

THE 1755 LISBON EARTHQUAKE AND THE GENESIS OF THE RISK MANAGEMENT CONCEPT

A. BETÂMIO DE ALMEIDA¹

*¹Full Professor - Instituto Superior Técnico, Universidade Técnica de Lisboa, Lisbon, Portugal
Member of the Academy of Engineering of Portugal*

ABSTRACT

The 1755 Lisbon earthquake is a landmark in the western cultural history by different reasons and perspectives. In fact, one of the most important cities in Europe was almost destroyed and a large number of people died due to the buildings collapse, fire and tsunami effects.

Within the European cultural framework of the XVIII century this event was a shock. The scientific, philosophical, religious and moral consequences of the disaster were discussed and the Lisbon earthquake was a catalyst for relevant changes.

At the epoch, the risk analysis and management concepts were still not created as disciplines. However, the Lisbon earthquake can also be considered as a very strong landmark in the genesis of the risk management applied to disasters as it is now considered. Based on historical sources and narratives this evidence can be shown: the most relevant actions developed after the earthquake can be interpreted as components of a risk management structure. The author describes the contributions that can be detected in what concerns: event identification and explanation; crisis response; mitigation and prevention and vulnerability concept.

INTRODUCTION

Most of the historical writings about man response to catastrophes and to dangerous situations converge towards the identification of the 1755 Lisbon earthquake as the first modern disaster and as a landmark associated to a crucial change in the cultural and social perceptions of natural catastrophes. This fact can be explained by the magnitude of the human disaster and by the historical epoch. However, other factors, intrinsically associated to the effective response to the event, also justify the choice of the 1755 earthquake as the genesis of a modern crisis management and of what is now named as risk management.

Following G. Y. Karven (Karven, 1995, p. 8) and as a general and simplified statement, this change can be partly characterized by the remark of J. J. Rousseau on the man responsibility and knowledge in what concerns the decision of the construction of cities in seismic zones. This position was published in 1756 as a contribution to the debate induced by the strong cultural 1755 aftershock that swept across the European continent. This position was very different from other traditional contemporary positions concerning the strong religious belief or the philosophical scepticism against the Nature and the Providence (Voltaire). This reaction of Rousseau can be considered as a symbolic beginning of the progressive development of rational methodologies and tools for the human control and management of the natural the manufactured hazards. This human goal represents an epistemological rupture and challenge: the man facing alone the uncertainty and the fate with its reason, trying to be an active actor and not just a potential victim.

Before 1755, other strong earthquakes were felt around the world¹ and in Lisbon several earthquakes were felt before the big one: eight (XIV c.), five (XVI c.), three (XVII c.) and in 1724 and 1750 (França, 1977, p. 59). However, the 1755 Lisbon earthquake introduce a dramatic change and remained in the memory due to: 1) its own characteristics (violent earth shake, extensive and durable fire and deadly water wave or tsunami in several locations); 2) the European cultural environment and movement and 3) the emergency and recovery actions executed by the national government.

The cultural impact of the 1755 Lisbon Earthquake on the western society is well documented (e.g. Buescu and Cordeiro,

2005, Fonseca, 2004), in what concerns, among others, the moral, the philosophical, the scientific, the social and the artistic components.

Some previous authors made references to the emergency action among other aspects of this event (e.g. Fonseca, 2004 and Marques, 2003). In this text, the author briefly describes in a structured way, the context of the change, the evidence of a proto risk management methodology associated to the 1755 Lisbon earthquake. The work is based on published bibliography and is framed by two key concepts – memory and knowledge – applied to the cultural history of the human response to catastrophes.

RISK CONCEPT AND ITS MEANING

Risk is nowadays a dominant concept in our societies and is associated to multiple conditions or factors: uncertain natural hazards; uncertainties involving science and technology and their effects on our health and quality of life; humankind vulnerability and lack of a consistent meta-discourse explaining life anguish and its meaning; and the appeal of a life game dealing with fears, chance and opportunities. The risk concept is now so important that our contemporary society is characterized by U. Beck as the “Risk Society” (Beck, 1986). The risk concept, as an evidence of fate, has roots in the Antiquity (Bernstein, 1998) but it acquires a growing importance and status in the Renaissance period as associated to the interference of natural hazards and fate uncertainties on the trade activity and on property². Some scholars associated the consolidation of the concept and the origin of its name to the Portuguese or Spanish navigations (Giddens, 2002, p. 21).

The notion of risk is inseparable³ from the ideas of probability and uncertainty (contingency). Rationalism and the Enlightenment change the previous human position when facing the uncertain fate: from observing God, the Creator and the perfect Observer, towards himself as an autonomous and finite observer.

² A trade risk ambience is presented by Shakespeare in his play “The Merchant of Venice” (1598?) which is an example of the travel contingency on the epochal European life.

³ The so called “technical dimension” of the concept defines the conceptual entity risk R in the following way: R = probability of the hazard (causal chain of events associated to the hazard) • Consequences. Nowadays, risk is considered as a multi-dimensional concept beyond the technical one: it has a social behaviour dimension and a psychological dimension (risk perception), among others.

¹ Namely in China (1649), Calcuta (1737) and Lima (1746), according to Migliorini (1981, p. 71), and also in England (1750).

In order to control the future contingency, probability quantification based on the past **experience** and **memory** was an essential step that began to be possible with Cardano (1525) and Pascal-Fermat (1654) in the domain of the games of chance (Hacking, 2002, p. 73 and Bernstein, 1988, p. 49). However games of chance were a pure human construction. Natural catastrophes were still considered in a different way.

