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ARCHITECTURAL HERITAGE SUSTAINABLE REHABILITATION: PROPOSAL FOR APPLICATION OF COST-BENEFIT ANALYSIS

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ABSTRACT

The decision to rehabilitate Architectural Heritage (AH) in a sustainable way is complex, because the associated costs require different levels assessment, given their relevance to all stakeholders in decision-making, and are not always easily quantifiable. Following recent decisions of the EU, it is urgent to carry studies to support AH sustainable rehabilitation projects. In this context, the use of methodologies based on Cost-benefit analysis (CBA) contributes positively to base decisions on AH rehabilitation investment projects. CBA is a method to assess the net economic impact of a public investment project and can be used for a variety of interventions. CBA is based on the conversion to monetary values of all costs and benefits, even when they are intangible. The purpose of a CBA is to evaluate if a project is feasible from the point of view of social welfare through the algebraic sum of their costs and benefits discounted over time. This paper presents a proposal for socio-economic evaluation of AH sustainable rehabilitation projects based on CBA, which integrates the development of community policies and financial instruments. It aims to provide technical support and contribute to the reflection about co-financing rates modulation.

Keywords: Cost-Benefit Analysis, Sustainable Rehabilitation, Architectural Heritage

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Introduction

The Architectural, Engineering and Construction (AEC) sector is an activity responsible for a significant portion of the negative environmental impacts in terms of final energy consumption (42%), gas emissions (50%) and wastes (22%) [1].The European Union has set goals and defines policies for environmental preservation and rationalization of resources [2]. Finding solutions to achieve these objectives in the AEC sector, it necessarily leads to a strong focus on sustainable and efficient management of built heritage [3].

Interventions in terms of rehabilitation of the Architectural Heritage (AH) currently play an important role in the sustainable management of the urban environment and the built heritage [4]. It is urgent to develop technical and scientific research studies, with economic bases, to support feasibility studies of the different rehabilitation strategies at a AH level. The decision to intervene or not is complex, since the associated costs require an assessment at different levels and its relevance for all stakeholders in decision-making, and it is not always easily quantifiable.

The built AH, encompassing environmental aspects resulting from the interaction between people and places through time, is a vital resource for collective identity and a differentiating factor and territorial enhancement that should be preserved for future generations [5].

Its conservation and enhancement presents a potential local, regional, national and, in specific cases worldwide projection. It has different audiences by several aspects which are attached, in historical, urban, architectural, ethnographic, social, industrial, technical, scientific and artistic order.

Interventions in AH, should therefore observe and take care of the various aspects and expressions that this characterization. AH gives an unique and irreplaceable character, crucial for future public enjoyment of the monuments, ensembles or sites and the respective contexts with which they have an interpretative relationship and information [5].

Given the increasing demands for performance, risk control, transparency in decision making and sustainability of the AH, as well as the need to maximize and preserve the conservation status of high buildings equity value existing in the national territory, approaches based on Cost-Benefit Analysis (CBA) methodologies emerge as an important contribution.

Cost-Benefit Analysis Framework

The methodologies based on CBA consist on methods for assessing the net economic impact of an investment project and can be used for a variety of interventions. In these circumstances, the aim of a CBA is to determine whether a project is feasible from the point of view of social welfare through the algebraic sum of the discounted costs and benefits over time [6-10].

The use of methodologies based on cost-benefit economic models, have been already several times proposed for the development of economic feasibility studies [7]. It is extremely important to decide the most appropriate strategy to adopt, considering all the possible alternatives in the construction life cycle and the required performance level. Another important concern is the expected benefit in terms of efficiency; sustainable strategies compared to conventional procedures (see Fig. 1).

The methodologies based on CBA can be powerful and highly functional tools, helping to support the decision process and compare the efficiency of different strategies in terms of cost effectiveness. In addition, CBA determining, for each case study, if future benefits are sufficient to justify the current costs of the project. The following aspects must be considered [8]:

1. Foresee the economic effects of the project;
2. Quantifying these effects, whenever possible, in monetary value;
3. Calculate the economic profitability, by an accurate indicator, to formulate a concrete opinion related to the expected performance.

