IMT School for Advanced Studies, Lucca

Lucca, Italy

Integrated Risk Assessment for Cultural Heritage Sites: a holistic support tool for decision-making

PhD. Program in Management and Development of Cultural Heritage

XXVI Cycle

By

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2016

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2016

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Acknowledgements

The development of this research has been a remarkable adventure in my life. It has been the opportunity to extend my mind in a track of learning and knowledge, intellectually and personally. In this adventure, I want to thank many people who helped to achieve my own objectives and expectations.

I like to express my deepest gratitude to my advisor, Prof. Andrea Zocchi, who opened to me an alternative way of thinking. I also thank to Prof. Emanuele Pellegrini for his patience and support. I would like to express my thankfulness to the University of the West of Scotland – UWS for accepting me as visiting research fellow and giving me the opportunity to approach to climate change problems and facilitating the contacts for interviews and data gathering. Specially, I feel a tremendous gratefulness to Prof. John Hughes from the Engineering Department and Prof. Alexandre Gagnon from Centre for Environmental Research at UWS for their guidance and feedbacks.

I also would like to thank to Historic Scotland for facilitating information. I express my gratitude to Ewan Hyslop - Head of Sustainability, Research, and Technical Education-, Dr. Mairi Davies – Climate Change Manager-, Stephen Watt –District Architect, North Region- and Alice Lyall –WHS Coordinator at Orkney-.

During my research, I also had the opportunity to be a visiting fellow at ICCROM. I would like to thank to Maria Mata Caravaca for her support during the archive research.

I also thanks to Joseph King, Gamini Wijesuriya, Catherine Antomarchi, Aparna Tandon and Anna Stewart.

I would like to thank to my classmates of MDCH. I not only enjoy their craziness but also I learnt a lot from them academically and personally. In particular, I have special thanks to Yesim Tonga -with who I built a sisterhood that it will last-, Bassma Abu El Fadl, Konstantinos Karatzias and Magdalena Jarosik. I would like to express my appreciation to all people who I meet at IMT, especially to my "politics' people" Lorenzo Ferrari –my trip pal-, Maria Romaniello, Luca Bernardi and Paola Varotto.

I feel an enormous gratitude to my "heritage musketeers" for being like sisters and cheerleaders to me: Silvia Arroyo and Claudine Deom. I also thank to Diana Sáenz, Marcela Flórez, and my "museum people and restorer´s team".

Last but not least, I have no words to express the support from my parents, Edith and Jorge, for helping me to achieve this point in my life. I also thank for teaching me the best and worst in life. I am deeply grateful for having my "ñoñis" in this process: Ale and Pipe. I love you all.

…y por supuesto a tí, Oscar Gaona, por tus sacrificios, tu tiempo, tu paciencia, tu espera, tus anhelos, tus esperanzas, tus frustraciones, por tu apoyo incondicional sin importar las circunstancias, por tu dedicación y cuidado… por tu amor, este trabajo te pertenece.

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Abbreviations

AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
ARC	Architectural Conservation Course
CCI	Canadian Conservation Institute
CIPA	International Committee for Documentation of Cultural Heritage
CPRAM	Cultural Property Risk Analysis Model
IATF	Interagency Task Force
ICA	International Council on Archives
ICOM	International Council of Museums
ICOMOS	International Council of Monuments and Sites
ICCROM	International Centre for the Study of the Preservation and Restoration of Cultural Property
IFLA	International Federation of Library Associations and Institutions
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISDR	United Nations Office for Disaster Risk Reduction
WHS	World Heritage Site

Abstract

The majority of the studies related to risk or the risk management of cultural heritage focus on natural hazards and armed conflict. However, cultural heritage sites face new and numerous threats that jeopardize their conservation. Currently, risk assessment focuses on specific cases of potential damage and hazards, and fails to take into account the interdependence between risk factors, causes, and management. This situation is compounded by the fact that the field of cultural heritage does not tend to operate a "culture of assessment" in which decisions are taken in an informed way. For this reason, the aim of this research is to propose an integrated management support tool for the identification and prioritization of risk factors in the conservation of cultural heritage sites. In order to achieve this objective, the research approaches the conception of risk used in the cultural heritage context, and offers a new definition. This research highlights the importance of conservation in terms of the preservation of values. This work adds to the field by explaining how these values can be merged with a "value-oriented approach" in decision-making. In managerial terms, this work also refers to the international standard for risk management and explains how to apply such concepts to the context of cultural heritage. This research constructs a holistic approach and defines the cultural heritage site as a complex system. From this perspective, this study proposes multiple-criteria methods for the realization of an integrated risk assessment for cultural heritage sites, suggesting the application of a rationale behind the Analytic Hierarchy Process (AHP) and the Analytic

Network Process (ANP) as tools for the integration of elements in risk management. In this sense, the methodology allows for links of interdependence to be established among the varying potential threats. It also provides support for decision-making in terms of the conservation of cultural heritage sites. Finally, this work concludes by indicating the benefits and challenges found in the use of multiple-criteria methods for the prioritizing of actions in risk management.

"You can´t compare apples and oranges", so the saying goes. But is this true?...

Thomas Saaty

Introduction

Background

Cultural heritage is not a narrow topic but a complex interdisciplinary field of knowledge. Its polysemic character involves a wide range of definitions that differ according to the perceptions of each state, nation or community. Despite the multiplicity of policies and legislation, cultural heritage is generally understood as the legacy of material remains and immaterial attributes inherited from the past (Vecco, 2010). Cultural heritage includes intangible culture such as traditions, languages, music, and so on, as well as tangible heritage such as cultural properties and natural heritage (UNESCO, 1972, 2006).

Most states of the globe recognize UNESCO as the international body for the protection and preservation of cultural heritage, regardless of their own legal systems. The Convention Concerning the Protection of the World Cultural and Natural Heritage, adopted by the General Conference of the United Nations Educational, Scientific

and Cultural Organization (UNESCO) at its seventeenth session in 1972, defines cultural heritage in Article 1 as:

> Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science;
>
> Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science;
>
> Sites: works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view. (UNESCO, 1972, p. 2).

All of these concepts are used by the World Heritage Committee and the Advisory Bodies to refer to world cultural heritage. The World Heritage Committee has identified and named several types of cultural property, which comprise the subjects of specific conventions or charters for their conservation. The types or categories of cultural properties are:

A. Historic Towns, Town Centers and Historic Urban areas

The International Council on Monuments and Sites (ICOMOS) has adopted the Washington Charter in which the definition of historic settlements includes historic urban

areas, towns, cities, and historic centers or quarters, together with their natural and manmade environments (ICOMOS, 1987, pp. 1-2). In addition, UNESCO has included the conclusions of the meeting of an expert group on historic towns, in which several categories of historic settlements are determined as follows (UNESCO, 2012b, p. 89):

- Towns which are no longer inhabited, being very close to the definition given for archaeological sites;
- Historic towns which are still inhabited;
- New towns of the twentieth century that are related in some way to the two categories above.

B. Archaeological Sites

For this category the World Heritage Committee takes into account the European Convention on the Protection of the Archaeological Heritage, adopted in 1985 and revised in 1992, in which archaeological heritage is defined as "all remains and objects and any other traces of mankind from past epochs." Archaeological sites of world heritage status may include, "structures, constructions, groups of buildings, developed sites, […] monuments of other kinds as well as their context, whether situated on land or under water" (Council of Europe, 1992, p. 3).

ICOMOS has developed its own a definition of archaeological heritage: "part of the material heritage in respect of which archaeological methods provide primary information. It comprises all vestiges of human existence and consists of places relating to all manifestations of human activity, abandoned structures, and remains of all

kinds (including subterranean and underwater sites), together with all the portable cultural material associated with them." (ICOMOS, 1990, p. 2)

C. Cultural Landscapes

UNESCO defines cultural landscapes as properties that represent "the combined works of nature and of man designated in Article 1 of the Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal" (UNESCO, 2012b, p. 86).

This means that a cultural landscape should not only meet the categories for cultural heritage defined above, but also encompass "a diversity of manifestations of the interaction between humankind and its natural environment" (UNESCO, 2012b, p. 86), including sustainable land use and a spiritual relationship with nature. The UNESCO expert group on cultural landscapes has determined several categories for this type of cultural property. These categories are:

- Landscape designed and created intentionally by man as parks and gardens;
- Organically evolved landscape as relic or fossil landscape, where evolutionary processes came to an end, and continuing landscape where a traditional way of life is still in process;

- Associative cultural landscape where there exists a strong relationship with nature for religious, artistic or cultural reasons.

D. Heritage Canals

Likewise, UNESCO incorporates the definition of heritage canals, defining them as a human-engineered waterway that, in order to be considered world heritage, "may be a monumental work, the defining feature of a linear cultural landscape, or an integral component of a complex cultural landscape" (UNESCO, 2012b, p. 89). The expert group for Heritage Canals at UNESCO has established four main factors that can be examined for this particular type of cultural property. In this sense, the consideration of a canal as world heritage relies on:

- Technology: This factor focuses on the use of the property and its characteristics. For example, the lining and waterproofing of the water channel; the engineering structures of the line with reference to comparative structural features in other areas of architecture and technology; the development and sophistication of construction methods; and the transfer of technologies.
- Economy: This factor emphasizes the contribution to the economy. For instance, nation-building, agricultural development, industrial development, generation of wealth, development of engineering skills applied to other areas, and industries and tourism.
- Social aspects: This factor refers to the impact of the canal in sociological terms, such as mobilization of people and exchange.

- Landscape: This factor refers to transformations in the forms and patterns of landscapes.

E. Heritage Routes

The definition given by UNESCO for heritage routes is based on a meeting of experts is which the theme "Routes as part of our cultural heritage" was discussed. This document determines that "a heritage route is composed of tangible elements of which the cultural significance comes from exchanges and a multi-dimensional dialogue across countries or regions, and that illustrate the interaction of movement, along the route, in space and time" (UNESCO, 2012b, p. 90). Taking this definition into account, the expert group points out that the definition of a heritage route is based on the concepts of exchange, continuity and dialogue between countries or regions. Moreover, a heritage route should consider multi-dimensional aspects such as religion, commerce or economic development, and may involve a dynamic cultural landscape.

According to Article 4 of the UNESCO Convention, each State Party recognizes its duty to ensure the identification, protection, conservation, presentation and transmission to future generations of cultural and natural heritage. In addition, Article 5 of the Convention states that each State Party, in order to ensure effective protection, shall endeavor:

a) To adopt a general policy that aims to give cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programs;

b) To set up within its territories, where such services do not exist, one or more services for the protection, conservation and presentation of the cultural and natural heritage with an appropriate staff that possess the means to discharge their functions;

c) To develop scientific and technical studies and research and to work out operating methods that will make the State capable of counteracting the dangers that threaten its cultural or natural heritage;

d) To take the appropriate legal, scientific, technical, administrative and financial measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage; and

e) To foster the establishment or development of national or regional centers for training in the protection, conservation and presentation of cultural and natural heritage, and to encourage scientific research in this field (UNESCO, 1972).

In light of this framework, risk management appears not only to be a mechanism by which to ensure the protection of cultural heritage sites, but also a mandatory aspect, since cultural heritage sites today confront new and numerous threats that jeopardize their conservation. Currently, cultural heritage is threatened not only by natural disasters and armed conflict but also by an important number of hazards that include risks relating to development pressures, lack of awareness, negligence and climate change.

In order to respond effectively to all such threats and potential risks, most cultural institutions face the challenge

of gathering enough resources for adequate management. The majority of institutions dealing with cultural heritage around the globe have limited budgets for conservation. The cultural institutions in charge of the conservation of cultural sites are mainly accustomed to managerial practices that normally indicate the allocation of a budget to on-going projects or programs that come as the result of a snap decision. Rarely is the decision to invest in a specific project or program based on a holistic diagnosis.

For these reasons, it is necessary to identify the causes that might affect the conservation of a cultural heritage site. It is also important to measure the impact that such causes might produce on the conservation state of a cultural heritage asset. From this perspective, a management tool that helps the decision-making process to prioritize those aspects that are most important is a useful instrument for the allocation of resources in a more effective manner.

The majority of studies related to risk or risk management in cultural heritage focus on natural hazards and armed conflict. Currently, risk assessment focuses on specific potential damage and hazards, and does not take into account the presence of certain interdependence among risk factors, their causes, and management. Considering individual risks in isolation, without taking into account the range of threats affecting a cultural heritage site and their interconnection, may prompt the development of new threats or increase the impact of existing hazards.

For these reasons, this research focuses on the development of an integrated and holistic approach to risk

management and takes risk assessment as a key process in the supporting of decision-making for the conservation of cultural heritage.

Aim and scope

The aim of this work is to propose an integrated assessment support tool for the identification and prioritization of risk factors for the conservation of cultural heritage sites. This work is not based on the study of single cases, but instead on a methodological scheme that has been adapted to the needs of risk management in the context of cultural heritage. For this reason, this study concentrates on risk management from the point of view of managers or decision makers.

The main argument of this dissertation is that an integrated and holistic approach to risk management will allow for the assessment of hazards in a way that takes into account their diversity and relationships of both dependency and interdependency. In this way, integrated risk assessment will provide a support instrument for well-informed decision-making.

This research does not pretend to provide a radical statement concerning the "right" methods for assessment. On the contrary, the intention is to provide a possible methodology that may work within the cultural heritage context, while incorporating various aspects from the discipline of management. Case studies are used to allow for the adaptation of methods, but do not form part of the scope of this research in the exploration of a particular site.

In order to achieve this objective, this research looks to clarify the conception of risk within the context of cultural heritage. In addition, this research aims to identify the principal and general hazards that jeopardize cultural heritage sites. Furthermore, it develops an approach for the clustering of such hazards in order to establish the extant relationships between groups. In this sense, this investigation also records any possible inter-links among hazards.

Finally, this research proposes the adaptation of multiple-criteria methods for the assessment and prioritizing of hazards. As a result, conservation decisions can be taken in an informed manner.

Literature Review

The study of risk management within cultural heritage is a topic that has attracted the attention of several institutions. However, there are a limited number of references that deal with the subject in a comprehensive way. Instead, the majority of such studies related to risk or risk management in cultural heritage focus on natural hazards and armed conflict. In this respect, the main sources of information used come from institutions related to cultural heritage, such as UNESCO, ICOMOS and ICCROM. These organizations, often jointly with various universities and research institutes, publish more extensive materials regarding risk management for cultural heritage.

In this sense, researches take two main ways. One field of study is dedicated to risk management for movable heritage, specifically museum's collections. In this area, the studies are extensive and cover different aspects from

specific agents of deterioration (Ashley-Smith, 2001; ICCROM & UNESCO, 2009) to museum environment (Blades et al., 2000; Michalski, 1993; Thomson, 1986). The references also cover emergency planning for museum´s collections, material degradation and preventive actions to objects (Canadian Conservation Institute, 1997).

On the other way, studies concentrate on cultural heritage sites where agents of deterioration or sources of risk exceed the aspects considered in museum´s collections. Indeed, aspects as climate change and management show as major issues of study. Taking into consideration this last group of studies, focus is placed on cultural properties inscribed as World Heritage Sites, while cultural heritage without such a status receives less attention. For these latter properties, the information available depends on the states to which they belong. For example, the United Kingdom produces several materials related to the topic through English Heritage and Historic Scotland, while other countries tend to have fewer references.

Looking through the references available for these three organizations it is evident that emphasis is given to natural disasters and armed conflict; although an increase in attention for the impact of climate change has occurred in recent years. Climate change requires a new approach to risk management for two reasons: one, there exists an inevitable connection and relationship between the hazards, and two, it drives attention since it combines risk management for both communities and properties.

Studies into the effects of climate change on cultural heritage, as well as better possible options adaptation, are still scant and the field itself remains largely unexplored.

The majority of the references point to the need for more research, a lack of publications, and the importance of studies on this particular subject. From the bibliography it is possible to highlight at least three main references that other publications constantly quote. These three works comprise the scoping study commissioned by English Heritage for University College London, the results of the Noah's Ark Project, and the materials gathered for the course "Vulnerability of Cultural Heritage to Climate Change" and the workshop "Climate Change and Cultural Heritage" held in Ravello, Italy between the 14th and 16th of May 2009. In the final of these three, several recommendations to governments and institutions are provided.

The first work constitutes a report for a scoping study of the likely risks and strategies for adaptation to climate change impacts in the English historic environment (Cassar & University College London. Centre for Sustainable Heritage., 2005). The European Noah's Ark Project studies the changes in the meteorological parameters that are most likely to affect built cultural heritage in Europe. To achieve this goal, the Noah's Ark Project gathers eleven institutional and research partners in Europe to provide Climate Risk and Vulnerability Maps for heritage managers and suggest guidelines for adaptation measures and strategies for minimizing the effects of climate change. In this respect, "The atlas of climate change impact on European cultural heritage: scientific analysis and management strategies" (Sabbioni et al., 2010 & Noah's Ark (Project), 2010) gives an overview of climate change and the vulnerability of cultural heritage across a broad

scale in Europe; although it does not concentrate on individual monuments. The Noah's Ark Project has identified patterns in threats to the built environment.

This extensive and comprehensive study focuses on mapping and material deteriorations gathered for the specific research interests of the partners involved. From this, a broad study has emerged that merges several references. One of these references is, in fact, that of the materials gathered for the course "Vulnerability of Cultural Heritage to Climate Change" and the workshop "Climate Change and Cultural Heritage", which have been compiled into a book titled *Climate Change and Cultural Heritage* (Lefèvre et al., 2010). This text collects the abstracts of the workshop and full texts from the course, in which the authors outline the results of the Noah's Ark Project in terms of mapping, effects and responses of materials due to climate change, as well as providing insights into the principles of mitigation and adaptation. This publication includes an important recommendation that was initially proposed by the workshop participants. It relates, specifically, to the vulnerability of cultural heritage to climate change and was approved by the Committee of Permanent Correspondents of the European and Mediterranean Major Hazards Agreement at its 57th meeting in 2009.

The three references mentioned above constitute the core of the recent literature regarding climate change and cultural heritage. From the partnerships and particular interests of each research group in the joint Noah's Ark Project, it is possible to track a specific focus in the rest of the literature. In this sense, it is possible to group together

several papers according to the topic found in the Noah's Ark Project.

The majority of references dealing with the definition of risk do not come from cultural heritage, since here definitions remain absent. Instead, the more specific fields of knowledge for this subject are management and business administration, as well as theoretical backgrounds pertaining to assessment methods. The field of management is involved in decision-making processes and the methodologies used to prioritize options.

Regarding the values of cultural heritage, it is possible to say that this is also a topic that has been developed to an extent. The Getty Institute and ICCROM have produced the majority of publications on this matter. However, these materials do not deal with decision-making values and are quite restricted at the moment of integrating cultural heritage values with methods of assessment.

Finally, the bibliographical references for risk management at cultural heritage sites appear to be dominated by the studies into natural disasters and armed conflict, especially those produced by UNESCO, ICCROM and ICOMOS, which concentrate on the relevant guidelines according to their individual roles. While the topic of climate change and cultural heritage is still quite new, the Noah's Ark Project results dominate the majority of the information on the subject, as well as outlining the particular interests of the project's partners.

Subjects such as conceptions and definitions of risk, as well as the principles and procedures of risk management, have been studied extensively in the fields of

management and business administration. These sources also contain research regarding assessment methods and decision-making.

The link between the two fields of knowledge, and the gap that exists for the application of managerial aspects to risk management in cultural heritage, constitutes an input to which this research aims to contribute.

Methodology

This research explores a wide range of literature and archival materials. First, a clarification of the concept of risk leads to a search for the first use of the term within the cultural heritage literature. This has been addressed in the literature review above and archival work undertaken at ICCROM and ICOMOS, which was made possible thanks to the acceptance of the research project by the ICCROM fellowship program. During four months, the search for materials was concentrated at the ICCROM archive and around ICOMOS materials. Furthermore, several interviews with ICCROM personnel were executed.

The literature review constituted a continuous task during almost all the research. Several references were consulted, with the thesis database of the United Kingdom proving particularly useful.

The initial literature review revealed a need to explore recent approaches to climate change. The interest in this subject consists of a need to explore the inter-links evident among hazards and approach various assessment methodologies. In this sense, vulnerability and

environmental assessments provided a clue. In order to approach this aspect in greater detail, this research was developed as a substantial portion of a visiting research fellowship at the University of the West of Scotland at Paisley, Scotland, where conjoined research on the impact of climate change was developed between the engineering and environmental departments.

Under these circumstances, the approximation to a particular case was an opportunity. Skara Brae in the Heart of Neolithic Orkney World Heritage Site and the possibility of gathering data from managers, community and scholars lead to the informed selection of this site as a suitable case study.

The context of Skara Brae, various climate data, site visits and interviews with personnel from Historic Scotland, site managers and scholars allowed for an understanding of how the relationships between hazards work. It has also allowed for the establishing of dependency and interdependency connections for hazards that threaten the site. In addition, the case study has facilitated the first adaptation of the Analytic Hierarchy Process to the risk assessment of cultural heritage.

The second case study, namely monuments in public spaces in the urban area of Bogotá, Colombia, was selected based on the data available and the need to adapt the Analytic Network Process to risk assessment for cultural heritage. The need to prove the utility of the methods chosen for different types of cultural properties also influenced this choice substantially. In addition, the need to apply the method to a context with various and indeed dramatic conservation problems, in order to really observe

the usefulness of the assessment methods, also shaped this particular selection. Finally, the Bogotá case study was selected due to an awareness for the need on the part of local authorities for relevant assessments that would allow for the effective shaping of local policy.

Structure

Following the introduction, this document is structured using three chapters and conclusions. The first chapter deals with the basic notions related to risk in the context of cultural heritage. It makes a historical review based on primary sources and archival research, tracking the use of risk within the context of cultural heritage.

Additionally, this first chapter offers a new definition of the concept of risk, integrating the former notion into current requirements. In this sense, it not only takes into account the traditional definitions used in the context of natural disasters, but also the integration of concepts related to climate change. In the same way, notions of risk from within management are introduced. As a result, a more robust definition of risk is defined. Together with this definition, this work highlights the importance of conservation as a matter of the preservation of values. Although values in cultural heritage is a well-discussed subject, this work shows how to merge these values with a "value-oriented approach" for decision-making. In this sense, the theories of value-focused thinking have been used to identify and create alternative decisions.

The second chapter deals with the principles and processes of risk management, taking its research from the

management and business administration fields. In this sense, steps have been drawn up according to the international standard for risk management. This chapter also compares the international standard with other procedures of risk management. In the last part of the second chapter, how each step of the international standard could be applied to cultural heritage is explained.

The third chapter focuses on combining the elements drawn upon in the first and second chapter. It deals with the importance and characteristics of an integrated assessment. To do so, it proved necessary to deal with a holistic and systemic approach, that is to say, to define a cultural heritage site as a complex system. The fundamental aspects of holism and the systemic perspective are explained within the context of cultural heritage.

As the primary step within risk assessment, the identification of risk factors has been facilitated by the case studies. Furthermore, the behaviors of risk factors or agents that might affect the conservation of a site are key. The behavior of risk factors, as well as of a complex system, drives the focus regarding the type of relations and connections of interdependency among them. This chapter also deals with the clustering of risk factors in order to facilitate the assessment.

Finally, the third chapter deals with an assessment of multiple-criteria methods for the achievement of an integrated risk assessment for cultural heritage sites. In this sense, this chapter explains the principles behind the multiple-criteria methods for analysis and assessment. Furthermore, it suggests the application of the rationale

behind the Analytic Hierarchy Process and Analytic Network Process as tools for the integration of elements in risk management. Therefore, it has proven necessary to explain in general terms the performance and purposes of the AHP and ANP as multiple-criteria methods for decision-making. Last but not least, this chapter proposes the use of the rationale of the AHP and ANP in the context of cultural heritage. This suggestion is supported through two examples. First, the information gathered through research into the impact of climate change and used to build an example of the AHP in the case of the Heart of Neolithic Orkney World Heritage Site in Orkney Islands, Scotland. Second, the use of the ANP for the formulation of a risk management plan for monuments in public spaces in the urban area of Bogotá, Colombia. Here the rationale of the AHP and ANP appears to be useful for the prioritizing of conservation needs. In this sense, the methodology allows for the establishing of links of interdependence among the different possibilities of threat. The rationale behind the AHP and ANP appears to be a tool from multi-criteria analysis and a possible way to assess risk in a holistic and integrated way, as well as providing support for decision-making in terms of the conservation of cultural heritage sites.

Finally, this research concludes by resuming the main aspects of each of the topics addressed in the chapters comprising this thesis. The conclusions also summarize the benefits and challenges found in the use of multiple-criteria methods for prioritizing actions in risk management and future developments opened up due to this research.

CHAPTER 1

Cultural Heritage and Risk

"Cultural heritage is always at risk. It is at risk from the depredations of war. It is at risk in the face of nature's occasional eruptions and irruptions. It is at risk from political and economic pressures. It is at risk from the daily forces of slow decay, attrition and neglect. It is even at risk from the hand of the over-zealous conservator!"

Herb Stovel

1.1. Tracking a concept

1.1.1. Risk in the context of cultural heritage

The term *risk* was coined in the cultural heritage context in 1972. The first use of the word is attributed to Hans Foramitti (1923-82), a pioneer of architectural photogrammetry, in his book *Mesures de sécurité et d´urgences pour la protection des biens culturels.* In the book's early pages, Foramitti directs our attention to a lack of preparation among the administrative personnel of historic

monuments when attending to emergencies and cases of "exceptional risk" (Foramitti, 1972, p. 6). The author is referring to floods, landslides and fires in particular. Foramitti´s book focuses on three aspects: security measures for the prevention of the robbery of art works, the fortifying of historic centers against fire, and the possibilities of intervention for conservators in case of emergency. From these three perspectives, the term is specifically used in relation to catastrophes and robbery. The book does not draw a clear distinction between natural disasters and other types of emergency. However, given his own experiences, Foramitti does develop a broad view of the diversity of risks to which cultural heritage is exposed.

Foramitti was an Austrian architect who contributed "to the development of a unified practical system for the recording and documentation of pieces of art and architecture" (Waldhäusl, 2004, p. 828). During his early years, he was engaged in military service during World War II and after graduating from the Faculty of Architecture at the University of Technology in Vienna, formed part of the Austrian Federal Office for the Preservation of Monuments and Sites. In 1964 he played a role in the foundation of the International Council of Monuments and Sites (ICOMOS). He subsequently co-founded CIPA, an ICOMOS committee, and "some years later he became the first Director of the UNESCO-ICOMOS Documentation Centre in Paris" (Waldhäusl, 2004, p. 830). As vice president of the Austrian ICOMOS, he was in charge of the application of the 1954 Hague Convention for the Protection of Cultural Heritage in Case of Armed Conflict and its Blue Shield initiative.