The development of the multi-dimensional concept of risk is the consequence of its association with present time decisions. Risk is a form for present descriptions of the future under the viewpoint that one can decide, with regard to risks, on the one or other alternative (Luhmann, 1992). A rational decision implies freedom and knowledge as well as confidence on world regularity and on the observer. Human risky decisions become dependent on probability and extent of loss or gain in external (from nature) and in manufactured (from our action upon the world) risks. In contemporary societies, causes of the events are veiled by the respective probability of occurrence that need to be trusted by the decision-makers. Rational options to make decisions can now be strongly related to future consequences (present futures) and to a new ethical responsibility: "there are no longer any dangers that are strictly externally attributable. People are affected by natural catastrophes, but they could have moved away from the endangered area or taken out insurance" (Luhmann, 2002, p. 71). Knowledge is useful when explaining the past and the present but is also vital for the prediction of future events because risky decisions are now those that can be regretted in the "future presents" should undesirable losses occur (idem p. 72).

To choose the best option in order to minimize losses is now the task of the risk decision-maker who becomes responsible for the future consequences. Memory and knowledge are supposed to furnish future scenarios that are felt as present virtual events and the decision-maker will face the burden of the uncertainty. This represents a new management responsibility related to the so called "natural hazards".

RISK MANAGEMENT STRUCTURE

To manage the future and the uncertainty become a growing demand of the social and economic activities associated to "progress" and "western civilization". Meanwhile, the public safety standards and expectations forced the risk decisions and analysis to become very complex and highly "risky". In the technological and the financial domains, the methods of reliability and risk analysis began to develop as scientific branches. The term "risk manager" was coined by the "Harvard Business Review" in 1956 and the risk management become well-known and accepted in the financial and the insurance activities. The nuclear industry and the environment hazards expanded the domain of risk management as an almost universal one.

A general standard structure for risk management is presented, in Figure 1. This structure has the following main components:

- **Risk assessment**
 - **Risk analysis**, the technical-scientific branch with the objective to make a detailed analysis of each identified scenario or danger in order to estimate the event probability and their consequences (risk estimation).
 - **Risk evaluation**, for guidance on risk decisions, including acceptable or tolerable risk criteria and proposal of measures.
- **Risk mitigation or control**
 - **Risk reduction**, to prepare and implement measures for risk abatement, planning of risk prevention or protection, including emergency and evacuation plans.
 - **Response to a crisis**, to prepare emergency actions, including evacuation, disaster relief and post-disaster aid (civil protection actions).

The **decision** component is the key component of all this process. Among different disciplines, **ethics** and **public perception** are crucial for assistance to decisions about residual, acceptable, shared or imposed risks. In what concerns decisions associated to public risks, as those related to natural hazards (e.g. earthquake, floods, fires...) or technological hazards, the decision falls in the political domain. In fact, despite all the scientific and technical knowledge, risk concept is also a social construction in what concerns the future and the response to the epistemological and random uncertainties. In this context any decision about public risks must take into consideration the risk public (or social) perception based on people values, culture and fears.

From 1755 to nowadays, a deep change occurred in what concerns the organized response to natural hazards and disasters as well as to human manufactured dangers. Detailed analysis, based on scientific knowledge and rationalism, constitute a major part of the "corpus" of practice of the risk management but there is another part that depends on the public reaction to knowledge and to information. **Risk communication** becomes a powerful way to reflexivity and to the building up of an efficient public preparedness as well as a radical or irrational risk aversion. The public response to a risk characterization or a disaster scenario strongly depend, among other factors, on the communication process

For sure is the strong utopian expectation and will of an almost perfect (no damage or no victims") risk management. However, it is believed that organization and preparedness can strongly reduce the losses and the damages. The criteria for **risk acceptance** by the public and for the risk mitigation measures are not just a technical complex problem. They also involve people behaviour and culture and the risk management need to be a hybrid process based on natural and social sciences.

MEMORY AND KNOWLEDGE RELATED TO EARTHQUAKES (BEFORE 1755)

Any catastrophic event, involving heavy human and economic losses, in a dimension that surpasses the normal human reference scale, unchains a process of reflection, interpretation and adjustment by the society. According to our contemporary reasoning this process can be considered as a collective response to overcome the anguish created in those that survive to such event. It is a way to move aside the idea of living a future similar horror. It can be considered as a survival process of human societies and the response pattern to catastrophes induced by natural factors and as a paradigmatic cultural process.

In fact, a relevant component of the human culture can be identified by the way it finds an interpretation or a meaning for the violent disruptions of the life and of the orderly structure of the world and also by the response to a post-event or to future events.

This topic is presented in a very clear and elegant way by Plato (428-348 BC) in the *Timaeus* where it is explained that several destructions of people occurred in the past and the same will happen in the future. The selected main causes for such events were the fire and the water: the earth is submerged by the gods in order to purify the inhabitants... and those who live in towns are pushed to the sea by the rivers.

Timaeus can be interpreted nowadays according to the contemporary risk management structure: hazard identification, selection of causes, characterization of effects and the contingent and probabilistic characteristic of the events (it happened sometimes and it can happen again, sometimes with large time intervals between).

Plato points to the fault of the Greeks in what concerns the prevention and protection because, "contrary to what the Egyptians do, other people do not preserve the knowledge through the writing".

