Canadian Conservation Institute
Institut canadien de conservation

International Centre for the Study of the Preservation and Restoration of Cultural Property

ICCROM

A Guide to Risk Management of Cultural Heritage

CO-CREATION

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Acknowledgment

This guide is an abridged version of the 2016 handbook The ABC method - A risk management approach to the preservation of cultural heritage, a joint publication of the Canadian Conservation Institute (CCI) and ICCROM, written by Stefan Michalski (CCI) and José Luiz Pedersoli Jr (for ICCROM). The ABC method evolved during ten years of teaching a three week ICCROM course on Reducing Risks to Collections to experienced professionals throughout the world, in partnership with the Cultural Heritage Agency of the Netherlands (RCE) and the Central Institute for Conservation in Serbia (CIK). The purpose of this booklet is to introduce this most recent thinking on how to achieve effective preservation to anyone responsible for its planning and implementation.

The authors wish to acknowledge the contribution of all colleagues and organizations who participated in the development of the ABC method, as well as all contributors who kindly provided photographs to support this publication.

Foreword

Cultural heritage tells the stories of the world's many peoples. The material part of that heritage, objects and sites, tells us of their activities, their perceptions, their skills, and their ideas. It is unique, irreplaceable and unfortunately, vulnerable. Our heritage institutions bear the solemn responsibilities not only of prolonging their survival but also of making them accessible, so that we can know our past. In practical terms, we must plan how best to reduce the risks to the heritage in our care, and then act on those plans.

What are the possible imminent risks to a cultural property? What are the risks of highest probability? Which of those are expected to cause greater and wide-ranging damages? Do damages differ from a cultural property to another? Do these damages suddenly occur or are they accumulative over time? How can these damages be well understood and assessed for sound decision making relevant to mitigation and prevention? What are the priorities, given available human capital and budgets? Which institutions and entities are responsible for cultural sites and museums with whom can collaboration be sought for risk prevention and treatment?

Answering these questions generates an intertwining and complex web of information, which, in turn, requires adequate management through specific expertise and methodologies that optimise available resources within time and capacity limitations.

This guide, supported with examples and illustrations, provides a scientific model and methodology for risk examination and assessment. It enables cultural heritage professionals and institutions to devise intervention plans based on thorough assessment, which can ultimately facilitate decision-making processes. The methodology adopted throughout this guide was developed in compatibility with the specific requirements of cultural heritage management, and derived from risk assessment methodologies implemented in other fields, such as public health and insurance.

ICCROM and its ATHAR Regional Conservation Centre in Sharjah (ICCROM-ATHAR) regularly disseminate knowledge and skills relevant

to risk management by implementing training courses and publishing key sources and material in order to benefit the organisations' member states. The following guide presents a methodology that ICCROM developed in partnership with CCI and other leading heritage organizations by synthesising the outcomes of several international and regional courses implemented in the past decade.

Given the current social, economic and political crises prevalent in the Arab region, as well as the cultural crisis underlying many of these turbulences, the urgent need to study and explore imminent risks to cultural heritage has become more critical. Hence, risk anticipation and assessment, in addition to sound decision making to best utilise available resources, are considered essential factors for obtaining desired outcomes.

This guide places at the hands of professionals in charge of cultural sites and museums a methodology for studying risks in a simplified manner that does not require elaborate expertise for implementation. Readers will benefit from the application of information and expertise explored by the sources this publication provides. Likewise, this guide represents a key resource for decision makers who may not have sufficient knowledge and skills required for the intricate process of risk assessment and evaluation.

We hope that this guide equips professionals working in the related fields of cultural heritage, particularly in museums, with a useful foundational tool that will assist them in performing their duties and achieving their objectives.

Dr. Zaki Aslan

Regional Representative of ICCROM for the Arab States.

Director of ICCROM-ATHAR Regional Conservation Centre in the U.A.E.

Contents

Welcome to risk management

WHY RISK MANAGEMENT FOR CULTURAL HERITAGE?

Heritage managers and caretakers often have to prioritize and make choices about how best to use the available resources to protect collections, buildings, monuments and sites. This means, for instance, having to decide among options such as increasing security against theft and vandalism, improving building maintenance to reduce water leaks, installing air conditioning in collection storage areas, hiring specialized pest management services, installing fire alarm and fire suppression systems, implementing disaster preparedness and response plans, building new storage facilities, buying '*conservation quality*' packaging materials, intensifying conservation and restoration treatments, etc.

What to do first? What are the priorities of the heritage asset in its specific context? How to optimize the use of available resources to maximize the benefits of the cultural heritage over time?

Risk management can help us answer these questions and make better decisions about the preservation and use of cultural heritage. It allows us to consider all risks relative to each other in order to establish priorities and plan our resources better. We can also apply risk management to deal with any situation that requires a comparison between two or more specific risks, that involves a dilemma between preservation and access, or between preservation and environmental sustainability, etc.

Can you think of a situation where you had to compare risks to make a decision?

Another important benefit of risk management for cultural heritage is that it encourages collaboration between different disciplines and sectors. It also supports the effective communication of risks and risk-related issues to decision makers, with transparent priorities.

WHAT IS RISK?

Risk can be defined as ***'the chance of something happening that will have a negative impact on our objectives'***.

Every time we think about *risk* we have to consider both its *chance of happening* and its *expected impact*. If we think only about one or the other we will have an incorrect understanding of the risk. It is their combination that matters. For instance, the impact of an airplane crash is often catastrophic, but the chance of it happening while we are flying is very tiny. The risk of dying in a plane crash is therefore small, and most of us accept it without thinking twice as we travel around in airplanes. On the other hand, the risk of developing some type of cardiovascular disease if we have a sedentary lifestyle and eat poorly is much bigger. It has a higher chance of happening, and has a serious negative impact. That is why many of us do not accept this risk, and instead take action to eat a healthier diet, to avoid smoking, and to exercise on a regular basis.

It is also important to remember that ***risk*** refers to the future, i.e. to something that *may happen* in the future causing a negative impact on our objectives.

Risks (big and small) are present in our everyday life, and many of our daily decisions have to do with accepting, rejecting or modifying them.

How many risks have you already dealt with today?

RISKS TO CULTURAL HERITAGE

The same concept of ***risk*** applies to cultural heritage. Many things can happen that will have a negative impact on heritage collections, buildings, monuments, sites, and on our objectives concerning their use and preservation. The impact of risks in this case is expressed in terms of the ***expected loss of value to the heritage asset***.

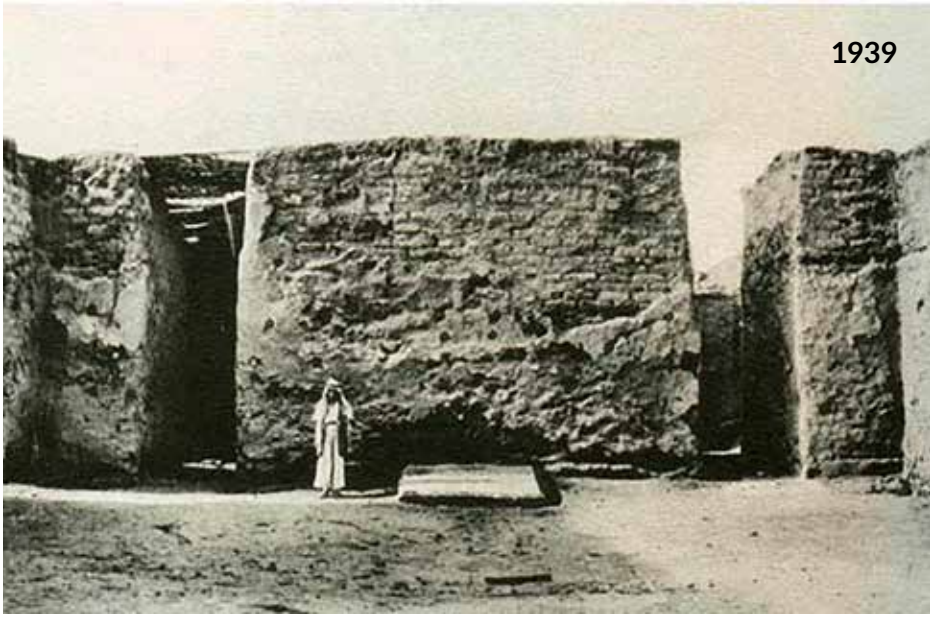
Types of risks to our cultural heritage vary from sudden and catastrophic events (such as major earthquakes, floods, fires, and armed conflict) to gradual and cumulative processes (such as chemical, physical, or biological degradation). The result is loss of value to the heritage asset. For example, if a historic house catches fire there is usually a large or total loss of value to the building and its contents. When fragile objects of a museum collection are broken during an earthquake there is a loss of value in that collection. The fading of colors in traditional textiles exposed to daylight also causes loss of value. Sometimes the risk does not involve any type of material damage to the heritage asset, but rather the loss of information about it, or the inability to access heritage items. Hence, for instance, a museum collection or an archaeological site will lose value if they are not properly documented or if the existing documentation about them goes missing. Heritage managers and caretakers need to understand these risks well so as to make good decisions about protection of the heritage (for future generations) while also providing access for the current generation.

The images on the next pages are examples of things that have already happened, but they illustrate what might happen in the future to our heritage assets. They help us imagine the kinds of risks cultural heritage is exposed to.

Can you think of other risks to cultural heritage?

Examples of different types of events and processes that cause damage and loss of value to heritage assets.
Top: Destruction of heritage buildings caused by armed conflict (Syria, 2013. Image courtesy of Kamal Bittar).
Bottom: Historic house building and contents damaged by strong winds and heavy rain during a typhoon (Philippines, 2013. Image courtesy of Aparna Tandon, ICCROM).

Examples of different types of events and processes that cause damage and loss of value to heritage assets. Discoloration and weakening of the feathers of a ceremonial fan caused by light and ultraviolet radiation over a period of 30 years (Cairo Museum, Egypt, between 1970 and 2000. Image courtesy of ICCROM Archives).



Examples of different types of events and processes that cause damage and loss of value to heritage assets. Weathering and erosion of earthen architecture structures at a heritage site over a period of 65 years (Royal Palace of Mari, Syria, between 1939 and 2004. Image courtesy of the Syrian Directorate-General for Antiquities and Museums).

WHAT IS RISK MANAGEMENT?

Risk management is everything we do to understand and deal with possible negative impacts on our objectives. It includes the identification, analysis, and prioritization (we call it evaluation) of risks. Then we take action to '*treat*' risks, i.e. to avoid, eliminate or reduce the risks that we consider unacceptable. We can also transfer those risks to others. For instance, when we insure our collections we transfer the risk of theft or damage to the insurance company (for a fee).

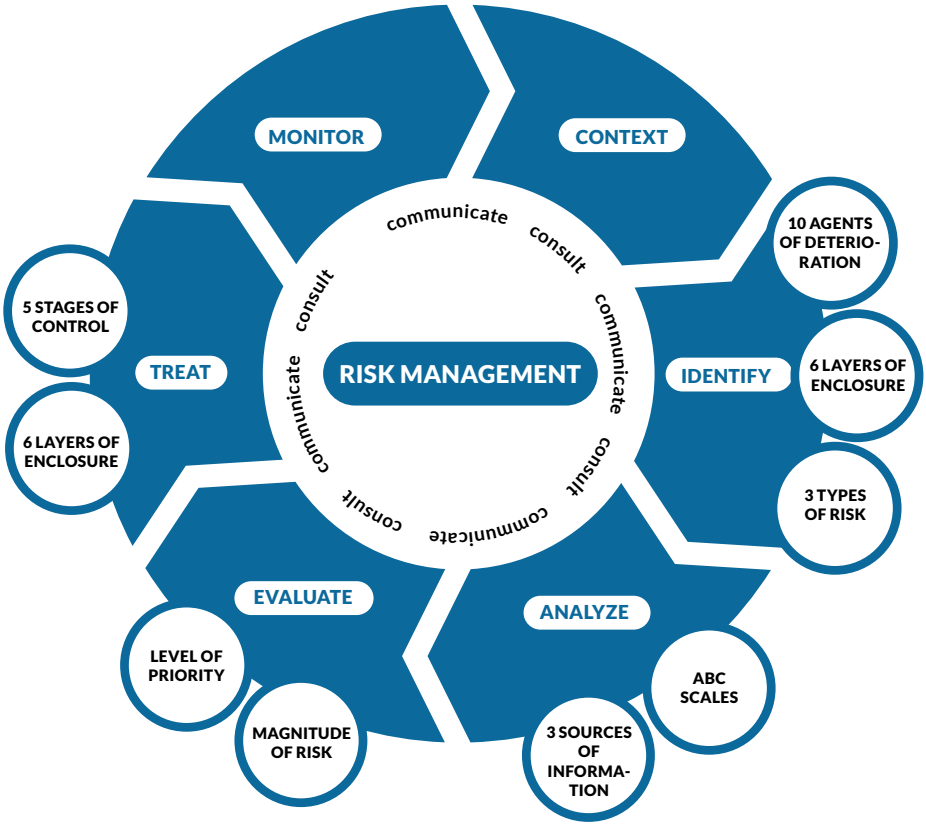
If one or more risks are evaluated as acceptable we don´t need to do anything about them. For example, when there is no copyright or security issue, more and more heritage institutions allow their visitors to take pictures using flash because they know that in most cases, the risk of damage by light from flash photography is tiny or very small. In other words, we can consciously *accept* those risks.

It is important to remember that risk management is a continuous process. We have to keep monitoring the risks and adjusting our actions to ensure that negative impacts on our objectives will be minimized.

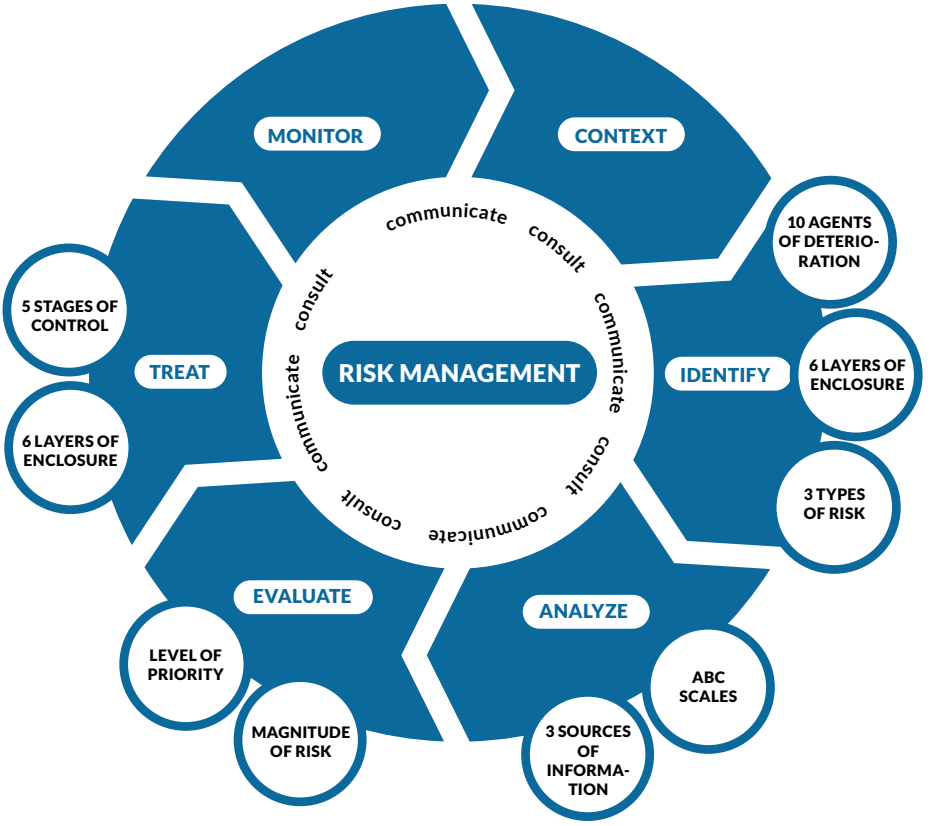
Used in fields such as public health, the environment, and technology, risk management is an essential tool for government and industry to reach their objectives in a more controlled and successful way.

