
- Identification of the output of the process (last purpose) also contribute to determine the most appropriate structure and type of documentation for the research site;
- The chosen structure for risk analysis will depend upon the type of activity or issue, its complexity and the context of the risks.

Qualitative, semi-quantitative and quantitative **methods** can be used, as well as or a combination of these, depending on the circumstances, as referred in ISO 31010:2009 (ISO, 2009c):

- **Qualitative** assessment defines consequence, probability and level of risk by significance levels such as "high", "medium" and "low", may combine consequence and probability, and evaluates the resultant level of risk against qualitative criteria. Figure 3.15 illustrates qualitative assessment.

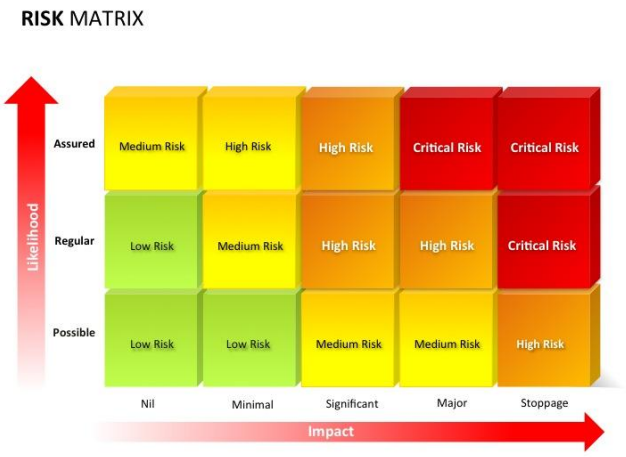


Figure 3.15 – Example of qualitative risk matrix

- **Semi-quantitative** methods use numerical rating scales for consequence and probability and combine them to produce a level of risk using a formula. Scales may be linear or logarithmic, or have some other relationship; formulae used can also vary. Figure 3.16 illustrates this case.

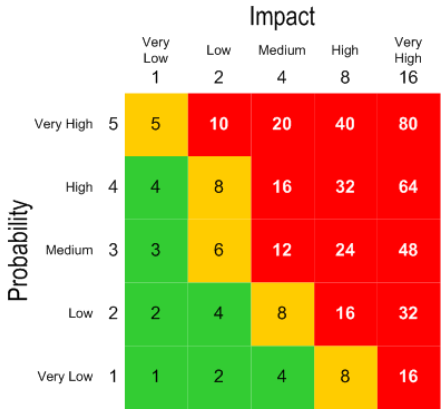


Figure 3.16 – Example of semi-quantitative risk matrix

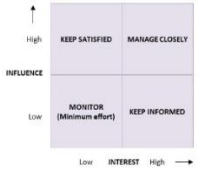
- **Quantitative analysis** estimates practical values for consequences and their probabilities, and produces values of the level of risk in specific units defined when developing the context. Full quantitative analysis may not always be possible or desirable due to insufficient information about the system or activity being analysed, lack of data, influence of human factors, etc. or because the effort of quantitative analysis is not warranted or required. In such circumstances, a comparative semi-quantitative or qualitative ranking of risks by specialists, knowledgeable in their respective field, may still be effective.

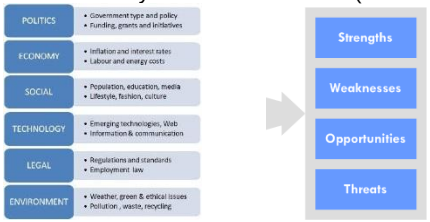
The ***methods*** to analyse the risks can only be decided after the former steps of the context definition are accomplished and the risk analysis structure defined.

Guidance oriented to perform risk analysis and risk evaluation at the research sites case studies may be produced, to help implementing BINGO WP4.3 (Risk analysis and evaluation).