This Convention is perhaps the first international charter to consider a particular type of emergency that might jeopardize the conservation of cultural heritage. Its main chapters and protocols emphasize the effects of attacks due to armed conflict, such as destruction and fire. Also, the Convention highlights the importance of documentation and registration as mechanisms of cultural heritage protection (UNESCO, 1954).

Taking this into account, it is evident that the earliest references to risks for cultural heritage address fire and security concerns. For this reason, Foramitti uses the term within the same context. His book calls our attention to a methodology for prevention based on three steps: inspection, action plan and decision. From 1968 onwards, Foramitti was asked to collaborate in lessons at the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) in Rome. Numerous letters between him and ICCROM´s coordinators show how the photogrammetry classes for the Architectural Conservation Course (ARC) introduced, little by little, content related to emergencies, protection against fire, and security, with 1975 seeing the first lesson on the 1954 Hague Convention (Jokilehto, 1975). ICCROM was prone to this matter, having worked with the Scuola Centrale Antincendi in Rome since the early 1960s (ICCROM, 1964) and worked for the salvage of cultural properties and works of art during the Florence and Venice floods of 1966 (ICCROM, 1966).

Until 1982, Foramitti was linked to teaching ICCROM courses. Each year he placed greater focus on emergencies at cultural heritage sites and explored the

application of international charters such as the 1954 Hague Convention and 1972 Convention concerning the Protection of the World Cultural and Natural Heritage. Equally important was his interest in documentation as a technical measure for the prevention of future damage, which constituted the basis of his work after the Fruili earthquake of 1976.

With ICCROM being in charge of training in conservation matters worldwide, its courses evidently contributed to the spread of the most important issues in the field. In this sense, Foramitti´s ICCROM papers and lessons constitute a starting point for the consideration of the concept of risk in cultural heritage.

A turning point came after the Montenegro earthquake in 1979, when the most important organizations related to the protection of cultural heritage, namely ICCROM and ICOMOS, focused their attention on natural disasters in particular. Efforts at the international level concentrated on two aspects: the principles of reconstruction in relation to research into the behavior of traditional structural systems, and disaster preparedness programs. Both directions provide a range of initiatives developed over the course of several decades by numerous institutions.

"Particularly since the 1979 earthquake in Montenegro, the strategy has been to give particular attention to the development of training and the preparation of guidelines in risk preparedness" (Jokilehto, 2000, p. 173). In this sense, ICCROM began a strategic planning response, implementing courses and workshops via a managerial approach. Training was given to local

heritage managers and focused on management tools for assessing damage, emergency measures and indicators of legal protection (Jokilehto, 2000).

Subsequent earthquakes during the early 1980s prompted the first course dedicated specifically to disaster preparedness. The International Course on Preventive Measures for the Protection of Cultural Property in Earthquake-Prone Regions was taught in Skopje in 1985 (ICCROM & IZIIS, 1985). The output comprised a series of recommendations highlighting various criteria for restoration and the importance of planning, maintenance and documentation for prevention (Jokilehto, 2000).

In parallel, the ARC courses after 1982 dedicated a part of their program to earthquakes, taught by Sir Bernard Feilden, and introduced lessons on preventive conservation in museums, imparted by Gail de Guichen (ICCROM, 1982-1986). The experience gathered from the response to the Montenegro earthquake, the first course on disaster preparedness at Skopje, and the ICOMOS meeting in Guatemala in 1979 constituted inputs for the 1987 publication *Between Two Earthquakes* by Sir Bernard Feilden, then director of ICCROM. In this publication, the term *risk* is clearly defined for the first time and the organization of measures before, during and after an earthquake is outlined (Feilden, 1987). The very same order of actions today provides the methodological steps with which disaster risk-management plans are structured.

The 1990s saw the consolidation of disaster and emergency preparedness plans. On the one hand, the United Nations Office for Disaster Risk Reduction (UNISDR) declared the 1990s the International Decade for

Natural Disaster Reduction (The United Nations Office for Disaster Risk Reduction, 2015). On the other hand, the Hague Convention was subject to a review, in part due to the Yugoslav Wars (Boylan, 1993). Intergovernmental organizations such as UNESCO and ICCROM developed a series of workshops and roundtables for these two scenarios. The aim was to include the importance of the values of cultural heritage in the preparation, mitigation, and planning actions of risk-preparedness plans.

Due to these two major initiatives, the concept of risk for cultural heritage took on two more traditional meanings in relation to, first, natural disasters and, second, armed conflict. In response to the latter, the Interagency Task Force (IATF) was created with the collaboration of ICCROM, UNESCO, the International Council of Museums (ICOM), ICOMOS, the International Council on Archives (ICA), and the International Federation of Library Associations and Institutions (IFLA). The Interagency focused primarily on the Blue Shield program as part of the Hague Convention and looked to provide expertise, stimulate networking, raise public awareness, promote standards of prevention and identify resources for assistance in cases of armed conflict (Jokilehto, 2000). The discussion meetings among such agencies identified several problems. For instance, a certain number of conventions were not applied or were not well known by governments. Furthermore, the Hague Convention was ineffective in several cases. A lack of documentation failed to allow for the identification of cultural heritage and the development of accurate restoration and reconstruction processes after an event. If such documentation did exist it

was inaccessible to community groups, task forces and military forces. In addition, a lack of financing and the need for increased technical capacity within communities after an event were identified (ICCROM, 1992).

However, such problems were not only present within the context of armed conflict. Similar situations were also identified in the case of natural disasters. For these reasons, a fourth roundtable on risk preparedness was assembled in Paris in 1996 to establish a Risk Preparedness Scheme which can be summarized in five action points (ICOMOS, 1996):

a. Creation of Cultural Heritage at Risk Fund
b. Blue Shield Intervention Program
c. Preventive and Operational documentation on cultural heritage
d. Training and production of manuals
e. Public awareness

The variety of meetings for the two initiatives ended up with the convergence of actions since several strategies were useful in both cases. In this sense, the programs settled by different agencies encouraged authorities in risk preparedness with regard to both armed conflict and natural disasters. In this context, Herb Stovel explores the idea of a series of manuals that examine the relations among conflict, disaster and the daily decay of cultural heritage (Stovel, 1994). This initial idea was developed in Stovel´s document *Risk Preparedness Guidelines for World Cultural Heritage Sites,* in the outlines and proposals provided for training courses on risk preparedness, before being further developed in his book *Risk Preparedness: A*

Management Manual for World Cultural Heritage (Stovel, 1998).

Published jointly by ICCROM, ICOMOS and UNESCO in 1998, this book not only provides clear definitions for risk and other concepts related to the subject, but also offers a consideration of the managerial approach. The book is addressed, in particular, to conservation managers and decision makers with the intention of providing site-specific guidelines and training guides for courses (Jokilehto, 2000).

At the end of the 1990s, and after a series of major earthquakes, ICOMOS organized a workshop in Assisi for experts in the field. The aim was to discuss the implementation of policies of reconstruction and the importance of response plans. As a result, the Declaration of Assisi was created, which highlights the need to integrate preventive measures that consider both historic buildings and movable heritage, such as works of art, and their importance for the cultural value of a community (ICOMOS, 1998). In some ways, the Declaration of Assisi highlights the joint need for risk preparedness for collections and built heritage during the planning process.

The idea of involving measures for museum collections was not new at this stage. Since 1982, ICCROM´s ARC courses had introduced lessons related to museum environments (ICCROM, 1982-1986). Gradually, different aspects of safety and security for museum collections were presented in several classes, with an emphasis placed on preventive conservation instead of mere emergency procedures (Jokilehto, 2000). Accordingly, it is important to highlight that the discipline of preventive

conservation consolidates a more integrated process, owing to the complexity of interrelated factors in the conservation of collections, and has done so since the introduction of risk-management approaches to museum practices in the 1990s (Staniforth, 2013). Risk assessment in preventive conservation as a tool for identifying and qualifying risk for collections was used for the first time in 1993 for the collections on exhibit at the Canadian Museum of Nature (Muething, Waller, & Graham, 2005). This assessment not only considered disasters but also integrated the risks produced by light, UV radiation and pest infestation, among others. It was perhaps indeed in museums where the risk management approach better integrated several factors and was applied as a method for the effective allocation of resources (Waller, 2013).

Over the years, preventive conservation has focused on collections and environmental conditions, shifting nowadays towards sustainability issues (Staniforth, 2013). In this sense, the concerns of preventive conservation for collections merge with the current problems faced by the conservation of cultural heritage sites. During the 2000s, the attention given to the risks faced by cultural assets extended beyond natural disasters and armed conflict to take into account climate change, resilience, sustainability and precautionary actions (Staniforth, 2013).

It is understandable that natural catastrophes attract great interest. The tsunami that affected Japan in March 2011, the recent earthquake in Nepal, and the earthquakes in China and Chile in 2008 and 2012, respectively, are examples of the exposure of cultural heritage sites to natural disasters. Their unpredictable character and impact

on human life make natural disasters a top priority in risk management. It is therefore not surprising that many studies of risk for cultural heritage sites focus on the impact of natural threats. In addition, current attacks on Syrian heritage show how cultural heritage can be exposed to political instability (UNESCO, 2012).

However, even more cultural heritage sites are affected by a variety of risks that have an accumulative or progressive impact, such as urban development pressures, abandonment or mass tourism, rather than a sudden impact, as is the case with natural disasters. In addition to analyses of catastrophic events and cultural heritage, vulnerability to pervasive and subtle long-term impacts is garnering greater attention (Sabbioni, Brimblecombe, Cassar, & Noah's Ark (Project), 2010).

Modifications to criteria for the inclusion of a world heritage property on UNESCO´s List in Danger provide a good example of this abovementioned shift. With natural disasters and armed conflict initially topping the list, UNESCO´s World Heritage Center received a proposal for amendments to the Operational Guidelines in 1994 in which several external factors that might affect a site were cited, including development and tourism pressures (ICCROM, 1994).

Today, according to paragraph 179 of UNESCO´s Operational Guidelines, a world heritage site might be in danger if the property faces:

> a) ASCERTAINED DANGER. The property is faced with specific and proven imminent danger, such as:
> i) serious deterioration of materials;

ii) serious deterioration of structure and/or ornamental features;
iii) serious deterioration of architectural or town-planning coherence;
iv) serious deterioration of urban or rural space, or the natural environment;
v) significant loss of historical authenticity;
vi) important loss of cultural significance.

b) POTENTIAL DANGER. The property is faced with threats could have deleterious effects on its inherent characteristics. Such threats are , for example:
i) modification of juridical status of the property, diminishing the degree of its protection;
ii) lack of conservation policy;
iii) threatening effects of regional planning projects;
iv) threatening effects of town planning;
v) outbreak or threat of armed conflict;
vi) threatening impacts of climatic, geological or other environmental factors.
(UNESCO, 2015, p. 40)

Although UNESCO´s Operational Guidelines use the terms of risk, danger and threat interchangeably, a broader conception of the possible factors that might impact upon cultural heritage is clear. Unsurprisingly, the number of situations in which impacts are related to managerial aspects is key. Generally speaking, the last fifteen years have seen a transition from specific risks, such as catastrophes, towards an extensive and complex net of factors and circumstances affecting the conservation of cultural heritage, most of which pertain to its management.

As stated by Jokilehto (2000), "Risk preparedness should not be conceived only in relation to emergencies. It should also be integrated into the ordinary routine of managing cultural heritage resources, as well as into the management of our daily environment" (p. 179).

To summarize, cultural heritage and its values are constantly jeopardized by a multiplicity of aspects. On the one hand, cultural heritage is threatened by natural disasters: earthquakes, floods and fires, as well as the effects of weathering. On the other hand, manmade disasters also affect the conservation of cultural heritage, such as the aftermath of war and the impact of pollution, urban pressure and industrialization (ICOMOS, 2000). An overview of the literature related to heritage at risk shows an increase in attention with regard to this subject over the last two decades: "The current threats to our historic heritage are incomparable to those of earlier times now that we live in a world that has been undergoing faster and faster change since the last decades of the twentieth century" (ICOMOS, 2000).

The focus on conservation has moved to tangible rather than intangible heritage. However, this does not mean that traditions and cultural expressions are not under pressure and faced with the threat of disappearance. Instead, here we see evidence of the transformation in communities´ consciousness about the significance of cultural values changing throughout time. For many years, the connection between tangible and intangible heritage remained implicit, with the importance of this interrelation for protection being largely ignored. This situation is clear in a statement by Michael Petzet, former ICOMOS

president: "the loss of handicraft traditions – a loss which must be fought in the interest of sustainable development – monuments are endangered during rehabilitation work by the use of inappropriate methods and technologies when properly trained professionals and other preservation specialists are not available at all or in sufficient numbers and preservation know-how is missing" (ICOMOS, 2000).

In conclusion, the concept of risk for cultural heritage has transformed over the last four decades. From post-World War II protection concerns and disaster response plans, which remain valid today, to the need for a managerial approach and integrated assessments that consider the multiplicity that characterizes risk. Time has revealed a convergence of actions in the preventive conservation of collections and the use of risk management as an effective method for prioritizing strategies in museums, opening up the possibility of incorporating risk-assessment processes in a more comprehensive manner into site-planning actions. Heritage sites are now engaged in an increasing understanding and awareness of conservation issues, while focusing on improving decision-making practices with the inclusion of communities.

1.1.2. Cultural World Heritage at Risk: An illustration

One way to form an initial impression of the subject of cultural heritage at risk is to consider the major catastrophes that several sites have faced in recent years. News, videos and images from Nepal´s earthquake remind us of the enormous impact of such events. It is

understandable that natural hazards constituted an important interest at the moment of approaching risk management in this context. Indeed, natural hazards demonstrate a threat of the highest magnitude for cultural heritage and routinely involve significant losses of life and personal belongings. However, a comparative look at cultural heritage reveals that natural disasters are not the main concern for cultural properties at risk.

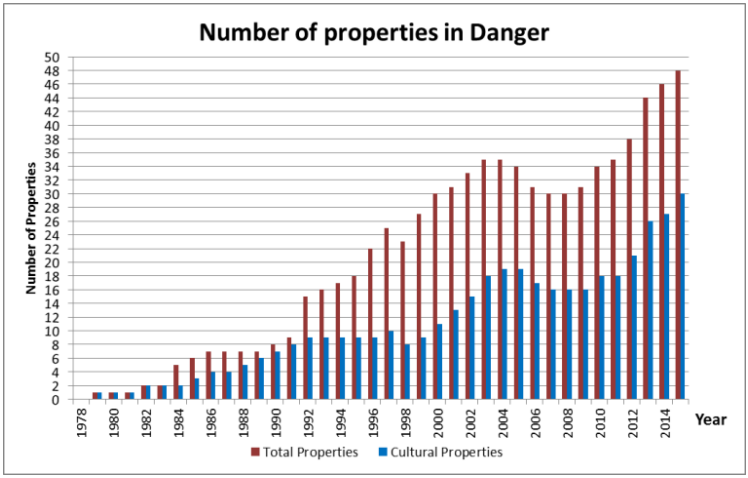
Taking into account the information provided by UNESCO for World Heritage sites, since an absence of compelling information for cultural heritage that is not given the status of World Heritage is evident, it is possible to state that the reasons for which cultural heritage is at risk do not relate to natural disasters as a principal hazard for the jeopardizing such sites (UNESCO, 2008).

A look to the 2015 UNESCO list of World Heritage sites shows that 802 properties are cultural sites, 197 are natural and 32 are mixed sites. While only 48 properties on the list are deemed to be in danger, that is, approximately 4.65% of the total number of World Heritage sites.

Analyzing exclusively the data from the List of World Heritage in Danger from UNESCO, it is possible to see two correspondent phenomena. From one side, the constant increase of new inscriptions into the list and from another side, the growth of cultural sites in danger. In this sense, both, the cultural sites inscribed as properties in danger as well as the total sites on the danger´s list, are increasing rapidly (see Graphic 1). This situation allows to state that World Heritage is at risk constantly and the situation of cultural world heritage sites is not facing an

exclusively circumstances. On the contrary, it reflects the tendency of properties at risk year by year.

On the other hand, and focusing on cultural properties, the UNESCO list of World Heritage sites in danger demonstrates that of the 48 properties on the list in 2015, 30 are cultural and only 2 are in danger due to natural catastrophes. This means that only 0.2% of all World Heritage sites are on the danger list due to the threat of natural disaster: Bam and its Cultural Landscape in Iran and the Tombs of Buganda Kings in Uganda.



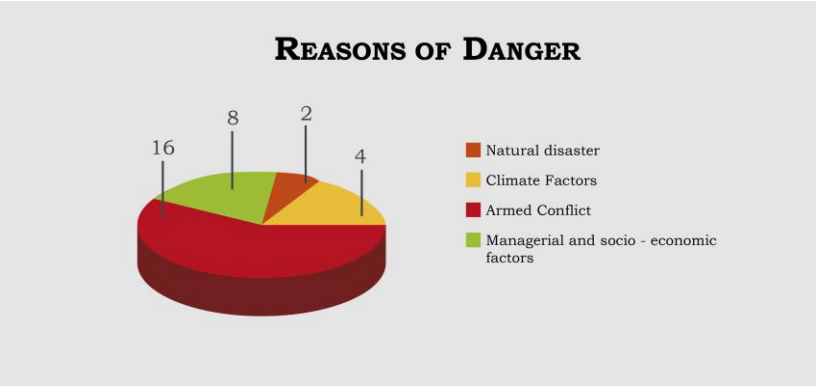
Graphic 1. ***Number of World Heritage properties in danger by year.*** ***Red bars show the total number of properties (cultural, mixed and natural sites) inscribed on the list in Danger every year. Blue bars show the correspondent number of only cultural sites of such inscription.***

There are four properties listed due to climate factors, such as heavy rains. Although these may cause floods and avalanches that prompt disaster, here these hazards are taken as climate factors: whenever climate

factors adhere to extant environmental factors but suffer a deviation from the regular pattern. Such factors are generally predicted to an extent and are not sporadic.

In any case, the sum of properties in danger in 2015 due to environmental factors – natural disasters and climate – is only six, itself a small number in relation to the rest of the properties on the list (see Graphic 2).

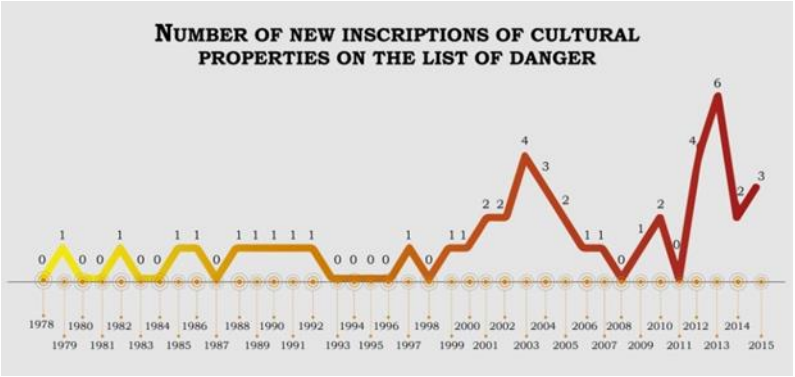
As can be seen in the graph, almost a quarter of cases correspond to a combination of socioeconomic and managerial hazards. For instance, properties are placed in jeopardy due to developmental pressures, improper interventions and poor management plans. 8 out of 30 cultural sites face several threats that constitute risks for their conservation, including development, looting and lack of maintenance, among others.



Graphic 2. ***Reasons for which cultural world heritage properties are on the danger list in 2015.***

The majority of properties in danger feature on the list due to armed conflict. This number has increased since

2012 due to the actions of the Islamic State (ISIS) in the Middle East and the dismantling, illicit trafficking and destruction of archaeological sites in Syria (see Graphic 3). Another spike can be seen for 2003 and 2004 due to the wars in Iraq and Afghanistan. In this sense, 16 of the 30 cultural properties are on the list for the aforementioned reason, and thus account for 1.5% of the UNESCO list. If natural properties are included, the number of sites affected by current and dramatic armed conflict rises to 21 properties of 48 on the list of danger, representing more than 2% of the total list.



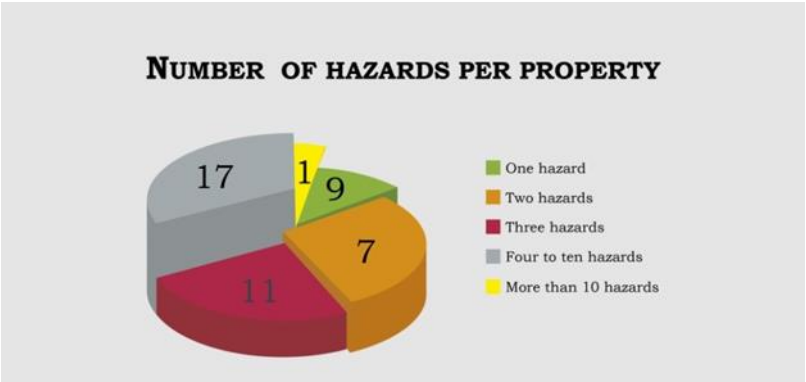
Graphic 3. ***Number of cultural world heritage properties introduced on the danger list per year.***

On the danger list, armed conflict corresponds to 53.3% of the cultural properties at risk, while managerial and socioeconomic aspects represent 26.6%, and environmental factors account for 20%, with 6.6% comprising natural disasters.

If the statistics from 1978 are analyzed – the year in which the danger list was created – up to 2015, 45 cultural properties have since been included as heritage sites in danger, and only 6 are on the list due to natural disaster. Four properties have been included due to earthquakes: Natural and Culturo-historical Region of Kotor in 1979; Kathmandu Valley in 2003; Bam and its Cultural Landscape in Iraq in 2004; and Humberstone and Santa Laura Saltpeter Works in Chile in 2005. One property is on the list in danger due to fire, namely the Tombs of Buganda Kings at Kasubi in Uganda, added in 2010, and another property due to a tornado, that is, the Royal Palaces of Abomey in Benin in 1985.

Most of the properties face a combination of hazards. Only 9 of 45 cultural properties are affected by one threat alone. Graph 4 shows the number of cultural heritage sites affected by more than one hazard at a time. Indeed, the majority of sites are threatened by more than four hazards. Taking into account the findings outlined above, the notion of risk is becoming more complex. It is clearly shifting from fires and earthquakes to management aspects; thus cultural heritage sites are listed with the greatest number of hazards than before.

Managerial aspects require the interdependence of other aspects and, furthermore, some hazards are interconnected with other threats. For instance, armed conflict is generally connected with vandalism, looting or a lack of policies. For these reasons, it is common today to find that the cultural heritage sites listed as being in danger face a series of strongly connected hazards.



Graphic 4. ***Number of hazards of cultural world heritage properties listed on the list of danger from 1978-2015.***

Finally, looking at the information from the 45 properties included on the list of danger since 1978 to date, the reasons or causes for related risk become clear. As can be seen in Graph 5, 29 of 45 cultural properties have suffered the impacts of development pressures. This hazard is largely related to urban pressures and, albeit less frequently, hazards linked to agricultural expansion.

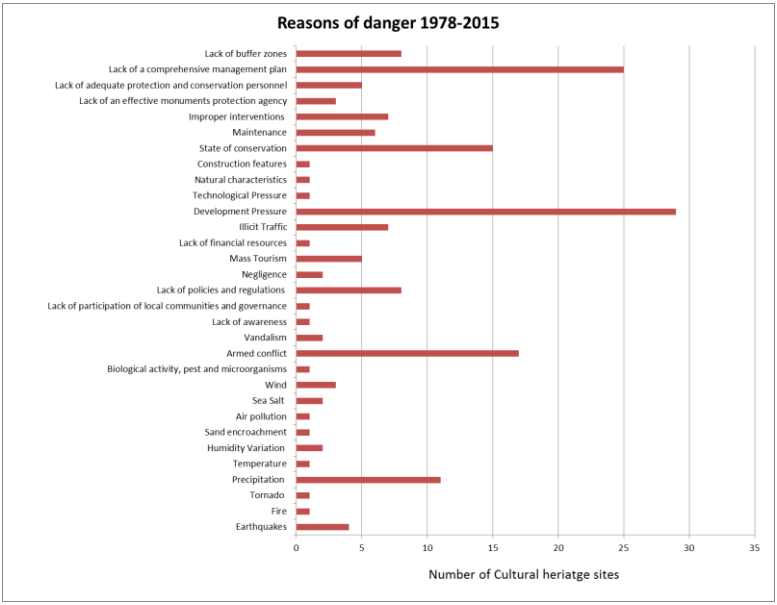
Following the number of cultural sites affected, a lack of management plans or problems represents 25 of 45 cultural properties. The third hazard affecting the conservation of cultural World Heritage sites is that of armed conflict – 17 properties have suffered the consequences of this threat.

Hazards can thus be grouped into three sets according to the number of cultural properties affected. Group one comprises the hazards that have affected 15 to 45 sites. Group two is made up of the hazards that have

affected 5 to 15 cultural properties. Finally, the third group encompasses the hazards that have jeopardized less than 5 cultural World Heritage sites.

In this sense, development pressures, a lack of management plans and armed conflict belong to the first group. In the second group, state of conservation affects 15 properties. Generally, this hazard is connected with other threats since it is also often a consequence of the effects of other factors. In addition, the deterioration of natural materials is also part of the state of conservation.

In the same group it is possible to find hazards related to climate change, such as heavy rains and impacts resulting in variations in rain patterns; threats linked to sociopolitical and economic factors, such as illicit trafficking and a lack of policies and regulations; and hazards associated with site management, such as problems with buffer zones, improper interventions and a lack of maintenance.



Graphic 5. ***Hazards threaten cultural world heritage properties since 1978 to 2015 per number of cultural sites affected.***

1.2. What is risk? Key concepts

Understanding risk management for cultural heritage in a wide context requires the clarification of a set of key concepts and related terms. The first reference to a definition of risk for cultural heritage can be found in Feilden´s publication *Between Two Earthquakes*, in which risk is understood as "the probable loss, combining the hazard of location and the vulnerability of buildings and their contents. Risk can be removed, transferred, shared, accepted, or accommodated" (Feilden, 1987, p. 22). In this sense, hazard is "the probability that a disastrous event of

given intensity will occur in a particular place" and vulnerability is "the degree of loss that will be sustained by an element from an earthquake of given intensity" (Feilden, 1987, p. 22).

It is clear that Feilden´s perspective is focused on earthquakes. However, his indication of a relationship between hazards and vulnerability, as determinants of risk, is the principle through which the concept *risk* for cultural heritage has developed through time.

From a similar perspective, Herb Stovel (1948-2012), a Canadian professor and respected expert in heritage conservation, defines risk as "Hazard x vulnerability; i.e., the degree to which loss is likely to occur, as a function of the nature of particular threats in relation to particular physical circumstances and time" (Stovel, 1998, p. vii). Understanding hazard as "a particular threat or source of potential damage (fire, floods, earthquakes are types of threat)" and vulnerability as an "estimation of the level of loss associated with particular hazards" (Stovel, 1998, p. vii).