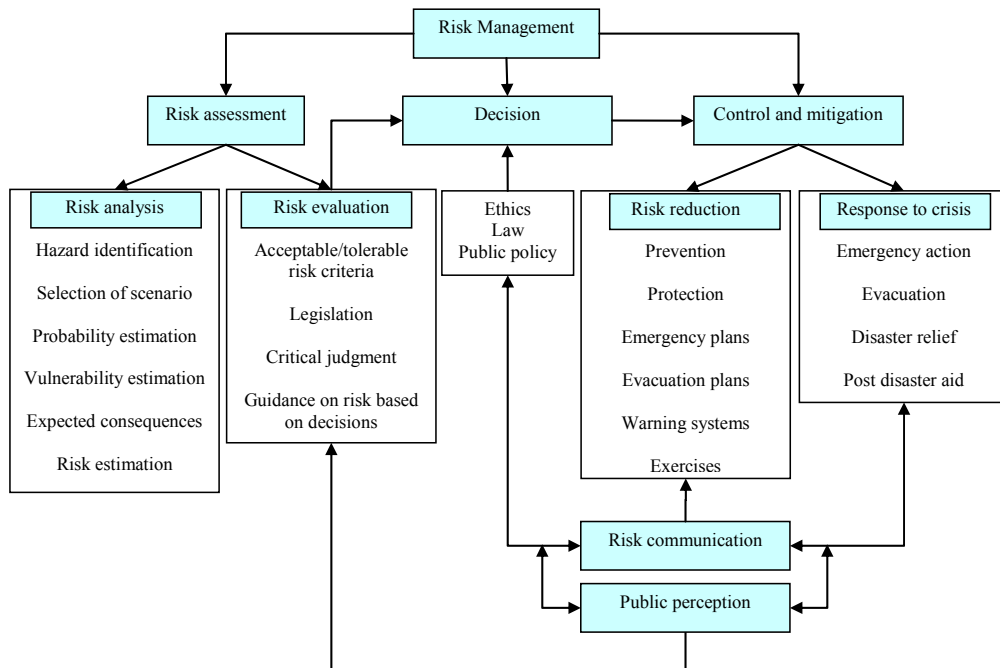


Figure 1 – A standard risk management structure.

The lack of memory concerning the causes and effects of events that “periodically” strike the humans would maintain the ignorance of the man, as “children who know nothing about what happened in the ancient times”... Memory and knowledge is the key for protection according to Plato.

In fact, among other catastrophes, reminiscences of strong and deadly earthquakes can be found in classic Antiquity culture. Biblical interpretations of earthquakes in Palestine are presented in the Old Testament (De Boer and Sanders, 2005, p.22):

2 Samuel 22:8 – “Then the Earth shook and trembled; the foundations of heaven moved and shook, because he was wrath”;

Jeremiah 10:10 – “the Lord is the true God...at his wrath the earth shall tremble”.

Earthquakes are also mentioned in the New Testament as catastrophic events involving powerful forces at work within and upon our planet. In Greece, the city of Sparta was devastated by a powerful earthquake that shook Sparta about fifty years later during Plato’s lifetime, Helike, a city on the Corinthian coast, was swallowed by an earthquake and a tsunami in 373 BC.

In what concerns the knowledge about the causes or the explanation of such kind of catastrophes, two types of theories can be found in the Classic Antiquity⁴: those based on divine (Gods) action; and those based on physical grounds.

Several Greek philosophers presented different physical conjectures based on “active principles”: the water (Thales of Miletus – 624-546 B.C.); the air (“blow theory”) by Anaximenes, in the sixth century BC; the air and the fire (Anaxagoras, in the fifth century BC), among others. Aristotle (384-322 BC) discussed in his work *Metereologica* early theories and developed his own explanation through the “pneuma” concept associated to the wind generation and internal circulation inside the earth regulated by the external climatic conditions. Aristotle’s ideas were widely accepted in the XVIII century, more than two thousand years after his death.

⁴ A description of the knowledge of this epoch in what concerns the earthquake phenomena can be found in Serra, 2005.

Despite the epistemic uncertainty, the predominant representation of the seismic activity in the ancient Western World was that of a passive and cavernous earth (planet) traversed by active fluids that were the cause of earthquakes.

The development and consolidation of the Christianity reinforce the divine component associated to only one God. The theory of Aristotle was accepted in the Middle Age with one important safeguard added to the theory by St. Thomas Aquinas (1225-1274): “the main cause of earthquakes is God, and can only collaterally be attributed to subterranean winds” (Fonseca, 2003, p. 102). Before, Philastrios, abbot of Brescia (fall of the fourth century AC), wrote as the heresy number 102 (“Liber de Haeresibus”) the belief in the natural causes of earthquakes (Bernard, 2003, p. 18). Natural phenomena including earthquakes could be interpreted as divine messages.

The Renaissance and the “Scientific Revolution” periods made a change and put again questions and reflections in what concerns the interpretation of the earthquakes. Do “the cause of the earthquakes will be within or over the earth?” smartly asks Galileo (1564-1642) possibly inspired by the Constantinople earthquake (1556) where a comet and an unsent set of stars had been observed in the sky.

New physical explanations were presented since the XVII century, namely the “explosion theory”, possible inspired by the developments in applied thermodynamics (Keller, 1998, p. 135). Around 1750, a new theory was proposed based on the electricity and inspired in the work of B. Franklin associated to atmospheric phenomena (Keller, 1998, p. 136).

The 1755 earthquake occurred in Lisbon and Portugal in a key corner of the knowledge path related to natural catastrophes and also in the history of risk management practices.

THE 1755 PROTO-RISK MANAGEMENT EMERGENCY RESPONSE TO CRISIS

In what concerns the risk management structure (Figure 1), the first evidence of the change corresponds to a specific step of the process: the event realization and response to the crisis. In what concerns the 1755 earthquake this response had a strong and efficient political leadership under the power of the marquis of Pombal.