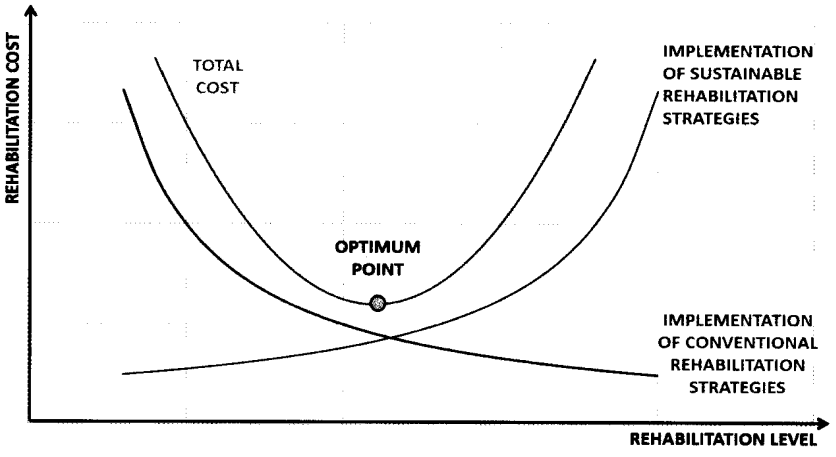

Fig. 1. CBA approach: Cost x Rehabilitation level.

The CBA is based on the monetary value conversion of all costs and benefits even when they are intangible, through several adjustment (prices distortions; monetary value for the non-monetary impacts; inclusion of indirect effects; and social rates different from financial rates) [9]. For the application of a CBA of investment projects, to support the decision making process, the following generic items should be considered:

Project identification: Definition of social and economic objectives to accomplish the project and the context of its implementation, as well as the design and materials indicators. The project must be clearly identified, defined a unit of analysis (individual project, stage of a larger scale project, group project, etc.). If it is not possible to quantify all the social effects, replacement values shall be established linked to the project objectives.

Feasibility analysis: Conducting an analysis to guarantee the project feasibility from a technical point of view [7].

Financial analysis: Getting information required about all cash-flows and how they are distributed over the project implementation and operation time. This analysis has three purposes: i) to gather the necessary information for the analysis of cash flow; ii) evaluate the financial viability of the project; and iii) evaluate the financial benefits by calculating the profitability of the investor's point of view. These data are used to calculate the Internal Rate Return (IRR), the IRR calculated on investment Cost (IRR/C) and the IRR calculated on Capital (IRR/K) and the corresponding Financial Net Present Value (NPV) [11].

Economic analysis: Project suitability in terms of economic values of all costs and benefits. This economic analysis applies a series of corrections for the financial data, and considers the benefits and social costs not accounted in the financial analysis. These corrections eliminate tax effects, consider externalities that lead to social costs and benefits, and convert prices used in the financial analysis [11].

Multicriteria analysis: Comparison of alternative projects, allowing take into account several criteria simultaneously. It should be based on multiple choices, and the treatment of each condition choices regarding the final decision. It is normally used to synthesize opinions expressed, to determine priorities, to analyze conflict situations, to make recommendations or to provide guidance of an operational nature. It is useful for a quantitative approach, and the results of such analysis may lead to a profound change of the proposed investment, or even their rejection [9].

Sensitivity and Risk Analysis: Selection of variables and critical parameters of the CBA model (variations, positive or negative in relation to the value used as the best estimate, whose have a more pronounced effect on economic parameters) then proceeds to the risk analysis, associating to each variable a probability distribution. The results are express in terms of probability distribution or cumulated probability of IRR or NPV in a particular range of values. The curve of cumulative probabilities permits to assign the project a degree of risk.

At the end of the application of all these items described above, it becomes possible to obtain project performance indicators for a decision-making process.

Architectural Heritage Sustainable Rehabilitation Investment

Proposed Methodology

To apply CBA for investment projects in rehabilitation of Architectural Heritage (AH) a methodology is proposed to support the decision-making process, structured in six sequential phases, as shown in Fig. 2 [12, 13].

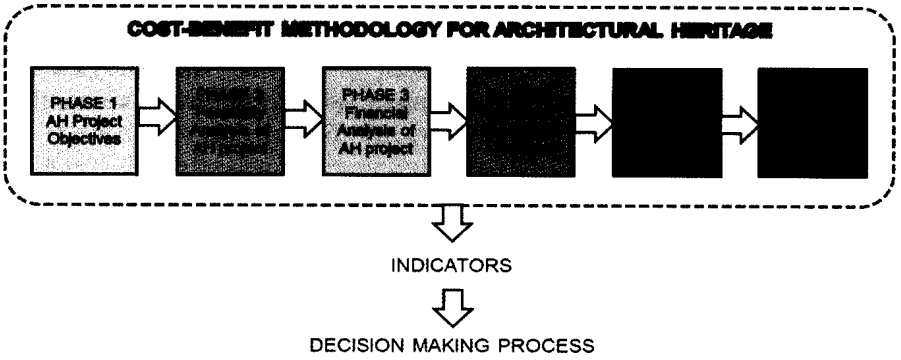

Fig. 2. CBA Methodology for Architectural Heritage (AH).