Although Fielden and Stovel's approaches (see Graph 6) may be the earliest and most commonly used references about cultural heritage at risk, today a consideration of context gives rise to new concepts. For example, from a managerial point of view it is possible to understand risk as "the distribution of probabilities of the effects caused by the incidence of certain factors" (Easton, 1978, p. 166). In other words, risk is "the degree of contingency or damage proximity" (Matiz López & Ovalle Bautista, 2006, p. 134). It encompasses "the possibility of

suffering, harm or loss or a situation involving exposure to danger" (Oxford Press, 1999, p. 675).

	RISK	HAZARD	VULNERABILITY
1987 **Bernard Fielden**	"The probable loss, combining the hazard of location and the vulnerability of buildings and their contents. Risk can be removed, transferred, shared, accepted, or accommodated"	"the probability that a disastrous event of given intensity will occur in a particular place"	"the degree of loss that will be sustained by an element from an earthquake of given intensity"
1998 **Herb Stovel**	"Hazard x vulnerability; i.e., the degree to which loss is likely to occur, as a function of the nature of particular threats in relation to particular physical circumstances and time"	"a particular threat or source of potential damage (fire, floods, earthquakes are types of threat)"	"estimation of the level of loss associated with particular hazards"

Graphic 6. ***Fielden and Stovel´s Risk Definitions***

Given the sheer number and diversity of terms, which concept of risk should we adopt? As can be seen, a multiplicity of concepts and synonyms is used – hazard, threat, danger, peril and jeopardy, among others – with a palpable absence of consensus affecting the field. "The lack of a consensus definition is due to the fragmented way in which the field of risk analysis has developed" (Meacham, 2001, p. 2).There are two main orientations concerning the

conception of risk. On the one hand, there is a more scientific approach to risk in which the goal is to be able to describe, in a general way, situations that are considered risky. The aim herein is to be capable of explaining and predicting possible future events (Rivera Berrío, 2010, p. 65).

In cultural heritage, this approach is used in the study of the impacts of climate change or the vulnerabilities of cultural heritage in earthquake or flood-prone areas. For example, the European Noah's Ark Project follows this path. The Noah's Ark Project studies the changes in meteorological parameters most likely to affect built cultural heritage in Europe, bringing together eleven institutional and research partners in order to provide "climate risk and vulnerability" maps for cultural heritage on a Europe-wide scale. In this respect, the project suggests guidelines for adaptation measures and strategies for minimizing the effects of climate change to heritage managers (Sabbioni et al., 2010).

Alternatively, there is a sociological approach to risk, which adopts a qualitative rather than quantitative principle by discarding predictions and instead considering the multidimensional character of risk (Rivera Berrío, 2010, p. 66). In this sense, the perception of risk as something influenced by the sociocultural context is introduced. In cultural heritage, this approach is used in studies related to the impact of armed conflict, for instance.

There are two elements that must be considered for both perspectives: first, the reality or facts behind the existence of risk and, second, probability, (Rivera Berrío, 2010, p. 67), since knowledge is always incomplete in

relation to risky contexts. For this reason, managerial standpoints are useful since they involve probability theory and decision-making processes.

As previously noted, *hazard* and *risk* are frequently used as synonyms. This is also the case for the preventive conservation of museum collections, in which risks are seen as agents of deterioration (Waller, 2013, p. 319). Yet while hazard and risk are indeed interrelated, they must be distinguished between.

Traditionally, within the cultural heritage context *hazard* refers to natural disasters. However, a more comprehensive understanding asserts that social, political and economic conditions determine the impact of a particular hazard. Today, for example, social vulnerability is as equally important as natural hazards *per se*. An analysis of the effects of climate change illustrates the above situation. It is therefore necessary to not only consider natural hazards but also individual decisions, policy-making choices, exposure and resilience. From this point of view, hazard can be defined as:

> A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards) (The United Nations Office for Disaster Risk Reduction, 2015 p. 9).

In this context, the term hazard does not refer to the extent of risk (Woodside, 2006, p. 9), but the source of potential harm, also referred to as a risk agent or risk factor. For the Society for Risk Analysis (SRA), hazard as the risk source (Society for Risk Analysis, 2015, p. 8) is "a condition or physical situation with a potential for an undesirable consequence, such as harm to life or limb" (Rivera Berrío, 2010).

Another useful distinction can be made between *hazard* and *danger*, the latter of which "expresses a relative exposure to a hazard. A hazard may be present, but there may be little danger because of the precautions taken" (Rivera Berrío, 2010, p. 109).

In contemporary discussions, the term *exposure* has been raised as a variable in understandings of the potential impact of a hazard. In this sense, the concept is "subject to a risk source/agent" (Society for Risk Analysis, 2015, p. 7); or, in other words, subject to a hazard. "However, just because something is exposed to a hazard does not mean that it is vulnerable or would necessarily result in an impact" (Woodside, 2006, p. 10).

The aforementioned statements bring up additional notions that require consideration. Being in danger depends on the degree of *sensitivity* to the effects of specific hazards. Put differently, the impact of a hazard rests on the corresponding responsiveness to the potential influence of such a source of risk; danger is only present where sensitivity is high enough to produce an effect.

Again, the recent attention paid to climate change as a risk agent for the conservation of cultural heritage raises

the importance of such concepts. From this point of view, "sensitivity might therefore apply to the inherent properties and characteristics of historic materials and assemblages and their response to any one or combination of […] hazards" (Woodside, 2006, p. 11). Accordingly, an impact is the effect of a hazard. A hazard will always present a threat, but it will only become a danger when something or someone is exposed to it.

Cultural heritage in danger not only means exposure to hazards but also addresses the sensitivity of cultural heritage to threats. Consequently, if a cultural heritage site is sensitive to a certain hazard, this will affect the current state of the place – it will generate an *impact* on the site. This impact is normally undesirable; hence it is understood as *damage*. An earthquake, for example, is a hazard and it will have an impact when the characteristics of a site prove sensitive to earthquakes. However, an earthquake will always be a hazard and its status as such will not change with decisions, while risk does change according to the decisions taken. Risk will increase or decrease according to decision-making (Rivera Berrío, 2010, p. 113). Henceforth, references to *risk* denote the actions to be taken in decision-making scenarios. Even negligence and an absence of action constitute decisions.

On the other hand, impacts are also understood as *types of risk* or a *magnitude of risk*. As already noted, the terms are used interchangeably. Preventive conservation in museum collections, for instance, cites magnitude or type of risk in terms of probability (understood as frequency of occurrence) and severity. The severity of an effect constitutes the fraction susceptible and the loss in value

(Waller, 2013, p. 321). Here, magnitude or type of risk denotes the impact of the hazard. In addition, severity also refers to impact. Alternatively, frequency of occurrence and intensity are characteristics of the hazard itself and not of *risk*, as explained later on.

Within the preventive conservation context, risk and hazard are taken to be the same concept. Likewise, type, magnitude and severity of effect are understood, with indifference, to denote impact. This is one example of the indiscriminate use of terms and it highlights the need for a clarification of the key concepts related to risk within the cultural heritage context.

Assuming that the concept of *risk* is negative or denotes *damage* is the most usual way of addressing the issue. Almost all disciplines take this approach to risk. Until the nineteenth century, conceptions of risk also came with positive connotations.

> Modernist notions of risk also included the idea that risk could be both "good" and "bad". […] From this perspective, "risk" is a neutral concept, denoting the probability of something happening, combined with the magnitude of associated losses or gains. In other words, there once was such a thing as a "good risk as well as a 'bad' risk (Lupton, 2013, p. 9).

With the exception of the market and investment sectors, the positive sense of risk has largely been lost due to the lack of a distinction between risk and uncertainty. "Risk is now generally used to relate only to negative or undesirable outcomes, not positive outcomes" (Lupton, 2013, p. 9). From this point of view, *risk* and *uncertainty* are

used interchangeably. "The term risk is often used to denote a phenomenon that has the potential to deliver substantial harm, whether or not the probability of this harm eventuating is estimable" (Lupton, 2013, p. 10). In today's conceptions, risk can be assessed and managed, while uncertainty indicates a lack of information.

> In modernity, risk, in its purely technical meaning, came to rely upon conditions in which the probability estimates of an event are able to be known or knowable. Uncertainty, in contrast, was used as an alternative term when these probabilities are inestimable or unknown (Lupton, 2013, p. 8).

Given these points, risk entails a degree of probability for which uncertainty is an interrelated notion. The greater the probability and uncertainty, the greater the risk will be (see Graph 7). This also means that most knowledge is available and that the greater the comprehension of a phenomenon, the lower the level of uncertainty at the decision-making moment. More knowledge and less uncertainty also allow for a change from precaution to prevention. Prevention means acting accordingly with a certain amount of information.

Graphic 7. ***Relation uncertainty and probability.***

From this point of view, a *risk* will indicate what might happen, but not whether it will happen for sure. Knowledge about causes and effects allows for an estimation of future scenarios in which probabilities provide the basis for a prediction (Rivera Berrío, 2010, p. 82). *Probability* is also a concept that has two emphases. First, the classical approach asserts that probability "applies only in situations with a finite number of outcomes which are equally likely to occur" (Society for Risk Analysis, 2015, p. 5). This means that the frequency of events is involved. Second, there exists a more subjective or judgmental perspective in which uncertainty is key.

In other words, probability is the degree of belief in the occurrence of an event (Society for Risk Analysis, 2015, p. 6) or a related estimation according to the information

available. "Probability has a value at any time that represents the total available knowledge about the process at that particular time" (Meacham, 2001, p. 3). In cultural heritage both interpretations are used depending on the character or type of hazard that cultural heritage is exposed to.

Risk, understood as the probability of the occurrence of an undesired event, is the technical meaning adopted in decision-making theory. Decision under risk is also decision under probabilities (Rivera Berrío, 2010, p. 95). All things considered, it is challenging to come up with a single definition of risk. "Risk is a term that is understood and applied in different ways across the disciplinary fields of knowledge" (Lupton, 2013, p. 20).

The notion of risk[1] is a complex concept that had changed throughout history. From early societies that created a system of beliefs for dealing with danger, to modern and postmodern times in which control and assessment have proved fundamental for believing in a form of risk management. From the first ideas of risk and natural hazards, to changes within modernity and the introduction of a scientific (and probabilistic) approach, the shift from a risk linked purely to nature to a risk in which human behavior is included is crucial (Lupton, 2013).

Today, prediction, measurement, control and decision-making processes are the main elements associated with risk. Risks are more globalized in contemporary society, impacts major and the prospects of identification lower in societies with an increased obsession

[1] From *riscum,* Latin use referring to dangers during maritime travels.

with risk (Beck, 1992). "Risk analysis, risk assessment, risk communication and risk management are all major fields of research and practice, used to measure and control risk" (Lupton, 2013, p. 10).

An more holistic definition of risk has been shaped by Meacham (2001):

> the possibility of an unwanted outcome in an uncertain situation, where the possibility of an unwanted outcome is a function of three factors: loss or harm to something that is valued, the event or hazard that may occasion the loss or harm, and a judgement about the likelihood that the loss or harm will occur (p. 4).

Applying this definition to cultural heritage, it can be seen that the following are involved: loss or harm (impact or damage) to something (cultural heritage) that is valued (heritage values), the event or hazard that may occasion the loss or harm (risk source), and a judgement about the likelihood that the loss or harm will occur (probability).

It is important to note two aspects of this definition: the distinction between *possibility* and *probability*, and the absence of *vulnerability* from the statement. First, *possibility* refers to a degree of uncertainty while *probability* is understood as judgement. This places probability in the subjective approach as a degree of belief in the occurrence of an event, as stated before. In essence, both terms refer to the same issue. The problem is seen to be one of uncertainty and the other as a degree of belief.

Second, vulnerability is a concept that allows for control and management to be introduced as part of the equation. Vulnerability, as Fielden and Stovel state, is closely related to the meaning of impact instead of the concept itself. Once again, studies that relate the impacts of climate change to cultural heritage provide an approach to the term. The IPCC (2001) defines vulnerability as a function of character magnitude, rate of hazard (in this case climate variation), exposure, sensitivity and adaptive capacity (p. 388). Put alternatively, vulnerability is a function of the degree of responsiveness to the impact of hazards, the degree of exposure to the hazard and adaptive capacity (Woodside, 2006).

In this context, *adaptive capacity* refers to the degree to which adjustments in practices, processes or structures can moderate potential damages or cope with the consequences. Within social sciences, adaptive capacity is the ability of societies and institutions to adapt to and cope with the impacts of hazards, depending on factors such as technology, access to information, resources and management capabilities (Woodside, 2006).

In this sense, adaptive capacity is related to *resilience* and *reflexivity*, where the former is defined as "the ability to absorb disturbances, to be changed and then to re-organize and still have the same identity" (Woodside, 2006, p. 12). In other words, it constitutes the ability of cultural heritage, take materials for instance, to endure the impact of a hazard without implementing changes in either structure or ways of functioning. For the behavior of historic materials towards hazards, resilience is inversely proportional to sensitivity. However, resilience is not only

seen in the physical reactions of materials but also in communities, since they exhibit an ability to adapt to certain circumstances. Here the actions of individuals must be taken into account as they may have an important effect on hazards. In this respect, the concept of reflexivity is useful, although it does not involve decision-making.

> The term reflexivity is often used in the sociological literature to denote the responses of people in contemporary Western societies to risk. […] Reflexivity is a defining characteristic of all human action, involving the continual monitoring of action and its context. It involves the weighing up and critical assessment of institutions and claim-makers (Lupton, 2013, p. 23).

For a better understanding of the concepts up to now see the synthesis in the Graph 8.

CONCEPT	DEFINITION
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards)

Risk Factor	Source of Risk / Risk Agent
Danger	"Expresses a relative exposure to a hazard"
Exposure	"Subject to a risk source/agent"
Sensitivity	Responsiveness to the potential influence of a source of risk; danger is only present where sensitivity is high enough to produce an effect
Impact	The effect of a hazard / also understood as types of risk or a magnitude of risk (specially in preventive conservation for collections)/ Probability and severity of a hazard
Severity	Fraction susceptible and the loss in value
Probability	The classical approach asserts that probability "applies only in situations with a finite number of outcomes which are equally likely to occur"/ probability is the degree of belief in the occurrence of an event or a related estimation according to the information available
Possibility	Refers to a degree of uncertainty
Vulnerability	Function of the degree of responsiveness to the impact of hazards, the degree of exposure to the hazard and adaptive capacity
Adaptive Capacity	Refers to the degree to which adjustments in practices, processes or structures can moderate potential damages or cope with the consequences.
Resilience	"the ability to absorb disturbances, to be changed and then to re-organize and still have

	the same identity"
Reflexivity	"Reflexivity is a defining characteristic of all human action, involving the continual monitoring of action and its context. It involves the weighing up and critical assessment of institutions and claim-makers"

Graphic 8. ***Summary of concepts and definitions.***

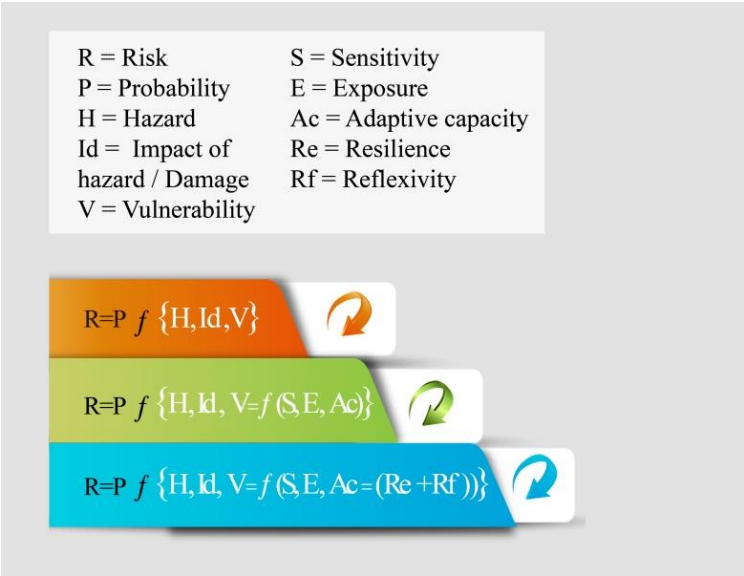
Within a cultural heritage context, Woodside (2006) proposes adaptive capacity in two ways. First, in terms of the physical capacity to adapt without altering the properties of historic materials, character and cultural significance – understanding the limitations of cultural heritage for modifications on the site, integrity or values. Second, the capacity of the people and institutions responsible for managing the site to cope with and adapt to hazards, identifying the requisite knowledge needed to inform decision-making and management plans (p. 13).

To sum up, vulnerability results from physical, social, environmental and economic factors (hazards) – among others that increase susceptibility due to the impact of the hazard (World Bank Institution, 2014) – and depending on exposure, the ability to adapt to situations and assess the circumstances. Vulnerability can thus be seen from two perspectives: one, a physical or biophysical view that concerns natural hazards; and two, a social view that concerns the contextual conditions that may increase a society´s sensitivity. Natural hazards cannot be controlled, but vulnerability can. Both, biophysical and social vulnerability are understood in terms of "systemic" vulnerability (Woodside, 2006), which is the case for cultural heritage.

Although vulnerability is sometimes seen as the amount of damage incurred after the occurrence of a hazard, here this particular perspective is related to the state that cultural heritage is in before it encounters a hazard.

Given these points, the notion of *risk* used in this work denotes the probability of an unwanted outcome as a function of one or a combination of hazards, hazard impacts and vulnerability. Here vulnerability is also understood as a function of sensitivity, exposure to hazards and adaptive capacity. This last point is taken to entail a combination of resilience and reflexivity. The entirety of these elements, the risk, demands decision-making actions.

In this sense, for cultural heritage risk is the probability (the degree of belief or uncertainty in the occurrence) of an unwanted outcome (loss of value for cultural heritage), which is a function of one or a combination of hazards (risk sources), hazard impacts (degree of damage or expected consequences) and vulnerability. Vulnerability is a function of sensitivity (degree of responsiveness to a hazard), exposure (subject to a hazard) and adaptive capacity (the ability to adapt to hazard impacts, and monitoring and critical assessment by individuals) (see Graphic 9). The consideration of risk in cultural heritage indubitably entails the decision-making process.



Graphic 9. ***Notion of risk used in this work.***

Hazards or threats, called risk sources or risk factors, are those circumstances, facts, aspects or influences that might affect the conservation or preservation of a cultural heritage site. Risk factors might include environmental, political, social, economic and institutional aspects among others. Indeed, risk factors do not operate alone but are interdependent on one another, acting together and affecting one another. In other words, at-risk cultural heritage sites are influenced by more than one factor at any time.

The impacts upon or damages to cultural heritage not only involve the materiality of the properties but also disturbances to communities, memory, traditions and identity. Sensitivity is closely linked to the physical characteristics of historic materials, ensembles and

constructions systems. Exposure is related to the location of a cultural heritage property and the hazards likely to occur at a specific site in terms of geography, geology and social conditions. Meanwhile, resilience is associated with preventive measures, preparedness and adaptation to risk factors. In this sense, resilience is a consequence of policy, decision-making, resources and institutions. Finally, reflexivity is also part of the managerial side of the equation, since it is not only about individual awareness but also a response to assessments, controlling and monitoring actions, institutions and governance.

According to Lupton (2013), risk awareness is characterized by fascination:

> today the decisions of individuals or organizations can be identified as the root cause of disasters, and therefore it can be demanded that their decisions be opposed so as to obviate danger. The concept of risk has gained importance in recent times because the dependence of society´s future on decision-making has increased; it now is dominating ideas about the future (p. 18).

In conclusion, risk in a cultural heritage context is a multidimensional problem that combines what preventive conservation identifies as technical and managerial components. While there exist several hazards that are merely physical and technical, today the influence of management on controlling, preventing, adapting and assessing impacts is increasing and occurring with greater frequency in considerations of risk. Furthermore, contemporary Western societies are shifting from reactive

to preventative thinking: hence the relevance of the saying "prevention is better than cure".

1.3. What is at stake? Values

The multidimensional character of the notion of risk involves different issues, such as the objective or subjective aspects of probability, benefits and consequences, data, units of measurement, time, locations, perceptions and values (Meacham, 2001, p. 2).

Within the risk management context, values comprise the weight or importance given to the decisions taken. “Values are not only philosophical principles; they also characterize the consequences of decisions that are important” (Keeney, 1996a, p. 127). Within this framework, values establish the preferences that exist between one alternative and another at the moment of taking a decision.

In the public sector, this issue is crucial since the social and political spheres influence decisions. Values highlight the problem of deciding how to allocate resources. For instance, whether to invest in the preservation of cultural heritage rather than the construction of a new road, or to spend money on the construction of flood defenses for a site threatened by climate change instead of on a control system for humidity affecting the site. Values drive decisions. What is considered important is what values reflect. An assessment of values means that a decision might be taken in a more informed way. “Without values, there would be no public concern about risk, no public debate about risks, and probably no public agenda to address them. Values are at

the core of all risk issues and should be explicitly accounted for in managing risks" (Keeney, 1996a, p. 127).

From the managerial point of view, values are an essential part of the decision-making process and play a role in all of its dimensions. Taking cultural heritage as an example, it is important to realize that there are two main levels for decision-making: external and internal. The first refers to situations in which the final decisions rest on individuals or institutions outside of the organization itself. In other words, the decision-maker is an external agent of the cultural heritage institution. This is the case when the decision-makers are ministers, government agencies and trustee's foundations, among others, that is to say, out of the scope of the direct management of the site, collection, museums and so on. In this case, decision-making depends, in part, on the values of such external agents. The allocation of resources or regulations rests on how important these agents consider cultural heritage conservation to be in relation to other issues of governance.

The second refers to decision makers inside the institution; that is to say, decisions taken by directors, conservators and curators as the direct managers of cultural heritage. In this case, the decision-making process faces the challenge of determining which action is more relevant than any others placed on the table. In other words, both levels of decision-making, both internal and external, involve values that privilege actions or options and, generally, decisions are taken at both levels. "Balancing higher authorities with local needs is a challenge faced by most managers" (De la Torre, 2005, p. 3).

Accordingly, cultural heritage poses various qualities that need to be clarified. Values as a driving force

for decision-making are closely interrelated to the values of cultural heritage. This means that there are two dimensions to values: values for decision-making and the values of cultural heritage.

Values for decision-making can include transparency, quality, excellence and even the privilege of educational and cultural relevance over economic or development issues, if the decision is taken at an external level. Instead, the values of cultural heritage are "used to mean positive characteristics attributed to heritage objects and places" (De la Torre, 2005, p. 5). Nevertheless, since the end of the 1990s we have seen an increasing interest at heritage sites in values that reflect a more destructive and cruel part of history, far from the heritage that has given us the great and beautiful creations of the past (Logan & Reeves, 2009, p. 1). For example, Auschwitz and the Hiroshima Atomic Bomb Dome were listed as World Heritage sites in 1997 and Robben Island, Nelson Mandela´s detention place, was inscribed in 1999.

A set of values determines the cultural significance of heritage. "Cultural significance is the term that the conservation community has used to encapsulate the multiple values ascribed to objects, buildings, or landscapes. From the writings of Riegl to the policies of the Burra Charter, these values have been ordered in categories, such as aesthetic, religious, political, economic, and so on" (Avrami, Manson, & De la Torre, 2013, p. 351).

Logically, the values for decision-making at the internal, and even external level, might have iterations for the values related to cultural heritage. Decisions in the field of conservation are frequently based on the values of cultural heritage, such as authenticity (ICOMOS, UNESCO,

& ICCROM, 1994), originality, aesthetic, integrity, and so on. "The ultimate aim of conservation is not to conserve material for its own sake but, rather, to maintain [and shape] the values embodied by the heritage" (Avrami et al., 2013, p. 351). The special relevance of values of cultural heritage for decision-making in conservation has been termed a values-based approach (Poulios, 2010).

Although the main purpose of risk management is to reduce the probability of unwanted outcomes, generally this objective isn't taken into account in the decision-making process. Within the cultural heritage context, the unwanted outcome refers to a loss of values for cultural properties. It has always been the case that while strategies to mitigate a loss of values are proposed, key decisions are normally taken by external agents (Baer, 2001). Despite being the ultimate objective, the values of cultural heritage are often not taken into consideration during the decision-making processes of risk management. "The appropriate subject would be decision-making where values, valuation and minimization of total risk were key factors in the development of a successful risk management strategy" (Baer, 2001, p. 54).

Another key point is the need for an assessment of values. The consideration of some cultural heritage values as more important than others is problematic. However, this is unavoidable in most risk-management situations. "Through the classification of values of different disciplines, fields of knowledge, or uses, the conservation community [defined broadly] attempts to grapple with the many emotions, meanings, and functions associated with the material goods in its care. This identification and ordering of values serves as a vehicle to inform decisions

about how best to preserve these values in the physical conservation of the object or place" (Avrami et al., 2013, p. 352).

To sum up, there are values for decision-making and values for cultural heritage. Decisions can be taken at an external or internal level. Both levels of decision-making involve values that, in some cases, might constitute a reiteration when the decision is related to the conservation of cultural heritage. There is clearly great complexity in the issue of site values and the implications of management decisions (De la Torre, 2005, p. 3). Decision-making values in risk management for cultural heritage are ultimately the values of cultural heritage. "Values, meaning what we care to achieve, are essential to risk management. Understanding the relevant values is critical to making good decisions about risk" (Keeney, 1996a, p. 126).

CHAPTER 2

Risk Management for Cultural Heritage

"If you can look into the seeds of time,
And say which grain will grow and which will not,
Speak then to me."

Macbeth, William Shakespeare

2.1. Risk Management

Today, it is not surprising to hear about risk management in cultural heritage. The impact of events such as earthquakes and the subsequent media attention makes it well known. Common assumptions about risk relate it to natural disasters. However, risk management has a broader meaning.

Definitions, methods and objectives differ widely according to the field of knowledge of risk management: project management, insurance, security, public health, safety, and so on. "Depending upon the discipline in which

one places oneself. Therefore, risk has a different ontological and epistemological status, and is researched and understood accordingly in different ways, using different tools, methods and frameworks of analysis" (Lupton, 2013). One area that has developed risk management to a large extent is project management (Raz & Michael, 2001, p. 9), the processes of which are shared with other disciplines.

From this perspective, and indeed for all areas of knowledge, risk management is a process that helps "decision-making by taking into account uncertainty and the possibility of future events or circumstances [intended or unintended] and their effects on agreed objectives" (ISO, 2007, p. v). Risk management is "the identification, assessment, and prioritization of risks followed by the coordinated […] application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events" (Douglas, 2009, p. 46).