Figure 2 - Lisbon after the earthquake. Camping outside the damaged town and executions of robbers and looters. (Copper engraving, Germany, 1755 Kozac Collection, K2119).

This political action reflects one of the aspects of the structural changes which occurred in the XVIII century: the development of the modern state. Faced to a major disaster in its capital the modern state assumed the collective responsibility for their consequences and for the relief. The King of Portugal gave to Pombal full responsibility and power for dealing with the emergency response and later for the Lisbon reconstruction. This leadership is symbolically remembered by the famous phrase that Pombal is supposed to have said and that seems to be a synthesis of his action plan as an answer to the question “what should we do?": “bury the dead and feed the living”.

The emergency action included different tasks as the following ones (Conceição, 1829)⁵:

- The **disposal of bodies**, in order to avoid the outbreak of plague; Pombal concluded that the best way to solve this problem was to collect them on barges and sunk them beyond the river Tagus; the Church agreed and the traditional religious rites were exceptionally disregarded.
- The **treatment**, the **feeding** and the **housing** of the survivors; emergency hospital were created and special measures were applied to provide the transport of food from different parts of the country and by ship in order to avoid the hunger in Lisbon, including the price control; to provide materials for the new houses and orders for the removal of debris, camps were set up to house the homeless (Figure 2).
- The guarantee of **public security** by troupes and courts in order to stop looting and the recovery of stolen wells, exemplar death punishments were applied; a pass system was set up to regulate entrance and exit from the city.
- The fight against **superstition** and **prophecies** that could induce a fatalist terror and also the fight against reactionary positions (e.g. the repressive actions against the rumour that a new earthquake would struck again on the anniversary of 1755 earthquake).
- Special **financial resources** were mobilized; legislation was prepared (1756) to regulate an extraordinary tax for imported merchandise (França, 1977, p. 69).
- **International aid** came from different countries: food and supplies from England, timber from Hamburg, a generous gift in cash from the Queen of Spain (Francis, 1985, p. 124) and other came from Brazil, Italy, France, Sweden and Holland (França, 1977, p. 67).

⁵ A collection of official providences (14, until December 1758) published in 1829 by Claudio Conceição and based on a compilation made by A. Patrício de Lisboa in 1758 (new edition published in 2005).

These types of actions are very similar to those considered in the present disaster and crisis management and civil protection planning.

RECONSTRUCTION AND RISK MITIGATION

The reconstruction of the damaged part of Lisbon began with demolitions and removal of debris and, one year after the earthquake, the area was disencumbered.

Very soon the works related to the rebuilding of Lisbon were in progress (Figure 3 and 4) and a concerted set of measures and special legislation were approved along the following months:

- General Manuel da Maia, Chief Engineer of the Kingdom, was asked to submit a report (“dissertação”) for the reconstruction of the city; this report comprises three documents dated 4 December of 1755, 16 February of 1756 and 31 March of 1756; in this report Maia presents different solutions.
- The survey and register of streets, squares and houses in the damaged part of the city in order to avoid future quarrels (Conceição, p. 73 – Providence XIV); and the prohibition to construct new houses and the order to demolish those that were out of the plan (Conceição, p. 75).
- A complex logistic planning involving the materials, the construction processes, human resources, financial aids and legal measures were prepared including the control of price speculation (França, 1977, p. 103).
- A team of architects and engineers developed plans for the reconstruction taking into consideration the structural safety, the urban aesthetics and public health.



Figure 3 –Pombal implementing the reconstruction of Lisbon, M. S. Carmo Sendim (Municipal Museum of Lisbon).

In what concerns what we can now call risk mitigation, based in the control of consequences (less vulnerability) for the inhabitants, Maia recommended in his report (December, 1755) that the new buildings should not be very high (control of the number of floors), in order to diminish the consequences of their ruin should another earthquake occur and, also, that the new streets should be wider, in order to allow an easier way to flee from the debris.

Maia introduce a very interesting aspect related to public perception and memory it would be very dangerous: to allow a free rebuilding of the city without constraints to the height of the buildings was established because the people would forget the horror of the 1755 earthquake and the law of no more than two floors. A few months before the discussion across Europe about the earthquake, Maia also reflected about a less vulnerable area for the reconstruction and even referred the negative influence of water (sewage) in the dynamic behaviour of the land.

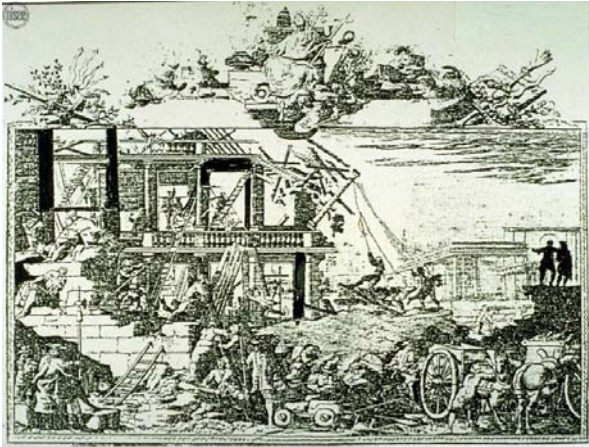


Figure 4 - Repairs and new construction after the Lisbon earthquake. (Copper engraving, 18th c., Kozac Collection, K278).