4 | Synthesis - List of steps to perform in WP4

Table 4.1 – List of steps to perform in WP4

	STEP	Guidelines chapter	What to do	BINGO output
BINGO FRAMEWORK:				
	Understand how BINGO Risk Framework will be integrated into BINGO CC Adaptation WP5 → WP4	2.2	- How to integrate risk management into CC adaptation strategy definition in BINGO (WP5) - How to integrate results from Knowledge/ Science and Risk Assessment in WP5	
	Set BINGO common language (vocabulary) and Agree on risk definition	2.1.3	- BINGO Glossary - $r = p \times c \Leftrightarrow r = p \times c$ (f (exposure, susceptibility, resilience))	
OVERSIGHT AND ACCOUNTABILITIES :				
	Identify risk owners	3.2.1	- Identify risk owners - Identify accountabilities	
	Identify the **Stakeholders** Assemble BINGO team	3.2.2	 - Identify external and internal stakeholders ; - Perform a stakeholders analysis (*if adequate for the research site*)  - Assemble team (risk owners, scientific partners & stakeholders) adjusted for the purpose of study in BINGO - Identify their accountabilities	**D4.1 REPORT**
	Understand the research site	3.2.3	- Description of the research site (D4.1) from the risk point of view	

CONTEXT for the risk management process:				
	Establish the **External context** for the risk management process From the Organization (risk owner) to the Process (FMR → RMP)	3.4.1 3.4.2.1	- PESTLE Analysis & SWOT (if considered necessary) 	**WP 4.1 REPORT**
			- key drivers and trends having impact on the objectives of the organization: o CC drivers; o "Costumers trends"; o Others.	
			- Relationships with, and perceptions and values of external stakeholders: o Understand external stakeholders perceptions of risk; o Understand external stakeholder objectives.	
	Establish the **Internal context** for the risk management process From the Organization (risk owner) to the Process (FMR → RMP)	3.4.2.2	- Relationships with, and perceptions of internal stakeholders: o Understand external stakeholders perceptions of risk; o Understand external stakeholder objectives.	
			- Governance & Internal Stakeholders - Goals & Objectives - Strategies - Resources - Internal culture	
	Extent of RMP development at each research site *(adapted from depth and breadth)*	3.4.2.3.2		
	Define **Objectives and goals** of the RMP	3.4.2.3.3	- Define the Objectives to address in BINGO	
	Identify **events** or **types of possible risks** that can affect achievement of the objectives	3.4.2.3.3	- Define events or type of risk to address within BINGO objectives	
	Define the **Scope** of the RMP Define Scope's **Specific objectives**	3.4.2.3.4	- Define the activity, process, function, project, product, service or asset that the risk owner wants to manage. Define it in terms of time and location - Define specific objectives that are mensurable	

	Define **Risk criteria**	3.4.2.3.5	- Decide or define the acceptable level of risk for each activity; - Determine what is unacceptable; - Clearly identify who is responsible for accepting risk and at what level.	**WP 4.1 REPORT**
	Define **Risk analysis structure and methods**	3.4.2.3.6	- At 1st stage: Define **structure** of risk analysis - At 2nd stage: Set **methods** for risk analysis	
RISK IDENTIFICATION				
	- *identify of **risk sources**,* - ***events,*** - *their **causes** and their **potential consequences**.*			**WP 4.2 REPORT**
RISK ANALYSIS				
	- Assess Likelihood - Assess Consequences - Estimate Level of risk			
RISK EVALUATION				
	- Compare magnitude of risks against risk criteria evaluation/RS			**WP 4.3 REPORT**
	- Rank risks within the RS			
	- Check harmonization among Research sites (risk evaluation and ranking) and discuss discrepancies with RS teams			

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APPROVED

Head of Water Resources and Hydraulic Structures Unit

Teresa Viseu

AUTHOR

Fernanda Rocha

Assistant Researcher

Head of Hydraulic and Environment Department

Helena Alegre

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ANNEX
BINGO Risk vocabulary

BINGO RISK GLOSSARY: Terms and Definitions

NOTES:

1 - The basis of this GLOSSARY is ISO Guide 73:2009.

2 – Some terms and definitions were added. So far (24-sep-2015) their origin is the PREPARED Project

3 – The column CLARIFICATION intends to develop further clarification to the definitions, always doubts arise.

The International Standard (ISO 31000:2009) can be applied to any type of risk, whatever its nature, whether having positive or negative consequences. The International Standard (ISO 31000:2009) can be applied throughout the life of an organization, and to a wide range of activities, including strategies and decisions, operations, processes, functions, projects, products, services and assets.