Due to the enormous impact of natural disasters, the application of risk management has addressed mainly those threats in particular. In this sense, the World Bank (2014), for instance, defines risk management as "the process of identifying, analyzing and quantifying the probability of losses in order to undertake preventive or corrective actions" (p. 4). Within the cultural heritage context, this orientation has not been eluded. The majority of studies related to risk management in cultural heritage focus on natural hazards (ICOMOS, 2006, 2007; Jigyasu, 2000; Jokilehto, 2000; Stovel, 1998; UNESCO, 2007; UNESCO, ICCROM, & Agency for Cultural Affairs of

Japan, 2005). However, it should also be used beyond these sources of risk.

Taking into consideration the first chapter, risk management for cultural heritage is a tool that can offer information for management plans, managerial decisions and decision-making processes at any site, museum, library or collection. In this sense, risk management can be used not only for natural disasters but also for a multiplicity of hazards that cultural heritage faces. If risk is the probability of unwanted outcomes – in this case the loss of values for cultural heritage – as a function of one or a combination of hazards, impacts and vulnerability, then risk management is the methodological process that allows for the gathering of information for taking cognizant decisions in order to minimize, prevent or reduce the likelihood of such an unwanted outcome. In this sense, decisions can be taken either to reduce or avoid impacts to or control vulnerability. "Risk management embraces all the decisions we make and activities we undertake" (Keeney, 1996a, p. 127).

2.1.1. Principles

According to standard ISO/DIS 31000 Risk Management – Principles and guidelines on implementation (2007), written by the International Organization for Standardization, "the implementation of risk management will depend on the varying needs of a specific organization, particular objectives, context, structure, products, services, projects, the operational processes and specific practices employed" (p. 1).

On the other hand, standard ISO 31000 (2007) establishes some principles for managing risk in a way that is more effective. The principles are:

- Risk management should create value to the organization: contributes to achievements of objectives, improvement and reputation;
- Risk management should be an integral part of organizational processes;
- Risk management should be part of decision-making;
- Risk management should explicitly address uncertainty;
- Risk management should be systematic and structured;
- Risk management should be based on the best available information;
- Risk management should be tailored: flexible and adaptable to different situations;
- Risk management should take into account human factors;
- Risk management should be transparent and inclusive: involving all stakeholders and right holders;
- Risk management should be dynamic, iterative and responsive to change;
- Risk management should be capable of continual improvement and enhancement.

(ISO, 2007, p. 2).

Looking at these principles within the cultural heritage context, it is possible to state the following:

- Risk management helps to accomplish the main purpose of conservation, since it gives priority to actions in order to reduce hazard. In addition, risk management contributes to the more efficient administration of sites.

- Risk management should be integrated with other management procedures at a site. In order to be efficient, risk management cannot be taken as an independent procedure within the administrative aspects of the site. It is important to consider the cultural heritage site as a "system". This notion is already present in studies on the impacts of climate change on cultural heritage. "Although they are no doubt physical, in terms of being assemblages of built and organic materials, their significance is founded in social and cultural meanings and values. Furthermore, they are dependent on some form of social system for their management, maintenance and continuing sustainability" (Woodside, 2006, p. 8). As a system, any intervention will affect the whole. In this sense, risk management provides procedures that affect the entire system and all normal organizational processes. For this reason, risk management should be part of an integrated system of prevention.

- A risk management approach can provide a decision-making method, since it constitutes "the application of all available resources in a way that minimizes overall risk" (Waller, 2013, p. 317). For instance, this method has been used since the 1990s in museum collections in Canada and the United States. Robert Waller worked at the Canadian Museum of Nature, finding that risk management "can be used, not only to organize thoughts on any decision affecting the preventive conservation of collections, but also to provide a method for considering the most difficult decision we face – how limited resources can best be

applied to the protection of collections" (Waller, 2013, p. 318). From the pure theory of risk management, the ultimate objective of the method is to be a tool for taking decisions in the most informed way possible.

- Risk management should explicitly address uncertainty since most of the hazards are indeed unpredictable. This is the case, specifically, for natural disasters that strike unexpectedly.

- Risk management should be systematic and structured since a cultural heritage site should also be considered as "a system similar to a social system or eco-system, dependent on human values and actions for their survival" (Woodside, 2006, p. 9). The theory of systematic approach was taken from biology. In 1928, Ludwing Von Bertalanffy defined a system as a group of elements that are related among themselves and with their context. In other words, a system is a general model with certain characteristics that are shared by a group of entities of a different nature (von Bertalanffy, 1950; 1982). In this sense, a cultural heritage site is a system and each part is interrelated. For instance, values are linked to historic materials; state of conservation is related to conservation decisions; and decisions are linked to resources available, and so on (Taylor & Cassar, 2008). For these reasons, risk management should not only be systematic itself, but also part of the general management of the site.

- Risk management should be based on the best available information regarding the hazard, impact and vulnerability. In this sense, risk management should consider the support of results provided by research into cultural heritage. Although in a permanent state of development, this field of knowledge should generate new approaches everyday, as well as data and information regarding a variety of issues. These include the deterioration of historic materials under certain circumstances, information about the frequency and variation of hazards, methods of assessment or different possibilities for the measuring of probability. New knowledge about cultural heritage and procedures for conservation should be integrated in risk management.

- Risk management should be tailored to the realities of each cultural heritage site, since every place is different and in a continuous state of change. Cultural heritage as a system that changes over time. For example, exposure to a hazard might change, historic materials undergo modifications, or the management context might be subject to adjustments. In this sense, no one cultural heritage site is equal to another. Risk management has to adapt to each case in particular and to change accordingly with the context. Risk management should thus be dynamic and responsive to change.

- Risk management should take into account human factors since cultural heritage cannot exist apart from this. On the one hand, human values give cultural

significance to a site yet, on the other hand, several hazards are man-made. Furthermore, decisions are taken by managers or stakeholders.

- Risk management should involve all the relevant stakeholders since an assessment of values is fundamental for having all the information available for the taking of decisions. In addition, all stakeholders are crucial for a site´s management.

- Risk management should be capable of continual improvement and enhancement according to changes affecting cultural heritage sites and the involvement of new knowledge and practices.

It is clear that risk management for cultural heritage complies with the basic principles of standard ISO 31000. In this context, risk management, as a useful instrument for preservation, should work via holistic approach to control a wide range of risk factors. Also, it should function systematically if its programs for treatment and monitoring are integrated. Lastly, it should be integrated in practices as a result of institutional management.

2.1.2. Process

According to the area of knowledge, risk management involves a series of basic steps. Raz and Michael (2001) have conducted a study in which different

tools for risk management are tested in order to analyze their use and level of success. The study explores not only the tools implemented but also the process of risk management in differing fields of application. They find that, in general, all disciplines consider the following to be fundamental stages: identification, assessment or quantification, response and control. The focus on a strategic approach to risk management is applied using seven steps (Raz & Michael, 2001, p. 9):

1) Identify where risk factors might arise;
2) Structure the information about risk assumptions and relationships;
3) Assign ownership of risks and responses;
4) Estimate the extent of uncertainty;
5) Evaluate the relative magnitude of the various risks;
6) Plan responses;
7) Manage by monitoring and controlling execution.

From this point of view, risk management is considered in emergency situations. However, as previously stated, risk management should be part of the normal practices and procedures of an organization or institution. For this reason, a number of variations in the risk management method are proposed. Some of these consider, for example, focusing on two main phases: first, risk assessment through identification, analysis and prioritization; second, risk control through risk-management planning and corrective actions (Raz & Michael, 2001).

For standard ISO 31000 (2007), the risk management process is as follows:

a) Establish the context:

This refers to the definition of basic parameters, scope and criteria for managing risk. It involves both external and internal context. External context refers to any element outside of the organization that could influence objectives. This aspect includes a legal and regulatory framework, policies and stakeholder interests (ISO, 2007, p. 9). For instance, a cultural policy might affect the conservation of cultural heritage sites.

In contrast, internal context refers to any element inside the institution that might affect the objectives (ISO, 2007). Within the cultural heritage context, for example, this could be internal stakeholders, human resources, financial capabilities, systems and technologies available, among others.

As a part of this step, the definition of responsibilities, assessment methods and risk criteria can be included. "Risk criteria express the organization´s values, objectives and resources" (ISO, 2007, p. 10). These criteria should address aspects that could make risk acceptable or tolerable. "There is no consensus on what makes a risk 'acceptable' [or on whether that is even possible]" (Meacham, 2001, p. 3).

There are several ways to determine societal risk acceptability, for some authors it is possible to review what has been accepted in the past, while others refer to risk perceptions and preferences determined by questioning people (Meacham, 2001, p. 5). In any case, risk acceptance is

always controversial and difficult to establish. Within the cultural heritage context, for instance, it implies the degree of deterioration that is acceptable for historic materials or the acceptance of a certain level of exposure to a hazard.

Most of the time, risk is not accepted but instead tolerated, since some hazards are imposed upon individual´s decisions. "Individual acceptance, for example, implies that one has all of the pertinent information on which to base a decision, that one understands the information and that one is free to choose whether they want to accept or reject the risk (Meacham, 2001, p. 6). Acceptance implies that an individual´s decisions may modify risk.

> The setting of acceptance or tolerable levels of risk not only requires judgements regarding the risk, but also about acceptable distribution of risks across various populations. This requires value judgments and various ethical issues to enter into the decision-making process, including valuing consequences, paternalism versus autonomy, equity considerations, and a responsible decision process (Meacham, 2001, p. 6)

All of these aspects have to be taken into account at the moment of defining the criteria for assessing risk. To sum up, this phase refers to the knowledge of the organizational environment. It deals with understanding the external and internal context of the institution in charge of the site. According to the international standard for risk management, the external environment involves (ISO, 2007, p. 9):

- Cultural, political, legal, financial, regulatory and economic aspects;
- Key drivers and trends affecting the organization;
- External stakeholders.

While the internal context includes:

- Capabilities and resources of the institution;
- Decision-making processes;
- Internal stakeholders;
- Policies, values, objectives and strategies of the institutions;
- Institution structure;
- Standards and reference models.

In other words, this phase detects and recognizes all the elements that may influence the institution. Through this step, it is possible to define risk criteria, risk-assessment methodologies, risk level to be evaluated, acceptance of level of risk and processes for risk treatment.

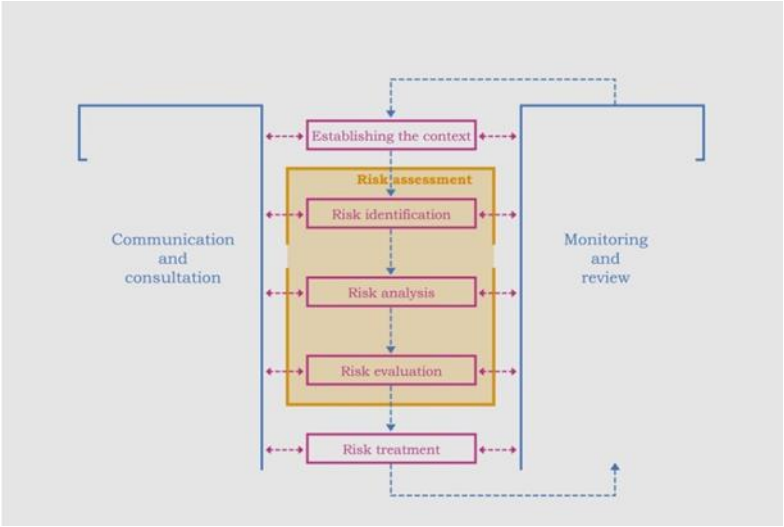
b) Risk Assessment

Risk assessment is one of the most critical and fundamental parts of the risk-management process. This phase contributes to the information and data necessary for the decision-making process. The limits, constraints and advantages of the methods selected for the assessment will later guide the relevant decisions, alternatives and opportunities. This does not constitute a separate phase from the item outlined above and this assessment is intrinsically related to risk perception and acceptance.

> Numerous methods exist for assessing, with the selection of a method or mode for assessing or

> expressing risk often made to support a particular position or to impact the receivers´ perceptions of risk. […] This issue is complex as the choice of a risk assessment method is often intimately tied to how the risk is expressed and what is known about the hazard and the consequences (Meacham, 2001, p. 7).

This process determines what might happen, as well as how and why it might happen. "Each risk concerns the possibility of detrimental consequences and their likelihoods. The management part of risk management concerns decisions about these risks" (Keeney, 1996a, p. 127). For these reasons, risk assessment becomes a critical part of risk management. Risk assessment involves three main processes (see Graphic 10).



Graphic 10. ***Process of Risk Management*.**

Source: Adapted from standard ISO 31000 (ISO, 2007, p. 8).

i) Risk identification:

This refers to understanding the threat posed by hazards. More specifically, recognizing the magnitude of values, human life, assets, cultural properties exposed to hazards and the vulnerability or increase in sensitivity that hazards place on former vulnerabilities and actions (World Bank Institution, 2014).

This step seeks to recognize each hazard, known as a risk source or risk factor. In addition to identification, this phase also aims to describe the circumstances, context and potential impacts of each hazard, as well as possible causes and scenarios. This identification process should be carefully conducted and precise since if a risk factor is not identified it will not form part of the subsequent analysis. The previously settled criteria have to match with the procedures for identifying risk and so it is possible to decide to leave apart certain types of risk sources.

It is important that identification is made in a systematic and structured way, including hazards both under the control of and out of the control of the institution. Here it is possible to use different kinds of tools to form a checklist, including brainstorming, interviews, judgments and workshops, among others.

ii) Risk analysis

A risk analysis should consider all of the identified factors and their interdependence. Risk analysis generates a general diagnosis of a situation at a site. Such a diagnosis

provides a way to determine, through critical scrutiny, analysis and perception, the causes of an unacceptable situation (Easton, 1978, p. 86). For this reason, risk analysis is the process of data interpretation in which the sources of risk are related to their indicators. Risk analysis is the first step in the evaluation and delineation of priorities.

> Risk analysis is about developing an understanding of the risk. Risk analysis provides an input to risk evaluation and to decisions on whether risks need to be treated and the most appropriate risk treatment strategies. […] The way in which likelihood and consequences are expressed and the way in which they are combined to estimate a level of risk will vary according to the type of risk and the purpose for which the risk assessment output is to be used. These should all be consistent with the risk criteria. It is also important to consider the interdependence of different risks and their sources (ISO, 2007, p. 11).

Most of the time, this step is not an independent or separate process from risk identification. Generally, it is a phase that is undertaken in parallel, actually forming part of the risk identification. However, this stage considers the sensitivity, exposure conditions and strategies that are already on place in order to estimate the risk. Here an analysis of hazard, impact and vulnerability is undertaken. Risk analysis also studies the acceptance or degree of toleration for each hazard.

For these reasons, risk analysis shapes the fundamental aspects needed to assess risk. During this phase, hazards are clustered and the relationship between

them is studied. Within a cultural heritage context, hazards have strong ties of interdependence and interconnection that need to be established.

The methods used at this stage are crucial to the assessment. As in all disciplines, the key to risk assessment and risk management rests on the methodology of measurement, which is a consistent problem and commonly constitutes a focus of criticism. The typical problem here is that "the data, tools, and methods for assessment and prediction may be lacking. These factors interject uncertainty, with which some people, such as regulators, politicians and lay people, have trouble dealing. Also, because of the difficulties in some analyses, simplifying assumptions may be made, which some parties may not understand or agree with" (Meacham, 2001, p. 7).

The range of methods used depends on the field or discipline to which risk management is applied. In addition, no one perfect method exists. System, scenarios or process analyses can be used according to the area of application.

> Analysis may be qualitative, semi-quantitative or quantitative, or a combination of these, depending on the circumstances. In practice, qualitative analysis is often used first to obtain a general indication of the level of risk and to reveal the major risks. When possible and appropriate, one should undertake more specific and quantitative analysis of the risks as a following step. Consequences may be determined by modelling the outcomes of an event or set of events, or by extrapolation from experimental studies or from available data.

> Consequences may be expressed in terms of tangible and intangible impacts. In some cases, more than one numerical value or descriptor is required to specify consequences for different times, places, groups or situations (ISO, 2007, p. 11).

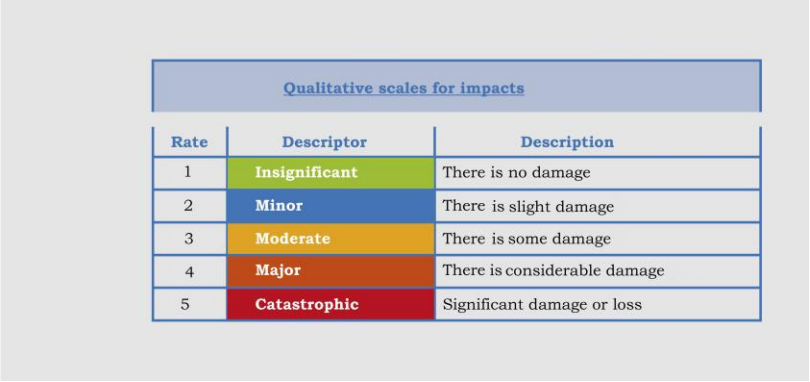
Qualitative analysis uses words or descriptive scales for specifying the magnitude of potential impacts and the likelihood of a hazard´s effects. The scales can be adapted and adjusted according to the relevant circumstances, and different scales can be used for different risks. These scales are used to analyze the frequency of occurrence and impacts. Standard ISO 31000 (2007), along with several technical norms related risk management, suggest scales of frequency for occurrence and impact, as shown in Graphs 11 and 12 respectively.

Qualitative scales for frequencies of ocurrence

Level	Rate	Descriptor	Descriptions
A	5	**Almost certain**	It will happen in the majority of cases
B	1	**Probable**	It will probably happen in the majority of cases
C	3	**Possible**	Eventually it will happen
D	2	**Improbable**	It may happen in some cases
E	1	**Rare**	It may happen in exceptional cases

Graphic 11. ***Qualitative scales for frequencies of occurrence for hazards.***

Source: Adapted from standard ISO 31000 and the technical norms for risk management. (ICONTEC, 2004; ISO, 2007)



Qualitative scales for impacts

Rate	Descriptor	Description
1	Insignificant	There is no damage
2	Minor	There is slight damage
3	Moderate	There is some damage
4	Major	There is considerable damage
5	Catastrophic	Significant damage or loss

Graphic 12. ***Qualitative scales for impacts of hazards.***

Source: Adapted from the standard ISO 31000 and technical norms for risk management. (ICONTEC, 2004; ISO, 2007)

Semi-quantitative analysis assigns rates to qualitative scales. In this case, it is not mandatory that the rates given to each description match exactly with real magnitude or impact. Indeed, the qualitative and semi-quantitative methods are used when the exact numbers cannot be provided, either due to a lack of data or because the type of hazard does not allow for quantitative expression.

According to this analysis, the rates can be combined in different ways, but the method chosen has to be explicit and consistent. The idea is to obtain a priorization more precise than the one achieved with qualitative methods alone, being aware that in any case an exact expression of risk remains absent.

Standard ISO 31000 (2007) and several technical norms related to risk management suggest semi-quantitative scales, as in the example shown in Graph 13.

Semi - qualitative scales for frequencies of ocurrence				
Level	**Rate**	**Descriptor**	**Descriptions**	**Rank**
A	5	**Almost certain**	It will happen in the majority of cases	76 -100 %
B	4	**Probable**	It will happen probably in the majority of cases	51 -75%
C	3	**Possible**	It will happen eventually	25 -50 %
D	2	**Improbable**	It may happen in some cases	16 -25%
E	1	**Rare**	It may happen in exceptional cases	0 -15 %

Graphic 13. ***Example of a semi-quantitative scale for frequencies of occurrence.***

Source: Adapted from standard ISO 31000 and technical norms for risk management. (ICONTEC, 2004; ISO, 2007)

Some problems with semi-quantitative methods reside in the fact that, possibly, ranks do not adequately show the relativity of risk. In most of these cases, the ranks in the middle of the scales do not allow for differentiation among risks. For this reason, prioritization may be inconsistent.

Conversely, quantitative methods apply to exact numbers, thus reflecting a "realistic" behavior for risk. The economic and financial sectors tend to use such methods. This type of analysis relies on the availability of data and the kinds of hazard at play. The quality of the analysis depends on how accurate and reliable the data are, as well as data integrity.

In conclusion, the final result of risk analysis is the principal input for risk evaluation.

iii) Risk evaluation

The risk evaluation process consists of estimating the collected information and the outcome of a risk analysis. The evaluation takes as a reference the ideal situation or an optimal scheme. The estimation of risk factors allows for the identification of key problems, needs and priorities. It also allows for a definition of those actions to be taken by the institution in the short, medium and long term. Both risk analysis and risk evaluation can be global or specific, depending on the hazard and the institutional context.

Global analysis and evaluation may require increased time and resources in comparison to their particular or local counterparts, but with an imminent need to manage risk this will not prove viable. Alternatively, the results of a punctual evaluation release the need for a global or general analysis:

> The purpose of risk evaluation is to assist in making decisions, based on the outcomes of risk analysis, about which risks need treatment and treatment priorities. Risk evaluation involves comparing the level of risk found during the analysis process with risk criteria established when the context was considered. […] In some circumstances, the risk evaluation may lead to a decision to undertake further analysis. The risk evaluation may also lead to a decision not to treat the risk in any way other than maintaining existing risk controls. This decision will be influenced by the organization´s risk appetite

and the risk criteria that it has established (ISO, 2007, p. 12).

From the outcomes of the risk analysis, risk evaluation will allow for hazards and their impacts to be weighed using comparative estimations. These valuations will show the magnitude or seriousness of the hazard, among others factors. In this way, it is possible to establish the various necessities and priorities.

Comparative estimations are made based on the previously established criteria and must always be consistent. For instance, risks that have been analyzed quantitatively must then be compared with quantitative criteria. Such a comparison will allow for the identification of the acceptancy or toleration level for each hazard. Hazards that are classified as unacceptable must be addressed.

In this sense, evaluation means to assign a magnitude that implies the analysis of environment or context, criteria, variables, indicators and the selection of the evaluator. "By definition, the evaluation is relative, associated to a conceptual and logic reference framework; it is not possible to define it in absolute terms" (Martínez & Escudey, 1998, p. 10)[2].

In other words, risk evaluation process assigns a value to each risk factor. A scale in the magnitude assigned will allow identifying which is the most threatened factor. Having a scale from the worst to the best factor will allow the prioritization of actions for the risk treatment process.

[2] Originally in Spanish. The translation is mine.

3) Risk Treatment

Risk treatment constitutes the response given by an institution in order to deal with a problematic situation and the needs that have been identified in the risk assessment. "Risk treatment involves selecting one or more options for addressing risks, and implementing those options" (ISO, 2007, p. 12). Risk treatment implies the design and implementation of specific programs. Corrective programs should focus on the design, preparation, coordination and implementation of actions and procedures in order to manage the risks detected in previous phases. The capacity to respond to certain risk factor depends on the real possibilities available to the institution, as well as its administrative and technical capabilities and resources.

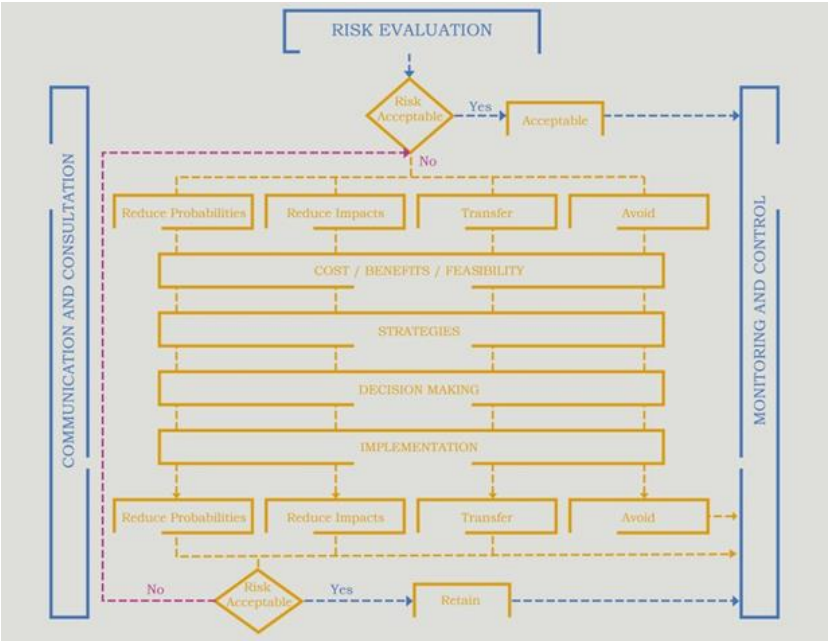
Risk treatment involves the identification of alternatives and options, the evaluation of alternatives, decision-making processes, planning for the execution of the best options and the implantation of actions. This is a cyclical process and the final decision could form one or a combination of options. Among the options it is possible to find the following, according to standard ISO 31000 (2007) (see Graphic 14):

- Avoid the risk or a hazard, by deciding not to start or continue with specific actions;
- Reduce or change the likelihood or probabilities of the hazard
- Reduce or change consequences or impacts;
- Transfer or share the risk with another party or parties; and
- Accept the risk.

"Selecting the most appropriate risk treatment option involves balancing the costs and effort of implementation against the benefits derived" (ISO, 2007, p. 13). For these reasons, the ISO 31000 establishes the need of evaluations as cost- benefits and feasibility for choosing the best alternative for risk treatment. Although these methods are useful for evaluating projects chosen as risk treatments, there are other kinds of alternatives that allow estimating the best option. As it is going to be mention in the next chapter, multiple criteria methods are also possible.

Risk treatment is not only a matter of choosing the best or optimal alternative, but is also a process in which risk perceptions, stakeholder interest and values should be considered. Generally, the alternatives do not satisfy everyone involved. For this reason, the previously selected criteria are crucial in order to select the best alternative.

> Risk treatment might also introduce secondary risks that need to be assessed, treated, monitored and reviewed. These secondary risks should be incorporated into the same treatment plan as the original risk and not treated as a new risk, and the link between the two risks should be identified. Decision makers and other stakeholders should be aware of the nature and extent of the residual risk after risk treatment. The residual risk may be documented and subjected to monitoring, review and, where appropriate, further treatment (ISO, 2007, p. 13).



Graphic 14. ***Risk Treatment Process*****.**

Source: Adapted from standard ISO 31000 and technical norms for risk management. (ICONTEC, 2004; ISO, 2007)

3.1) Decision-making:

A fundamental step in risk treatment is the selection of alternatives or options for confronting hazards, impacts and probabilities, that is to say, for facing risk. Commonly, decisions are taken based on the decision maker´s value system and available resources (Meacham, 2001, p. 9).

As mentioned in the first chapter, there are various values that drive such decisions. These values are different from the cultural heritage values that may come to constitute criteria during the risk-management process. The

values adopted within decision-making are the maximum principles that any institution should adopt as standards for determining any action.

An emphasis on values as a fundamental element in the decision-making was first developed in the 1990s. Ralph L. Keeney has developed what he calls value-focused thinking (Keeney, 1996b), in which decisions should focus on values first, before of thinking of alternatives. This is an important shift in the risk-management process since traditionally risk treatment has dealt with deciding between the best or optimal alternatives.