Have you ever used risk management in your work before?

Because of its importance as a management tool, international standards have been developed. One of them is ISO 31000:2009, *Risk Management - Principles and guidelines*. The figure below shows the main steps defined by the standard (inner ring) as well as concepts and tools developed for the heritage sector. In the next chapters we explain these steps, concepts, and tools in more detail.



Doing risk management



you are here

CONTEXT

IDENTIFY

ANALYZE

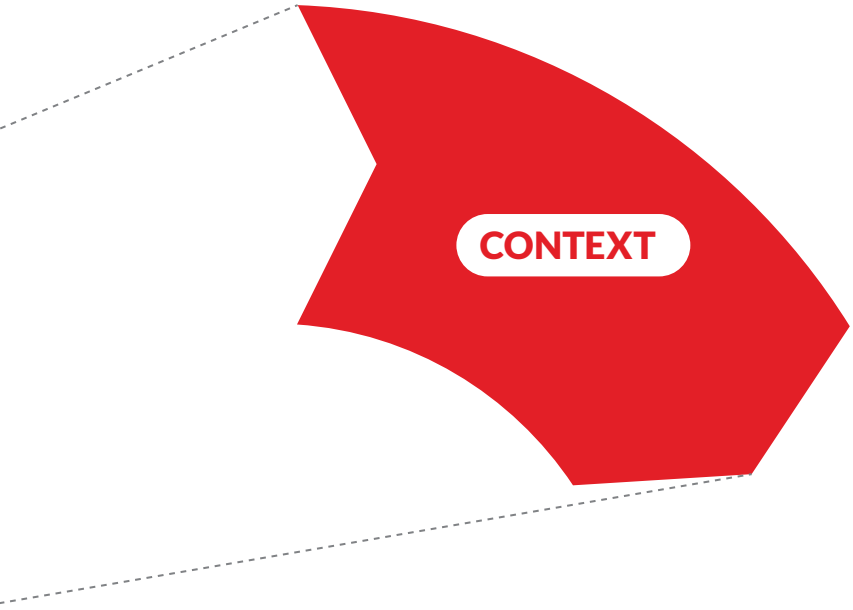
EVALUATE

TREAT

MONITOR

Context

1 UNDERSTANDING THE CONTEXT



CONTEXT

IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR

1 UNDERSTANDING THE CONTEXT

In this step we try to understand all relevant aspects of the context in which the heritage asset is situated. This includes its physical, administrative, legal, political, socio-cultural, and economic environments.

It is also important to identify all the actors, inside and outside the organization, that can help us in the process (from the cleaning and security staff to the Director and the heritage authority, the fire brigade, the police, the civil defense, the local community, universities, potential donors, etc.). Obviously, we must clearly define our objectives, as well as the scope of our actions. It must be clear to everyone what the '*heritage asset*' is. For instance, the '*heritage asset*' could be all archaeological sites in the country, or one particular archaeological site, or only a specific part of an archaeological

site. It could be all historic house museums in the city, one particular historic house museum, or only a specific part of the collection of one museum.

What about your heritage asset? What is it?

All this information about the context is necessary to be as effective as possible when doing risk management.

As an example, one might be interested in managing risks to a heritage site that contains the remains of an ancient village plus a museum. The site is located in a moderately seismic rural area, nearby a river. There is a native community nearby that uses part of the site as a sacred place. There is a growing demand for access to the site by national and international tourism. It has no management plan, and there are no specific laws that regulate the protection and economic exploitation of this kind of heritage in the country. The museum has the mission to collect, conserve, and display the archaeological findings from the site. It operates under the responsibility and budget of the National Board of Museums. The site is under the administration of the Department of Archaeology. The staff is very small and cannot satisfactorily meet all the maintenance, security, conservation, and documentation needs of the site and the museum collection. Students from the local school work as volunteer guides. The two park rangers that are stationed nearby help patrol the area whenever they can. The country is going through a difficult economic period, which means shrinking resources for the heritage sector, but some outside sponsors have indicated their interest in making contributions.

Can you recognize the different aspects of the context in the example above that are relevant for risk management?

Try it yourself:

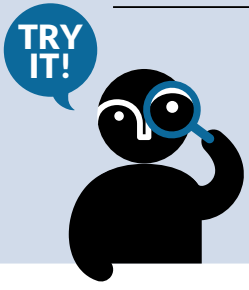
UNDERSTAND YOUR CONTEXT

Consider your heritage asset. For each aspect of the context shown on page 20, find at least one specific element that is important to understand in order to successfully manage risks to that asset. You can use this form to document your findings. Discuss your results with colleagues.

HERITAGE ASSET

POLITICAL ENVIRONMENT

PHYSICAL ENVIRONMENT



LEGAL ASPECTS

ADMINISTRATIVE AND OPERATIONAL ASPECTS

SOCIO-CULTURAL ENVIRONMENT

FINANCIAL CONTEXT

ACTORS AND STAKEHOLDERS

Identify

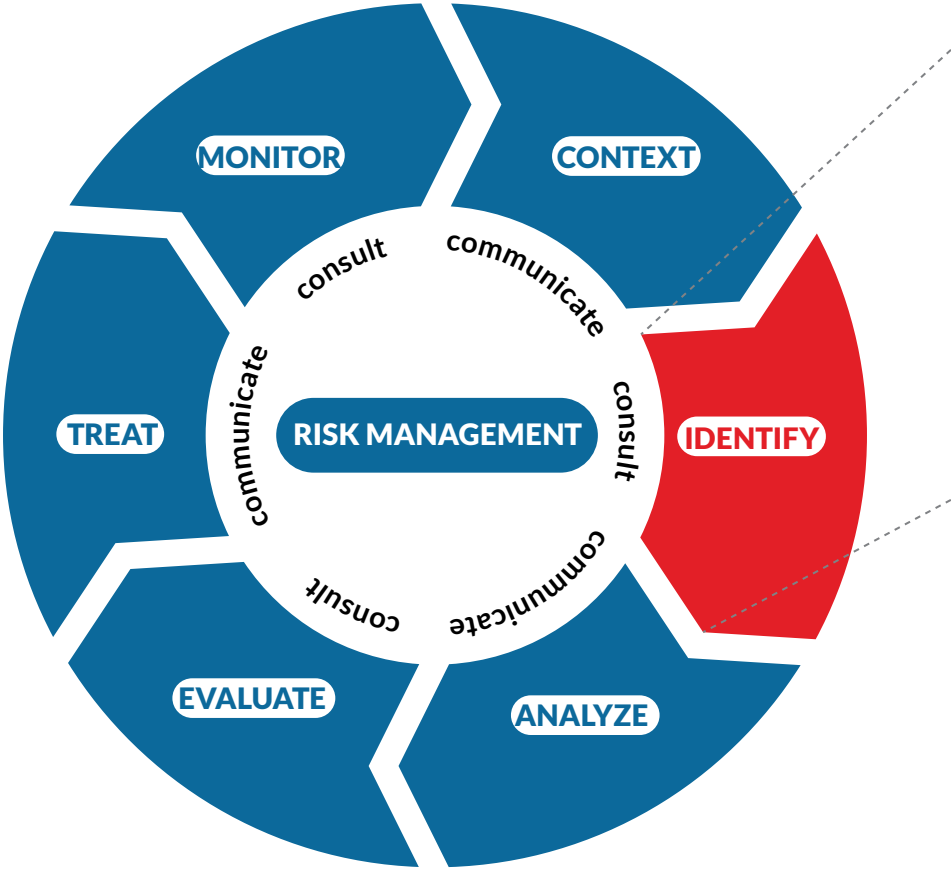
1 **WHAT ARE THE RISKS?**

2 **THE 10 'AGENTS' OF DETERIORATION AND LOSS**

3 **THE 6 'LAYERS' OF ENCLOSURE**

4 **THE 3 'TYPES' OF RISK OCCURRENCE**

5 **COMMUNICATING RISKS**



CONTEXT

IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR

1 WHAT ARE THE RISKS?

In this step we try to identify all the risks that threaten our heritage collection, building, monument or site. It is important that we do not miss any significant risk. If we are not aware of the different risks that affect our heritage, our decisions and use of resources will be based on an incomplete picture and will therefore be less effective.

When we identify risks, the main question to ask ourselves is this: ***What can go wrong and cause damage and loss of value to the heritage asset?*** With our knowledge and experience we can discover many risks.

Give yourself 5 minutes and try to find as many things as possible that could go wrong, causing damage and loss of value to your heritage asset. Can you find three? Five? Ten? More?

Sometimes, however, this is not enough to identify all risks. Tools have been developed to help us identify risks in a systematic and complete way. They help us think about different possible causes, different levels of observation, and different types of risk occurrence. These tools are described below and on the next pages.

2 THE 10 'AGENTS' OF DETERIORATION AND LOSS

Imagine that you are a heritage object, building, monument or site. Now try to imagine what can cause damage and loss of value to you in the future, in the specific location and context where you exist. In order to help, the diagram on the next page shows *10 agents* that can cause deterioration and loss to heritage items.

- Start with physical forces: ***what kinds of physical forces can affect me here? What could cause them?*** (E.g. strong winds, earthquakes, inadequate handling, overcrowding, accidental collisions, visitor traffic, etc.).
- Now move to criminals: ***what kinds of criminal acts could affect me here?***

(E.g. opportunistic theft, armed robbery, vandalism, terrorist attack, etc.)

- Now to fire: ***what are the possible causes of fire that could affect me?***
- Water: ***what kinds of water damage can I suffer, and where would the water come from?*** (E.g. tsunami, river flood, rainwater penetration into the building, water pipe leaks, raising damp from ground water, inadequate cleaning procedures, etc.)

And so on for all the other agents. The tables on the next pages contain additional information about common sources of the agents and typical effects they cause on susceptible heritage items.

Agent of deterioration:
PHYSICAL FORCES

Common sources	Typical effects on heritage
Incorrect handling, storage, transportation; collisions, wind erosion, excavations, construction works, armed conflict, earthquakes, traffic, overload, etc.	Collapse, deformation, breakage, abrasion, wear, tearing, etc.

Examples

Collapse of shelves, breakage, deformation and abrasion of ceramic and other fragile objects in the storage room of a museum caused by earthquake (Image courtesy of ICCROM Archives).

Wind erosion of a stone column in a heritage site
(Image courtesy of Anwar Sabik, ICCROM).

Painting torn by accident while being handled
(Image courtesy of José Luiz Pedersoli Jr.).

Agent of deterioration:
CRIMINALS
(thieves and vandals)

Common sources	Typical effects on heritage
Political, ideological, economic motivation, etc.	Disappearance, destruction, disfiguration, etc.

Examples

Theft of part of a sculpture (head) in a heritage site (Image courtesy of Stefan Michalski).

Extensive damage to a museum collection caused by a bomb blast (Image courtesy of AbdelHamid Salah, EHRF - Egypt).

Graffiti vandalism on the wall of a heritage structure (Image courtesy of Anwar Sabik, ICCROM).

Agent of deterioration:

FIRE

Common sources	Typical effects on heritage
Lightning, forest fires, gas leaks, fireworks, faulty electrical installations or equipment, smoking, candles, arson, construction and renovation works, etc.	Total or partial burning, collapse or deformation by heating, soot deposition, etc.

Examples

Heritage building damaged by fire (Image courtesy of Firas Otman).

Books from a library collection damaged by fire (istock.com/Robert Koopmans).

Unsafe burning of incense in temples can cause fire (istock.com/Andrea Zanchi).

Agent of deterioration:

WATER

Common sources	Typical effects on heritage
Tsunami, flooded rivers, rain, ground water, water pipes, cleaning procedures, firefighting, etc.	Staining, weakening, deformation, dissolution, corrosion, weathering, salt efflorescence, biological growth, etc.

Examples

Staining and soluble-salt damage in museum objects caused by the flooding of storage rooms located in the basement (Image courtesy of Hisham Sayegh).

Staining and stronger iron-gall ink corrosion of an archival document affected by a water leakage (Image courtesy of José Luiz Pedersoli Jr.).

Wetting and damage to archaeological findings exposed to extreme rain during excavation in a heritage site (Image courtesy of Firas Otman).

Agent of deterioration:
PESTS

Common sources	Typical effects on heritage
Local fauna (insects, rodents, birds, bats, etc.). Sources of food and nesting materials attract pests.	Staining, perforation, weakening, loss of parts, etc.

Examples

Significant loss of parts in a book chewed up by mice
(Image courtesy of José Luiz Pedersoli Jr.).

Heritage building has its wooden structure weakened by termites (Image courtesy of José Luiz Pedersoli Jr.).

Weakening, perforations and losses in a wooden sculpture caused by termites (Image courtesy of ICCROM Archives).

Agent of deterioration:
POLLUTANTS

Common sources	Typical effects on heritage
Industries, vehicles, construction and renovation works, storage and display materials that emit gases, visitors, restoration materials that contaminate the object, etc.	Discoloration, weakening, staining, darkening, erosion, corrosion, etc.

Examples

Darkening and staining of the stone façade of a heritage building caused by air pollution (Image courtesy of Stefan Michalski).

Efflorescence of salts (powdery white coating) in a sea shell from a natural history collection caused by chemical reaction with acetic acid, a gaseous pollutant (Image courtesy of ICCROM Archives).

Artwork on paper contaminated with residue of adhesive tape (Image courtesy of ICCROM Archives).

Agent of deterioration:
LIGHT AND UV

Common sources	Typical effects on heritage
Sun, electrical light sources (lamps).	Color fading (primary effect of light); yellowing, weakening and disintegration (primary effects of UV).

Examples

Daylight entering this museum display room through the windows will cause gradual color fading and weakening of susceptible materials (Image courtesy of of Stefan Michalski).

Color fading of a military uniform and its medal ribbons caused by exposure to light (the areas not exposed to light show much stronger colors) (Image courtesy of ICCROM Archives).

Weakening and breakage of the textile fibers in this historic house's curtain caused by exposure to UV from daylight (Image courtesy of Stefan Michalski).

Agent of deterioration:

INCORRECT TEMPERATURE

(too high, too low, fluctuations)

Common sources	Typical effects on heritage
Local climate, sunlight, incandescent lamps, heaters, etc.	Faster deterioration by chemical reactions, deformation, dehydration, embrittlement, softening, etc.

Examples

Embrittled low-quality paper, a chemically unstable material that deteriorates notably faster at warm temperatures (Image courtesy of José Luiz Pedersoli Jr.).

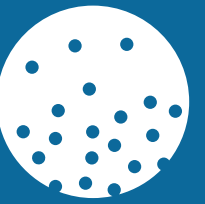
Degraded cellulose nitrate negative, a chemically unstable material that deteriorates notably faster at warm temperatures (Image courtesy of Funarte - Brazil).