SOURCE: ISO Guide 73:2009, definition nº	OTHER SOURCES	Terms	Definitions	CLARIFICATION
			1. RISK	
1.1		**RISK**	Effect of uncertainty on objectives. NOTE 1 An effect is a deviation from the expected — positive and/or negative. NOTE 2 Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process). NOTE 3 Risk is often characterized by reference to potential events and consequences, or a combination of these. NOTE 4 Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence. NOTE 5 Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood.	

		2. RISK MANAGEMENT		
2.1		**RISK MANAGEMENT**	Coordinated activities to direct and control an organization with regard to **risk.**	
2.1.1		**Risk management framework**	Set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving **risk management** throughout the organization. NOTE 1 The foundations include the policy, objectives, mandate and commitment to manage risk NOTE 2 The *organizational arrangements* include plans, relationships, accountabilities, resources, processes and activities. NOTE 3 The risk management framework is embedded within the organization's overall strategic and operational policies and practices.	
2.1.2		**Risk management policy**	Statement of the overall intentions and direction of an organization related to **risk management.**	
2.1.3		**Risk management plan**	Scheme within the **risk management framework** specifying the approach, the management components and resources to be applied to the **management of risk.** NOTE 1 Management components typically include procedures, practices, assignment of responsibilities, sequence and timing of activities. NOTE 2 The risk management plan can be applied to a particular product, process and project, and part or whole of the organization.	
		3. RISK MANAGEMENT PROCESS		
3.1		**RISK MANAGEMENT PROCESS**	Systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analysing, evaluating, treating, monitoring and reviewing risk.	
	PREPARED Project	**Scope**	Primary aim. Example: Protection of public health; Protection of public safety; Protection of environment; Protection of economic activities	

3.2			**Communication and consultation**	
3.2.1		**Communication and consultation**	Continual and iterative processes that an organization conducts to provide, share or obtain information and to engage in dialogue with **stakeholders** regarding the management of **risk** . NOTE 1 The information can relate to the existence, nature, form, likelihood, significance, evaluation, acceptability and treatment of the management of risk. NOTE 2 Consultation is a two-way process of informed communication between an organization and its stakeholders on an issue prior to making a decision or determining a direction on that issue. Consultation is: - a process which impacts on a decision through influence rather than power; and - an input to decision making, not joint decision making.	
3.2.1.1		**Stakeholder**	Person or organization that can affect, be affected by, or perceive themselves to be affected by a decision or activity. NOTE A decision maker can be a stakeholder.	
3.2.1.2		**Risk perception**	View of stakeholder's on a risk, reflecting the needs, issues, knowledge, belief and values	
3.3			**CONTEXT:**	
3.3.1		**Establishing the context**	Defining the **external and internal** parameters to be taken into account when managing risk, and setting the **scope** and **risk criteria** for the **risk management policy**.	
3.3.1.1		**External context**	External environment in which the organization seeks to achieve its objectives. Can include: - the cultural, social, political, legal, regulatory, financial, technological, economic, natural and competitive environment, whether international, national, regional or local; - key drivers and trends having impact on the objectives of the organization; and - relationships with, and perceptions and values of external **stakeholders.**	

3.3.1.2		**Internal context**	Internal environment in which the organization seeks to achieve its objectives. Include, but is not limited to: - governance, organizational structure, roles and accountabilities; - policies, objectives, and the strategies that are in place to achieve them; - the capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, processes, systems and - technologies); - information systems, information flows and decision-making processes (both formal and informal); - relationships with, and perceptions and values of, internal stakeholders; - the organization's culture; - standards, guidelines and models adopted by the organization; and - form and extent of contractual relationships.	
3.3.1.3		**Risk criteria**	Terms of reference against which the significance of a **risk** is evaluated. NOTE 1 Risk criteria are based on organizational objectives, and **external** and **internal** context. NOTE 2 Risk criteria can be derived from standards, laws, policies and other requirements.	
3.4			**RISK ASSESSMENT**	
3.4.1		**RISK ASSESSMENT**	Overall process of **risk identification**, **risk analysis** and **risk evaluation.**	
3.5			**RISK IDENTIFICATION**	
3.5.1		**RISK IDENTIFICATION**	Process of finding, recognizing and describing **risks.** NOTE 1 Risk identification involves the identification of risk **sources, events**, their causes and their potential consequences. NOTE 2 Risk identification can involve historical data, theoretical analysis, informed and expert opinions, and stakeholder's needs.	
3.5.1.1		**Risk description**	Structured statement of risk usually containing four elements: sources, events, causes and consequences.	
3.5.1.2		**Risk source**	Element which alone or in combination has the intrinsic potential to give rise to **risk.** NOTE A risk source can be tangible or intangible	Risk source is where the hazardous event potentially begins. (PREPARED Project)