> Focusing on alternatives is a limited way of thinking through decision situations. It is reactive, not proactive. […] You do not control decision situations that you approach through alternative-focused thinking. This standard mode of thinking is backwards, because it puts identifying alternatives before articulating values. It is values that are fundamentally important in any decision situation. Alternatives are relevant only because they are means to achieve your values (Keeney, 1996b, p. 537).

In addition to values, there are different approaches to a decision, especially when risks can be treated. Among these it is possible to find bootstrapping, expert judgement and formal analysis. The first approach refers to the study of policies, procedures or decisions that have been taken in the past in similar situations. The problem with this approach is that "reflects the bias that whatever was right in the past was correct" (Meacham, 2001, p. 10). The second method is useful for technical aspects of the problem, but is

limited to echoing just one point of view. In such a case, the values of the different stakeholders are likely to be disregarded. Finally, the third approach brings up the different types of tools and methods used in decision analysis, including feasibility and strategies for alternatives.

> Although, well-structured and presumed to be comprehensive, such approaches are often questioned as to their ability to accommodate all relevant consequences and options, as to their approaches to valuation [such as the value of a human life], and as to the rigor which is actually used in practice (Meacham, 2001, p. 10).

Indeed, as mentioned above, values should guide decision-making. The problem with almost all approaches to decision making is that they are focused on alternatives. However, the focus will depend on the context of the risk management and the aim in using such a process. Some hazards require a reactive position from the decision maker. Other situations allow for the use of risk management to get the most from the decisions taken (profit, better investments, etc.), where a proactive position is convenient.

In general terms, decisions can be taken in three settings: under certainty, under risk and under uncertainty. Decisions under certainty are possible when the problems, alternatives, impacts, probabilities and consequences are well known. Decisions under risk are taken when problems and alternatives are known, but the results unknown. Finally, decisions under uncertainty are those in which the majority of variables are unknown. It is possible for

alternatives to exist, but the result is uncertain (Rivera Berrío, 2010).

> Regardless of the decision-making approach taken, five crucial generic complexities exist for resolving acceptable risk problems: uncertainty about how to best define the decision problem, difficulties in assessing the facts of the matter, difficulties in assessing relevant values, uncertainties about the human element in the decision-making process, and difficulties in assessing the quality of the decisions that are produced (Meacham, 2001, p. 10).

Commonly, decision-making faces several problems. Among the challenges present there exists the degree of uncertainty related to the results of the options available, as well as the alternatives that represent conflicts or competition among them. In addition, decision-making faces the need to allocate the responsibility linked to the results and address the fact that frequently such decisions are taken by several parties in which attitudes and perceptions about risk play an important role.

Normally, decisions pursue multiple objectives (Keeney, 1996b). In this sense, decision-making has to integrate different aspects: be specific regarding the values informing the decision, the criteria established in the context of the risk-management process, the feasibility of alternatives and the element of being multipurpose.

In addition, the assessment and the decision making should be a continuous process prospective and planned strategically. The decision making is a process to convert information into action (Martínez & Escudey, 1998), based on the best alternative or at least on the most feasible,

optimal and beneficial options. Under this perspective, decisions could be strategic, managerial or operational (Martínez & Escudey, 1998).

4) Monitoring and Control

Monitoring and control operates for those programs taken to be correct or which manage a risk factor. This phase should be continuous, constant and involves the reviewing of all aspects considered from the first phase onwards. This step checks and verifies the optimum results and operating decisions. Practically, it constitutes a mechanism for evaluating the processes of risk treatment.

Standard ISO 31000 (2007) states that this phase is concerned with the periodic review of the implementation of risk treatment and the detection of any changes in the process itself or in the external and internal context in which it develops. It also includes a review of the general framework of the risk-management process. For this reason, the monitoring and control phase is a continuous and regular activity during the whole process (see Graph 8).

Normally the adoption of programs or projects is the way in which a treatment is implemented. A manner to control and monitoring the risk is also the application of project´s evaluation methods. From the project management point of view, the evaluation could be *ex-ante, on-going and ex-post*. The first refers to the assessment introduced at the beginning of a project, taking the role of problem setting. The second, it is the evaluation done during the process. In this case, the evaluation is a control

of the project´s performance, allowing a rapid correction if it is needed. The last, it is the evaluation executed at the end of the project (Bottero et al., 2008). The ex-ante evaluations are methods that can control the execution and development of a project. The ex-post evaluations are methods able to check the results of a project.

To sum up, monitoring and control in risk management also requires the application of evaluations methods to the projects chosen for treating a risk factor. Today, it is very common to introduce ex-ante methods since the tendency is shifting towards a preventive way of thinking.

5) Communication and consultation

This is the last stage of the risk-management process and, as with monitoring and control, it is a continuous and regular activity from the beginning of the process to the implementation of treatments. It provides a way of maintaining the permanent exchange of internal and external stakeholders.

2.2. Risk Management for Cultural Heritage Sites

The process of risk management can be applied to cultural heritage. In fact, the method has been used in preventive conservation for museum collections for almost two decades. In such cases, four basic steps are involved in the risk-management process: identification of risks, assessment of the magnitude of each risk, identification of possible mitigation strategies, and evaluation of the costs

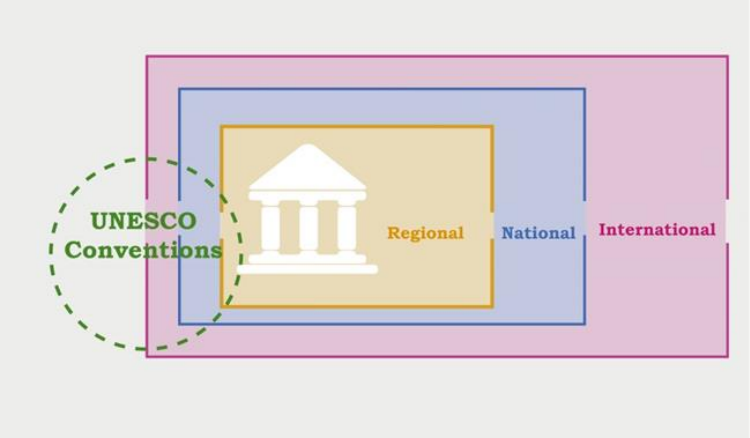
and benefits of each strategy (Waller, 2013, p. 319). Although preventive conservation has worked like this for many years, the approach does not follow the concepts denoted in the first chapter. For instance, the identification of risks is, in fact, the identification of hazards. In addition, the magnitude of risk is seen as probability, susceptibility and loss in value, thus excluding aspects such as vulnerability or exposure. In light of this problem, risk management in museum collections has been modified process wise and ICCROM´s courses have introduced steps from the Australian standards of risk management (ICCROM & UNESCO, 2009).

The context for cultural heritage sites is broader than for other contexts where risk management is applied due to the number and variety of factors. For this reason, it is necessary to adapt the methodology of risk management for heritage sites. Taking into account the standard ISO/DIS 31000 Risk management: Principles and guidelines on implementation, written by the International Organization for Standardization (ISO, 2007, pp. 1-25), and their previous application to preventive conservation in museum collections (ICCROM & UNESCO, 2009), the adjustment of the procedures for risk to situations of cultural heritage may apply as follows:

2.2.1. Establishing the context

The only area that has considered this phase is that of preventive conservation for museum collections (ICCROM & UNESCO, 2009). For cultural heritage sites, this step refers to the context in which the site is immersed and the management environment.

In this sense, the external context comprises the regulatory framework, policies, laws and provisions for the protection of cultural heritage. This aspect can be international, national or regional according to the location of the site (see Graphic 15). For instance, the UNESCO conventions state whether if it is a World Heritage site and if the country in which it is located has subscribed to the relevant treaties.



Graphic 15. ***External context of a cultural heritage site.***

Source: Based on the methodology for risk management for collections (ICCROM & UNESCO, 2009).

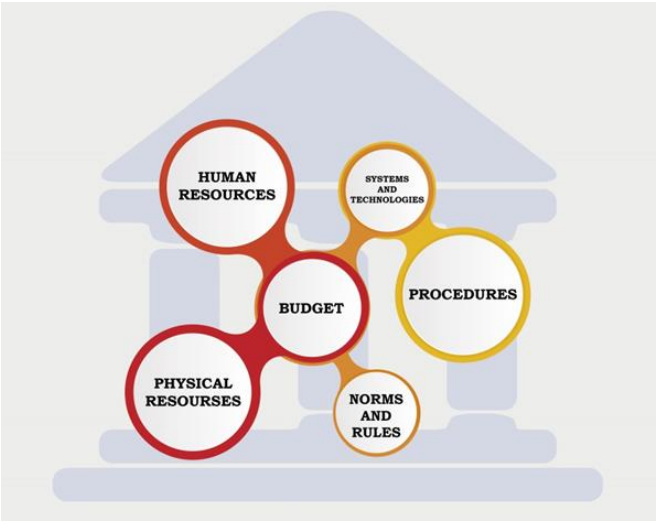
The consideration of the regulatory framework will be useful for establishing the responsibilities and requirements of the state that pertain to the cultural heritage site in question. Also, it will allow for knowledge of whether the state is a party involved in the site´s management. In addition, it will be possible to recognize the role of the stakeholders.

Furthermore, the external context will allow us to identify the main interests or values of such stakeholders and determine the identity of the decision-maker. In this sense, it will be possible to define the decision-making path or process and levels of decision among different decision-makers. For example, it will be possible to know what type of decision depends on the site manager, on ministers and on public employees, among others.

On the other hand, the internal context refers to the organization in charge of the management of the site itself: the type of institution – public, private, NGO, human resources – number of people, competences and functions, internal norms and rules, procedures and capabilities for the management of the site. Budget, governance structure, flow of decisions and, fundamentally, values, also comprise this context (see Graph 16).

These aspects will provide the panorama within which stakeholders, both external and internal, are involved and will provide critical information the general identification of the cultural heritage site.

The whole process of establishing the applicable context is made through several tools, such as interviews, questionnaires, site visits and literature reviews.



Graphic 16. ***Internal context of a cultural heritage site.***

2.2.2. Risk Assessment

As mentioned above, risk assessment is the overall process used for the identification, analysis and evaluation of hazards. As clarified in the first chapter, the term risk is normally used as a synonym of hazard. Almost all the literature written about risk management for cultural heritage and the preventive conservation of museum collections uses the term risk when in fact talking about hazards.

In spite of this, risk assessment within a cultural heritage context involves the comprehensive identification, quantification and evaluation of hazards in order to clarify the conservation concerns (Muething et al., 2005).

2.2.2.1. Risk Identification

Risk identification seeks to identify the risk factors that influence a specific Cultural Heritage site. This step should recognize "sources of risk, events or sets of circumstances, and their potential consequences. The aim of this step is to generate a comprehensive list of risks based on those events and circumstances" (ISO, 2007, p. 11). Considering every single risk factor is crucial because if one is not identified it will be excluded from further analysis. Stovel mentions that, "the best means to protect cultural heritage at risk is to ensure that adequate attention in advance planning is given to the identification of heritage attributes, the risk to these attributes and appropriate response measures for these risks" (Stovel, 1998, p. 21).

The main risks factors are:

A. Environmental factors:

An environmental factor is defined as an element of natural origin. An element's incidence on a site may be continuous, periodic or associated only with events, such as emergencies (EPA, 2002, p. 2). The characteristics of environmental factors are mainly frequency of action and intensity of variation. Both aspects determine the level of loss or damage on a site. Frequency of action refers to permanent or occasional incidences, while intensity of variation is defined as the level of fluctuation of an element during a specific time (Guerrero, 1996, p. 84). From this point of view, environmental factors include natural disasters, climate change and more complex aspects, such as ecological fragmentation or natural resources in distress, which may enormously affect the conservation of a site.

It is important to make the distinction between disaster and emergency. In the risk management for cultural heritage, a disaster is defined as "an event whose impact exceeds the normal capacity of property managers or a community to control its consequences" while an emergency is "an unexpected event which may result in loss – and which, if uncontrolled or poorly managed, may become a disaster" (Stovel, 1998, p. vii). Disasters are the materialization of risk (Rivera Berrío, 2010) in a tangible and overwhelming form. For this reason, natural hazards have become so relevant in cultural heritage.

B. Sociopolitical factors:

This refers to factors of anthropogenic origin. In other words, these factors are derived from human activity. They may constitute risks from social or political circumstances and aspects related to governance issues. These factors are more complex and deal with the interdependence of a considerable number of factors that determine the reality of a community at a specific site. Most of the time, social and political situations are intrinsically linked to economic factors. For these reasons, it is difficult to establish hazards that are entirely social or political. However, it is possible to fit into this category threats such as armed conflict, vandalism, lack of awareness, lack of participation of local communities, lack of policies, governance problems and negligence.

- Armed Conflict: Regardless of its origin, whether social, economic or political, armed conflict is a hazard that entails impacts that are extremely difficult to prevent and control. The attack on a heritage site may come from deliberate targeting or collateral damage. The

first refers to the process used to select objects or installations to be attacked, taken or destroyed during armed conflict. This denotes a conscious effort and in some way the recognition of the values of the site. Often, a deliberate attack to a cultural heritage site is perpetrated because the symbolic value of heritage is used as a form of communication between the sides in conflict. The second refers to damage that is unintended or incidental. Obviously, countries with some kind of political instability, war and conflict present sites with some kind of damage that has occurred as a collateral result.

- Vandalism: This activity is similar to deliberate targeting because, by definition, vandalism is an act that deliberately destroys or damages property. Vandalism may occur in situations free from armed conflict or constitute an act that does not come directly from a conflict. Vandalism may occur in the form of looting, plunder and dismantling, among others. Most of the time, these actions are related to illicit trafficking.

- Lack of awareness: This is one of the most important risk factors because, even though it is difficult to detect, it has the most dramatic of effects (ICOMOS, 2006, 2007). Lack of awareness produces a loss of identity and the detachment of communities from their own heritage. Recognition of the values of a site by a community guarantees its conservation. This factor sometimes entails social fragmentation caused by international and internal migration, armed conflict and a lack of education. Also, it is an actor that is highly interdependent with political will.

- Lack of participation of local communities and governance: Today, the tendency to manage heritage sites requires the involvement of local communities in bottom-up approaches. This condition is more important when traditional communities are attached to the land and the environment, as well as traditions and sites, in a strong way. However, the effectiveness of decision-making processes and conservation depends on cultural behaviors towards managerial practices. Sharing governance, involving all stakeholders and local communities might prove a successful mix in the preservation of a cultural site.

- Lack of policies: Policies are plans of action that guide decisions and achieve objectives. In addition, policy allows for the establishment of rules and guidelines for the managing of sites. Logically, a lack of policies reduces the instruments available for protecting a site. An absence of policies creates effects for both the planning process and decision-making.

- Negligence: This occurs when a policy or legal framework exists. The negligence of managers and governmental dependencies may be selective or they may completely ignore their responsibility and participation in decisions regarding the preservation of cultural heritage. In the first case, decision makers act in favor of specific projects or pay attention to certain sites more than others. The second refers to doing nothing about the preservation of a heritage site from the legislative and jurisdictional framework to practical management.

Even though, the inappropriate conservation and repairs can be considered as negligence as well, this kind of situations is taken as part of managerial factors. In the same sense, actions of "overprotection" which might cause or increase vulnerability affecting resilience or capability for adaptation, are also included among managerial factors.

C. Economic factors:

Economic factors refer to risks of a financial or monetary origin. They include risk agents that come from interests in acquiring capital or gaining resources. Mass tourism, illicit trafficking, development pressures and technological pressures are just some of the hazards that comprise this category.

- Mass tourism: Tourism refers to the people who travel for recreational, leisure or business motivation and stay more than 24 hours in a destination. Cultural heritage tourism has a positive impact on conservation and is an excellent way to raise awareness and secure financial resources. In this sense, tourism brings with it positive economic and social effects, by increasing and reinforcing identity. It provides communities with the possibility to develop activities related to heritage in a sustainable way. However, tourism becomes a hazard when a large number of people visit a place in a short period of time and exceed the capabilities of the site in terms of space, management, administration, human resources and commodities. Mass tourism is more often a threat due to improvements in technology and communications services.

- Illicit trafficking: Illicit trafficking refers to the subtraction of elements from the context in which belong, be it a local community or a nation, due to economic interests. Illicit trafficking may be a form of vandalism that follows economic motivations. Most of the time, this factor is related to a lack of adequate policies, awareness and education. In addition, it is associated with areas of armed conflict or poor social and economic environments. One of the causes of illicit trafficking is an increase in the heritage market of actors with sufficient economic resources, which encourages looting and illicit excavations.

- Development pressures: The damages caused by development pressures are the results of the economic structures of each country and global dynamics as a whole. The necessity of societies to extend human activities generates fast levels of growth in urban and suburban areas. The effects of development pressures are also the consequences of a lack of suitable planning policies.

- Technological pressures: This refers to the need to install new technologies and services for a range of human activities. It represents the supply of lines of communication, entertainment and infrastructure. For instance, the installation of antennas, towers, technical advices and cables is seen every day.

D. Physical factors:

This refers to the intrinsic characteristics of a site and its placement. Sometimes cultural value may rely on such features. However, if this remains uncontrolled or

unmanaged, thus it might affect conservation itself. For instance:

- Construction features: This factor also springs from the intrinsic characteristics of a structure or building, or of the site where it was constructed. This is not understood as a risk for external agents, but as one inherent to the site.

E. Managerial factors

Managerial factors denote aspects related to the structure, organization and mechanisms used to manage a cultural heritage site. They refer to the body in charge of planning, and the execution and monitoring of conservation actions. Aspects such as the management of human resources, finance, security and data management are included here. From a conservation point of view, institutional collaboration might be considered in terms of agreements with other bodies or organizations that allow collaborative work in the preservation of a site. Furthermore, managerial practices, as well as standards and guidelines for conservation, should be included.

This group of factors includes a lack of guidelines, procedures and programs intended to protect a site, or inadequate actions for conservation or restoration; for instance, a lack of maintenance, which is one of the most common risks for complete properties. Additionally, this group may include insufficient, inadequate or an absence of the monitoring of the state of conservation. This refers to a compiled study of the situation of a property or an assessment of its physical condition in a concise and precise

way. For a state of conservation report, every manifestation of deterioration within the property is registered, along with information regarding the location and an evaluation of the impact of the damage. Furthermore, this group of factors also includes inadequate interventions in restoration and conservation, be it due to incompatible materials or techniques. In this sense, this factor also includes misguided conservation actions, inappropriate repairs and "overprotection" interventions which might affect the capability of a site for being resilient.

Taking into account the fact that cultural heritage sites may be damaged by numerous factors, as is noted above, the set of actions that managers can take in order to reduce, minimize or prevent dangers is vital. This group of measures should be integrated and should follow a strategy that allows for control over any damage.

2.2.2.2. Risk Analysis

Risk analysis, evaluation and identification are not normally separated. For this reason, the main part of the literature refers to the entire process of risk assessment as a whole. Within the cultural heritage context, the preventive conservation of museum collections has focused intensively on the development of different kinds of tools for the quantification of hazard.

The Canadian Museum of Nature was the first place to employ and demonstrate the necessity for a methodology of risk analysis. They quantified hazard according to severity in terms of loss of the collection or, in other words, in relation to the impact on heritage objects. In

the same way, they compare values in order to arrive at priorities for their actions. The methodology developed by the institution is that of the Cultural Property Risk Analysis Model (CPRAM). This method distinguishes three types of risk according to their frequency and severity (Muething et al., 2005). "The CPRAM has identified four variables to be used in risk estimation. The variables are fraction susceptible [FS], loss in value [LV], probability [P], and extent [E]. Each of these variables is a simple ratio and is between 0 and 1, inclusive" (Muething et al., 2005).

This was one of the first methodologies of risk analysis to be used in the cultural heritage field. Several modifications have been applied to preventive conservation in museum collections since then. However, the rationale proposed by Robert Waller for The Canadian Museum of Nature is still in practice. ICCROM and the Canadian Conservation Institute (CCI) still operate under the same principles (ICCROM & UNESCO, 2009).

2.2.2.3. Risk Evaluation

This step is not clearly separated from identification and other processes of risk assessment. As mentioned before, risk assessment tends to be considered for one process only. In particular, analysis and evaluation are always actions that are intrinsically connected. This is a process in which the hazards are also quantified in relation to other kinds of variables since the ultimate objective is to arrive at a ranking of priorities.

In the case of The Canadian Museum of Nature, the CPRAM considered a calculation of magnitudes of risk that

were added in order to generate a risk total and, by comparison, to arrive at a ranking of risks according to severity. This way, high-priority risks can be identified (Muething et al., 2005).

In addition to preventive conservation for museum collections, risk evaluation for cultural heritage sites requires a balance of estimations. Generally, the estimations are related to the frequency and impact of hazards, without considering the vulnerability of a site. In this sense, the sensitivity and exposure of a cultural heritage site to a hazard might, in particular, increase the value of the estimation. In the same direction, the existence of any action or procedure related to adaptive capacity, such as resilience and reflexivity, should minimize the estimation of risk.

Similarly, the ranking of risk that results from the analysis should vary according to the interdependence of and relationships among hazards. The affectation of a particular hazard might raise the estimation given to other hazards. For instance, if a cultural heritage site is affected by an increase in rain precipitation due to climate change, the estimation given for flooding should be dependent on the value given for rain precipitation.

2.2.3. Risk Treatment

It is important to highlight that any risk assessment has the aim of assisting and informing subsequent decision-making, planning and treatment. A risk assessment does not give solutions in itself, but instead provides priorities of action.

Risk treatment is characterized by a focus on case-by-case concerns, since the problems faced are specific and particular to each cultural heritage site. The literature largely concentrates on risk-assessment methods instead of treatment alternatives. This situation is evidenced by Raz and Michael in their study of the use and benefits of tools in risk management. They find that managers tend to focus their attention on certain methods in order to obtain information and that they are willing to invest resources and time in the earlier steps of risk management, namely risk identification and assessment, instead of concentrating on treatment or control (Raz & Michael, 2001).

This situation is also evident in the cultural heritage context. There are few references related to risk treatment and decision-making that are specific to this field of knowledge. Reports by UNESCO and ICOMOS allow for some general aspects of priorities and alternatives for World Heritage sites in danger, although the decision-making process is regularly placed out of the scope of the reports.

In numerous cases several solutions for risk rely on managerial practices. In fact, as UNESCO mentions:

> The factor or factors which are threatening the integrity of the property must be those which are amenable to correction by human action. In the case of cultural properties, both natural factors and man-made factors may be threatening, while in the case of natural properties, most threats will be man-made and only very rarely a natural factor [such as an epidemic disease] will threaten the integrity of the property. In some cases, the

> factors threatening the integrity of a property may be corrected by administrative or legislative action, such as the cancelling of a major public works project or the improvement of legal status (UNESCO, 2015, p. 49).

This statement is consistent with the analysis of hazards that threaten cultural heritage properties. It is clear that an important numbers of sites are inscribed on the danger list due to risks that require basic management changes in order for them to be treated.

2.3. As a conclusion

Even though risk management process is well defined and used in several areas such as finances and industry, cultural heritage has approached to risk partially. Managers of museum´s collections first adopted the risk management methodology aforementioned. Logically, the existence of an International Standard - ISO has become a useful support tool, being the base for the process proposed by ICCROM and UNESCO in their international workshops (ICCROM & UNESCO, 2009). Those institutions adapted and modified the Standard in order to meet the needs from museum´s collections. However, it is still the challenge of the real application to museums worldwide, since there are a numerous groups of museums and different types of them around the globe. Also, the process of risk management mentioned above implies an effective commitment from managers in order to be applied. In this sense, the real situation of many museums offers an enormous challenge on this sense.

On the other hand, cultural heritage has approached to risk management process also in cases of natural disasters. It is maybe in this aspect in which management of cultural heritage sites has adopted the risk management standard. Nevertheless, disasters are only one of a considerable number of risk factors that might affect the conservation of a site. In this sense, the major challenge consists in the integration and holistic view to the complexity of cultural heritage. In addition, everyday new threats emerge as, for instance, climate change which impacts mutate and accelerate rapidly. New and evolving hazards represent a challenge to cultural heritage managers as well.

CHAPTER 3

Integrated Risk Assessment for Cultural Heritage Sites

"Cultural heritage links us to our history and identity through structures, objects and traditions. It gives places meaning through references to the past. It enriches our quality of life, contributes to a community's economic well-being and is fundamental to a healthy society."
Bonnie Burnham

A holistic and integrated approach to risk management for cultural heritage sites is a potential aid and support for the conservation of cultural heritage. In this sense, risk management uses a procedure by which to identify, evaluate, analyze, control and correct risks. In fact, almost all references to risk management stress this point and "emphasize the value of integrating measures for the protection of cultural heritage" (Stovel, 1998, p. 9).

According to Stovel, to be prepared for risk means to develop a strategy that "should integrate all necessary administrative, operational and technical measures and should be developed and implemented by site managers" (Stovel, 1998, p. 9). In the same sense, a conservation plan should be developed in accordance with the goals of the institution in charge of the site and should be developed while taking into account its present and future needs (Rose, 1992, p. 35). Consequently, risk management is a support tool for the prevention of damage to cultural heritage.

Although, Stovel concentrates his studies exclusively on the risk management of disaster, and while the majority of risk-management approaches for cultural heritage predominantly focus on disasters, all of the methods address the same point: the importance of the integration of both technical and managerial aspects for effective site conservation.

Looking beyond these arguments, integration not only refers to relations among technical methods when coping with a risk and the management elements involved, but also refers to considerations concerning the collective hazards that affect the site.

Normally, a hazard does not affect a site in isolation. Even an earthquake or other disaster that may be sporadic may have consequences across the site that interact with a conjunction of factors. For instance, the impact of an earthquake not only depends on the features of the phenomenon itself, but also on the state of conservation, maintenance, and construction characteristics of the site, among others.

Taking into account such circumstances, risk management for cultural heritage should not only consider disasters or a specific and concrete hazard, but also take into account holistic and integrated methods. In this way, risk management could become an effective support tool for the prevention of damage to cultural heritage.

3.1. Key concepts for integrated risk assessment

3.1.1. Holistic Approach

Holism originates from a Greek term meaning "whole", "entire" or "all". A holistic approach is used as a methodological and epistemological view in various systems, whatever their nature, be it biological, social or economic. "Holism considers systems to be more than the sum of their parts. It is of course interested in the parts, but primarily in terms of how they give rise to and sustain in existence the new entity that is the whole" (Jackson, 2003, p. 4).

In contrast, the traditional scientific method tends to look for the specificity of each part. Reductionism understands the study of parts as a way to comprehend the whole. However, the whole might be a completely different entity that cannot be explained through the detail of each part alone. "The whole emerges from the interactions between the parts, which affect each other through complex networks of relationships" (Jackson, 2003, p. 3).