Softening and deformation of a (paraffin wax) candle exposed to higher temperature from direct sunlight while stored leaning against the wall (Image courtesy of José Luiz Pedersoli Jr.).

Agent of deterioration:

INCORRECT RH

(too high, too low, fluctuations)



Common sources	Typical effects on heritage
Local climate, ground water, inadequate air conditioning, micro-climates, etc	Deformation, cracking, flaking, delamination, weakening, corrosion, mold growth, staining, etc.

Examples

Cannon balls made of iron suffering from corrosion because of high relative humidity (Image courtesy of José Luiz Pedersoli Jr.).

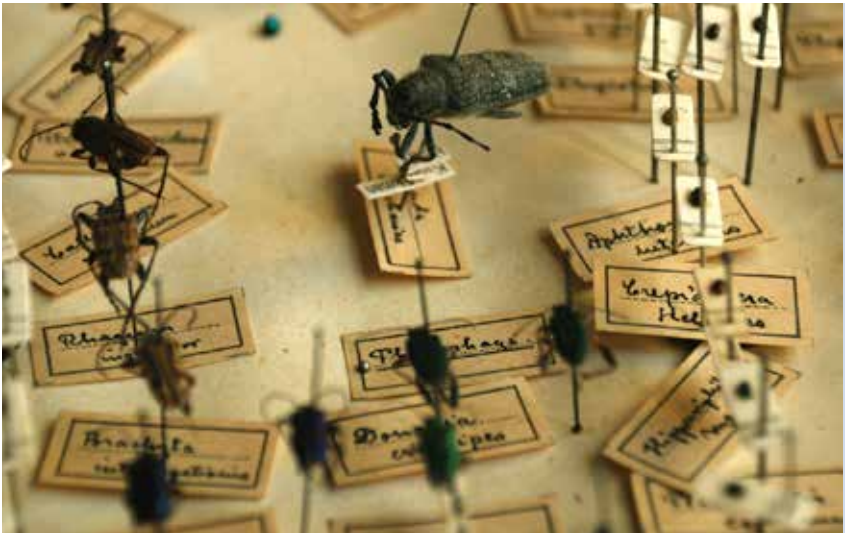
Loss of paint in a polychrome wooden sculpture caused by large fluctuations in relative humidity (Image courtesy of ICCROM Archives).

Mould growth on a book exposed to conditions of high relative humidity (istock.com/Charles Taylor).

Agent of deterioration:
DISSOCIATION

Common sources	Typical effects on heritage
Lack of inventory, poor documentation or identification, misplacing objects, hardware and software obsolescence, staff retirement, etc.	Loss of information about heritage assets, (temporary) loss or inability to access heritage items, etc.

Examples



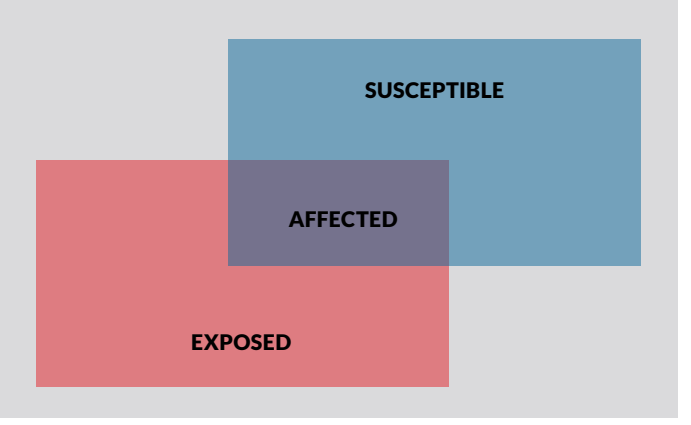
Detachment and loss of labels will make it impossible to identify and find the right information about the specimens in this natural history collection (istock.com/Jesse Karjalainen).

Inappropriate storage procedures can cause (temporary) loss of books in this library collection (Image courtesy of José Luiz Pedersoli Jr.).

Loss of data and information about the heritage asset caused by failure of their digital storage system (istock.com/DSGpro).

By systematically considering all 10 agents we can be more confident that we have not missed any relevant risk. Remember that there might be several risks for the same agent (e.g. water damage by flooding; water damage by pipe leaks; water damage by rainwater infiltration into the building, etc.). It is also important to remember that damage and loss of value will only occur when the heritage item is both *susceptible* and *exposed* to the agent, as illustrated in the diagram below. In this diagram, the entire heritage asset is represented by the grey rectangle. Suppose that part of it, indicated by the blue rectangle, is susceptible to a certain agent of deterioration. On the other hand, the part of the heritage asset that is exposed to that agent is indicated by the red rectangle. This means that only the items that are both susceptible and exposed to the agent will be affected, i.e. will suffer damage and loss of value. For example, wooden objects and buildings are susceptible to termites. They will be affected if exposed to this agent. A metal sculpture displayed outdoors is exposed to direct sunlight. This sculpture will not be affected by light and UV because it is not susceptible to this agent.

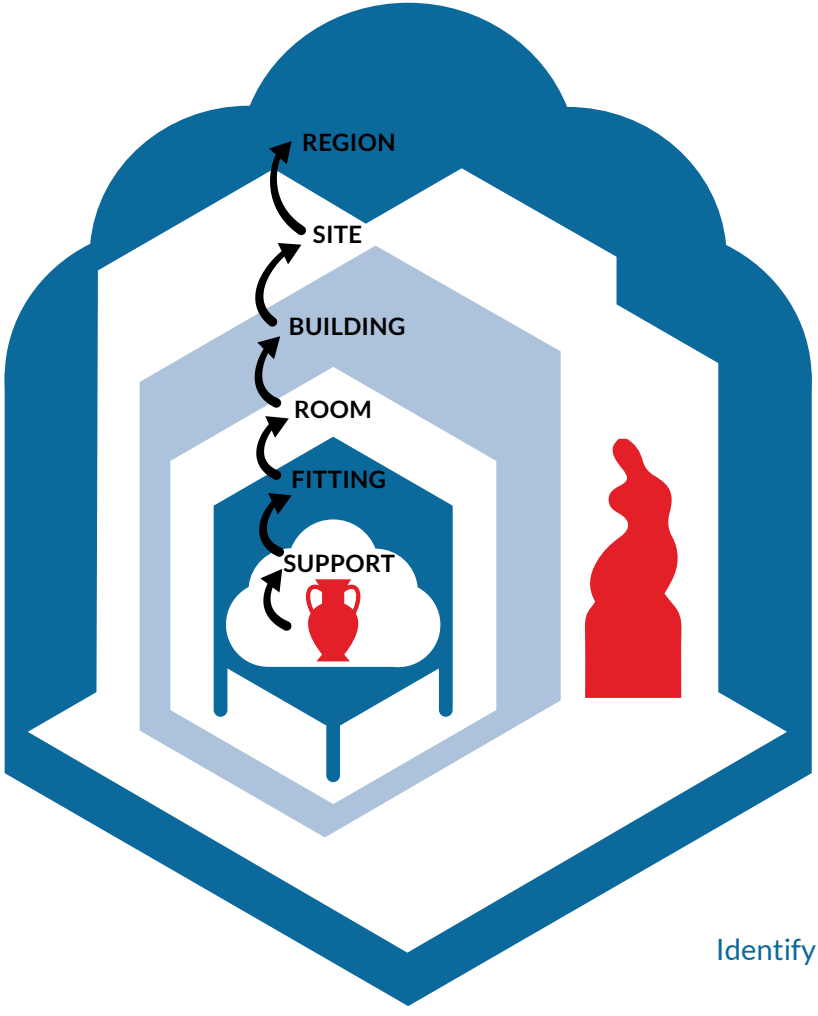
Can you name one agent of deterioration and identify a part of your heritage asset that is both *susceptible* and *exposed* to this agent?



3 THE 6 'LAYERS' OF ENCLOSURE

Imagine again that you are a heritage item, and think about the different layers that exist around you as shown in the diagram below. If you are an object from a museum collection, think about: the *packaging* in which you are stored, or the *support* on which you are displayed; your storage cabinet or display case *(fittings)*; the storage or exhibition space *(room)*; the building where the collection is kept *(building)*; the surroundings of this building *(site)*, and the geographic area where the museum is located *(region)*. If you imagine that you are an outdoor sculpture or monument, a building or a site, then the relevant layers are only the *site* and the *region* where they are situated.

The layers can be layers of protection, but they can also contain sources of danger.



Can you think of different kinds of dangers that may exist in each layer, which could cause damage and loss of value to you as a heritage item?

For instance, a flood of the nearby river could cause water damage. The construction of new buildings and roads could damage archaeological sites. Poor quality locks in the windows of a storage room, and poor surveillance around the building could facilitate theft of precious artifacts. Incorrect or missing identification on the packaging of objects in storage could result in temporary or permanent loss of objects. The pictures below and on the next pages show more examples of dangers to heritage items that can exist within each of the six layers of enclosure.

Examples of dangers to heritage assets at the different layers of enclosure. Excessive lighting of a coloured flag inside a showcase will cause fast fading of sensitive colours (fittings) (Image courtesy of José Luiz Pedersoli Jr.).

Examples of dangers to heritage assets at the different layers of enclosure. Accidents due to inadequate cleaning procedures inside a museum exhibition room can cause breakage of fragile items (room) (Image courtesy of Stefan Michalski).

Examples of dangers to heritage assets at the different layers of enclosure. Large trees around a heritage building can fall on it causing serious damage (site) (istock.com/barmixmaster).

Examples of dangers to heritage assets at the different layers of enclosure. Strong earthquakes can cause the collapse of various heritage buildings and monuments in the affected area (seismic region) (Image courtesy of Aparna Tandon, ICCROM / Tapash Paul Drik).

By systematically looking at each of the different layers around the heritage item we can be more confident that we will not miss any relevant risk. Remember that there might be several dangers at any given layer. Think about each agent at each layer. It is also important to consider the different procedures that are normally carried out in each layer, e.g. the cleaning of showcases and storage rooms, surveillance routines, building maintenance, documentation and storage of data and records, etc.

4 THE 3 'TYPES' OF RISK OCCURRENCE

Another useful approach for a complete identification of risks is to consider the three different types of risk occurrence, as indicated in the table below. .

Rare events	Common events	Cumulative processes
"Rare" events occur less often than about once every 100 years. As a result, rare events are not part of the direct experience of most heritage organization staff. From the perspective of the total heritage of a nation, such events may happen every few years, and from a global perspective, these events can become routine.	Common events occur many times per century. These are events that are part of the direct experience of many heritage organization staff or of people in the vicinity of the heritage organization.	Cumulative processes can occur continuously or intermittently. Over the years, most heritage organization staff will have observed the cumulative effect of one or two such processes on some items, that is to say, they will have seen the item "age." Very frequent events can also be considered as cumulative processes for risk analysis.
Examples: Floods Damaging earthquakes Large fires Theft Visitor knocking over a special item	**Examples:** Water leaks Damaging earthquakes (some parts of the world) Small fires Collapse of overloaded furniture Many handling "accidents" "Petty" theft	**Examples:** Yellowing of newsprint Fading of some colours Corrosion of metals Erosion of stone Wear and tear of textiles that are handled daily

Try it yourself:

IDENTIFY RISKS

Identify the specific risks that affect your heritage asset in its own context. Think about the 'agents', 'layers', and 'types', as described above. You can use the form shown on the opposite page for guidance. Discuss your results with colleagues.

	Rare events	Common events	Cumulative processes
 Physical forces			
 Criminals			
 Fire			Generally not applicable
 Water			
 Pests			
 Pollutants			
 Light and UV	Generally not applicable		
 Incorrect T			
 Incorrect RH			
 Dissociation			

5 COMMUNICATING RISKS

When we do risk management we must engage, collect information, earn the trust of others, receive authorization from our superiors, etc. This means that we have to communicate with different people and audiences. A very important part of risk management is the communication of risks in a clear and meaningful way, particularly to decision-makers. If we fail to do so the risks might not be fully understood. This could result in a lower level of interest and involvement of stakeholders, as well as poor decisions and ineffective actions about risk treatment.

A useful way to communicate risks is through risk summary sentences. The risk summary sentence is a complete and meaningful sentence that refers to the future, identifies the danger or agent of deterioration, specifies the expected adverse effect, and indicates which part(s) of the heritage asset will (most likely) be affected.

Examples of risk summary sentences:

- *"Daylight entering through the windows in the new display rooms will fade all the high-sensitivity colors in the costumes exhibited in those rooms."*
- *"Visitors will touch the building's walls where they have access and deposit both oils and dirt that cause visible soiling."*
- *"Heavy visitor traffic on the unprotected mosaic floor of the heritage site will cause abrasion, detachment and loss of tesserae."*
- *"Bursting of the water pipe that runs over the collection storage room will cause damage to water-sensitive materials, such as stains, deformation, and mold growth if left wet for too long."*
- *"Failure in the digital storage system where the only existing copy of the museum collection inventory is kept will cause irreversible loss of information and will compromise intellectual access."*

In the sentences above, the danger has been highlighted in red, the expected adverse effect in dark blue, and the affected part of the heritage asset in light blue color.

The use of images to illustrate dangerous situations and their expected

Try it yourself:

COMMUNICATE RISKS (writing risk summary sentences)

Suppose that you work in a museum, and some of your colleagues are worried about the risk of theft. They wrote to the Director about it. Here is what they said:

Abdu: "We have a security problem in the museum."

Layla: "Our collection is at a high risk of theft."

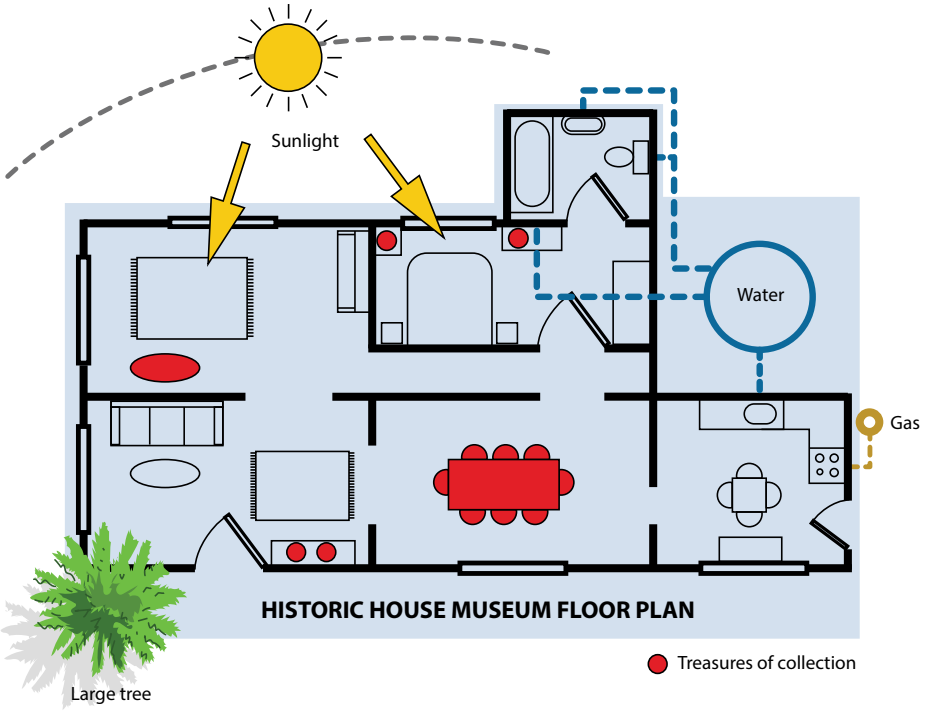
Anwar: "Thieves can easily steal the treasures of our collection."