In what concerns the **prevention** against the collapse of buildings under seismic forces, the most popular structural measure was the **wooden structure** or cage (“gaiola”) embedded in the walls (Figure 5). According to França (1977, p. 158) and Fonseca (2004, p. 93) experiments of this invention were made in a full-scale model, by using soldiers in march in order to test the efficiency of the structure under dynamic forces. These experiments can be considered as one of the first dynamic essays in the context of the earthquake engineering (Fonseca, 2004, p. 93). The reconstruction of Lisbon and the protection against seismic forces acting in the buildings left unforgettable memories that support the development of new technical procedures of building protection and damage mitigation in Portugal.

RISK COMMUNICATION AND EARTHQUAKE DESCRIPTIONS

The description of what happened in Lisbon, the horror in that All Saints Day, 1755, was communicated to other countries and to a large number of people outside Portugal. As a consequence of the earthquake and of the emotional shock that was felt, a popular literature was generated which described the event and the destruction and death associated to it. This had a tremendous effect on people and provoked an intense critical analysis and reflectivity related to the meaning of such a catastrophe.

Foreign eyewitness (e.g. merchants and diplomatic) descriptions and books, essays, poems and theatre plays had a deep and durable influence in the European imaginary⁶. *Candide*, the book of Voltaire related to Lisbon earthquake, published in 1759, became an international best seller (30 000 copies in the first year), “which became astounding at the time for a work of fiction (Dynes, 2000). A good information on the influence of the event in the European literature can be found in Buesco and Cordeiro, 2005. Another extraordinary vector of communication and of spreading of dramatic emotions was the large number of historical depictions of the 1755 earthquake⁷. Examples of these pictures are located at the Lisbon Municipal Collection (in Prague): the Kozac Collection. Some of the pictures try to acutely depict the events and are based on eyewitness (e.g. Le Bas engravings based on Paris and Pedegache drawings), others are fanciful depictions. However, they were very important in what concerns the spreading of the message and as documents showing aspects of the earthquake magnitude and power of

⁶ In 1804, in Paris, the drama “La Destruction de Lisbonne” was still represented. More information concerning other examples can be found in Brillhante (2005).

⁷ A beautiful set of Kozac Collection can be found in the nisee site and also in Kozac et al., 2005

destruction, the suffering of the inhabitants, the rescue actions and also the Lisbon reconstruction (Figure 3 and 4).

The motivations of the written or pictorial messages are diverse: to inform, to record, to understand or just the perverse sensational desire to show human suffering. Based on very different technological platforms the present media and communication channels mobilize similar motivations and are much more powerful. Again the 1755 earthquake was the first work in this component of risk communication as well as the interaction of world and image in scientific works (Keller, 1998).

THE MORAL AND PHILOSOPHICAL DEBATE

The 1755 earthquake originated a well-known moral and philosophical debate across Europe, involving some of the most prominent intellectuals of the Enlightenment movement: Voltaire (1694-1778), Rousseau (1712-1778) and Kant (1724-1804) among others.

The descriptions of the catastrophes shocked Voltaire and gave him the opportunity to manifest his deep moral perplexity in what concerned the Goodness and the Divine Providence when confronted with the destruction, the suffering and the death that happened in Lisbon.

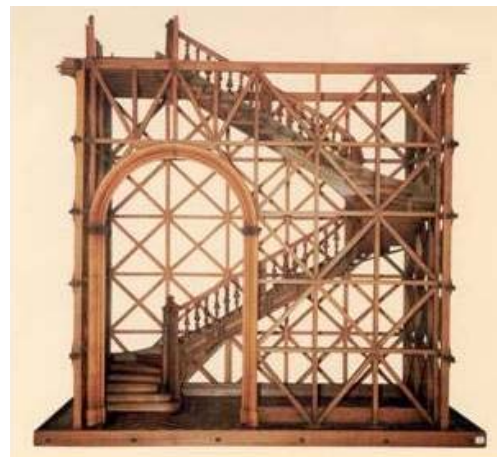


Figure 5 – A cage structure model. IST Museum (Lisbon, Portugal).

The “best of the worlds” concept of Leibniz (1646-1716) and Pope (1688-1744) as well as the meaning of the “justice of God” (the theodicy problem) were the background motivation for violent and satiric writings. Voltaire did not put in doubt the God’s existence but the coexistence of God with the evil on earth doing so horrendous works was something that could not make sense.

The “Poème sur le désastre de Lisbonne”, written shortly after Voltaire knew what happened in Lisbon was an opportunity to provoke discuss the Providence and other justifications on the face of the earthquake.

The epochal philosophical discussions about the Providence and Deism were very important because they touch the concepts of for knowledge and forethought and also a religious meaning indicating a particularly intervention and care of God on behalf of man, the belief in Providence is the belief “that God (or the gods) not only created the world but also governs it and cares for its welfare, particularly for men’s welfare” (Marques, 2003, p. 7).

In what concerns the development of risk analysis and management, any fracture of the Providence concept was necessary because:

- The disruption of nature’s order as the result of the impenetrable divine wills and punishments would be incompatible with a rational inquiry in the “natural causes” (natural laws, and in the search of the regularities of the “natural events” (frequencies).

The writings of Voltaire (e.g. the poem and the book *Candide* published in 1759) were a strong contribution for the change from the intellectual optimism and potential fatalism for a more sceptic position that is a necessary condition for the construction of future scenarios in a risk analysis context.

Rousseau's answer to Voltaire (1756) can be here enhanced by a new **social view** of disaster when he writes⁸: "...that nature did not gather twenty thousand houses of six or seven floors, and if the inhabitants of that great city had a spread out more and built smaller houses, much less damage would have been done, may be none at all. How many power wretches died in this disaster because they wanted to rescue their clothes, their papers, their money?"