The field of knowledge that has developed the most holistic approach to date is that of biology. In the 1920s and

1930s, the conception of an organism involved more than the sum of its parts, creating an entire entity with a certain degree of autonomy and leading to the systems theory drawn up by Ludwing von Bertalanffy (1982). Here von Bertalanffy argues that organisms should be studied as complex systems, since behaviors cannot be explained through the properties of their parts separately (Jackson, 2003).

Although the systems theory is considered a modern conception, the idea originates from pre-Socratic philosophers. The Greek concept is applied semantically to a model of order, totality and finality (Matiz López & Ovalle Bautista, 2006, p. 53). Within the theoretical framework of von Bertalanffy's systems theory, Aristotle's core principle remains: the whole is more than the sum of its parts, while the modern concept looks for the separation of complex processes into simple parts. Although the study of each part may help in the reconstruction of the whole, the process of separation does not explain the organization, hierarchy and coordination of the parts into the whole. In other words, the usual method of separation into parts is unable to offer a complete explanation of the behavior of the entire entity (von Bertalanffy, 1982). This is especially true in complex systems where the influences of social and psychological phenomena are present.

However, von Bertalanffy (1982) emphasizes that an understanding of the whole is possible if the parts are not studied in isolation, but instead alongside the relations, linkages, interdependences and behaviors evident among them. Von Bertalanffy (1950) defines two types of system: closed systems and open systems. Closed systems are those

in which the parts are interrelated and provide feedback to each other, but which do not enter into exchanges with the environment. On the contrary, open systems exhibit relations among their parts as well as interacting with their context or environment in order to maintain their existence (Jackson, 2003):

> Thus, he initiated and named the "general system theory" – a kind of transdiscipline in which systems were studied in their own right and which allowed insights from one discipline to be transferred to others. General system theory was soon embraced by management thinkers who transferred the open system model to their study of organizations (Jackson, 2003, p. 6)

Von Bertalanffy also defines the principal aspects of a system: structure, behavior and evolution. Here structure refers to relations among parts. Such relations are based on the principles of permanent or continuous interdependence, interaction and interrelation. Even though each part has its own function, each has to interact with another/others in order to establish a coordinated and dynamic ensemble. Coordination is fundamental for systems because it implies a degree of organization for each element. In addition, the dynamic of a system is determined by feedback, regulation and control. The control of a system allows for responses to environmental changes, whether or not they influence a system's dynamics (von Bertalanffy, 1982). In cultural heritage, for instance, a control might determine the degree of resilience to a hazard.

Norbert Wiener, a mathematician, has also introduced the concepts of control and communication in terms of the way in which a system might correct its behavior when modified by the environment, returning to its main goal or objective. Thanks to effective communications and control mechanisms, a system can regulate itself (Jackson, 2003).

A system's behavior refers to its performance according to its functionality and organization. This depends on the influence from the environment, possible changes, efficiency, effectiveness and even resources, among others. Finally, a system's evolution denotes its future in terms of modifications or transformations over time in accordance with its own dynamism (von Bertalanffy, 1982).

General system theory has also been applied in management. Analogical to Von Bertalanffy's concepts, organizations address the relationships between subsystems and an overall entity and, furthermore, stress the importance of linkages with the environment. However, the main difficulty for system theory in an organizational context is coping with the actions and influence of human beings both within or outside a system (Jackson, 2003).

A consideration of human minds and beings as part of the system opens this notion to what Jackson (2003) terms purposeful systems. In this sense, the humans involved in a system generate different roles according to their own purpose.

> The term "stakeholder" is used to refer to any group with an interest in what the system is doing. Decision makers or owners have the power to make things happen in systems; actors carry out basic tasks; customers or clients benefit or suffer from what a system does. Problem owners worry about the performance of some aspect of a system. Witnesses are affected by systems but unable to influence their behavior. Problem-solvers or analysts take on board the task of trying to improve systems (Jackson, 2003, p. 10).

The general system theory goes beyond the abovementioned notions to introduce the complexity theory. This presents concepts such as unpredictability, disorder and irregularity. Such concepts give us the chance to consider that small changes in a system might have great consequences in the future (Jackson, 2003).

All things considered, cultural heritage can be understood as a system. As mentioned before, cultural heritage in general and cultural heritage sites in particular behave as entities, that is to say, as wholes in which several elements interact. Cultural heritage involves a combination of materiality, values, communities, testimonies of the human mind, crafts, and history, among others, all of which interact with social, economic, political, and environmental situations in time.

It is possible to say that cultural heritage comprises a complex system of relations among an assortment of elements. Cultural heritage essentially involves human beings and their own values, which can be considered a system in itself. In this sense, value systems are subsystems

in the complex network of the management of a cultural heritage site.

From this point of view, it is obvious that a systematic approach is indispensable in the comprehension of the conservation needs of any cultural heritage site, as well as any of its manifestations, namely collections, sites, intangible expressions, and so on. In addition, cultural heritage is affected by a conjunction of hazards that also interact and are interdependent among themselves.

With this in mind, the holistic approach is an essential methodology for the analysis and evaluation of the risks that jeopardize the conservation of a cultural heritage site. In this sense, the way in which a hazard affects a site is never isolated. On the contrary, a hazard normally acts interdependently with other kinds of risk. Even the most sporadic of hazards, such as natural disasters, are interconnected with physical or construction features and the state of conservation of a site. This last point is also related to managerial practices, maintenance, personnel, capacity building, financial resources, and so forth. This means that analyzing and evaluating the risks that come with natural disaster should also include a consideration of all the relevant links. In addition, the recent notion of large-scale consequences due to small changes in the conditions of a system is reinforced by the results of studies related to the impacts of climate change on cultural heritage (Sabbioni et al., 2010; Sabbioni et al., 2008; Sabbioni et al., 2006).

For these reasons, the complexity of cultural heritage sites requires risk management plans from a holistic perspective and the adoption of systematic and integrated

methodologies for risk identification, analysis, assessment, and management.

3.1.2. Interdependency

As can be seen, cultural heritage is not just a system but also a purposeful and complex system comprising different symbiotic subsystems. "Complex systems are collections of diverse, connected, interdependent entities whose behavior is determined by rules, which may adapt, but need not. The interactions of these entities often produce phenomena that are more than their parts. These phenomena are called emergent" (Page, 2011, p. 6 and 7).

Diversity is one of the most important characteristics of systems, since variety may enhance or diminish a system's performance. In this sense, the more variations a system has the higher the level of complexity. Within complex systems, variation can be seen between systems or subsystems, across parts of a system and within elements. Nevertheless, diversity per se is not necessarily a condition for complexity, while emergent diversity, that is to say, variation among interactions, is a requirement for complexity (Page, 2011). In other words, the degree of interdependency and the diversification of relationships between entities make a system more or less complex.

However, diversity applies to a significant number of elements. It could refer to variation within attributes, diversity among elements or differences in configuration, such as variations among the connections between elements, subsystems or systems. Indeed, it is variation that

allows for the whole to be more than the sum of its parts. It is what leads to a reaction to minor or major changes, to adaptions to the environment or not, to performing well regardless of environment and providing robustness (Page, 2011). For Page, robustness refers to the ability of systems to maintain functionality. The larger the variation or the diversity, the more complex the system becomes.

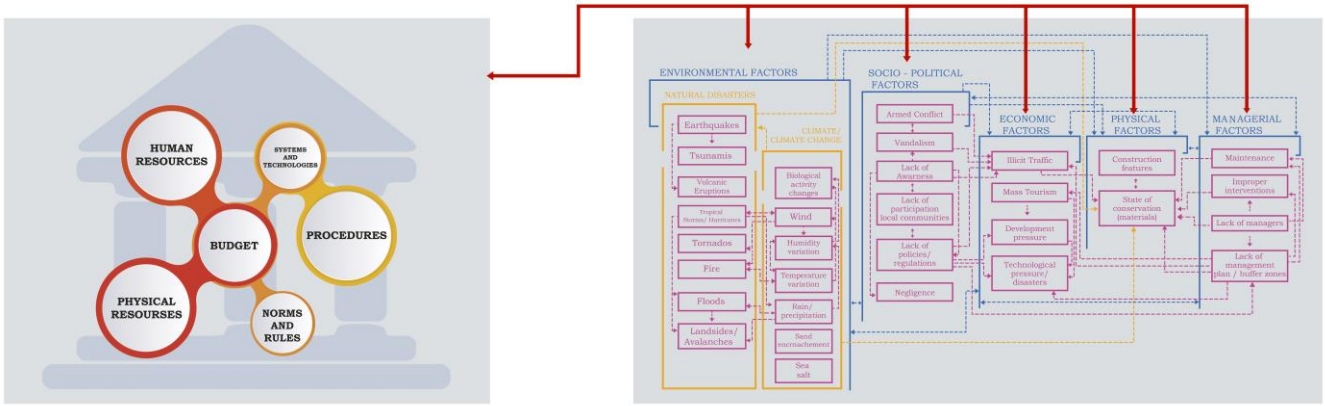
In the case of cultural heritage, the most important aspect to analyze from a risk-management perspective is that of the variances in relationships among the elements that interact on a site. Each place will have its own particular way of forming connections and will have its own set of hazards according to its location, construction, and community, among others.

In other words, risk management becomes a multifaceted task whenever it proves indispensable to identify the elements that compound the system (that is, the site), as shown in Graphic 16. In addition, it is crucial to identify the set of hazards that might have an influence on the site and their very own connections, as Graphic 18 indicates. This set of hazards behaves as a system in and of itself. In addition, it is fundamental that we establish the relationships that exist between a site's system and a system of hazards, as Graphic 17 shows.

The above-described situation is what Page refers to as the assemblage problem: "The fact that many complex systems are assembled" (Page, 2011, p. 19). This way of forming relations can be produced naturally or be self-assembled, or indeed be formed deliberately with a specific aim. Within the cultural heritage context, the connection lies in between the two. A part of the relationship might be

self-assembled, such as the impact of environmental factors on a site for example. Yet another part might be set up on purpose, such as sociopolitical factors or policy-making decisions that are able to alter the assembly process.

From this perspective, risk management places itself within the field of complex systems. "Systems that produce complexity consist of diverse rule-following entities whose behaviors are interdependent. Those entities interact over a contact structure or network. In addition, the entities often adapt" (Page, 2011, p. 17). When a system is able to adapt to changes in the environment, which is also referred to as a system's context, then it is identified as a complex adaptive system. "Adaptation occurs at the level of individuals or of types. The system itself doesn't adapt. The parts do; they alter their behaviors leading to system-level adaptation" (Page, 2011, p. 25).



Graphic 17. ***Relations between a site's system and a system of hazards.***

Currently, risk analysis and evaluation focuses on specific elements of potential damage and particular hazards and does not take into account the interdependence between risk factors, their causes and management. For example, programs for reducing risk concentrate on discrete threats rather than considering multiple risks and how together they affect cultural heritage, for example, earthquake and flooding preparedness programs (Jigyasu, 2000; Jokilehto, 2000; UNESCO, 2005; UNESCO et al., 2005).

Considering individual risks in isolation, without taking into account the range of threats affecting a cultural heritage site and their interconnection, might cause new threats or increase the impact of existing hazards. For instance, climate change might cause sea levels to rise, creating a threat that a cultural heritage site did not face before, or it might increase the impact of flooding or landslides on the same site. The assessment, in this case, should not only consider sea levels, flooding or landslides as hazards, but should also take into account the connections that these hazards pose for budget, management, and personnel concerns, to name but a few. For these reasons, the complexity of cultural heritage sites requires risk-management plans from a holistic perspective, taking in systematic and integrated methodologies for risk identification, analysis, assessment and management.

As mentioned in previous chapters, a cultural heritage site can be affected by several hazards, and estimations of their impact during the risk-assessment process should consider the relationships between risk

factors. An increase in or the existence of a particular hazard may produce another risk source or an increment in the impact.

However, such an assessment is challenging and only works in the short term since the systems that are taken into account are adaptable to changes through interdependent actions. "Owing to the interdependence of actions, complex systems can be predicted only in the very short run" (Page, 2011, p. 7).

The action of an element normally echoes across a network of relationships. For this reason, a small event can trigger larger consequences (Page, 2011). At a cultural heritage site, for instance, rain might cause a natural disaster as well as initiate a series of decisions that managers then need to take. One single element or hazard can trigger multilayered interactions (Page, 2011).

"Systems possessing diverse, connected, interacting and adaptive agents often prove capable of producing emergent phenomena as well as complexity. […] Emergence refers to higher order structures and functionalities that arise from the interactions of the entities" (Page, 2011, p. 25).

3.2. Risk factors interdependency

Taking into account the hazards detected in an analysis of the cultural world heritage sites inscribed on the list of danger by UNESCO and the new threats that climate change poses for cultural heritage properties, it is possible to establish a basic chart of relations among hazards or

groups. The groups are organized according to the results of risk identification and correspond to:

- Environmental factors. Including risk factors related to natural disasters and hazards linked to climate that become a hazard due to climate change. The natural disasters group includes hazards such as earthquakes, tsunamis, volcanic eruptions, tropical storms and hurricanes, tornados, fire, floods and landslides, and avalanches. In the group related to climate, we find hazards such as changes in biological activity, wind, humidity variation, temperature variation, rain and precipitation, sand encroachment and sea salt.
- Sociopolitical factors. This group involves the hazards of armed conflict, vandalism, lack of awareness, lack of participation of local communities, lack of policies and regulations, and negligence.
- Economic factors. Including hazards such as illicit trafficking, mass tourism, development pressures, technological pressures and technological disasters.
- Physical factors. Including hazards related to construction features and state of conservation in terms of the state of historic materials and fabrics.
- Managerial factors. Including hazards related to a lack of maintenance, improper interventions, lack of managers and lack of management planning, and buffer zones.

In complex systems such as those of cultural heritage, multiple factors influence or depend on more than one

factor or variable at the time. This situation is what Page (2011) refers to as the *problem of multiple causes.* For this reason, risk management for cultural heritage sites becomes an intricate task.

Taking the aforementioned into account, Graphic 18 shows a basic model of interdependency among risk factors, indicating with several lines the connections between groups and hazards. This means that some hazards or groups exhibit mutual reliance. This is indicated in Graphic 18 by the lines that run in both directions. In relationships of interdependence, hazards are responsible for the behavior of others and vice versa. In some cases, hazards are not interdependent but dependent on one another. This is shown in Graphic 18 by the lines that run in one direction alone.

The basic connections are given in three levels. At the highest level relations are settled between groups or sets of hazards. The blue lines in Graphic 18 indicate the connections among sets. In this case, environmental factors might affect sociopolitical, economic, physical and managerial factors. Sociopolitical factors might influence economic, physical and managerial factors.

It is important to note that under the multiple-cause perspective, sociopolitical factors do not influence environmental factors since they cannot produce natural disasters or climate change. Sociopolitical factors might affect the ability to respond to environmental factors but do not cause them. With the identification of interdependent connections among risk factors, relations are established according to influence on the performance of each element or group.

On the other hand, influence on the response to disturbances or capability to cope with a specific risk factor depends on the degree of organization and functionality of each element of the site and on the variation of each risk factor. This establishes another kind of relation that differs from those shown in Graphic 18.

Returning to the theme of connections between groups of hazards, economic factors might influence physical and managerial factors and vice versa. Physical and managerial factors also affect each other. Finally, managerial factors are also are related to sociopolitical factors.

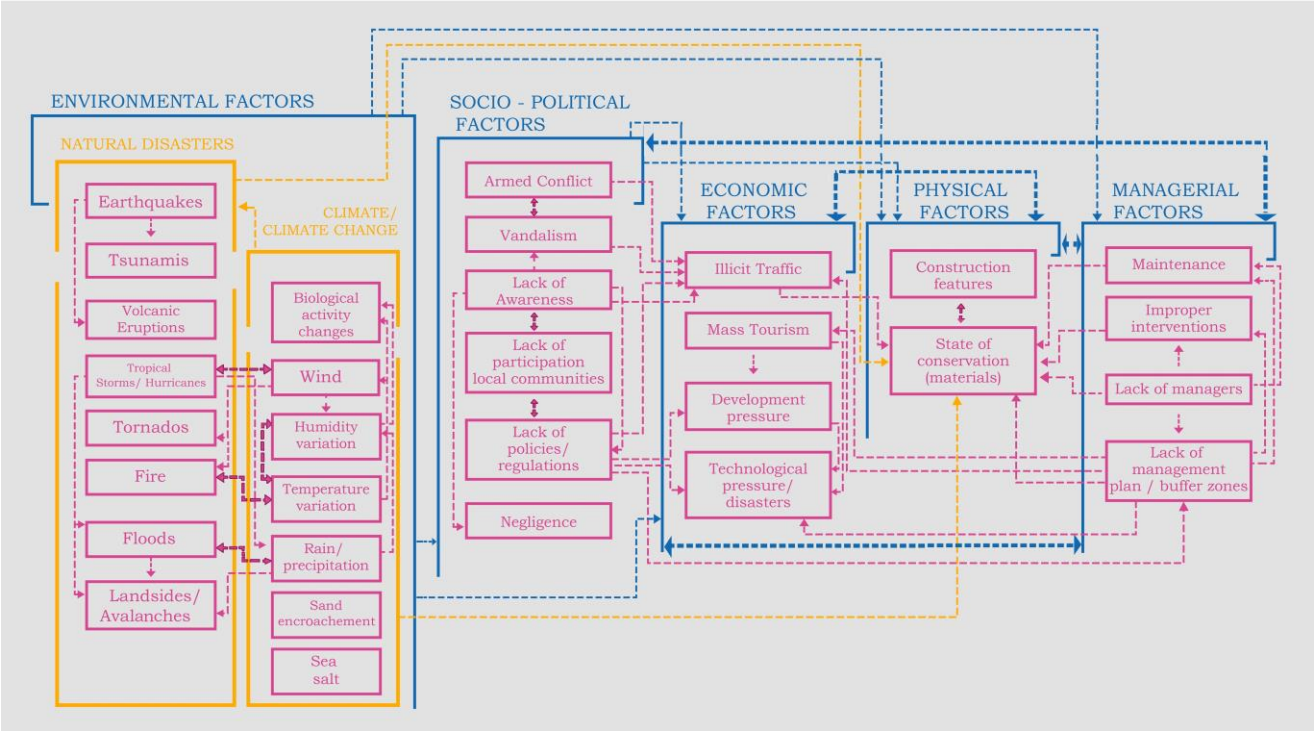
It is important to point out that Graphic 18 presents a general conceptualization of the relationships between groups. Further connections can be made if interdependency is calculated in a site-specific way or for a case-by-case scenario. For instance, in general terms, mass tourism is not responsible for climate. However, mass tourism might cause humidity and temperature variations. The Lascaux Caves provide an excellent example. Due to the physical conditions of the site, tourism has generated important variations in the microclimate inside the cave, reaching the point that managers decided to close the entrance to tourists. In terms of their relations, here the connections between factors should be different from those that are more general.

A second level is established among subgroups. The best example is shown in Graphic 18 in the yellow lines. Within environmental factors there exist two subgroups: natural disasters and climate, including factors of climate change. Crucially, connections can exist between levels. As can be noted, climate change influences natural disasters,

and a second-level relation might also affect a third-level relation; for instance, climate change factors may ultimately affect the state of conservation of a site.

At the third level of relations we find the connections among specific risk factors, as shown by the cyan lines in Graphic 18. At this level the features of interdependency or dependency are maintained. For instance, a lack of awareness causes a lack of participation on the part of local communities and vice versa. In this case, both hazards are interdependent. Conversely, a tropical storm might cause floods and avalanches, but a flood does not cause a tropical storm. This latter case demonstrates a dependent relationship.

It is useful to establish these relations at the moment of valuation, since estimations have to take into account the type of relationship between hazards, and the impact of one on the other.



Graphic 18. ***Relationship among hazards.***

3.3. Multiple Criteria Analysis: A tool for integration and decision-making

3.3.1. Multiple criteria methods

Multiple criteria methods focus on the selection of alternatives in order to solve specific problems. These methods allow for a choosing between different feasible options when an assessment pursues more than one objective. Multiple criteria methods are referred to as *discrete* when an assessment throws up a finite number of alternatives and meets with the following characteristics (Martínez & Escudey, 1998):

- The alternatives are identified, although their consequences might be uncertain, at least partially.
- It is a set of assessment criteria, also called attributes.
- Each criterion can be given a "weight", which is assigned by the evaluator.
- The set of criteria has to be consistent, exhaustive, coherent and non-redundant.
- A summary of the evaluation of each alternative, according to the criteria, is made through a matrix.
- The scale of evaluation could be qualitative or quantitative.
- The measurements can be expressed in any way, cardinal, nominal, and so on, although this has to be consistent.
- It allows for a synthesis of all alternatives in order to facilitate the prioritizing of alternatives and the selection of the best option.

Multiple criteria methods can be compensatory or not. They are compensatory when the weight of one criterion compensates for another, or when a selection of various criteria are considered simultaneously (Martínez & Escudey, 1998).

All studies relating to multiple criteria methods (Bottero et al., 2008; Dodgson et al., 2009; Martínez & Escudey, 1998; Romero, 1993; Thomas L. Saaty, 1999; Thomas L. Saaty, 2008) stress the point that no one alternative solves 100% of a problem. Normally, several options are combined to more or less achieve the criteria. In this sense, the alternatives solve the problem according to the degree of achievement.

When an alternative accomplishes a criterion in a better and superior way from that of others, it is called the *dominant alternative*. Choosing a dominant alternative as the better solution is a matter of logic. In contrast, an alternative that is inferior to others is called the *alternative dominated* (Martínez & Escudey, 1998). When alternatives perform in largely the same way and any difference among them is insignificant, the decision process for choosing an option is not evident. It is not possible to choose the best alternative, but it is possible to rank the options and filter by criterion in order to know the possibilities according to the criteria.

On the other hand, multiple criteria methods go beyond the possibilities given by methods that use only one criterion; for example, a cost-benefits analysis in which the criterion is, generally speaking, economic profit. It is important to note that multiple criteria methods do not look for a unique optimal result. Instead, the idea is to

select better alternatives, identify several good options and discard not so good choices, or to rank alternatives from best to worst according to the criteria.

From this perspective, several multiple criteria methods can be identified: Scoring, Multi-Attribute Utility Theory (MAUT), ELECTRE, Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), Analytic Hierarchy Process (AHP), and Analytic Network Process (ANP), among a considerable number of other options (Bottero et al., 2008; Brandon & Lombardi, 2011; Dodgson et al., 2009; Martínez & Escudey, 1998). Among the great number of methods available there exist several characteristics. For instance, some methods are compensatory, non-compensatory or partially compensatory. Some use quantitative methods, others qualitative or both. In conclusion, there exists a wide range of methodological options that can be applied or adapted to risk-management issues.

Since the application of the aforementioned methods to cultural heritage has been limited, this work will focus on the AHP and ANP methods. These methods have been used in several areas and disciplines, and are adopted by Marta Bottero, Isabella Lami and Patrizia Lombardi (2008) for their assessment of land and urban transformation in Torino, Italy, with some consideration being given to historical settings and the urban landscape. In addition, Brandon and Lombardi (2011) use this method in conjunction with the multi-modal approach in order to obtain more precise indicators for the assessment of sustainability in the built environment. For these reasons,

the AHP and ANP methods prove to be the most apt for application in the cultural heritage context.

3.3.2. Analytic Hierarchy Process and Analytic Network Process

The theory of decision-making has developed from the 1970s via two orientations. First, through the development of a framework that allows us to explain and describe how the decision-making process works. Second, how decision-making should be according to certain norms and projections (Romero, 1993). The theory of multiple criteria decision-making originates from the field of economics. The principal statement is that decisions are not taken based on one criterion alone, or one objective only. Instead, the normal environment for decision-making is one in which there are several problems to solve, with several alternatives available, in which the intention is to reach several objectives. Sometimes the alternatives and objectives may be in conflict, or the purpose may be to arrive at solutions related to the objectives.

There are several methodologies that exist for the multiple criteria analysis. One of these is the Analytic Network Process (ANP), which derives from the Analytic Hierarchy Process (AHP). The AHP and ANP methods were created in the 1980s by Thomas Saaty.

> The Analytic Hierarchy Process (AHP) is a basic approach to decision-making. It is designed to cope with both the rational and the intuitive to select the best from a number of alternatives evaluated with respect to several criteria. In this process, the decision maker carries out simple pairwise comparison judgments which are then

> used to develop overall priorities for ranking the alternatives. The AHP both allows for inconsistency in judgments and provides a means to improve consistency (T. Saaty & Vargas, 2001, p. 1).

In Saaty's words, multiple criteria thinking is used in daily life in order to make decisions for complex problems. However, the absence of a clear procedure turns the decision environment into one that is blurred and uncomfortable since it is difficult to clarify which might be the more convenient option (Thomas L. Saaty, 1998).

From Saaty's perspective, a holistic and complex problem needs to be broken down into smaller parts. Solutions for each part are combined to yield a global result. For Saaty, the decision-making method should (Thomas L. Saaty, 1998):

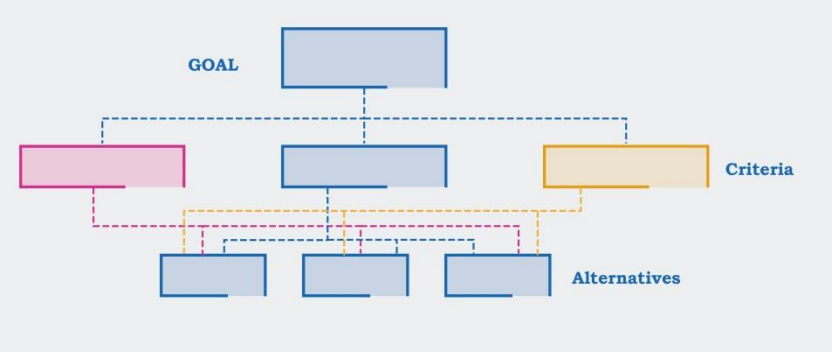
- Be easy to build;
- Be able to adapt;
- Be natural to intuition and general thinking;
- Be able to build consensus;
- Not require excessive specialization in order to use it.

From this point of view, the decision-making process should be able:

- To structure the problem by identifying its elements and relations;
- To give opinions;
- To represent opinions in a significant numerical manner;
- To use the numerical representation for prioritization;

- To synthetize partial results in global results;
- To analyze changes in opinion.

With these characteristics in mind, Thomas Saaty has created the AHP method in which the decision problem is addressed across three levels (see Graphic 19). "The goal of the decision at the top level, followed by a second level consisting of the criteria by which the alternatives, located in the third level, will be evaluated" (T. Saaty & Vargas, 2001, p. 1).



Graphic 19. ***Three levels of AHP.***

The first step is to choose the elements that are going to constitute the hierarchy. In this sense, there are some steps to follow (T. Saaty & Vargas, 2001):

1. To identify or define the goal is the starting point. In other words, identify which is the main question.
2. To identify sub-goals if it is necessary.
3. To select the criteria according to the goal.