Yasmin: "The museum is not secure during the night. The window locks are easy to break, we do not have guards, and there is no alarm or security camera."

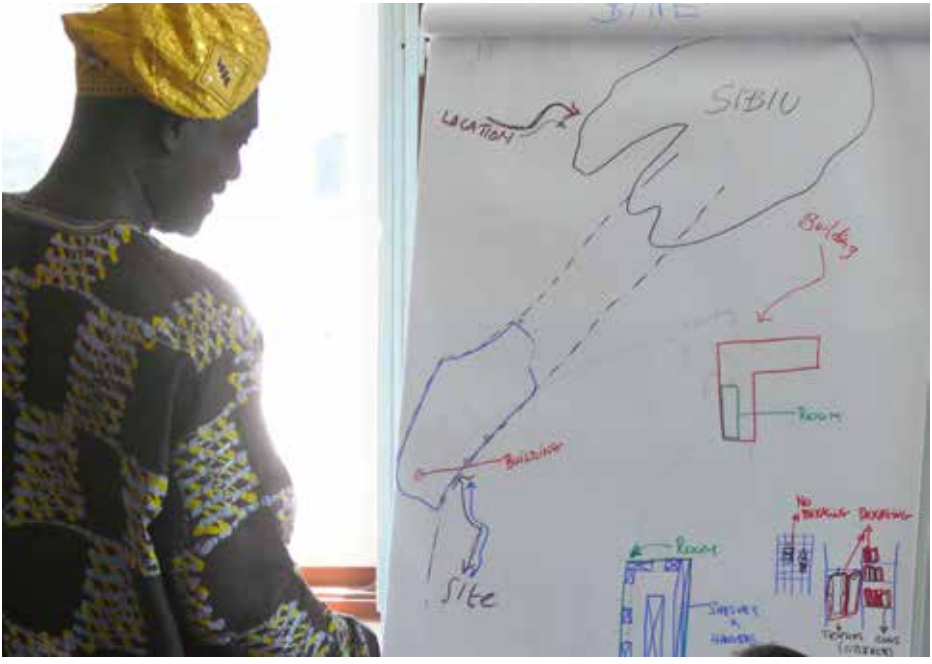
The Director is not fully satisfied with the way in which each person explained the risk. What information is missing in each case to help the Director completely understand the risk and to do something concrete about it? Can you write a better risk summary sentence?

Share your answers with your colleagues.

impact on heritage items can be very helpful when communicating risks. It also helps to use maps or floor plans to locate the sources of danger, and to locate the parts of the heritage asset that will be affected by each danger.



Example of a historic house museum floor plan showing different hazards that can cause damage and loss of value to the collection and the building: large trees next to the house, old gas stove/cylinder, water reservoir and water pipes, (direct) sunlight. The windows and doors of the house, possible entry points for criminals, are also indicated. It is possible to see which items of the collection or parts of the building are more exposed to the different hazards. The treasures of the collection are also identified.



Drawing maps showing the location of dangers and existing protective measures at the different layers around the heritage asset is a useful way to help us understand and (visually) communicate risks (Image courtesy of ICCROM Archives).

Analyze

1 ANALYZING RISKS

2 THE ABC SCALES FOR RISK ANALYSIS

3 SOURCES OF INFORMATION

4 EXAMPLES OF RISK ANALYSIS

5 HOW SURE ARE WE?

CONTEXT

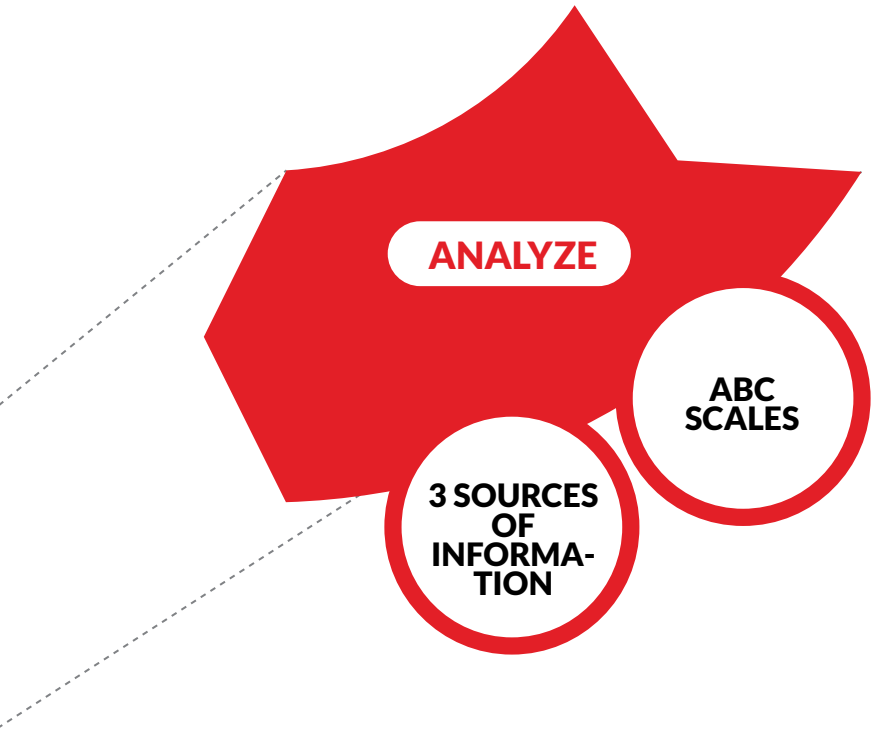
IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR



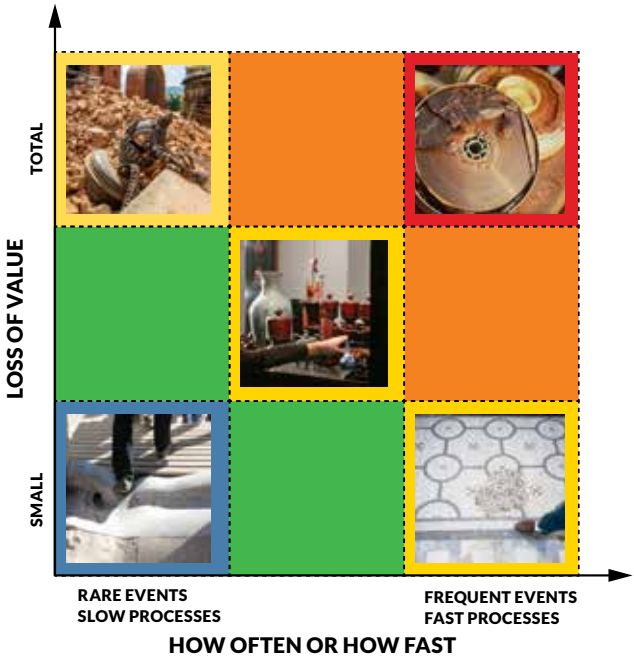
1 ANALYZING RISKS

Identifying the risks that threaten our heritage is necessary, but it is not enough if we want to manage those risks effectively. ***How big are these risks? Which ones are unacceptable? How can we prioritize them?*** We need to answer these questions in order to make effective decisions.

In this step we try to understand in detail each risk we have identified. We estimate their *chance of occurrence* and their *expected impact*. Remember that the impact of risks to cultural heritage is expressed in terms of the *expected loss of value* to the heritage asset.

When the risks are of the *'event'* type we try to estimate how often they occur. For example, *'a large earthquake damaging the heritage asset is expected to occur about once every 300 years'*, *'theft of heritage items is expected to occur about once every 30 years'*, *'rainwater infiltration through the roof affecting the museum collection is expected to occur about once every 3 years'*, etc. When the risks are of the *'cumulative process'* type we try to estimate how fast the damage will accumulate. For instance, *'total loss of relief decoration on the walls of the archaeological site caused by weathering is expected to occur in about 300 years'*, *'most audiovisual records on magnetic tape will have severely degraded and will no longer be accessible in about 30 years'*, *'the colored textiles recently put in exhibition will experience a perceptible fading in their most light sensitive colors in about 3 years'*, etc.

Depending on which part of the heritage asset is affected by the risk, and on the type and degree of damage in the items affected, the loss of value can vary from total to tiny or trace. For instance, imagine that the heritage asset is a historic house museum whose building is made of wood. A large fire will most likely cause total loss of value to this heritage asset. Theft of '*treasure objects*' from the collection in this museum would imply a large (but not total) loss of value to the entire heritage asset. Small or moderate water damage to a few books of average importance in this collection, on the other hand, would represent a very small loss of value to the heritage asset as a whole. Some dust accumulation on the objects of the collection and interior surfaces of the building would also mean a small or very small loss of value to the heritage asset.



Examples of risks to heritage assets classified according to their expected occurrence (how often or how fast) and impact (loss of value). Top left: major earthquakes are typically rare events that cause total or a very large loss of value to the affected heritage asset (Image courtesy of Aparna Tandon, ICCROM). Top right: chemical deterioration of a collection of cellulose nitrate films stored at warm temperatures is typically a fast process that causes total or a very large loss of value to that collection (Image courtesy of ICCROM Archives). Center: theft of valuable objects from a museum collection with poor security measures is typically an occasional event that causes significant loss of value to the collection every time it occurs (Image courtesy of Stephan Michalski). Bottom left: wear of the stone floor at the entrance of a heritage building due to visitor traffic is typically a slow process that causes a tiny loss of value to the building as a whole (Image courtesy of Stephan Michalski). Bottom right: local detachment of tesserae from mosaic floors in archaeological sites can accumulate fast if visitors are allowed to walk on them. In a few years, this would cause a small or moderate loss of value to the heritage site as a whole (Image courtesy of ICCROM Archives). In this diagram, the biggest risks appear at the top right corner. As we move towards the bottom left corner the risks become smaller.

2 THE ABC SCALES FOR RISK ANALYSIS

A tool has been created to help us calculate, compare, and communicate the magnitude of risks to cultural heritage. It consists of numeric scales (called the ABC scales) used to quantify the *frequency or rate* of *occurrence* and the *expected loss of value* for the different risks.

The ABC scales have 3 components. Component 'A' quantifies the frequency of the damaging event or the rate of occurrence of a process. Components 'B' and 'C' together quantify the expected loss of value to the heritage asset. The combination of A, B, and C defines the magnitude of risk. The 3 components are discussed below.

A

For *'event'* risks, this component indicates how often we expect the event to occur, i.e. the average time between 2 consecutive events. For *'cumulative process'*, this component indicates how many years it will take for a certain level of damage to accumulate.

A- Score	How often does the event occur? How many years for the accumulation of a certain level of damage?
5	~ 1 year
4 1/2	~ 3 years
4	~ 10 years
3 1/2	~ 30 years
3	~ 100 years
2 1/2	~ 300 years
2	~ 1 000 years
1 1/2	~ 3 000 years
1	~ 10 000 years
1/2	~ 30 000 years

For instance, if we expect *'a large earthquake damaging the heritage asset to occur about once every 300 years'* the A-score for this risk would be A=2½. On the other hand, if we expect that *'most audiovisual records on magnetic tape will have severely degraded and will no longer be accessible in about 30 years'*, the A-score would be A=3½.

For cumulative processes, we can fix a period of time that is relevant to our case (e.g. 10, 30 or 100 years) and estimate how much damage will accumulate in that period. For instance, when analyzing the risk of fading of colored textiles on display we can fix a period of 10 years (A=4) and then estimate how much fading will occur in those textiles in 10 years. We can also estimate the period of time required for a certain level of damage to accumulate. For example, if we estimate that it would take about 100 years for the colors in the textiles to fade completely under the current display conditions, the corresponding A score would be A=3.

B

This component indicates the size of the loss of value that we expect in each item of the heritage asset affected by the risk. By *'item'* we mean an object of a collection, an element of a historic building (e.g. a façade, the decorated interior of a particular room, the roof, a staircase), a part or a particular feature of a heritage site (e.g. a well, a burial area, a gate, a set of mural paintings), etc. To estimate the loss of value in the affected items we first need to visualize the type and the extent of damage they will suffer. Then we make a judgment about how much this damage represents in terms of loss of value in each item. The loss of value can vary from total loss to tiny or trace loss.

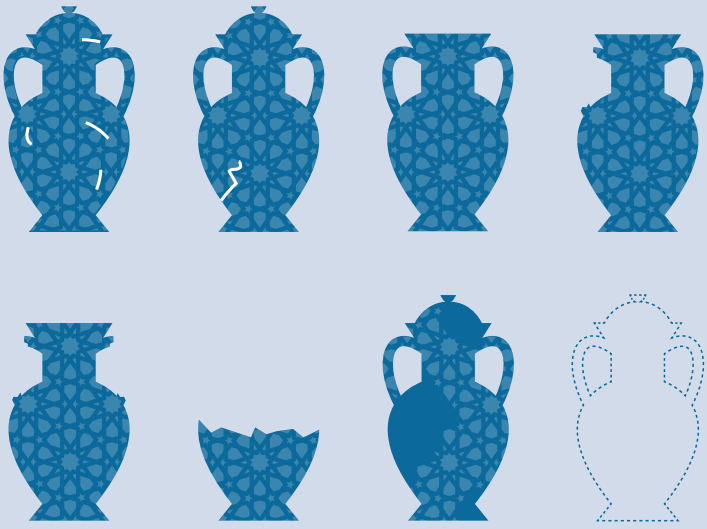
B-Score	Fraction of value lost in each affected item	Word guidelines
5	100 %	**Total or almost total loss** of value in each affected item
4 1/2	30 %	
4	10 %	**Large** loss of value in each affected item
3 1/2	3 %	
3	1 %	**Small** loss of value in each affected item
2 1/2	0.3 %	
2	0.1 %	**Tiny** loss of value in each affected item
1 1/2	0.03 %	
1	0.01%	**Trace** loss of value in each affected item
1/2	0.003 %	

For example, a total loss of value is expected in heritage items that are stolen or completely burned in a fire. A large loss of value can be expected in breakable items stored without any protection in case of a strong earthquake. A small to moderate loss of value can be expected in the façade of a historic building damaged by graffiti over a period of five years. When quantifying the expected loss of value it is especially important to consult and discuss with different people (among colleagues and other stakeholders you identified in your context) to obtain a consensus. It is also important to take into account the function or intended use of the heritage item.

Try it yourself:

PRACTICE YOUR LOSS OF VALUE JUDGMENT

In order to practice and improve our ability to judge and quantify loss of value, it is useful to compare images of the same item showing different kinds and degrees of damage. In the illustrations below, the item is a very important vase, known for its rare and beautiful decoration, and for its high historic value.



Discuss with colleagues and use the B-score table to quantify the loss of value corresponding to each image. Remember that total loss (B=5) means the complete destruction, elimination or permanent impossibility to use or access the heritage item. The different degrees of partial loss of value must be scored consistently in terms of how they compare to total loss. It is important to always provide an explanation for your scores.

Let´s look again at some images showing different types and degrees of damage caused by different agents of deterioration. How big do you think the loss of value in each case is? Use the B-score or the corresponding word guidelines to express your judgment of the loss of value.