3.5.1.3		**Event**	Occurrence or change of a particular set of circumstances NOTE 1 An event can be one or more occurrences, and can have several causes. NOTE 2 An event can consist of something not happening. NOTE 3 An event can sometimes be referred to as an “incident” or “accident”. NOTE 4 An event without consequences can also be referred to as a “near miss”, “incident”, “near hit” or “close call”.	
3.5.1.4		**Hazard**	Source of potential harm. A hazard can be a **risk source**.	
	PREPARED Project	**Hazardous event**	An event which can cause harm, e.g. a situation that leads to the presence or release of a hazard (Beuken, 2008). The hazardous event is part of the **event** pathway.	
3.5.1.5		**Risk owner**	Person or entity with the accountability and authority to manage a **risk.**	BINGO End-user
3.6			**RISK ANALYSIS**	
3.6.1		**RISK ANALYSIS**	Process to comprehend the nature of **risk** and to determine the **level of risk.** NOTE 1 Risk analysis provides the basis for risk evaluation (2.24) and decisions about risk treatment. NOTE 2 Risk analysis includes risk estimation.	
3.6.1.1		**Likelihood**	Chance of something happening. NOTE 1 In risk management terminology, the word “likelihood” is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period). NOTE 2 The English term “likelihood” does not have a direct equivalent in some languages; instead, the equivalent of the term “probability” is often used. However, in English, “probability” is often narrowly interpreted as a mathematical term. Therefore, in risk management terminology, “likelihood” is used with the intent that it should have the same broad interpretation as the term “probability” has in many languages other than English.	

	PREPARED Project	**Likelihood**	Chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically such as a **probability** or a **frequency** over a given time period. Probability is the measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is impossibility and 1 is absolute certainty. In some languages **probability** is used with the same broad meaning.	
3.6.1.2		**Exposure**	Extent to which an organization or individual is subject to an **event**.	
3.6.1.3		**Consequence**	Outcome of an **event** affecting objectives NOTE 1 An event can lead to a range of consequences. NOTE 2 A consequence can be certain or uncertain and can have positive or negative effects on objectives. NOTE 3 Consequences can be expressed qualitatively or quantitatively. NOTE 4 Initial consequences can escalate through knock-on effects.	
3.6.1.4		**Probability**	Measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is impossibility and 1 is absolute certainty. NOTE See definition 3.6.1.1, Note 2.	
3.6.1.5		**Frequency**	Number of **events** or outcomes per defined unit of time. NOTE Frequency can be applied to past events or to potential future events, where it can be used as a measure of likelihood / probability.	
3.6.1.6		**Vulnerability**	Intrinsic properties of something resulting in susceptibility to a risk source that can lead to an event with a consequence.	
3.6.1.7		**Risk matrix**	Tool for ranking and displaying **risks** by defining ranges for **consequence** and **likelihood**	
3.6.1.8		**Level of risk**	Magnitude of a **risk** or combination of risks, expressed in terms of the combination of **consequences** and their **likelihood.**	
	PREPARED Project	**Risk factor**	Something that can have an effect on the risk level, by changing the probability or the consequences of an event. Risk factors are often causes or causal factors that can be acted upon using risk reduction measures. Typically three main categories are considered namely human factors, environmental factors and equipment/infrastructure factors.	