4. To select the sub-criteria if it is necessary.
5. It is necessary to take into account the environment or context of a decision.
6. It is necessary to identify the people involved as decision makers and stakeholders.
7. To identify the relations between all the actors involved and actor goals.
8. To identify actor policies.
9. To identify options or alternatives.
10. To compare alternatives. In this phase, the AHP places a stress on cost-benefits analysis since the method was in fact proposed for decision-making in economics.
11. To rank alternatives.

The structure of the hierarchy is achieved by a comparison of the elements of the lower level with some or all of the elements of the upper level. "The hierarchy does not need to be complete; that is, an element in a given level does not have to function as a criterion for all the elements in the level below" (T. Saaty & Vargas, 2001, p. 2). This characteristic allows for the elimination of elements that are not considered important or the placing of greater specificity on those that are considered critical.

The basic rational of the AHP is to make paired comparisons among the levels of the structure in order to derive a scale. The comparisons are made by taking into account the preferences of the evaluator or the decision maker, depending on how the case is defined at the beginning of the process. It is important to identify the relations of dependency among the groups within levels in order to maintain consistency in the results.

> Absolute measurement (sometimes called scoring) is applied to rank the alternatives in terms of either the criteria or the ratings (or intensities) of the criteria; for example: excellent, very good, good, average, below average, poor, and very poor; or A, B, C, D, E, F and G. After setting priorities for the criteria (or sub-criteria, if there are any), pairwise comparisons are also made between the ratings themselves to set priorities for them under each criterion and dividing each of their priorities by the largest rated intensity to get the ideal intensity. Finally, alternatives are scored by checking off their respective ratings under each criterion and summing these ratings for all the criteria. This produces a ratio scale score for the alternative. The scores thus obtained of the alternatives can in the end be normalized by dividing each one by their sum (T. Saaty & Vargas, 2001, p. 5).

The preferences are settled through a scale, referred to by Saaty as a *fundamental scale*. This scale represents the judgments or intensities evident between two elements in order to be able to proceed with a pairwise comparison. Saaty's fundamental scale is shown in Graphic 20.

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

Graphic 20. ***Saaty´s Fundamental Scale.***

Source: (T. Saaty & Vargas, 2001)

Once the scale is used to compare the relevant elements, the result is a matrix. Since there exist a considerable number of ways to reach the scores, rankings and priorities, the AHP uses the eigenvalue formulation (T. Saaty & Vargas, 2001, p. 8). It is important to point out that it an explanation and analysis of both this work and the author rests outside of the scope of this research due to time and length constraints, which is something that can also be said for the mathematical procedures through which the priorities and rankings are done; this would be a good subject for future research. Thankfully, the AHP and ANP methods today use software programs, namely Expert Choice and SuperDecisions, which help to calculate both. This work uses SuperDecisions, a software program

that has proved easy to use in terms of the introduction of data, a process conducted both in graphic and verbal terms.

In all calculations a certain range of error is present. Through the software, this range is calculated and introduced into a formula in order to provide greater consistency in judgments. In this sense, the AHP includes a consistency ratio (CR). If the CR is over 0.10, then the judgments must be revised (T. Saaty & Vargas, 2001, p. 9). This statement is useful as a control method, especially when the evaluator is unfamiliar with the mathematical rationale behind the method.

The AHP and the software programs synthetize the rankings after the comparisons and normalize the values when there exists a dominant or dependent alternative that affects the preference of others (T. Saaty & Vargas, 2001).

To sum up, the AHP is a method that is based on problem-solving by building a structure through the identification of relations and influences linked to the problem. It also assesses such relations in order to identify priorities or preferences:

> It treats people separately from the conditions in which they find themselves, because so far no complete integrated theory of socio-economic-political-environmental-cultural factors exists that would enable us to deduce optimality principles for people's behavior. The AHP is an instrument used to construct a complete order through which optimum choice is derived. In the AHP approach a particular decision is not considered wrong merely because it does not follow a prescribed set of procedures. The purpose of the AHP is to assist

> people in organizing their thoughts and judgments to make more effective decisions (T. Saaty & Vargas, 2001, p. 12).

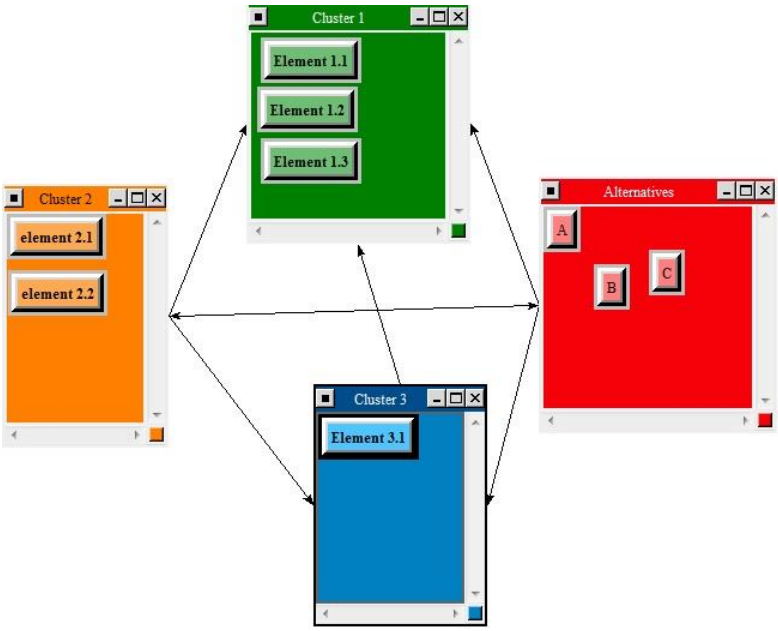
For all of these reasons, the AHP method has been useful in the planning, decision-making process and resource allocation stages across a diverse range of disciplines.

Saaty has also developed another type of methodology called the Analytic Network Process (ANP). The ANP method is based on the aforementioned AHP method. It too is a way to analyze causal influences and their effects through a holistic approach, involving the factors and criteria of a networked system instead of a hierarchical structure (T. Saaty, 2001):

> The ANP provides a general framework to deal with decisions without making assumptions about the independence of higher level elements from lower level elements and about the independence of the elements within a level. In fact the ANP uses a network without the need to specify levels as in a hierarchy. Influence is a central concept in the ANP (Thomas L. Saaty, 1999, p. 1).

The main difference with the AHP is that the ANP is a network of influences among elements and clusters, and such a network controls interactions (Thomas L. Saaty, 1999). From this point of view, relations can be made between elements without a hierarchical structure. Instead of using a matrix, it is a supermatrix that is weighted across the elements.

This methodology is especially useful when the problem is featured in terms of dependent and interdependent relations among elements. The difference in the ANP resides in a network structure instead of the subordinated relations of the AHP. The network structure is accurate with regard to the reality in which the elements interact among each other, instead of being organized in a hierarchical order (see Graphic 21). In this way, our attention is directed to relations of cause and effect (Bottero et al., 2008).



Graphic 21. ***Network Structure.***
Source: Based on Saaty's ANP; drawn using SuperDecisions Software

Similar to the AHP, the ANP uses pairwise comparison, allowing for both qualitative and quantitative judgments. In the same way, the ANP applies the same fundamental scale as the AHP (see Graphic 20). However, the ANP allows for relations between the elements of a cluster, among clusters, and also among feedbacks that are not present in a hierarchical model (see Graphic 21).

Logically, before any comparison it is important to establish the lines of: outer dependence or among clusters, inner dependence or feedback. In this sense, the ANP goes beyond the AHP by allowing for more robust lines of interaction among elements. The ANP as a network makes possible decision-making without concerns arising regarding what comes before or after, as is the case with the AHP. For this reason, the ANP deals with cycles and allows for the prioritizing of clusters or sets of elements, which is more accurate for some contexts in reality (Thomas L. Saaty, 1999).

3.3.3. The rationale behind the AHP and the ANP: An adaptation for integrated risk assessment for cultural heritage sites

Within the cultural heritage field, as with many other disciplines, a "culture of assessment" remains largely underdeveloped. Generally, decisions are taken in an intuitive manner instead of via a well-informed decision process. Intuitive decisions do not take into account aspects such as efficiency, efficacy, capacity, feasibility, costs, benefits, relevance and quality, among others (Martínez & Escudey, 1998).

This is the case for the conservation of cultural heritage, especially from the point of view of managers. A management institution, a Ministry of Culture for instance, has the important goal of protecting, preserving and conserving cultural heritage sites under its responsibility. The relevant decision maker should decide how to allocate resources, where and in what amount. Also, the decision maker should solve the problems of conservation for different sites. The point is, how to obtain the necessary information in order to decide in the most optimal way?

Taking into account the different natures and characteristics of each hazard, the different relationships among hazards, and the diversity of cultural heritage sites, it is necessary that the tools of assessment allow for the integration of a diversity of elements. In addition, the aim of a risk assessment is to provide the outcomes for decision-making processes that will ultimately protect cultural heritage sites.

Under these circumstances, as an assessment method multiple-criteria analysis, and in particular AHP and ANP, allows for the systematic integration of different types of indicators. The multiple criteria analysis allows for cross criteria and various alternatives. Both elements can be of a different nature. The logic used is that of crossing information in matrices or super-matrices, thus establishing relations from different points of view.

The multiple criteria analysis is a tool for decision-making and a planning instrument. With this method, the criteria are estimated in comparison to alternatives through a scale. This scale allows for the identification of priorities and degrees of importance from one aspect in relation to

another. This type of analysis is used to give solutions to complex problems in which different elements are at play. For instance, the method enables the crossing of information regarding social, economic or cultural aspects, and also allows for links to be made through one criterion in particular (Dodgson et al., 2009).

The multiple criteria analysis has not been used in an extended way in the field of cultural heritage. However, it has been used in sectors that require strategic planning. Within the cultural heritage context, the method has been used in Europe for the assessment of urban transformations, as in the case of Torino, Italy, for which the ANP was used (Bottero et al., 2008; Brandon & Lombardi, 2011).

Although the AHP and ANP as any other multiple criteria method, were created as assessment and decision-making processes for project management, the rationale behind these methods can be adapted to the needs of risk management in cultural heritage sites. On the one hand, the circumstances that cultural heritage management and conservation decisions face require an urgent method in which a decision can be taken in a more informed way. On the other hand, the characteristics of cultural heritage and the interdependency of risk factors within the risk management context entail a tool that integrates elements of different features.

With this in mind, the rationale behind the AHP and ANP can be adapted for integrated risk assessment. The AHP entails a more restricted methodology than that of the ANP and could be used to analyze the influence of

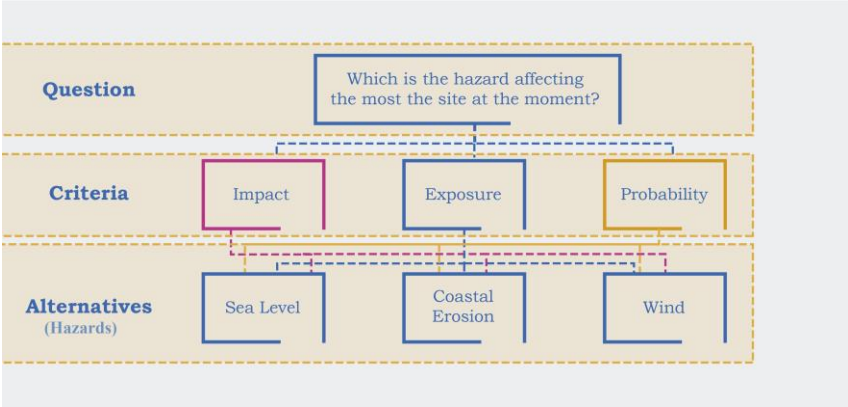
different risk factors for a cultural heritage site in a particular moment.

In this sense, the AHP procedure should be followed. First, the goal or the main question could be, which hazard affects a specific site the most? Due to the positive connotations linked to the AHP, the adaptation of the method should face an inversion. In other words, the AHP is made for selecting the best choices. Normally, a decision maker wants to know which the best and most advantageous alternative is in order to select it and execute it. Within a risk management context, it is necessary to know which the worst hazard is or which risk factor affects the conservation of a cultural heritage site. This inversion is easily made through the correct formulation of the question. This should address the hazard that most affects the conservation of the site. In the same direction, if the AHP allows for a ranking of priorities, it is possible to establish the best and worst options.

As Saaty suggests, the goal or main question might be specific in terms of location if needed, time-bound and measurable. In this sense, the question could be which is the hazard that affects a specific site during the evaluation timeframe?

The second aspect entails the selection of the criteria in light of the evaluation to be done there. Within the risk-management context, the criteria could involve aspects that turn a hazard into a risk. For instance, impact, exposure, probability, and so on. Finally, the alternatives or options are precisely the elements that one wants to know, that is to say, the hazards. In this way, the basic three-level structure

of the AHP could be made in the manner shown in Graphic 22.



Graphic 22. ***Example of AHP structure in Cultural Heritage.***

In order to shape a concrete example for the explanation of how an AHP methodology could work for risk management, reference will be made to the information and data collecting processes used in a research visit to Scotland. Although the research focused on the identification of factors related to the impact of climate change on cultural heritage, the data are useful for the building of an AHP structure.

Scotland has several cultural heritage sites inscribed as World Heritage Sites (WHS). Among these is the Heart of Neolithic Orkney World Heritage Site located at the Mainland in Orkney Islands (see Map 1).

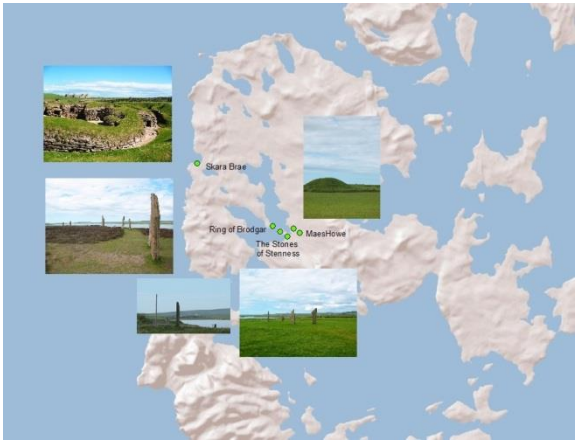
Map 1. ***Location of the Orkney Islands*****.**

The Heart of Neolithic Orkney World Heritage Site comprises six sites across two areas of the island of Mainland (see Map 2). The six sites are: the Skara Brae settlement, the Maenhowe Chambered tomb, the Stones of Stenness, the Watch Stone, the Barnhouse Stone, and the Ring of Brodgar (see Map 3).

The Heart of Neolithic Orkney was inscribed as a World Heritage Site in 1999 "as a group of sites deemed to be an outstanding testimony to the cultural achievements of the Neolithic peoples of northern Europe" (Historic Scotland, 2008, p. 4).

Map 2. ***Orkney Islands inset. Location of the Heart of Neolithic Orkney WHS.***

The sites of Orkney date back to 3000-2000 BC and constitute major ceremonial places, tombs and settlements, presenting a remarkable example of Early Bronze Age culture.



Map 3. ***Sites of the Heart of Neolithic Orkney.***

For this example, the focus will be that of the site of Skara Brae, a Neolithic settlement occupied from around 3100 to 2500 BC and located at the edge of Skaill Bay (see Map 4).

Map 4. ***Skara Brae at the edge of Skaill Bay, Orkney.***

"The remains originally came to light after a violent storm in 1850; later more was revealed by clearance excavations. The north side of the settlement had already been lost to the sea; a retaining wall was first built in 1925-6" (Historic Scotland, 2008, p. 9).

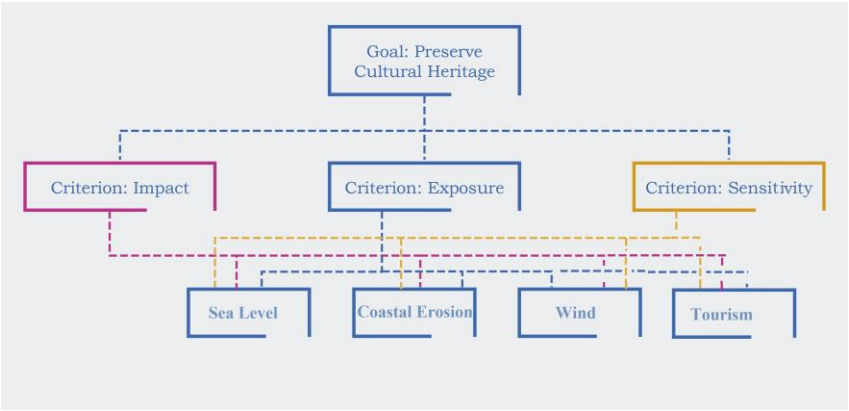
In order to build an AHP structure, let us assume that the decision maker, in this case an institution in charge of the management of the site as one pertaining to Historic Scotland, needs to decide about the implementation of

preventive measures to avoid danger at the site. In order to do so, it is necessary to know which hazard jeopardizes the conservation of Skara Brae the most. The ultimate goal is, in any case, to preserve the site.

Following the steps of the AHP structure, the next task is to select the criteria with which each hazard is to be evaluated. In order to exemplify the methodology, we will assume that the criteria will be impact, exposure and sensitivity. Obviously, other or more criteria could be chosen, for instance, probability, but in order for us to build a reasonably sized structure it will be assumed that the criteria are limited to these three.

Now, it is necessary to select the alternatives, in this case the hazards. In order to provide an example, the hazards selected are the rise of the sea level (labeled simply as sea level), coastal erosion, wind and tourism. It is important to note that according to the data collected during the research visit, more hazards can be identified. However, for this example, and to show matrices that are not too extensive for the purposes of this example, the selection comprises the four hazards indicated above.

With the goal, the question, the criteria and the alternatives now chosen, the basic structure of the AHP is shown in Graphic 23.

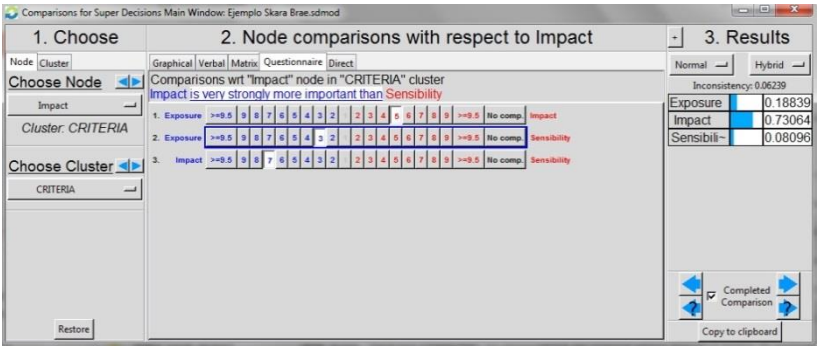


Graphic 23. ***Relation between criteria and hazards.***

Saaty´s fundamental scale (see Graphic 20) aforementioned, is useful for the weighting of each level in the pairwise comparison. In this sense, the evaluator should respond to the importance or preferences among the criteria. It is possible to manage an equal value for the criteria. In such a case, the priorities will be given according to the values provided in relation to each hazard and the criteria.

In this example, the questions will be: Is exposure more important than impact? If so, how much? The same question applies to all relations among the criteria. Using the SuperDecision software program, it is possible to introduce the necessary information. It is important to point out that the weighting of the criteria is undertaken by the evaluator, but that it can be based on the data collected, surveys, interviews, literature reviews, and so on. Since it is important to identify stakeholders, normally the weighting process corresponds to participatory actions and meetings in order to better fit to the assignation of values.

In this case, and using Saaty's fundamental scale, impact is strongly more important than exposure, and is given a 5. Exposure is very moderately more important than sensitivity, given a 3, and impact is very strongly more important that sensitivity, given a 7 (see Graphic 24). In addition, the inconsistency value is 0.06. As explained before, an inconsistency value over 0.10 indicates that the comparison values should be revised.



Graphic 24. ***Pairwise comparison, Criteria Level.***

Source: Taken from the SuperDecision software program

The resulting pairwise comparison matrix for the criteria or level 1 is shown in Graphic 25.

	Exposure	**Impact**	**Sensitivity**
Exposure	1.0	0.2	3
Impact	5	1.0	7
Sensitivity	0.3333	0.1428	1.0

Graphic 25. *Pairwise comparison matrix for criteria- level 1.*

The same scale works for the pairwise comparison at the second level, that is to say, for hazards. The question here is, which hazard exhibits a greater impact, exposure and sensitivity? In this case, the hazards are compared pairwise with respect to how much more harmful one hazard is than another, according to the criterion of the first level.

The way in which the AHP is formulated allows us to address the best options. In the case of risk management for cultural heritage, the rationale is maintained but inversely, since we need to identify the worst hazard. For this reason, the software allows for a change in the type of comparison. In this case, it has been changed in terms of damage. Thus the pairwise comparison is made according to each criterion for the question, which hazard is more harmful than the rest? For instance, in terms of impact at the specific site of Skara Brae, is sea level more or less harmful than wind? The same logic is applied to each hazard for each criterion.

For exposure and sensitivity, the type of comparison is changed in terms of significance. This means that the pairwise comparison asks, how significant is a hazard in terms of its exposure in relation to other hazards? The result will give us a series of matrices that cross hazards and criteria. An example of this is shown in Graphic 26.

Impact	Coastal Erosion	Sea Level	Tourism	Wind
Coastal Erosion	1.0	1.0	9.0	5.0
Sea Level	1.0	1.0	9.0	5.0
Tourism	0.1111	0.1111	1.0	0.2
Wind	0.2	0.2	5.0	1.0

Exposure	Coastal Erosion	Sea Level	Tourism	Wind
Coastal Erosion	1.0	1.0	9.0	0.33
Sea Level	1.0	1.0	9.0	0.33
Tourism	0.1111	0.1111	1.0	0.1428
Wind	3.0	3.0	7.0	1.0

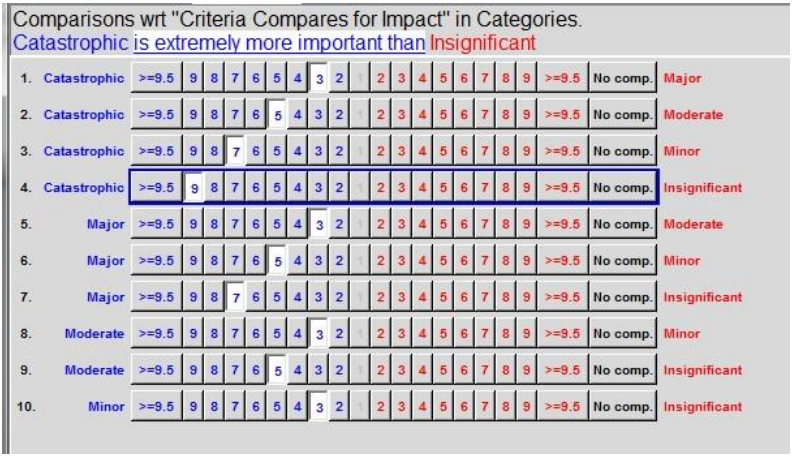
Sensitivity	Coastal Erosion	Sea Level	Tourism	Wind
Coastal Erosion	1.0	1.0	9.0	5.0
Sea Level	1.0	1.0	9.0	5.0
Tourism	0.1111	0.1111	1.0	1.1428
Wind	0.2	0.2	7.0	1.0

Graphic 26. ***Example of pairwise comparison matrices at level 2.***

After identifying the three pairwise comparison matrices for level 2, it is necessary to synthesize the priorities. To do so the AHP provides two approaches: a distributive mode and an ideal mode. The former takes into account the results of all alternatives in order to provide a composite global result. The latter indicates the preferred option according to the goal and the criteria (T. Saaty & Vargas, 2001).

In this example, and in the cultural heritage context, the ideal mode is the best way to establish priorities, since the objective is to see which hazard affects the site the most. The global result for establishing priorities should not be affected by the results of all the alternatives.

In order to synthetize the matrices, the SuperDecisions software allows for the introduction of the ratings between the hazards and the criteria. It is possible to create the rankings accordingly. At this point, it is perfectly adequate to use the ranking of frequency and impact, suggested by the ISO for risk management or create a new ranking. In this particular case, the impact of each hazard can be ranked according to the outline proposed by the ISO. As explained in Chapter 2, this rank can be: Catastrophic, Major, Moderate, Minor or Insignificant. In any case, it is important to establish the value of difference between ranks (see Graphic 27).



Graphic 27. ***Values between ranks.***

The same ranking procedure is executed for each criterion. This will allow for the assignation of ratings for each hazard, as shown in (Graphic 28).

	Priorities	Totals	Impact 0.553078	Exposure 0.253170	Sensitivity 0.193752
Sea Level	0.432086	0.728954	Major	High	High
Coastal Erosion	0.349528	0.589674	Major	High	Medium
Wind	0.156932	0.264753	Moderate	Medium	Medium
Tourism	0.061455	0.103678	Minor	Low	Low

Graphic 28. ***Ratings of hazards and criteria.***

The synthesis will show the priorities, as demonstrated in Graphic 29. In other words, taking into consideration each criterion, the weight among the criteria, the hazards, the difference between hazards, and the rankings given to the relation between hazards and criteria, the most damaging factor is the rising of the sea level, closely follow by coastal erosion.

Name	Graphic	Ideals	Normals	Raw
Coastal Erosion		0.808932	0.349528	0.349528
Sea Level		1.000000	0.432086	0.432086
Tourism		0.142229	0.061455	0.061455
Wind		0.363196	0.156932	0.156932

Graphic 29. ***Priorities.***

Once again, it is important to highlight that the intention of showing this example is to indicate how the rationale behind the AHP might be useful for the risk management of a cultural heritage site. In this example, real data has been gathered in relation to the impacts of climate change. However, and with the intention of being clear, several hazards and criteria, such as frequency and probability, have been deliberately omitted with the intention of keeping the matrices to a manageable size for the purposes of this demonstration.

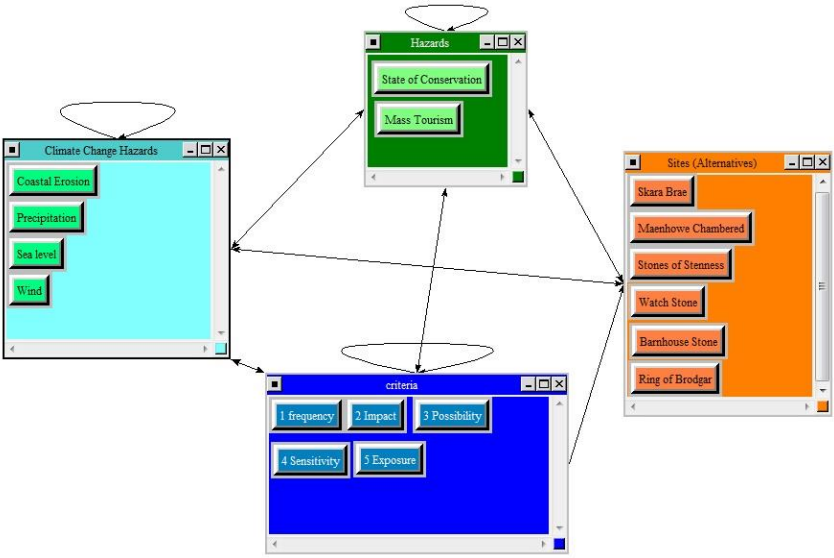
In addition, the immediate reflections on the aforementioned example turn our attention towards the relation between hazards and criteria. For instance, the rising of the sea level, coastal erosion and wind might be correlated. In the same way, exposure and impact might share a relation. In this case, the ANP method allows for us to establish connections, while the AHP is based on a hierarchical model.