Examples of different types and degrees of damage to heritage items. Starting from top left and moving clockwise: heritage building damaged by fire (Image courtesy of Firas Otman); discoloration and weakening of the feathers of a ceremonial fan caused by light and ultraviolet radiation (Image courtesy of ICCROM Archives); archival documents written on low-quality paper that became brittle and easily broken due to chemical deterioration at warm temperatures (Image courtesy of José Luiz Pedersoli Jr.); graffiti vandalism on the wall of a heritage structure (Image courtesy of Anwar Sabik, ICCROM).

When scoring B for 'cumulative process' risks, the degree of damage to be scored must be that expected to accumulate during the time period selected to score A. For example, when analyzing the risk of fading of colored textiles on display, if we fix a period of 10 years (A=4) to estimate how much fading will occur in those textiles, the B component must quantify the loss of value due to color fading expected to accumulate in 10 years (which may not be total fading).

NB: Loss of value is not always related to 'material damage'. When analyzing risks of dissociation by loss of information about the heritage item, or the inability to find objects because of their misplacement, it is the loss of intellectual or physical access that causes loss of value to these items.

Can you think about an example where the loss of value is not caused by material damage?

C

This component indicates how much of the heritage asset value is affected by the risk. ***Does the risk affect the entire heritage asset, a large part, a small part or just a tiny part of it? How important is the part of the heritage asset affected by the risk?***

To score C we estimate the percentage or fraction of the heritage asset value that will be affected by the risk.

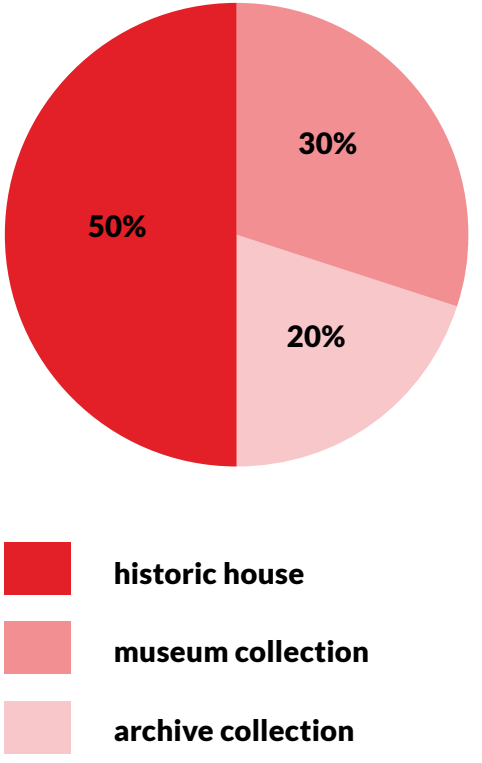
C- Score	Percentage of the value of the heritage asset	Word guidelines
5	100 %	**All or most** of the heritage asset value is affected
4 1/2	30 %	
4	10 %	A **large** fraction of the heritage asset value is affected
3 1/2	3 %	
3	1 %	A **small** fraction of the heritage asset value is affected
2 1/2	0.3 %	
2	0.1 %	A **tiny** fraction of the heritage asset value is affected
1 1/2	0.03 %	
1	0.01%	A **trace** fraction of the heritage asset value is affected
1/2	0.003 %	

For risks that affect the entire heritage asset (e.g. the complete flooding of a heritage site or a large fire in a historic house museum) the C-score is simple: C=5. However, most risks affect only part of the heritage asset. In these cases we need to know how the value of the heritage asset is distributed among its parts.

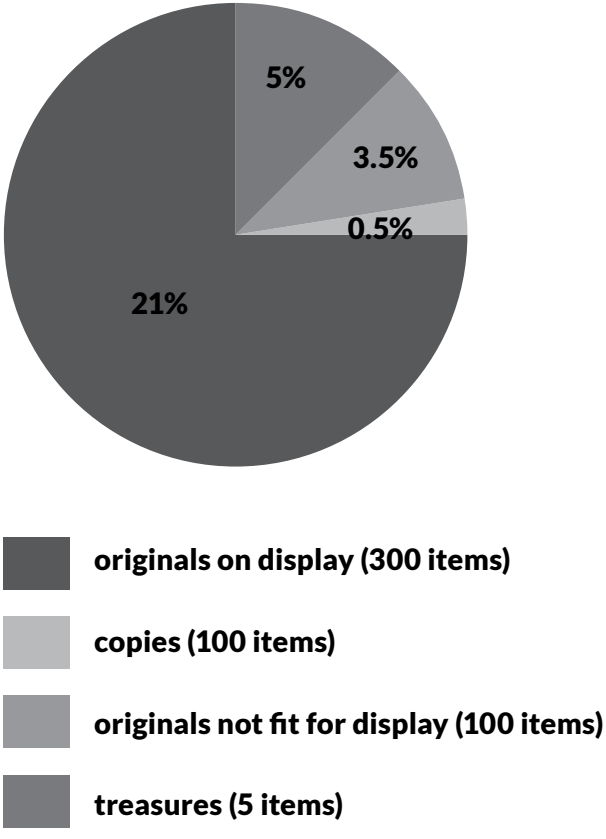
For instance, let´s suppose that the heritage asset is a historic house museum that contains a collection of furniture, clothing, and domestic artifacts, as well as a historic archive that belonged to the owners of the house. The main purpose of this museum is to preserve and present the lifestyle and the history of this prominent wealthy family from the region that owned the house and lived there in the 19th century. The house is a unique example of a typical architectural style that can no longer be found anywhere else. It is in very good condition, and most of its construction and finishing materials are original. Most of the furniture, clothing and artifacts that help show the family´s lifestyle at the time are typical for other rich families and therefore similar items can be found elsewhere. Actually, some of the artifacts on display are modern copies of original items that cannot be displayed anymore because of their poor condition. The only real 'treasure' among the objects of the museum collection is a unique set of 5 decorated vases of exceptional aesthetic quality made by a nationwide famous craftsman from that time. In the archive we can find letters of correspondence with family members who lived abroad, a small collection of illuminated manuscripts, and some rare business documents that provide testimony about the history of trading in the region. After discussion and consultation with stakeholders over several meetings, and taking into account the mission of the museum, the staff has estimated (quantitatively) how the value of this heritage asset is distributed among its different parts. These estimates are presented in percentages in the tables and pie charts below.

The pie charts help to visualize the *relative importance* of the different components of the heritage asset. In this type of chart, called *'Value Pie'*, the size of each slice of the pie indicates how much (%) each component represents of the heritage asset value.

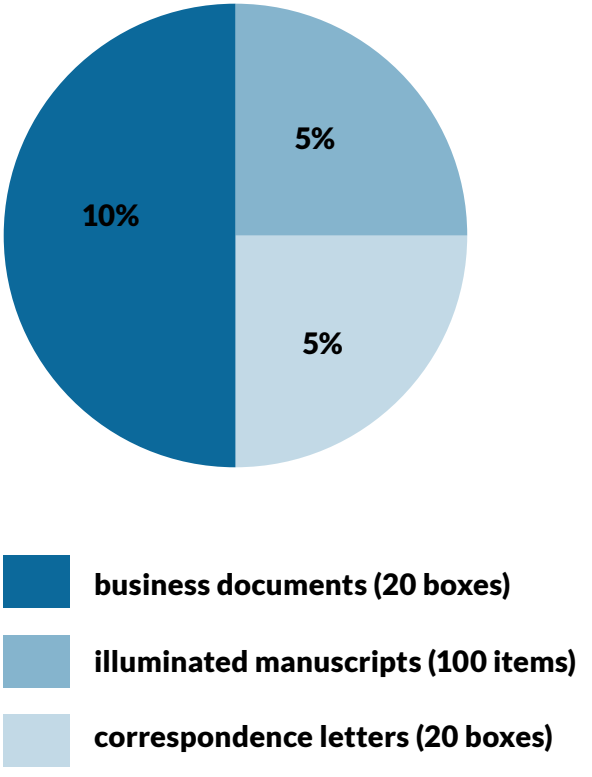
Main parts of the heritage asset	Percentage of the heritage asset value represented by each part
Historic house	50%
Museum collection	30%
Archive collection	20%
TOTAL	100%



Groups of different relative importance in the museum collection	Percentage of the heritage asset value represented by each group
Set of 5 decorated vases ('treasures')	5%
Original objects on display (300 objects)	21%
Original objects in very poor condition, not fit for display (100 objects)	3.5%
Modern copies of original objects (100 objects)	0.5%
TOTAL	30%



Groups of different relative importance in the archive collection	Percentage of the heritage asset value represented by each group
Correspondence with family members (20 archival boxes)	5%
Illuminated manuscripts (100 bound volumes)	5%
Business documents (20 archival boxes)	10%
TOTAL	20%

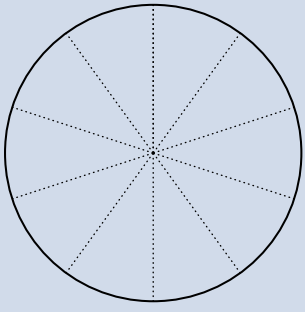


Try it yourself:

BUILD YOUR OWN VALUE PIE

Consider your own 'personal asset' and divide it into 3 to 5 groups. For example: 1. Your house (building only); 2. Your car; 3. Your furniture; 4. Your computer and your cell phone; 5. Your 'family treasures' (objects specially important to your family). Estimate how the total value of this 'personal asset', i.e. its importance to you, is distributed among the different groups. Draw a value pie to show your results. If possible, discuss the relative importance you give to each group with your family or with colleagues. Remember to give clear explanations to justify the numbers.

Main groups of my 'personal asset'	Percentage of my 'personal asset' value represented by each group
TOTAL	100%



Using the numbers from the tables on pages 72-74 we can score the C component of risks that affect different parts of the heritage asset under study (i.e. the historic house museum).

Example 1 - risk of opportunistic theft of original objects on display (except treasures, which are well-protected): assuming that the most likely scenario involves 1 small object stolen per event, the corresponding percentage of the heritage asset value would be 0.07% (21% / 300 objects). The closest C-score is C=2.

Example 2 - risk of water damage to the illuminated manuscripts caused by rainwater infiltration into the building: assuming that about 50 out of the 100 volumes will be affected by such an event, the corresponding percentage of the heritage asset value would be 2.5%. This corresponds to a C-score of C=3½.

After scoring the three components of each risk using the *ABC scales* we can calculate the *magnitude of risk (MR)*, i.e. its potential to cause loss of value to the heritage asset. This calculation is done by adding the scores of the 3 risk components:

$$A + B + C = MR$$

A more detailed discussion about the meaning of MR and its use for defining priorities is presented in *Evaluate - Magnitude of risk and level of priority (pages* 92-93).

3 SOURCES OF INFORMATION

In order to quantify each component of the risk, you will need to collect and analyze information. The main sources of information for analyzing risks to cultural heritage are summarized in the table below:

Regional statistics	Local and common knowledge	Scientific and technical knowledge
These statistics are the bedrock of understanding catastrophic risks. Many agencies around the world have developed vast resources to provide non-technical users with Internet tools to predict these risks.	This source of knowledge needs you to meet people, to discuss, to interview, and to do facility surveys, collection surveys, site surveys, etc. Do not underestimate or overestimate this source relative to the other two. This source includes the common sense and intuition of you and your colleagues.	The Canadian Conservation Institute (CCI) web page on agents of deterioration provides an introduction to the essential understanding of each agent. Beyond that, one needs to read more or talk to colleagues and find experts who can advise (local, international, university, research centres, etc.)
This is the usual source of knowledge about the frequency and intensity of rare events.	This is the usual source of knowledge about common events and about the intensity of cumulative hazards.	This is the usual source of knowledge about the sensitivity of heritage assets to cumulative processes and the source for most theories that can analyze risks.
Examples: • Geographic information systems (GIS) • Climate tables • Natural disaster statistical data • Government statistical data • Shared data between heritage organizations	**Examples:** • Facilities surveys • Building documentation • Staff knowledge • Memory of local residents • Observations of previous damage	**Examples:** • Technical literature • Science literature • Building design documents • Technical and scientific experts

4 EXAMPLES OF RISK ANALYSIS

Let us consider the historic house museum discussed on pages 71-74. We will analyze 3 risks to this heritage asset:

1 *A large fire will cause severe damage to the historic house and its contents.*

2 *Visitors will steal items of the museum collection on display.*

3 *The cardboard boxes recently acquired to store the documents of the archive, are not acid-free, which will cause faster discoloration and weakening of the documents.*

Risk 1. A large fire will cause severe damage to the historic house and its contents.

A-score

A large fire is a 'rare event' type of risk for a museum. National statistics from different countries[1] show that the average time between large fire events for museums with only basic fire control measures is about 300 years. By basic fire control measures we mean: local smoke alarms and portable fire extinguishers correctly positioned, in sufficient number, regularly inspected, tested and maintained; a telephone line and a fire station available full time; safety procedures for the operation of open flame devices. Most historic house museums around the world have only these or even less fire control measures. This is also the case of the museum in this example. Because we do not have national statistics from the country where the museum is located, we will use the fire statistics available from other countries as an approximation. The A-score in this case would be **A=2½** , which means that we expect a large fire to occur in the museum about once every 300 years. (This does not mean that it occurs exactly every 300 years. From the perspective of our decision-making about risk, it may be more helpful to express it as a 10% chance each 30 years.)

1 See, for instance: "Fire Risk Assessment for Collections in Museums", J. Tetreault, J.ACCR, vol. 33, 2008, p.3-21. Available online at: https://www.cac-accr.ca/files/pdf/Vol33_doc1.pdf (Retrieved: 07-07-2016).

B-score

Considering that the museum building has many wooden elements (floors, ceilings, stairs, roof framing, doors, windows), and that most objects of the collection of furniture, clothing, and domestic artifacts, as well as the documents of the historic archive are made of combustible materials, we expect total or almost total loss of value in each item of this heritage asset affected by the fire (building and objects). The effects of fire include partial or total collapse of the building, combustion of building parts and its contents, deformation or fracture of incombustible materials, deposition of soot, etc. The B-score in this case would be **B=5**.

C-score

Given the characteristics of the building and its contents, we expect that all or most of this heritage asset and its value would be affected in the event of a large fire. The C-score in this case would be **C=5**.

Magnitude of risk (MR)

The magnitude of risk is **MR=12½** (2½+ 5 + 5).

To summarize: we expect a large fire event to happen in the museum about once every 300 years on average (A=2½), which is the same as a 10% chance every 30 years, and the fire will affect all or most of the heritage asset value (C=5) causing total or almost total loss of value in each item affected (B=5).

Image to help illustrate and communicate the risk being analyzed in this example. As mentioned before, the use of images can be a powerful tool to help us communicate risks to others (istock.com/GordonImages).

Risk 2. Visitors will steal items of the museum collection on display.

A-score

Theft is also an 'event' type of risk, but it is more frequent than large fires. Many museum collections have experienced one or more thefts during their lifetime. It is therefore common to find information about past thefts in the records of the institution or in the memory of its staff. This information can be used to estimate the average time between 2 consecutive events. We can also make this estimation by looking at theft statistics (or the 'collective theft memory') from a larger number of museums in the country, in case they are available. In this example, according to the staff memory, the collection has suffered 3 events of theft of objects on display since the museum was opened 75 years ago. No major improvement concerning the security of the collection on display has ever been made despite these mishaps. Using this information we can estimate an average time of 25 years between 2 events of theft affecting objects on display. The A-score in this case would be **A=3½**.

B-score

A stolen item will no longer be available for the museum and its public. The B-score in this case is **B=5**.