Rousseau shifts the responsibility towards the behaviour or the actions of the man and identifies the present concept of **vulnerability** that can be related to the probability of damage or loss should an hazard occur. In the Rousseau's text it can also be identified the importance of a promptly **evacuation** of the population at the first tremors or alarm signals in order to avoid human losses. Similarly, but in the context a scientific knowledge contribution, I. Kant also makes a critical analysis of the plan of Lisbon in what concerns the direction of the Tagus valley and the orientation of the damages according to the earthquake physical theory presented by Kant and free of religious causes (Kant, 1756).

Rousseau also points to the idea that disaster is also a **social construction** according to existing cultural norms and whether an event is considered or not a disaster will depend on who is affected, where it occurs and the way it is known⁹ (disaster communication).

All these new ideas and concepts are important because they introduce a new social and ethical responsibility to the decision-maker and also introduce the idea that one of the meanings of disaster has to be found in the social and cultural context and it is now one of the dimensions of the risk management. This social dimension includes the **public behaviour** under a risk environment and need to be considered in the mitigation and emergency (evacuation and rescue) actions. The problem that was unveiled by Rousseau is still now very actual, as we can conclude from the U. N. report on disasters published in 2004¹⁰ where the problem of rapid urbanisation and high human vulnerability to earthquakes is pointed out (UN, 2004, p. 36) as well as the fact that decisions related to very fast development areas do not incorporate the risk and the risk management in what concerns the planning and construction processes¹¹.

NEW MEMORIES AND KNOWLEDGE

The 1755 earthquake was the origin of new memories associated to a catastrophe induced by a natural hazard as well as a catalyst for new attitudes and a new knowledge. The new memories were stimulated by the popular literature and depictions and by the study of the event in a restrict circle of people. Baptista and co-authors (1998) made a careful analysis of the several types of documents written between 1755 and 1759, including reports, chronics, letters and anonymous coeval sources. The total number of documents attained was 982. Official inquiries were sent to all parochial districts and one of them has a special importance (Portugal and Matos, 1974). It was an inquiry oriented for the seismic phenomena (1756). According to some authors, this inquiry can be considered as a landmark in the history of the

modern¹² seismology (Fonseca, 2004, p. 122). This kind of inquiry is important because it is one of the bases of encapsulated memories (database), related to physical evidences and to both quantitative and qualitative facts like damages and losses. The physical process explanation can then be scientifically based on factual information.

New efficient knowledge would only be possible if the minds freely believe in physical conditions and processes that can happen again and again due to neutral laws external to our "will and sins". This change was possible in the epoch of the 1755 event.

The debate between those who believed in divine causes and those who defended the natural causes was a reality in the epoch. J. Wesley, in a pamphlet titled "*Serious Thoughts occasioned by the Late Earthquake at Lisbon*" (1772) wrote "why should we not be convinced...that it is not chance which governs the world...; why, we have a general answer always ready, to screen us from any such conviction; All these things are purely natural and accidental; the result of natural causes". But there are two objections to this answer: first, it is untrue secondly it is uncomfortable... what is nature itself but the art of God? Or God's method of acting in the material world?" (Boer and Sanders, 2005, p. 85-86).



Figure 6 – Intensity distribution of relevant earthquakes that occurred in Portugal (1755-1911), presented by Paul Choffat (Choffat and Bensaude, 1912, p. 105).

Some were convinced as, for example, Cavaleiro de Oliveira, a Portuguese refugee in London that declared that the catastrophe was the result of a divine punishment applied to Portugal as the result of superstition, idolatries, persecutions and the actions of the Inquisition. The Jesuit Gabriel Malagrida also write a text (1756) about "the true causes" of the earthquake and threatened with a divine punishment those who have worked in the reconstruction of Lisbon. Meanwhile, Pombal would have secretly ordered a French religious to develop an explanation based on "natural causes" (França, 1977, p. 72).

⁸ Letter of Rousseau to Voltaire (citation based in Fonseca, 2004, p. 110).

⁹ Inspired on a contribution of Russel Dynes of the Univ. of Delaware, New York (Dynes, 2000).

¹⁰ "A Global report reducing Disaster Risk. A Challenge for Development".

¹¹ At a global level, vulnerability reduction is now a strategic goal (e.g. Hyogo Framework for Action – ISDR, 2005).

¹² The King of Portugal asked the Pope for a new saint as the protector of the kingdom: Saint Francis (Borgia) a Jesuit saint who was considered the "protector against the earthquakes". This request was satisfied in May, 1576 (França, 1977, p. 72). This attitude can be considered as a belief on a "divine public protection measure".