Within risk management for the cultural heritage context, the ANP could have two applications. On the one hand, it will permit connections between feedback and dependence for elements in the same structure, as Graphic 19 illustrates. On the other hand, it will allow for a comparison between sites where the relationships are

multiple, including feedback, and both outer and inner dependencies.

This way of using the rationale of the ANP will enable a decision maker, such as a government ministry, for instance, to decide the needs of different sites and allocate the available resources correspondingly, while also focusing on any aspects that are particularly urgent.

In the example of Skara Brae, it is fruitful to consider a comparison between each site of the Orkney Islands using our criteria and hazards as clusters. It is then necessary to use matrices and supermatrices in order to cross the information and data for each case. The network will clearly be more complex, following the basic structure shown in Graphic 30.



Graphic 30. ***Network Structure*****.**

Logically, the pairwise comparison will also be more extensive but indeed exhaustive, thus yielding more detailed information for the decision maker.

As previously mentioned, the Orkney example only considers the factors linked to climate change. However, a more extensive case study has been run in order to establish the priorities for the conservation of monuments in public spaces located in Bogotá, Colombia.

Bogotá has more than 400 monuments placed in public areas of the city. In 2012, due to a new legal regulation issued by the District, the conservation of monuments was placed under the charge of a recently formed institution: the District Institute for Cultural Heritage (IDPC, its acronym in Spanish). In order to allocate resources, the IDPC divided the city into three main areas and requested the formulation of a Preventive Conservation Plan for each.

During 2012 and 2014, studies were done for two of the areas. However, the team in charge of the formulation faced several obstacles. Initially, several hazards were selected and numerous aspects studied independently, leading to a complete evaluation and recommendation for each hazard or aspect. The main problem was that of the impossibility of synthetizing in one comprehensive result the complete panorama of the situation. Indeed, this was a methodological problem, since the method of synthesis was not drawn up and the criteria not settled from the very outset for all of the aspects evaluated. As a result, the IDPC ended up with a considerable number of recommendations and several action plans for each aspect. Logically, it was

impossible to reach a clear decision regarding what to do in terms of conservation.

Against this background, the third area was tackled in 2014. In this case, a method based on the ANP was proposed. The main question was oriented around knowing which monuments were in the worst state of conservation and the hazards that affected them the most. In addition, the clusters were defined as:

- Urban Cluster: Involved the evaluation of the urban landscape and the architectural features.
- Conservation Cluster: Included subnets for sensitivity to environmental factors, state of conservation, and vulnerability to natural disasters.
- Social Cluster: Involved social factors such as vandalism and the social appropriation of monuments.
- Management Cluster: Included legal protection, special provisions, copyrights, and so on.

The basic structure can be seen in Graphic 31. The methodology for gathering data was defined for each cluster according to the nature and disciplines involved. The urban cluster emphasized site visits for the collection of the majority of its information and geographical data from different institutions of the city. The social cluster gathered data through ethnographic methods, interviews, site visits and participatory meetings with diverse groups of stakeholders. The management cluster used information from past reports, legal publications, institutional reports, interviews and literature reviews. The conservation cluster used information from the meteorological stations in the city, data from the risk-management offices and condition surveys for each monument. This last cluster established

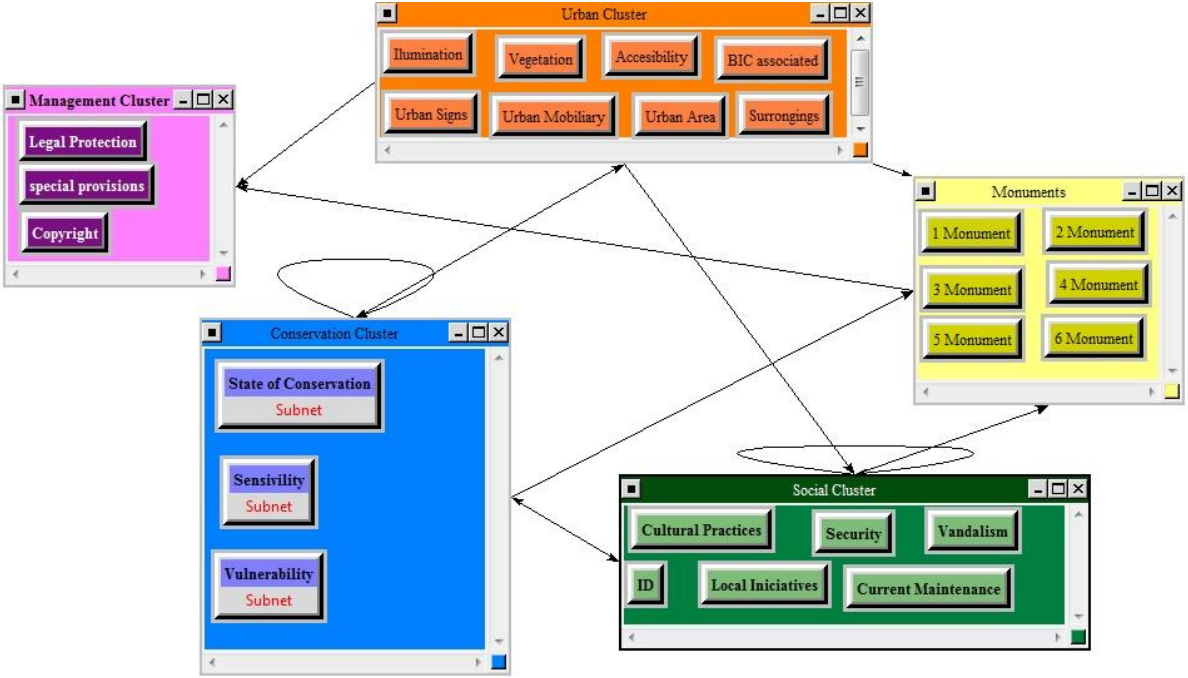
subnets where the ANP method was used to synthetize and cross the information.

Overall, 52 monuments and 120 variables were selected from the clusters (Matiz López et al., 2015). Matrices and supermatrices were completed, generating a synthesis in which the 52 monuments were ranked against 17 criteria.

Although the case involved an extremely large amount of data, the ANP was able to cross information to allow for the definition of four major strategic lines for preventive conservation and 26 objectives. In addition, four monuments were considered to be of high priority for urgent intervention, and 36 monuments were identified as being in need of minor interventions. Also, it was possible to rank the monuments into three groups with a time-bound framework for conservation actions: short (within the next year), medium (from 2 to 4 years), and long term (5 years).

In conclusion, with the AHP and ANP it is possible to assess a single site in relation to different hazards and reach a result concerning the most prevalent threat. In addition, this method can be used to compare the sites under via same criteria and determine which site is the most threatened.

With this information in mind, decisions can be taken in a more informed way and the allocation of resources can be implemented in a better manner according to the needs of each site.



Graphic 31. *Monuments in public space – Network Structure for Bogotá*

Conclusions

The majority of cultural heritage sites are jeopardized by a multiplicity of factors that threaten their conservation. These factors correspond to a diversity of sources with different characteristics across a range that runs from physical and natural aspects to sociopolitical, economical and managerial elements. Although conservation studies tend to focus on a particular hazard and the best options available to cope with its consequences, it is clear that a comprehensive view of cultural heritage and risk management is in urgent need.

In addition, the field of cultural heritage, globally, does not exhibit well-developed management practices. Decisions in conservation are taken frequently from an intuitive perspective, thankfully by an expert, instead of being the result of a rational and informed assessment.

These two elements construct a scenario in which decision-making can be a difficult process. Also, it may be of detriment to resource allocation. This situation is especially delicate when the management resides in public institutions since it might entail legal, punitive and disciplinary penalties. In a field where resources are limited and normally private or public assets are not even

comparable with other kinds of public concern, the allocation of funds must be proficient and based on the best option or scenario.

Considering the arguments expressed above, this work proposes an integral assessment method for use within risk management processes in order to prioritize needs, actions or alternatives. From this point of view, this research does not pretend to merely be a case study. Instead, this work uses information from cultural heritage sites to evidence how a methodology might work in order to obtain information that drives reliable decisions. In this sense, this work concentrates on a methodological proposal for integrated assessments as a support tool for decision-making.

Taking into account the fact that this research is oriented towards managers, the work addresses several aspects: risk in the context of cultural heritage, principles and processes of risk management, and integrated assessments. In relation to these points, it is possible to state the following:

- **The concept of risk in the context of cultural heritage**

Today, risk in the context of cultural heritage is an important topic. However, it is not clear how, who and when the issue was introduced as a mainstream aspect in cultural heritage. Through primary sources and extensive archival work, this research reveals how the term was introduced into the cultural heritage field and why the topic has gathered strength over time.

Although the first initiatives for such conservation, which were developed after World War II, already considered the consequences of armed conflict, the literature and archives relating to ICCROM and ICOMOS show that the term risk dates from the 1970s. Several natural disasters and their impacts on cultural heritage direct our attention to risk preparedness. In this sense, actions undertaken by ICOMOS, but particularly the training courses delivered by ICCROM, have helped to spread the topic across Europe and, more recently, worldwide. In this context, Foramitti played an important role as the first person to address the problem, both teaching and publishing on the topic; he was later followed by Bernard Feilden and Herb Stovel.

Although here the orientation was toward natural disasters and armed conflict, little by little factors such as development pressures, management problems and, recently, climate change, were introduced into the conception of risk. The special attention given to natural disasters and armed conflict seems to be obvious, since their impacts not only affect cultural properties but also communities. For the same reason, a similar increase in attention for the impacts of climate change has been seen in recent years as well.

Within this context, this work contributes to the historical perspective of the term in the discipline of cultural heritage. It exposes not only how the term was coined, but also gives an insight into the present situation and how the term risk is used today. Through an illustration from the List in Danger of World Heritage Sites from UNESCO, it is evident that the tendency of a

continuous rise in the number of properties threatened year by year is growing. It is also clear that the dangers are becoming more complex over time. This situation shows an increase of in the number of hazards that play a role in the conservation of sites and a growing consciousness at the international level regarding risk.

Although, the information provided by UNESCO offers an insight into global tendencies, it is still limited in terms of restricted data compilation for the cultural heritage sites in each country that are not necessarily inscribed as World Heritage, but which are indeed facing unwanted impacts from certain hazards.

The illustration also shows the complexity of those hazards that threaten cultural heritage sites. The majority of these sites face a simultaneous mix of factors. Finally, it is important to highlight that during this research several initiatives for counteracting the impacts of hazards were detected at the international level. In this sense, a considerable number of studies, materials and actions are in place for natural disasters, armed conflict and, lately, climate change. However, our attention is called to the complexity that development pressures pose for cultural heritage without a consistent focus on the problems and various solutions. This situation probably responds to the sociopolitical and economic causes behind such hazards, which change for each particular case. In addition, it seems to comprise an underestimation of the magnitude of this hazard, although it represents a major reason as to why a cultural property may be in danger.

- **The term risk**

Risk is a concept that is used in a diversity of fields. Although this particular subject is relatively new in the context of cultural heritage, it has been found in this research that several terms are used indistinctively. Hazard, threat, risk and danger are seen to be similar terms in the discipline. Even the Operational Guidelines of UNESCO use them as synonyms. However, a rigorous and careful look at the terminology shows that such terms and concepts have their differences.

It is important to point out that there exists a difference in understanding when referring to risk affecting lives and risk affecting cultural properties. Confusion seems to relate to the different meanings used for the same word and their indistinctive use. This is precisely the challenge for risk related to natural disasters and climate change, since these phenomena affect lives and cultural heritage. A variation in meanings generally produces several misunderstandings for decision makers, creating difficulties during the decision-making process.

In addition, the cultural context in which the term *risk* is applied also modifies its meaning. It changes what a decision maker or community considers to be risk or the level of tolerance accepted for a particular danger.

In this sense, one of the more challenging aspects during the research was that of clarifying and exploring the meanings related to each term used in the literature and in common language. This work has highlighted the most traditional definitions of risk within the cultural heritage context and explored the concepts in terms of recent

concerns in conservation, such as those linked to climate change. In addition, this research takes into account notions from within the field of management.

In order to avoid an undistinguished use of terms and concepts, this work clarifies the various meanings and delves into the theoretical background related to each. As a result, this research offers a broader and more holistic understanding of risk by considering it in relation to, in particular, the traditional notions related to natural disasters and the recent needs linked to climate change. Also, a managerial point of view is introduced. Here the concept of risk applied to cultural heritage is more robust, including aspects such as resilience, reflexivity and adaptive capacity. This research thus proposes an option that shifts the meaning of risk concentrated only on external hazards to a more comprehensive concept in which internal hazards and communities are involved.

It is clear, then, that terminology continues to be a challenge within the field of cultural heritage, not only in terms of referring to risk management but also among various conservation disciplines. The notion of risk proposed pretends to be an approximation of a holistic and multi-dimensional view towards cultural heritage, which is, in fact, a polysemic concept.

- **Values for decision-making**

In conjunction with the definition and clarification of risk, this work also highlights the importance of values. This aspect is well known in the context of cultural heritage. Although the subject is not free from debate, a

consensus as to the importance of values being the core of cultural heritage is present. Ultimately, what really matters is the value given by society to a site, not because of the materiality *per se*, but also because of the significance condensed in such materiality.

This research amplifies the subject, taking into account the fact that within the context of risk management for cultural heritage sites there are two perspectives: first, the values of cultural heritage and, second, the values in the decision-making process.

In this sense, this work stresses the second aspect since each decision is driven by a value or set of values. The importance of cultural heritage values and the emphasis given to this aspect normally blurs the other perspective. Here it has been found to be necessary that the role played by values in decision-making be highlighted.

From this perspective, the principles of the theories of value-focused thinking for identifying and creating alternatives for decisions has been developed. This research contributes to highlighting the importance of considering the values of decision-making within the context of cultural heritage, an aspect that has largely diminished to the present day. Finally, it is fundamental for risk management within a cultural heritage context to be able to merge the values of heritage with a "value-oriented approach" for decision-making. In this way, risk management may be truly effective as a strategy for conserving cultural properties.

- **Risk management for cultural heritage**

Although risk management is an area already in place in cultural heritage, it is indeed also a process for facilitating decision-making. It was originally created within the field of management to provide a methodology for the detection and prioritizing of those aspects that interfere with the production or achievement of objectives. Cultural heritage initially adopted this rationale in order to cope with the consequences of natural disasters. However, its application in this field goes beyond a merging of the identification, analysis and evaluation of hazards affecting cultural heritage, towards applying the principles and processes to decision-making for conservation.

In this sense, risk management is taken as a methodological procedure for minimizing the impact of hazards. From this point of view, this work takes as its reference the international standard for risk management, ISO 31000, which normalizes the well-defined steps of the process. Although the standard is a general guide for the process, especially for companies and the assets of production, its application to cultural heritage is not new. Risk management procedures for the collection management of museums and libraries follows the basic steps of the standard were already applied by ICCROM, both in various cases and across a selection of training courses.

From this perspective, this work has taken the principles stated by the norm and adapted them to the cultural heritage context. In this sense, risk management is seen as a process that helps to achieve managerial objectives, as well as allowing for the crucial integration of

process, conservation and site management. The importance of the systematic approach has been pointed out for the achievement of such integration, as well as the dynamic nature of heritage. In the same direction, this research has highlighted the possibility of using risk management as an approach for decision-making. In this sense, this work proposes a merging of risk assessment methods and decision-making methods. In this way, this work focuses on the idea of well-informed decisions based on the dynamism and flexibility of methods that can respond to changes in the conditions of cultural heritage, as well as to the introduction of human factors. In addition, this research takes on the perspective of risk management in terms of coming from a project management perspective to achieve the aim of merging those aspects related to cultural heritage and decision-making.

The steps established by the standard are very useful for organizing a procedure that helps in addressing and solving the problem of risk. In this sense, the initial stage at which the external and internal elements come together in a cultural heritage site is identified as being key for the correct identification of risk factors and the application of certain methods during assessment.

Furthermore, it has been found in this research that several cases of risk management in cultural heritage take risk assessment as merely a risk evaluation. This situation explains, among other reasons, why hazards are studied in isolation and decision-making for conservation does not come from an integral perspective of analysis. In this sense, the standard is convenient when allowing for an understanding of risk assessment as an intricate procedure

that involves identification, analysis and evaluation. Most of the time, these steps are not clearly separated into isolated phases or moments.

Another challenge faced during this work related to the identification of risk factors or sources. In the field of cultural heritage is not a clear classification of sources of risks. As a clear consequence of the isolation in which hazards are studied, this proved an incipient approach to identifying the interactions and features of different categories of hazards. Not even UNESCO's resources contain a clear categorization for hazards. In many cases, hazards are expressed as impacts and their causes are not related to them. In other cases, a description of hazards is given that is not then linked to their possible causes. As a result, the initiatives concentrate on the impacts instead of addressing the causes. Once again, an important lesson is taken from studies related to climate change since hazards are inevitably connected.

Within this panorama, this research has focused on offering an approximation of a classification of risk factors according to their causes. This proposal of clustering is useful when establishing connections between hazards and developing an evaluation. Normally, the assessment methods of a more holistic approach require clustering and a clear understanding of relationships between factors. The groups proposed do not pretend to be exhaustive; instead, they facilitate evaluation and allow for the proper functioning of assessment methods.

Finally, it has been found that studies tend to focus on assessments instead of risk treatments. Within the cultural heritage context, risk treatments are concentrated around

the situation of a specific site and also a specific hazard as a consequence of studies into a particular hazard and the result of intuitive decision-making. It would not be exaggerating to say that not enough information exists regarding how to solve a conservation issue, since conservation science is constantly developing. In contrast, the study aims to highlight the fact that decision-making is not based on an assessment of alternatives. This situation is, indeed, common in the context of cultural heritage. There is not only the fact of using risk assessment but also the application of assessments to alternatives for the risk treatment. At this point, the application of project management principles to alternatives for risk treatment in cultural heritage is still an area in need of development, especially in terms of decision-making processes. This is an aspect that is becoming increasingly important since many of the sources of risk reside in managerial practices.

On the other hand, a need for the clarification of terminologies for such aspects is also found wanting. It was found during this research that in the context of cultural heritage there persists an undistinguished use of terms related to assessments; a clear distinction exists between risk assessments and management assessments. In addition, roles are not well defined in the cultural heritage literature, with indistinctive decision makers and problem solvers being used in cases where functions reside in different groups. From this perspective, there exists a need to involve managerial thinking in cultural heritage. Although the practice of management of cultural heritage sites is becoming more important, significant developments still need to occur in this area.

- **Integrated Risk Assessment**

Several references related to risk assessment in the context of cultural heritage point out a need for integration with site management or, at least, a taking care of the more integrated measures of protection. However, these references do not mention how to achieve that objective. In this sense, this research proposes a holistic approach to cultural heritage and risk management. This means that a specific site should be looked at through a systemic lens, as should the hazards affecting the site.

From this perspective, the systemic view is taken from biology and applied to management. With such a background, this work suggests an application to cultural heritage management. In the same sense, this research proposes the use of such a point of view in the approach to risk management. The aim here was to look for a more holistic standpoint that allows for an integration of the different elements at play in the reality of cultural heritage.

It is clear that the systemic view has to be applied to each site since each one shares particular characteristics. It is not always right to analyze a cultural heritage site with a pre-defined blueprint. However, systems feature structures, behaviors and evolutions that can be analyzed across all cases.

A holistic approach through the systemic view provides a way in which relations between the components of a site can be analyzed as a whole. This is also a manner in which the risk factors can be studied in relation to their integral nature, instead of being addressed in isolation. This

approach opens up the possibility for analyzing the relationship between hazards, thus generating an integrated view of risk management.

The clusters of risk factors are settled accordingly to their causes as mentioned above, and are fundamental at the moment of establishing relations. This work establishes a relation of dependency and interdependency among risk factors. This means that one hazard may produce increments or reductions in another.

The net formed by such connections will affect any assessment. In this sense, an isolated study of a hazard will not provide information about how other hazards may influence its impact on the cultural heritage site. From the idea of integrated risk assessment, the interconnection among hazards becomes a primary aspect to take into account. The second aspect relies on the method for assessment, keeping the integrated view and reflecting the different kinds of relations found.

- **Multiple-criteria methods for assessment**

One of the biggest challenges faced during this research was to find possible assessment methods that accomplish two characteristics: one, a method able to evaluate elements of a different nature; and two, a method that allows for the reproduction of connections among elements. Additionally, it was not an extensive amount of cases within risk management of cultural heritage with comparisons between assessment methods. In other words, sites where risk management plans were taken normally used one methodology for the assessment without further

evaluations that allow comparison among results or the applications of different assessment method.

For these reasons, this work has concentrated on references that originate within the field of management. One case has proven particularly enlightening: the assessment of land and urban transformation in Torino, Italy. This case uses multiple-criteria analysis as a methodology for evaluation. Taking into account that the urban landscape could be linked to cultural heritage elements, the case and the related publications by Patrizia Lombardi proved key for the focus adopted in this research.

Consequently, this work has explored multiple criteria as an assessment method. However, the mathematical knowledge that forms the base of multiple criteria is completely out of the scope of this research. For this reason, software was used herein for the necessary calculations.

It is important to note that the aim of this work is to propose a possible methodology that can be applied in the context of cultural heritage. In this sense, the focus of this research has been to understand the rationale behind the methods instead of the expression of mathematical formulas. Following the tracks of multiple criteria and the cases in which they have been used, the Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP), were found to be suitable methods for areas with certain compatibility to the realities of cultural heritage, such as urban and built environments. In addition, the AHP and ANP comprise methods that are designed for decision-making processes from the point of view of the field of management.

In this sense, this work has explored the theoretical background of the AHP and ANP and proposes an adaptation for the risk management of cultural heritage. The point to be highlighted is that this research examines the rationale behind AHP and ANP as multiple-criteria methods, in order to be suitable for an integrated and holistic risk assessment of cultural heritage. However, these methods are made for aiding in the selection of a best option or alternative, thus facilitating the decision-making process. For this reason, it is necessary to invert the goal of the method when it is used for risk management, since the objective is to find out what jeopardizes a site.

The adaptation and application of the AHP and ANP to a case within the cultural heritage context brings up the virtues and challenges of these methods. In terms of benefits, these methods are quite flexible and allow for adaptation to different circumstances. Also, the software used allows for the shaping of hierarchies and networks in a way that better reflects the realities of the study.

In addition, these methods were created to be easy to use without the need for an advanced mathematical background. Furthermore, the methods were created in order to allow for a comparison of different kinds of elements, including companies, production assets or any other kind of decision-making process in which it is necessary to select alternatives. From this point of view, it would not be forceful to apply the rationale of these methods to a different field of knowledge.

These are methods that allow for the conjunction of qualitative, quantitative and semi-quantitative data since pairwise comparison conveys all the information in

numerical rankings. However, these rankings can reflect the preferences even if they are qualitative through the system of weighting. In sum, they are methods that combine rational and intuitive information. As a result, the AHP and ANP methods allow for the mixed character of information and data, both of which are important benefits for the characteristics of cultural heritage.

The ANP in particular reflects a better method for real situations since it allows for a comparison between elements at any level. Here then it is possible to shape the situation of any particular case.

On the other hand, there were several challenges in the adaptation and use of AHP and ANP methods. Besides the limits posed by the mathematical knowledge – solved using a software program – the multiple criteria discrete method only works for one decision maker. However, it is possible to use participatory initiatives in order to combine the preferences from different levels of decision-making, since at some sites the decision-making process is broken down in different spheres. Through participatory mechanisms it is possible to unify the criteria, weight and preferences. Similarly, the methods will require several preliminary steps in order to establish the criteria and weights, since stakeholder interests are fundamental in the context of cultural heritage. Unfortunately, not enough studies are dedicated to the methodologies applied to assessments in cultural heritage and comparisons.

In addition, the necessity of an interdisciplinary view was clear for the identification of hazards and establishing of their connections in the most accurate of manners. In this way, the methods can be more consistent.

From an operational point of view, the software used was approachable. However, it is important to know the distinctions for each number on the scale of the pairwise comparison and make sure that the rankings are very clear for the case being assessed. The rankings and weights work better when strong distinctions exist, since the numbers very close one to another do not really provide differences in prioritization.

As another challenge, a careful use of terms has been employed. Once again, terminology played a vital role during pairwise comparison. Since the logic of the AHP and ANP was shifted in order to find the hazard affecting a site the most, instead of looking for the best alternative, the terms used in the comparison needed to be precise.

Finally, this research has contributed to the field by providing several inputs for future developments. It has provided support for the greater use of the AHP and ANP in several cases of risk management for cultural heritage in order to show how this will allow for a better methods for the adaptation of the methodology. However, it would also be interesting to explore the other types of multiple-criteria analysis in future research. As such, it will possible to compare the results from different methods in same case studies. Thus it will be possible to see which method is more suitable, reliable and accurate for decision-making. Also, it will be possible to establish if there is a method that works better for a specific kind of cultural heritage, for instance, archaeological sites, urban areas, and so on. In order to do so, an interdisciplinary approach is indispensable.

Last but not least, this research has revealed several gaps in the cultural heritage field that the writer hopes will be addressed in future work. In relation to this matter, it is fundamental to prove the robust conception of risk in different situations and to approach risk management from a perspective that is both more holistic and more integrated. In addition, it is important to highlight the magnitude of the problems that development pressures pose for cultural heritage and the few actions and initiatives, as well as the little research surrounding this matter today.

To summarize, this research has looked for an integrated management support tool for the identification and prioritizing of risk factors for the conservation of cultural heritage sites. Instead of using case studies, this research has considered a methodological scheme that is adapted to the needs of risk management in the context of cultural heritage. For this reason, this work concentrates on risk management from the point of view of managers and decision makers.

…Consider a hungry person who likes both apples and oranges and is offered a choice between a large, red, pungent, juicy looking Washington State apple and an even larger, old and shriveled, pale colored orange with a soft spot. Which one is that person more likely to choose? Let us reserve the situation and offer the same person on the next day a small, deformed, unripe apple with a couple of worm holes and a fresh colored navel orange from California. Which one is he or she more likely to choose now?

Thomas Saaty

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