C-score

The most probable scenario for future events would be the opportunistic theft of a small (easy to hide), original object of the collection displayed without a showcase or any other protection. This is what happened in the 3 previous thefts. The 'treasure' of the collection, i.e. the set of 5 decorated vases, is locked inside a robust showcase, and there is always a museum guard in the room. The other rooms have no permanent security guards, and the museum does not have security cameras. Because the modern copies of objects on display are clearly identified as such, it is easy to spot the original objects. For this scenario of 1 original object of the collection on display stolen per event, and based on the relative value assessment shown on pages 72-74, the C-score would be **C=2**. This means that a tiny fraction of the heritage asset value is expected to be affected per event.

Magnitude of risk (MR)

The magnitude of risk is **MR=10½** (3½+ 5 + 2).

To summarize: we expect an opportunistic theft event to happen in the museum about once every 25 years (A=3½), which will most likely affect 1 original object of the collection on display (except the 'treasures') or a tiny fraction of the heritage asset value per event (C=2), resulting in total loss of the stolen item (B=5).

Image to help illustrate and communicate the risk being analyzed in this example. As mentioned before, the use of images can be a powerful tool to help us communicate risks to others (Image courtesy of Stefan Michalski).

Risk 3. The cardboard boxes recently acquired to store the documents of the archive, are not acid-free, which will cause faster discoloration and weakening of the documents.

A-score

Deterioration by exposure to volatile substances released by cardboard boxes is a 'cumulative process' type of risk. As discussed before, for this type of risk we can define a period of time that is relevant to our case and estimate how much damage will accumulate in that period. In this case, a period of 30 years has been chosen to assess how much damage will accumulate in the documents stored inside the boxes. Therefore, the A-score is **A=3½**.

B-score

Observations made on similar archival collections stored for long periods of time in the same kind of boxes show that, the only type of deterioration actually caused by the box is a more pronounced yellowing or browning of the sheets of paper that stay in direct contact with the inside of the box. There is no evidence that the substances released by the box contribute in a measurable way to accelerate the weakening of the paper documents kept inside it. Weakening of this kind of paper over time is primarily caused by acids that already exist inside the paper, introduced during its production. Therefore, in our example, because the archival items kept in the boxes (family letters and business documents) have only historic/informational value and no aesthetic value, only a tiny loss of value is expected to accumulate in each item affected over a period of 30 years. The B-score in this case is **B=2**.

C-score

Observations made on similar archival collections stored for long periods of time in the same kind of boxes show that only the sheets of paper that remain in direct contact with the inside of the box are affected. This means that only 2 sheets of paper are affected per box. In our example, given that each box contains about 200 letters or documents, only 1% of these items will be affected (2 in 200). According to the relative value assessment shown on pages 72-74, the 40 boxes containing family letters and business documents represent 15% of the heritage asset value. The fraction of the heritage asset value affected by this risk is therefore 1% of 15%, i.e. 0.15%. The C-score in this case is **C=2**.

Magnitude of risk (MR)

The magnitude of risk is **MR=7½** (3½ + 2 + 2).

To summarize: in a period of 30 years (A=3½) we expect a tiny loss of value (B=2) to accumulate in a tiny fraction of the heritage asset value (C=2), i.e. in about 1% of the archival items (letters and documents) caused by their storage inside 'low quality' cardboard boxes.

Image to help illustrate and communicate the risk being analyzed in this example. As mentioned before, the use of images can be a powerful tool to help us communicate risks to others (Image courtesy of the Brazilian National Archives).

Try it yourself:

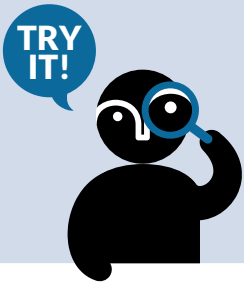
CALCULATE THE MAGNITUDE OF A RISK

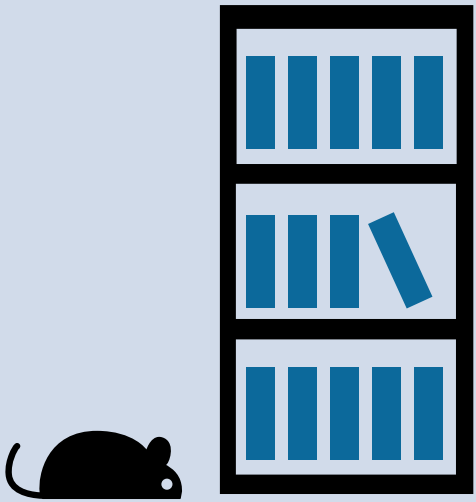
Use the ABC scales to calculate the magnitude of the risk described below.

Risk summary sentence: *mice will enter the library building and damage books of the collection by chewing on them.*

Risk analysis: *The library collection has 10 000 books, all of them kept on open shelves. The books on the lower shelves are close to the floor, and can easily be reached by mice. There is a high population of mice in the area where the library is located. They can enter the building and the collection room through openings such as cracks, holes, vents, drains, doors, windows, etc. The collection has suffered damage by mice in the past. The library staff remember 3 events of book damage by mice in the past 30 years. The frequency of this kind of event can therefore be estimated as about once every 10 years. Because the staff are aware of this problem, the collection is monitored regularly. This allows them to quickly identify and react to the presence of mice chewing on the books. The most probable damage expected to occur in this situation is the partial destruction of the covers of a few books per event. In the opinion of the library staff and users consulted by them, this degree of damage corresponds to a loss of value between tiny and small in each book affected. No significant loss of information is expected, and the books have no special value except for their informational content.*

Based on the past events and considering the current monitoring measures, the staff estimate that an average of 3 books will be affected per event in the future. All 10 000 books of the collection are equally important for the functioning of the library.





A + B + C = MR

HOW OFTEN

LOSS OF VALUE IN EACH AFFECTED ITEM

PERCENTAGE OF THE VALUE OF THE COLLECTION AFFECTED PER EVENT

MAGNITUDE OF RISK

5 HOW SURE ARE WE?

When we analyze risks we try to predict the loss of value to our heritage asset in the future. We can never be 100% sure about what exactly is going to happen. There is always some *uncertainty* about the future, and we have to deal with it. Sometimes this uncertainty is small, sometimes it is big.

For example, how certain are you that it is going to rain tomorrow? The uncertainty in this case will depend on where in the world you are, and on how much information is available about the weather forecast.

In risk management it is important to recognize that uncertainty always exists, and to show it explicitly.

One way to express our uncertainty when using the ABC scales is to provide not only a score for the most likely scenario (like we did in the previous section), but also scores for the plausible *'worst case'* and *'best case'* scenarios for each component of the risk. This means that instead of 1 score we will have 3 scores for each component: the most likely, the plausible *'worst case'* (we call it *'high estimate'*), and the plausible *'best case'* (we call it *'low estimate'*). Sometimes the most likely will coincide with the *'worst case'* or the *'best case'* scenario.

For instance, if we look at the risk of theft analyzed in the previous section for the historic house museum, there is uncertainty about the number of items on display that will be stolen per event. Our most likely scenario was of 1 item stolen per event, based on what happened in the previous thefts, and on the information available from other museums about this kind of risk. The plausible best case would also be 1 object stolen per event, which is the minimum that can be stolen. In this example, the *'low estimate'* coincides with the most likely. But it is possible that the number of objects stolen in future opportunistic theft events will be bigger. We are not 100% sure about this. We know it is not realistic to estimate that all the objects in a room will be stolen in 1 event, but it is plausible to consider that, on average, up to 3 small items might be stolen per event. This would be the

worst case scenario for this component of the risk. So instead of 1 C-score we have the 3 following C-scores:

- ***Most likely:*** 1 original object on display (not a *'treasure'*) stolen per event. C=2
- ***Low estimate*** *(plausible best case scenario):* same as most likely. C=2
- ***High estimate*** *(plausible worst case scenario):* 3 original objects on display (not *'treasures'*) stolen per event. C=2½

This means that the *magnitude of risk* will also be presented using 3 MR values (low, most likely, high) to show our *level of uncertainty*.

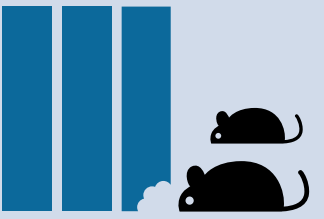
In our example above, assuming that the uncertainty for the other components (A and B) is negligible, the MR value for the risk of opportunistic theft would vary between 10½ and 11 (10½ being the most likely estimate).

Try it yourself:

QUANTIFY UNCERTAINTY

Think about the risk of book damage by mice that you analyzed before. Is there uncertainty in the analysis of this risk? Can you explain the causes of this uncertainty? Can you provide low and high estimates for each component of the risk (A, B, C)? As a consequence, how would the MR value vary for this risk?

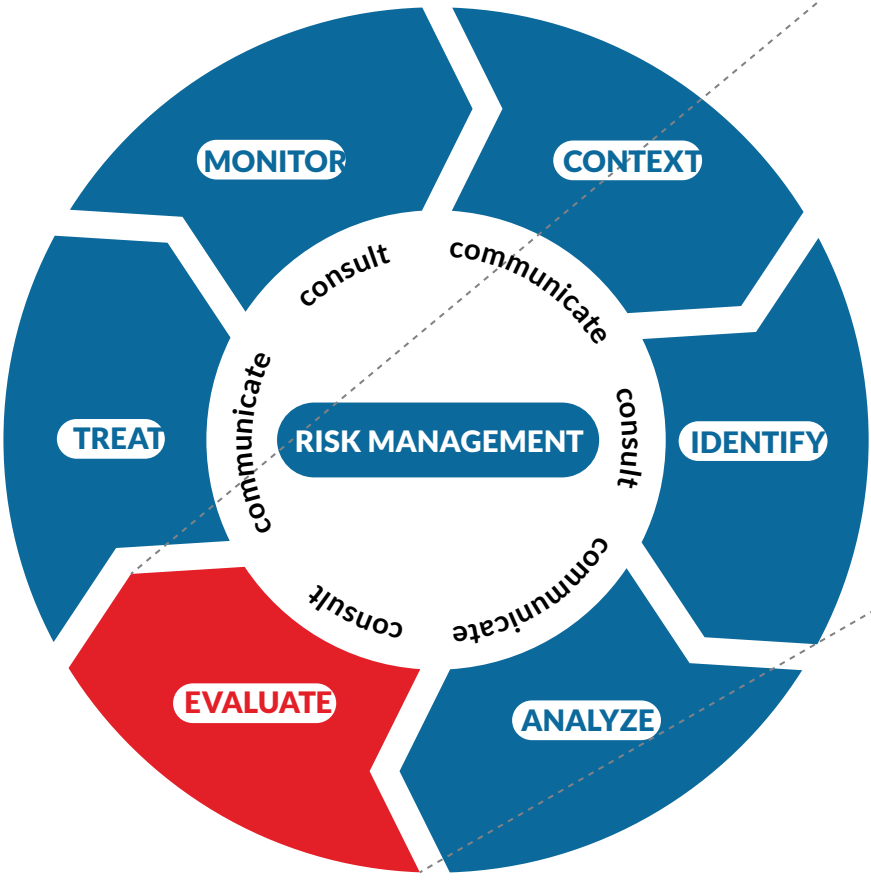
	LOW ESTIMATE	MOST LIKELY	HIGH ESTIMATE
A			
B			
C			
MR			

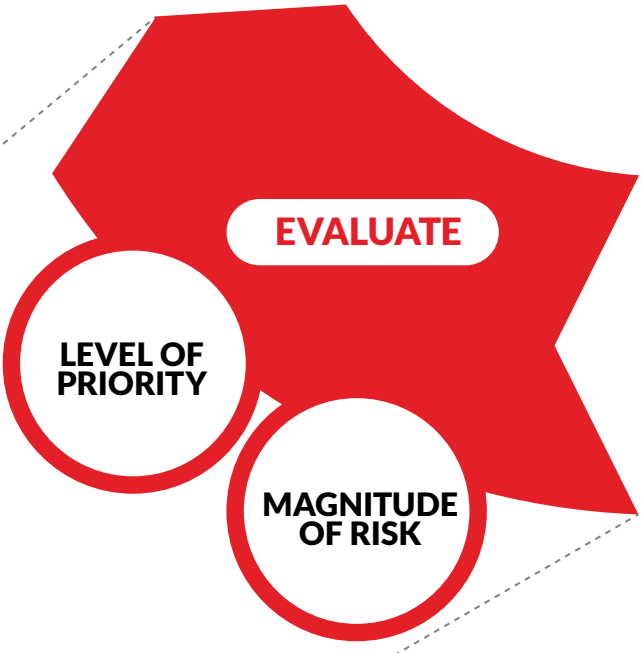


Evaluate

1 **MAGNITUDE OF RISK AND LEVEL OF PRIORITY**

2 **COMPARING RISKS**





CONTEXT

IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR

1 MAGNITUDE OF RISK AND LEVEL OF PRIORITY

Now that we know the magnitude of each risk, we can use this information to improve our decisions about the heritage asset. In this step we compare the risks with each other, we evaluate their level of priority, and we decide within the institution which risks are acceptable and which ones are not and therefore must be *'treated'*.

The main criteria used to compare and evaluate risks is their magnitude (MR).

On the next page is a scale of MR values classified according to their level of priority: catastrophic (in red color); extreme (orange); high (yellow); medium (green); and low priority (blue). The biggest possible value of MR obtained with the *ABC scales* is 15. A risk with MR of 15 means that the entire heritage asset is expected to be completely lost in 1 year. This is possible, for instance, if the heritage asset is located in a war zone.

In this scale, each decrease of 1 unit in the MR means that the risk is 10 times smaller. For example, a risk of MR=14 is 10 times smaller than a risk of MR=15. A risk of MR=13 is 100 times smaller than a risk of MR=15, and 10 times smaller than a risk of MR=14. A risk of MR=12 is 1 000 smaller than a risk of MR=15, and so on.

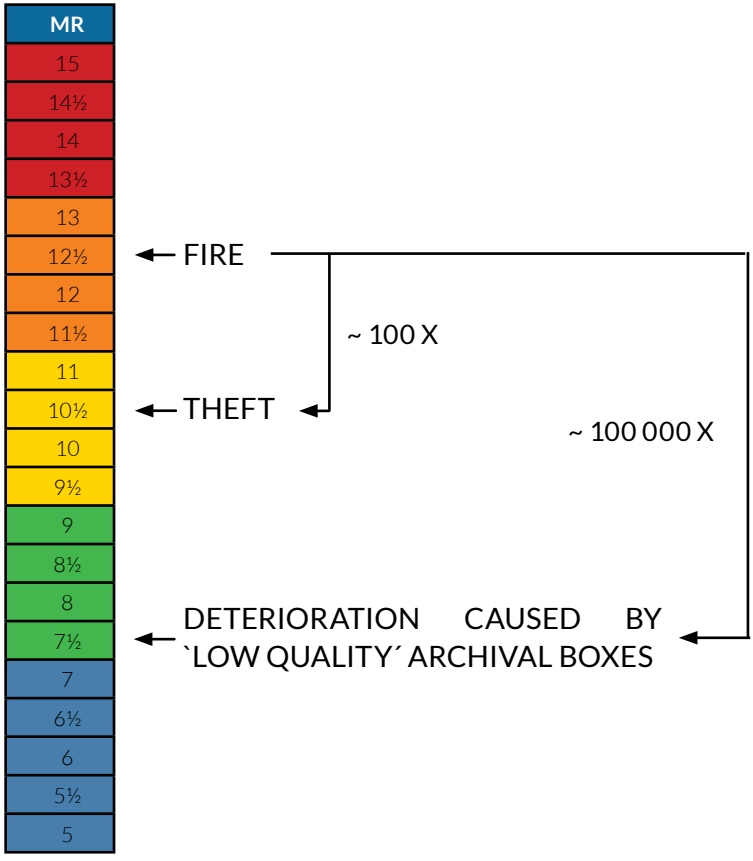
The expected loss of value to the heritage asset for each MR value is shown in the last column of the table. By considering these numbers, we can discuss within the institution and decide which level of risk is acceptable, and which ones are not. For instance, some heritage institutions may consider acceptable a loss of value to the entire heritage asset that is equal or smaller than 1% in every 1 000 years (which is equivalent to 0.1% in every 100 years). This means that risks of MR ≤ 10 are acceptable, whereas those of MR > 10 are not acceptable. Other institutions may think differently about the level of risk that is acceptable for the heritage assets under their responsibility.