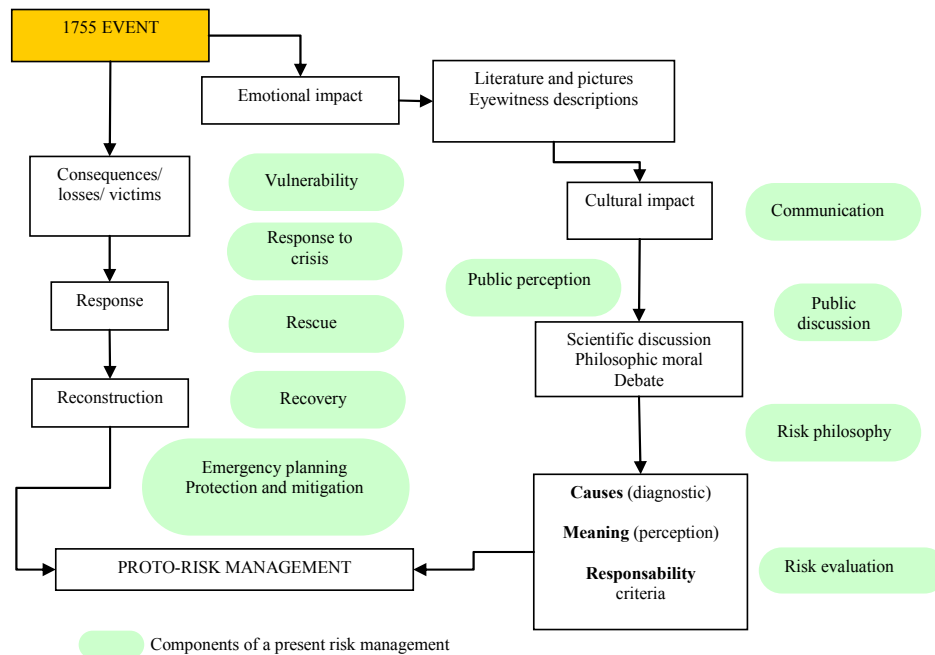


Figure 7 - 1755 roots on nowadays risk management structure.

The new way of thinking is exemplified by John Michell, a professor at Cambridge University and one of the “fathers” of the modern seismology. Michell analysed reports of the 1755 earthquake and, in 1760, published a book titled *Conjectures concerning the Cause and Observations upon the Phenomena of Earthquakes*. In this book, the author proposed “a method for determining where the earthquakes originated. He suggested that the directions of wave propagation at different locations in plotted as lines on a map and that the lines be extended until they intersected. “He thus confirmed that the Lisbon earthquake had originated in the Eastern Atlantic” (Boer and Sanders, 2005, p. 95). Until now, the 1755 earthquake has been a permanent challenge for the scientists in order to understand the physical process of the earthquake. New scientific theories were developed after the 1755 earthquake (e.g. Bevis, 1757; Michell, 1760; Kant, 1756; Drijghout, 1763). Seismology began its development and a long way was made until the contemporary knowledge about the general sources and mechanisms of the seismic activity.

The enquiry proposed by Michell has been pursued by others now with powerful computer techniques (e.g. Baptista et al. 2003 and 1998). However, it remains some important uncertainties and there are several proposals for the location of the origin of the earthquake. But it is sure that the 1755 earthquake remains a reference for the scientists in the seismological domain (Figure 6).

The 1755 earthquake remained in the memory of the Lisbon inhabitants for a long time. According to Choffat (1912) “the 1755 earthquake left in the inhabitants of Portugal a terror¹³ associated to quakes, and the majority of the population expects the repetition of this catastrophe”... and the author refers the public reaction during the 1909 (23 April) earthquake (Benavente earthquake)...”In Lisbon, many people remained outside during the night” (Choffat and Bensaude, 1912, p. 19).

¹³ The 1906 (S. Francisco) and 1908 (Messina) earthquakes motivated special conferences by different Portuguese scientific associations in order to tranquilize the people by explaining “the earthquake theory” (Choffat and Bensaude, 1912, p. 6).

Memory and knowledge are very important elements for the risk management:

Memory (data) / (Scientific) Knowledge

- **Risk analysis**
 - Physical process (seismology) → probabilities
 - Expected consequences (earthquake engineering) → risk assessment
- **Risk mitigation**
 - Prediction and detection of the event → early warning
 - Evacuation → relief assistance (civil protection)
 - Expected consequences (earthquake engineering) – risk assessment
 - Mitigation of consequences → vulnerability control → anti seismic buildings (earthquake engineering) and urban planning

Unfortunately, a feasible earthquake prediction is still not fully guaranteed in all situations but the vulnerability control based on dynamic response of the buildings and on the control of damages is now possible (earthquake engineering and advanced codes). A good urban planning based on risk can also reduce the vulnerability. For an efficient relief a good organisation and preparation is very important.

Good protection can be obtained by a good memory and knowledge management (as Plato wrote in the *Timaeus*). However this memory management need to preserve a sufficient and healthy public oblivion; but some, among us, need to know, to remember and not to forget the memories, and to be responsible for the implementation of a good enough system of protection and for an efficient public information and education.

CONCLUDING REMARKS

The author is confident that the historical evidence is consistent enough (and not anachronistic) to sustain the conjecture that links the response to the 1755 earthquake to the genesis of what is now called the risk management. The risk management concept implies a strong rational position facing the past (memory and knowledge) and the future

(planning, prevention and protection) catastrophic events. The **Enlightenment** movement and the philosophical discussions concerning the moral responsibility associated to the Lisbon earthquake opened the way to the acceptance of rational (scientific) enquiry about the causal conditions of this kind of natural catastrophes.

Among the several changes induced in the European culture by the 1755 Lisbon earthquake, the genesis of the risk management as an integrated methodology applied to severe accidents and catastrophes was one of them. In Figure 7 it is presented in a simplified way the association of historic facts related to the 1755 earthquake and some of the components that nowadays belong to a standard risk management structure. This heritage results from both the cultural epoch and contemporary political and philosophical conditions and also from the specific characteristics of the earthquake. Two hundred and fifty years after, the event can be considered as one of the foundational landmarks of risk management that initiated a new phase: the “age of reason” based on the political and expertise will as well as on the human responsibility. From an ethic of fatality the world began to change towards an ethics of responsibility.

A main characteristic of the risk management is the acceptance of human **responsibility** in what concerns the magnitude of the consequences of an event, including the identification of local **vulnerability** concept developed in the twenty century.