3.7			**RISK EVALUATION**	
3.7.1		**RISK EVALUATION**	Process of comparing the results of **risk analysis** (2.21) with **risk criteria** (2.22) to determine whether the **risk** (2.1) and/or its magnitude is acceptable or tolerable. NOTE Risk evaluation assists in the decision about risk treatment (2.25).	
3.7.1.1		**Risk attitude**	Organization's approach to assess and eventually pursue, retain, take or turn away from risk.	
3.7.1.2		**Risk appetite**	Amount and type of **risk** (that an organization is willing to pursue or retain.	
3.7.1.3		**Risk tolerance**	Organization's or **stakeholder**'s readiness to bear the **risk** after **risk treatment** in order to achieve its objectives. NOTE Risk tolerance can be influenced by legal or regulatory requirements.	
3.7.1.4		**Risk aversion**	Attitude to turn away from **risk.**	
3.7.1.5		**Risk aggregation**	Combination of a number of risks into one **risk** to develop a more complete understanding of the overall risk.	
3.7.1.6		**Risk acceptance**	Informed decision to take a particular **risk.** NOTE 1 Risk acceptance can occur without **risk treatment** or during the process of risk treatment. NOTE 2 Accepted risks are subject to **monitoring a**nd **review.**	

3.8			**RISK TREATMENT**	
3.8.1		**RISK TREATMENT**	Process to modify **risk**. NOTE 1 Risk treatment can involve: - avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk; - taking or increasing risk in order to pursue an opportunity; - removing the risk source; - changing the likelihood; - changing the consequences; - sharing the risk with another party or parties (including contracts and risk financing); and - retaining the risk by informed decision. NOTE 2 Risk treatments that deal with negative consequences are sometimes referred to as “risk mitigation”, “risk elimination”, “risk prevention” and “risk reduction”. NOTE 3 Risk treatment can create new risks or modify existing risks.	
	PREPARED - **Risk reduction measures**	**Risk reduction measure**	Set of actions allowing modification of risk. RRM includes any process, policy, device, practice, or other actions which modify risk and may not always exert the intended or assumed modifying effect.	
	PREPARED - **Risk reduction measures**	**Risk reduction action**	Specific action needed to properly implement the selected RRM. Actions can be of very different nature.	
3.8.1.1		**control**	Measure that is modifying **risk.** NOTE 1 Controls include any process, policy, device, practice, or other actions which modify risk. NOTE 2 Controls may not always exert the intended or assumed modifying effect.	
3.8.1.2		**risk avoidance**	Informed decision not to be involved in, or to withdraw from, an activity in order not to be exposed to a particular **risk.** NOTE Risk avoidance can be based on the result of **risk evaluation** and/or legal and regulatory obligations.	
3.8.1.3		**risk sharing**	Form of **risk treatment** involving the agreed distribution of **risk** with other parties.	

			NOTE 1 Legal or regulatory requirements can limit, prohibit or mandate risk sharing. NOTE 2 Risk sharing can be carried out through insurance or other forms of contract. NOTE 3 The extent to which risk is distributed can depend on the reliability and clarity of the sharing arrangements. NOTE 4 Risk transfer is a form of risk sharing.	
3.8.1.4		**risk financing**	Form of risk treatment involving contingent arrangements for the provision of funds to meet or modify the financial consequences should they occur.	
3.8.1.5		**risk retention**	Acceptance of the potential benefit of gain, or burden of loss, from a particular **risk** NOTE 1 Risk retention includes the acceptance of **residual risks.** NOTE 2 The **level of risk** retained can depend on **risk criteria.**	
3.8.1.6		**residual risk**	**Risk** remaining after **risk treatment.** NOTE 1 Residual risk can contain unidentified risk. NOTE 2 Residual risk can also be known as “retained risk”.	
3.8.1.7		**resilience**	Adaptive capacity of an organization in a complex and changing environment.	
3.8.2.1		**monitoring**	Continual checking, supervising, critically observing or determining the status in order to identify change from the performance level required or expected NOTE Monitoring can be applied to a **risk management framework**, **risk management process**, **risk** or **control**.	
3.8.2.2		**review**	Activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives NOTE Review an be applied to a **risk management framework** (2.3), **risk management process**, **risk** or **control.**	
3.8.2.3		**risk reporting**	Form of communication intended to inform particular internal or external **stakeholders** by providing information regarding the current state of **risk** and its management	
3.8.2.4		**risk register**	Record of information about identified **risks.** NOTE The term “risk log” is sometimes used instead of “risk register”.	

3.8.2.5		**risk profile**	Description of any set of **risks.** NOTE The set of risks can contain those that relate to the whole organization, part of the organization, or as otherwise defined.	
3.8.2.6		**risk management audit**	Systematic, independent and documented process for obtaining evidence and evaluating it objectively in order to determine the extent to which the **risk management framework**, or any selected part of it, is adequate and effective.	