What about you? Which level of risk would you consider acceptable for your heritage asset?

Level of priority	MR	Expected loss of value to the heritage asset
13½ - 15 Catastrophic priority All or most of the heritage asset value is likely to be lost in a few years.	15	100% in 1 year
	14½	30% per year
	14	10% per year = 100% in 10 years
	13½	3% per year = 30% every 10 years
11½ - 13 Extreme priority Significant damage to all the heritage asset, or total loss of a significant fraction of the heritage asset, is possible in approximately one decade. All or most of the heritage asset value can be lost in one century	13	10% every 10 years = 100% in 100 years
	12 ½	3% every 10 years = 30% every 100 years
	12	1% every 10 years = 10% every 100 years
	11½	0.3% every 10 years = 3% every 100 years
9½ - 11 High priority Significant loss of value to a small fraction of the heritage asset, or a small loss of value in most or a significant fraction of the heritage asset is likely in one century.	11	1% every 100 years
	10½	0.3% every 100 years
	10	0.1% every 100 years = 1% every 1 000 years
	9½	0.03% every 100 years = 0.3% every 1 000 years
7½ - 9 Medium priority Small damage or loss of value to the heritage asset over many centuries. Significant loss to a significant fraction of the heritage asset over many millennia.	9	0.1% every 1 000 years = 1% every 10 000 years
	8½	
	8	0.01% every 1 000 years = 0.1% every 10 000 years
	7½	
7 and below Low priority Minimal or insignificant damage or loss of value to the heritage asset over many millennia.	7	0.001% every 1 000 years = 0.01% every 10 000 years
	6½	
	6	0.0001% every 1 000 years = 0.001% every 10 000 years
	5½	
	5	0.00001% every 1 000 years = 0.0001% every 10 000 years

2 COMPARING RISKS

A comparison of the MR values for the 3 risks analyzed in the example of the historic house museum (pages 78-83) is shown on the next page. The risk of a large fire affecting the building and its contents (MR=12½) has an extreme priority. A risk of this magnitude is equivalent to losing about 3% of the heritage asset value every 10 years (or 30% per century, or 100% in about 300 years). The museum direction considers this level of risk as *'not acceptable'*. The risk of opportunistic theft of objects on display (MR=10½) has a high priority. It is 100 times smaller than the fire risk. A risk of this magnitude is equivalent to losing about 0.3% of the heritage asset value every 100 years (or 3% per millennium). The museum direction considers this level of risk as *'just beyond acceptable'*. The risk of deterioration of archival documents caused by low quality storage boxes (MR=7½) has a medium (almost low) priority. It is 1 000 times smaller than the theft risk, and 100 000 times smaller than the fire risk. A risk of this magnitude is equivalent to losing about 0.003% of the heritage asset value per millennium. The museum direction considers this level of risk as *'acceptable'*.



Comparison of the 3 risks analyzed in the example of a historic house museum (see pages 78-83).

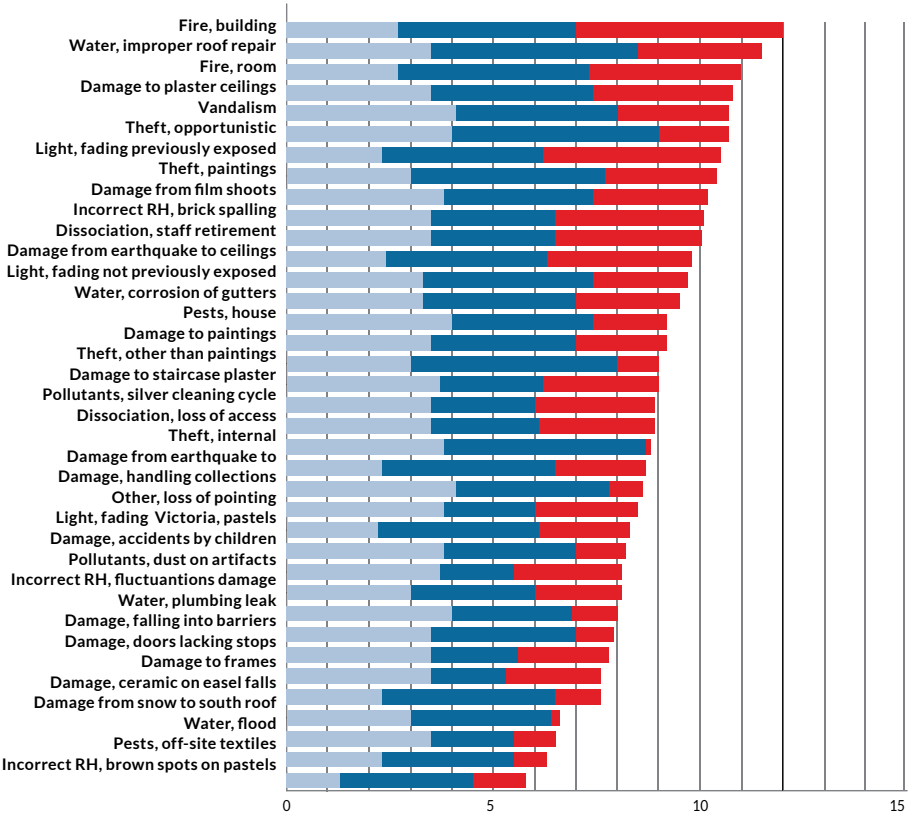
The MR priority graph

To compare, prioritize, and show all the risks that affect our heritage asset in a concise way, a graph like the one presented opposite is useful. It shows 37 risks to a historic house museum, organized in decreasing order of MR. The historic house museum in this example is located in a cold country in the Western Hemisphere. It has a mixed collection that includes furniture, paintings, pastel drawings, silverware, textiles, ceramics, etc. Part of this collection is stored off-site, in a warehouse located in another part of the city. The museum building has high architectural value. It is made of a special kind of brick, and has a rare type of decorated roof. Its interior is also highly decorated, with detailed woodwork, painted ceilings, etc. The risks are identified in the graph by a simple title, e.g. *Fire*, *building*. The scores of their 3 components are shown in different colors (A-light blue; B-dark blue; C-red), and the total length of the colored bars indicates the magnitude of each risk in the numeric scale at the bottom of the graph. As we can see, there are different types of risks to the museum building and the collection. Some of them have natural causes (e.g. snow, pests, earthquake); others are manmade (e.g. vandalism, film shoots, theft). The risks of highest magnitude for this heritage asset are those of fire, partial collapse of the roof and decorated ceilings because of absent or improper maintenance, vandalism and opportunistic theft. The risks of flooding, pest damage to the collection in the off-site storage, and the formation of mould brown spots on the pastel drawings caused by incorrect RH are the smallest. The difference in MR between the smallest and the biggest risk in this example is about 6 units, which means 1 million times! In the next 2 years, the museum has decided to focus its attention on those risks with MR ≥ 10.

A-score: **How often does the event occur?**
How many years for the accumulation of a certain level of damage?

B-score: **Fraction of value lost in each affected item.**

C-score: **Percentage of the value of the heritage asset affected.**



Example of a MR priority graph showing 37 risks that have been identified and analyzed for a heritage asset.

Treat

1 TREATING RISKS

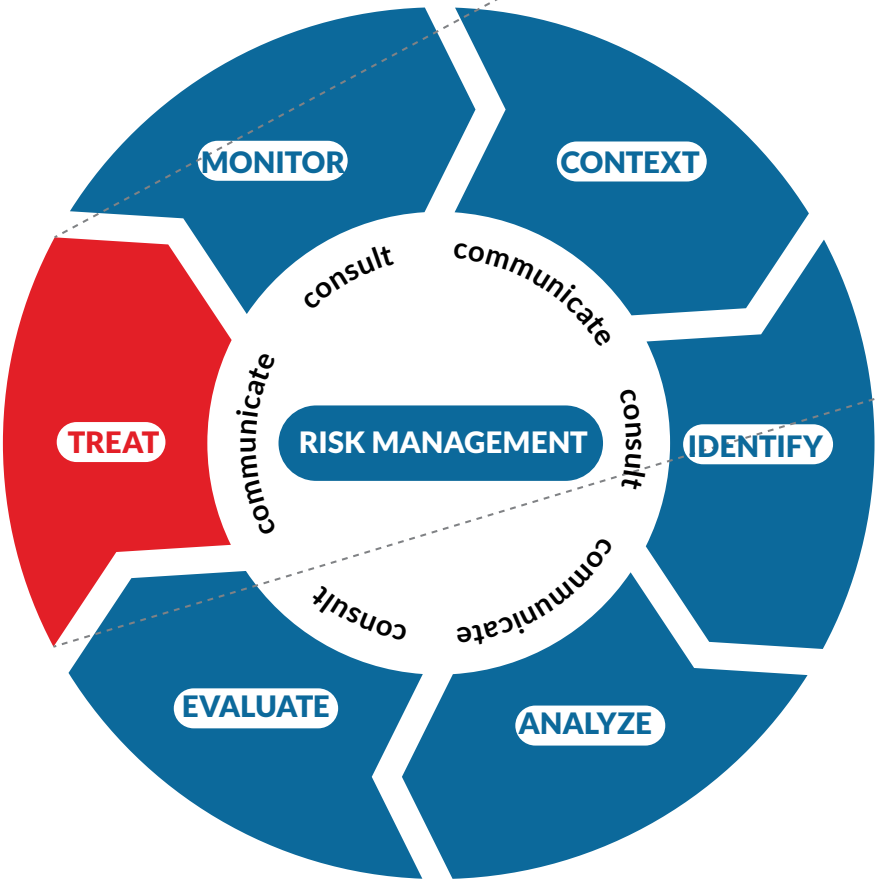
2 THE 6 'LAYERS' OF ENCLOSURE

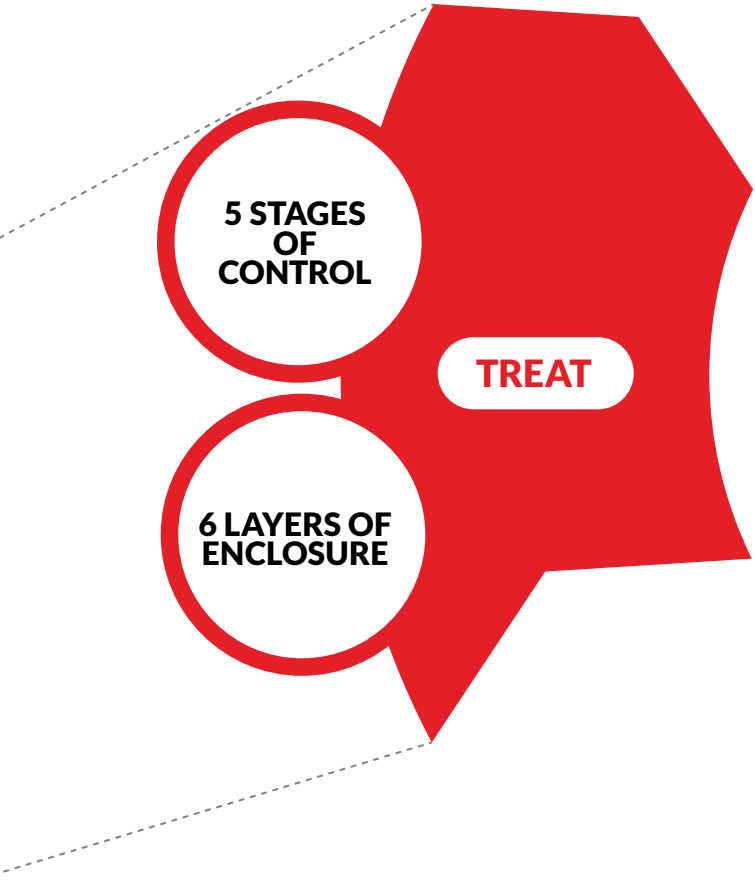
3 THE 5 'STAGES' OF CONTROL

4 COMBINING 'LAYERS' AND 'STAGES'

5 SELECTING THE BEST OPTIONS

6 PLANNING AND IMPLEMENTING SELECTED OPTIONS





CONTEXT

IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR

1 TREATING RISKS

This is the last step of each *risk management cycle*. Now that we know the risks and their magnitude, and have determined which ones are the priority risks to our heritage asset, we can start thinking about effective measures to eliminate or reduce those risks. This is what we call *'treating the risks'*. Some useful tools to help us do that in a systematic way are presented below.

2 THE 6 'LAYERS' OF ENCLOSURE

The 6 layers of enclosure around heritage assets have been introduced in the *Identify* section (page 49). When developing options to reduce risks it is useful to think about what can be done in each layer of enclosure to reduce the occurrence or the impact of each risk.

For instance, in the example of a risk of opportunistic theft of objects on display in the historic house museum (discussed in previous sections), we could think of measures at each layer of enclosure such as the following:

- attach the objects to their base *(support)*
- display the objects inside showcases *(fittings)*
- install security cameras in the display rooms *(room)*
- forbid the entrance of visitors carrying bags, backpacks, suitcases inside the museum *(building)*

3 THE 5 'STAGES' OF CONTROL

Another tool to develop risk treatment options is to think about 5 different *'stages'* to control the risks:

1 **AVOID** the cause of the risk or everything that makes the risk higher. This is the first logical thing to do, and the most effective (when possible).