From 1755 to nowadays the way how to see and to react to public catastrophes changed very much: risk management is based on rational knowledge (logos), on the public response and perception (pathos) and is also an organized attitude (ethos) that the political power can not forget and need to be well prepared.

The historical memory of the 1755 landmark should constitute a strong motivation for a continuous up to date and integrated effort concerning the public protection against catastrophes in Portugal.

REFERENCES

Baptista, M.A. et al., The 1755 Lisbon Tsunami; Evaluation of the Tsunami Parameters, *J. Geodynamics*, Vol. 25, N° 2, pp. 143-157, 1998.

Baptista, M.A. et al., New Study of the 1755 Earthquake, source based on multi-channel seismic survey data and tsunami modelling, *Natural Hazards and Earth System Sciences*, European Geosciences Union, 3, pp. 333-340, 2003.

Beck, U., *Risk Society. Towards a New Modernity*, Sage Publications, London 260p. (first edition in 1986). 2003.

Bernstein, P.L., *Against the Gods. The Remarkable Story of Risk*, J. Wiley, New York, 383 p. 1998.

Boer, J.Z., Sanders, D.T., *Earthquakes in Human History. The Far Reaching Effects of Seismic Disruptions*. Princeton University Press, Princeton e Oxford, 278 pp. 2005.

Brilhante, M. J. O Grande Terramoto de Lisboa. *Ficar Diferente*. Editores – Gradiva, Lisboa, 431-449 p. 2005.

Buescu, H. C. and Cordeiro, G., O Grande Terramoto de Lisboa. *Ficar Diferente*. (Editors), Gradiva, Lisboa, 638 p. 2005.

Buescu, H. C. and Cordeiro, G., O Grande Terramoto de Lisboa. *Ficar Diferente*. Editores – Gradiva, Lisboa, 638 p. 2005.

Choffat, P. and Bensaúde, A., *Estudos sobre o Sismo do Ribatejo de 23 de Abril de 1909*, Imprensa Nacional, Lisboa, 146 p.1912.

Conceição, C. (1829), *Em que sé Notícia do Terramoto do 1º de Novembro*, Capítulo VII do Tomo XIII do Gabinete

Histórico, Impressão Regia, Lisboa, Franesi, Lisboa, 105 p. 2005.

Dynes, R. R., The Dialogue Between Voltaire and Rousseau on the Social Science View. *International Journal of Mass Emergencies and Disasters*, Vol. 18, n.º 1, pp 97-115. 2000.

Fonseca, J.D., 1755, O Terramoto de Lisboa, *Argumentum*, Lisboa, 139 p. 2004.

França, J.A., *Lisboa Pombalina e o Iluminismo*, Livraria Bertrand, Lisboa, 389 p. 1977.

Francis, D., *Portugal 1715-1808. Joanine, Pombaline and Rococo Portugal as seen by British Diplomats and Traders*. Tamesis Books Limited, London. 1985.

Giddens, A., *Runaway World. How Globalisation is Reshaping our Lives*, Profile Books, 104 p. 2002.

ISDR, *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*, World Conference on Disaster Reduction, Kobe, Hyogo, Japan (www.unisdr.org/wcdr/), 22 p. 2005.

Kant, I. (1756) *Writings on the Lisbon Earthquake*, Portuguese edition of the three essays about earthquakes published in Konigsberg, Almedina, 137 p. 2005.

Keller, S.B., *Sections and Views: Visual Representation in Eighteenth Century Earthquakes Studies*, *BJHS*, 31, pp. 129-159. 1998.

Kervern, G.Y., *Éléments Fondamentaux des Cindyniques*, Economica, Paris, 110 p. 1995.

Kozac, J. T. Moreira, V. S. And Oldroyd, D. R., *Iconography of the 1755 Lisbon Earthquake*, Geophysical Institute of the Academy of Sciences of the Czech Republic, Praha, 2005.

Luhmann, N., *Observations on Modernity*, Standford University, Standford, 147 p. 1992.

Marques, J. O. A., *Facing the Epicurean Dilemma: Rousseau and Voltaire in Search of Providence*, XIII th Colloquium of the Rousseau Association: “Rousseau, Voltaire and Fanaticism”, Oxford, UK, 19 p. 2003.

Mendonça, J.J.M., *História Universal dos Terramotos que tem havido no Mundo, de que há notícia, desde a sua Creação até o Século presente, com huma Narração Individual do Terramoto do primeiro de Novembro de 1755, e notícia Verdadeira dos seus efeitos em Lisboa, todo Portugal, Algarves, e mais partes da Europa, África, e América, aonde se estender*. Oficina de António Vicente da Silva, Lisboa. 1758.

Oliveira, F.X. (1756), *Discurso Patético sobre as calamidades presentes sucedidas em Portugal*, (1757 e 1762), with postface by J.P. Pires, Franesi, Lisboa, 245 p. 2004.

Portugal, F and Matos, A., *Lisboa em 1758, Memórias Paroquiais*, C.M.L., Lisboa, 442 p. 1974.

Serra, J. P., *A Antiguidade Clássica e os Tremores de Terra: mythos e logos, O Grande Terramoto de Lisboa. Ficar Diferente*. Editores – Gradiva, Lisboa, pp 109-136. 2005.

U.N., *Reducing Disaster Risk. A Challenge for Development. A Global Report*, United Nations, N. York, 148 p. 2004

Voltaire, *O Desastre de Lisboa, seguido de Carta a Voltaire por Jean-Jacques Rousseau*, Portuguese Edition, Franesi, Lisboa. 2005.

Voltaire (1759), *Candide ou l’Optimisme*, Spanish Edition, Edhasa, 252 p. 2004.