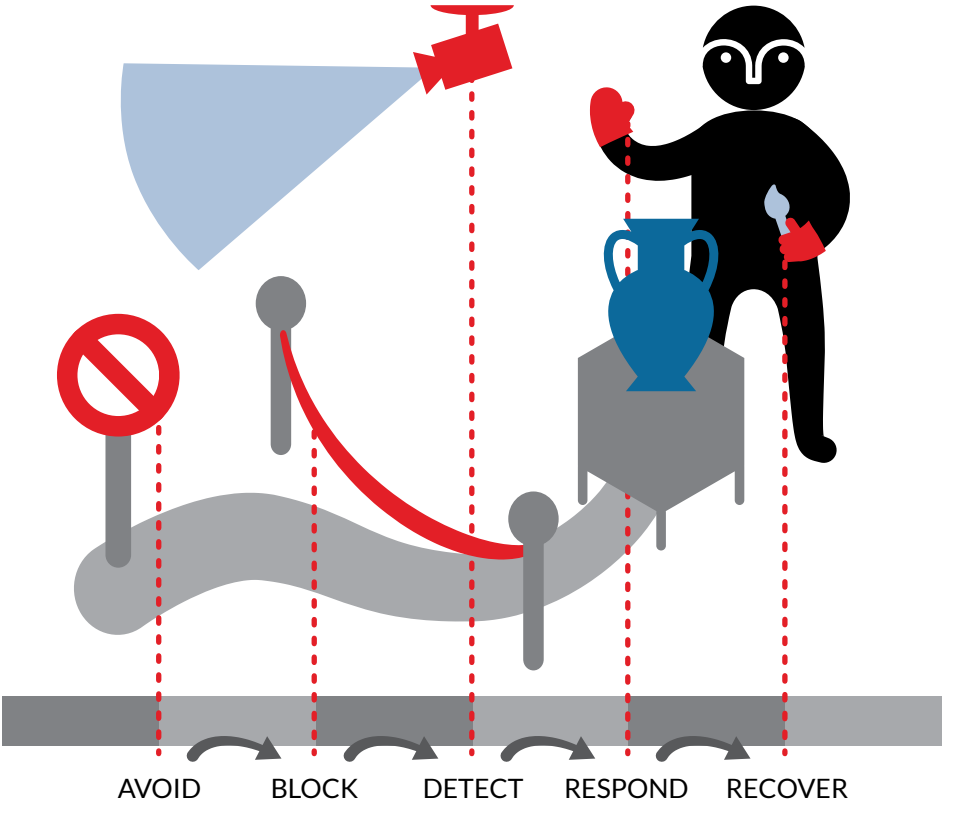
2 **BLOCK** the agents of deterioration. If it is not possible to avoid the risk, the next logical action is to put a protective barrier somewhere between the heritage asset and the source of the agent.

3 **DETECT** the agents of deterioration and their effects on the heritage asset. It is important to monitor the different agents so that we can react quickly in case they threaten, or begin to damage, the heritage asset. Detection alone is not enough. We need to respond effectively whenever a problem is detected.

4 **RESPOND** to the presence and damaging action of the agents of deterioration on the heritage asset. This stage includes all planning and preparations to enable a quick and effective response. DETECT and RESPOND should always be considered together when we are developing options to reduce risks.

5 **RECOVER** from the damage and losses caused to the heritage asset. If everything else fails, the only option is to try to recover the items or parts of the heritage asset affected by the agents of deterioration. Various actions can be taken to ensure successful recovery (complete and updated documentation of heritage items, budget allocated for emergency, insurance, expertise identified and contacted in advance of any event, etc.)

The 5 *'stages of control'* include both preventive and reactive measures to reduce risks to our heritage assets. Of course, prevention is much more important and more effective than reaction. However, good risk management always integrates these two types of action in order to achieve the best possible results.



In the example of opportunistic theft at the historic house museum, the measures to reduce risk assigned to a particular *'layer'* can also be assigned to a particular *'stage of control'*:

- forbid the entrance of visitors carrying bags, backpacks, suitcases inside the museum (AVOID);
- attach the objects to their base OR display the objects inside showcases (BLOCK);
- install security cameras in the display rooms (DETECT)

Using the 5 'stages of control', can you think about other measures than those already listed which could reduce the risk of opportunistic theft?

4 COMBINING 'LAYERS' AND 'STAGES'

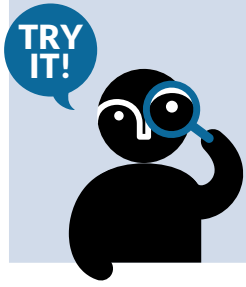
For each risk to be treated we can use a table like the one below to help us think about all the possible options in a systematic way. At each *'layer of enclosure'*, think about which type of action or *'stage of control'* could be introduced or improved. Remember that it is not necessary and sometimes not even possible to fill all the cells in the table. This is just another tool to help you to think more widely!

	Region	Site	Building	Collection room	Fittings	Packaging, Supports
Avoid						
Block						
Detect						
Respond						
Recover						

Try it yourself:

DEVELOP OPTIONS

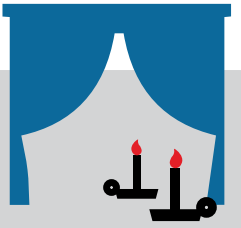
Use the table on the opposite page to develop different options to reduce the risk of book damage by mice that you analyzed before.



The illustrations below present examples of risk reduction measures using different *'stages of control'* at different *'layers of enclosure'* of heritage assets.

AVOID:

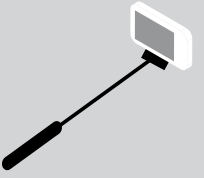
Avoid placing new heritage assets in areas that are affected by tsunami or flooding.



Avoid risky practices such as lighting candles and unsupervised construction works with open flames inside heritage buildings.

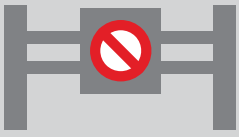
Avoid food and other attractants for pests in collection areas.

Avoid losing information about the heritage asset by keeping an updated inventory and backup copies.

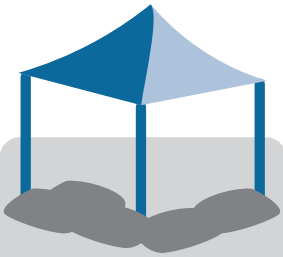


Museums around the world have prohibited the use of 'selfie sticks' to avoid accidental damage to works of art.

BLOCK:



Block unauthorized entrance of visitors in fragile areas of a heritage site.



Block rainwater and direct sunlight in susceptible areas of a heritage site.

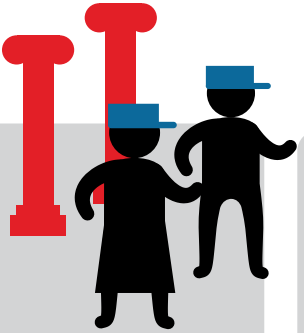
Block the entrance of several agents of deterioration (water, pests, pollutants, etc.) inside a heritage building by proper maintenance of its roof.

Curtains and filters on windows help block/ reduce the incidence of light and UV on sensitive materials inside a historic house museum.

A showcase in a museum exhibition room protects manuscripts from vandalism, theft, physical contact, dust, etc.

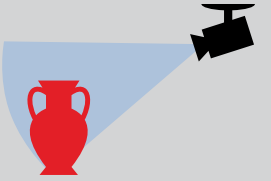
Packaging with shock-absorbing material blocks the damaging action of physical forces on fragile archaeological glass and ceramic objects.

DETECT:



Guards patrolling a heritage site will detect attempts of theft and vandalism.

Conservators inspecting an outdoor sculpture will detect the level of deterioration by environmental factors (rain, pollutants, pests, etc.).



Security cameras will detect the presence and movement of people inside and around the museum building.

Smoke alarm inside a heritage building will detect and signal the beginning of a fire.

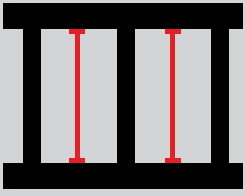
An alarm system will detect and signal unauthorized entrance inside the museum storage room.

A digital thermo-hygrometer will monitor the levels of temperature and relative humidity inside collection areas.

Detect the levels of light and UV to which a traditional costume is exposed using a light and UV meter.

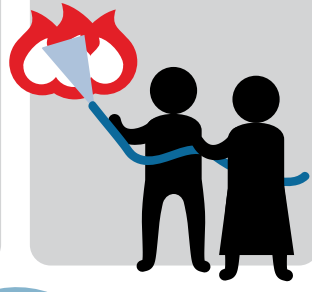
RESPOND:

Rescue archival records from a flooded historic city (wet documents must be dried quickly to prevent mould growth).

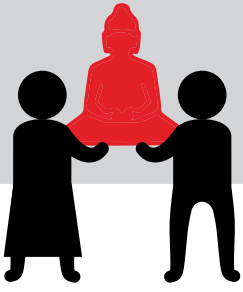


Stabilize the structure of a traditional wooden building at risk of collapsing because of termite infestation.

Firemen fight a fire in a heritage building.



Remove sacred sculptures from a building at risk of collapse following a strong earthquake.



Use inert gas on objects infested by harmful insects.

RECOVER:

Reconstruct a monument destroyed by vandalism.

Work with police to recover stolen rare books.

Restore museum objects after accidental breakage.

Recover digital data about the heritage asset from a damaged hard disk.

5 SELECTING THE BEST OPTIONS

After considering all possibilities to reduce priority risks based on the different combinations of *'layers'* and *'stages'*, we will end up with many options. ***Which ones are the best?*** To select the best option(s) for reducing a given risk we should think about a few things:

- ***How much does the option reduce the risk? Does it eliminate the risk completely? Does it reduce 'most' of the risk? Or does it bring about only 'some' or a 'small' risk reduction?*** Our main goal is to find options that reduce most, if not all, of each priority risk.
- ***How much does it cost to implement the option?*** Remember that some options can have initial costs and, in the following years some maintenance costs.
- ***Does the option reduce more than one risk?*** For example, putting the object in a showcase will reduce the risk of opportunistic theft, of mishandling and of dust contamination.
- ***Is the option feasible? Does it conflict with other options?***
- ***Does the option create new risks to the heritage asset?***

Try it yourself:

SELECT OPTIONS

Consider again the example of the risk of book damage by mice. After taking care of all the bigger risks to the library collection, the Director has decided to treat this risk. She thought of different options to reduce it. Unfortunately there is not enough money to implement all these options now. Your task is to select the best option, taking into account how much it reduces the risk, and the cost of its implementation. The table below shows the 4 options proposed by the Director, their expected level of risk reduction and approximate cost of implementation. Which option would be your first choice? Why? Can you think of other options to reduce this risk?

Option	Risk reduction	Cost of implementation
Hire a pest control company to exterminate mice inside and around the library using traps and baits.	90%	$ 500 service every year
Replace open shelves by bookcases with sealed doors.	90%	$ 500 paid each year for 30 years (for a loan of $15 000)
Seal all openings in the library building through which mice can enter.	50%	$ 1 000 paid each year for 30 years (for a loan of $30 000)
Restore the books every time they are damaged by mice.	10%	$ 100 service every year

For all options, the cost of implementation shown in the table is per year, planned for a period of 30 years.

6 PLANNING AND IMPLEMENTING SELECTED OPTIONS

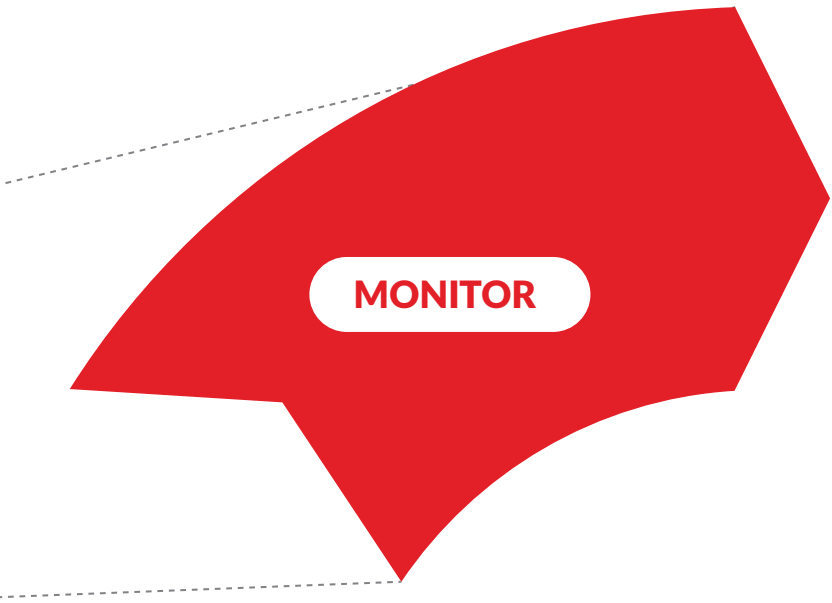
After selecting the most effective options to treat the priority risks, the next step is to make a plan for their implementation. In this plan we should include a realistic timetable (***how long will it take?***), measurable outcomes (***what changes or what improvements will we be able to notice, to measure?***), clear roles and responsibilities for the persons and sectors of the organization to be involved in the treatment of each risk (***who will do what?***), and necessary resources (***what equipment, materials, funding, and human resources will it require?***).

While the implementation of some actions will be simple, others will probably require the participation of different colleagues and sectors of the organization. Sometimes it will require the participation of professionals from outside the organization or even the involvement of institutions from outside the heritage sector, for instance, collaboration with universities, research institutes, the Fire Department, the Police, Customs, Civil Defense, the Army, etc. It is important that we are ready and willing to work with these other actors in order to manage risks to our heritage asset.

The *risk treatment plan* should be fully integrated into the larger management system of the organization. Communication is particularly important at this point because this is a time when concrete changes take place in the organization, which need to be clearly understood and supported at all levels.

Monitor

1 MONITOR AND REVIEW; NEXT CYCLES



CONTEXT

IDENTIFY

ANALYZE

EVALUATE

TREAT

MONITOR

1 MONITOR AND REVIEW; NEXT CYCLES

Once our risk treatment plan is implemented, and the risk reduction measures are in place, it is important to check regularly how they are performing over time. If necessary, we make changes to improve their results.

Because risk management is a continual process, we should keep repeating the cycle and stay alert for significant changes that may occur. These can be changes in the context of the heritage asset or in our value assessments; it can be also the appearance of new important risks, or the availability of new knowledge that may modify the results of our risk analysis and the prioritization of risks, etc. When these changes occur we have to review and adjust our decisions and actions as necessary to continue to be effective in reducing risks to the heritage asset.

There is something else we must learn to do at each step of the risk management cycle: document our work carefully. This will seem like a heavy task during the first cycle, but it will ensure that the effort required for subsequent cycles will be much less, and that the process will be traceable and transparent.

Final considerations

The ultimate goal of risk management is to help heritage professionals and organizations in charge of collections, buildings, monuments, and sites to achieve their objectives in a more controlled and successful way. This means both optimizing the preservation of these heritage assets and optimizing their benefits to society over time.

By assessing the risks that affect our collections, buildings, monuments and sites in their specific context, we are in a better position to make more effective decisions about the sustainable use and safekeeping of these heritage assets. This is particularly relevant in situations where resources are limited and we have to make choices

With this introduction to risk management you can start to look at your heritage asset through new eyes. This new perspective includes an understanding of the heritage asset context and significance, a comprehensive assessment of risks that threaten the heritage, good communication with different actors and stakeholders, and the development of cost-effective measures to reduce (mitigate) priority risks.

We hope that this guide has inspired you to learn more and to continue to work with risk management for cultural heritage. It is just the beginning of a path through which you can acquire a lot of useful knowledge and accomplish great tasks for the safeguard and preservation of heritage assets. Stay alert for training opportunities, and keep looking for further information and resources on risk management for cultural heritage that are available on the Internet or elsewhere. In particular, for more detailed information about the method introduced in this guide, we suggest that you refer to the joint publication by the Canadian Conservation Institute and ICCROM: *The ABC method - A risk management approach to the preservation of cultural heritage*.

ICCROM ATHAR

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ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property) is an intergovernmental organization (IGO), and the only institution of its kind dedicated to the protection and preservation of cultural heritage worldwide, including monuments and sites, as well as museum, library and archive collections. ICCROM fulfils its mission through collecting and disseminating information; coordinating research; offering consultancy and advice; providing advanced training; and promoting awareness of the value of preserving cultural heritage.

ICCROM-ATHAR is a regional conservation centre founded by ICCROM and the Government of the UAE. ICCROM's 27th General Assembly, convened in Rome in November 2011, decided to establish ICCROM-ATHAR Regional Conservation Centre in Sharjah in the United Arab Emirates where it is based since its inception in 2012.

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