AH Project Objectives (Phase 1)

An investment project in AH rehabilitation should demonstrate that the planned investments will have as main objective the improvement of their condition. The development should be at a local, regional, national and international level. It is important to identify *ex ante* the main parameters that determine the objectives, considering that AH investment projects have specific goals, as well as cultural targets.

For a structured and detailed identification of this type of investment projects, it is essential to proceed as follows [7]:

1. Describe the type of infrastructure that is the rehabilitation action object: museum, monument or historic building, archaeological park, etc.;
2. Detail the services offered (research center, information and restoration services, internal transport, etc.);

3. List the cultural and/or artistic programs provided;
4. Report the following technical data:
   a) Basic data, including the number of expected users (per day, per season, per year, etc.) and the maximum capacity of the rehabilitated infrastructure;
   b) Technical features such as covered areas (m^2) and exhibition halls of museums and historical monuments or buildings, total area of parks or archaeological areas (m^2), number of seats, usable area of the theaters (m^2);
   c) Features architectural, construction and design of museums, historical monuments or theaters;
   d) Technical characteristics and design of buildings or parts of buildings dedicated to additional services;
   e) Characteristics and design of air conditioning, lighting and communications systems, etc.;
   f) Mobility and access systems (possibly more car parks) and links to the local road network;
   g) Significant technical elements, such as special architectural constructions, experimental technologies of restoration, communications systems.

Feasibility Analysis of AH project (Phase 2)

The feasibility analysis of an investment project in AH rehabilitation refers not only to verify the possibility of implementation of various specialties of the project, but also involves the consideration of aspects related to marketing, management, performance analysis, etc. Different alternatives can be adopted considering the identified socio-economic objectives. In the case of an investment project in AH, the key question relates to the potential flow of users.

The analysis of alternatives should take account of technological solutions and methods of rehabilitation to adopt, as well as other possible options for infrastructure (for example, consider the possibility of changing the purpose for which it is intended) [9].

Financial Analysis of AH project (Phase 3)

The financial analysis of an investment project in AH rehabilitation must be taken into account revenue comprising entrance tickets (covering only a fraction of actual costs), the sale of collateral services and related commercial activities.

As financial costs must be considered personal and maintaining of the AH, at a medium and long term. The most appropriate time horizon will be between 15 to 20 years [7].

Economic Analysis of AH project (Phase 4)

Considering investment projects in AH rehabilitation it should be considered as social benefits, the public to pay for the service offered, and as social costs, the loss for the resulting company the diversion of production factors of their best alternative uses (for example, the social opportunity cost of staff employed is equivalent to the product of these people when engaged in other activities) [12].

As negative externalities AH rehabilitation projects refers to loss of land and other raw materials and the eventual loss of mobility and congestion during the construction phase. As positive externalities, the increase revenues in the tourism sector, as well as any further growth of income from other activities (trade, restaurants, leisure activities, etc.) [13].

Multicriteria Analysis of AH project (Phase 5)

With regard to interventions in terms of structural rehabilitation of the PA and The main challenge in AH investment projects are the selection of the most efficient rehabilitation technique. So, it should take into account the following [12]:

1. Preserving security and integrity of its users/occupiers;
2. Keep the infrastructures operating;
3. Minimize human and material losses;
4. Minimize intervention costs.

Thus, it is possible to identify technical and economic objectives. Technical objectives are: i) minimize the structural/seismic vulnerability; ii) functionality assurance/operation of the building; and iii) minimizing the complexity of the intervention. The main economic objective is minimizing the total cost of the building rehabilitation intervention.

This fundamental point of view of decision-making related to the total cost of the intervention should account for separately from the others objectives. The interest relates primarily to its use in the context of an approach on the principle of maximizing the benefit-cost ratio.

Sensitivity and Risk Analysis of AH project (Phase 6)

It is considered as a determining factor for the success of a AH rehabilitation investment projects, the analysis of personnel and operating costs (maintenance, operation, use), as well as the dynamics of long-term input prices [12].

For a sensitivity and risk analysis it should also be considered the cost of the investment; the growth rate of staff salaries; the growth rate of effective demand (number of visitors per year); the input prices; and as regards maintenance the risks related to possible damage, regardless of its cause.

Final Remarks

The decision on investment projects making should be supported by a CBA, based on economic models Cost-Benefit (EMCB), covering a number of areas, which are particularly relevant: i) technical, ii) financial, iii) environmental, iv) planning, v) competitiveness and vi) economic and social development.

The proposed methodology for CBA of investment projects in the rehabilitation of the Architectural Heritage (AH) has an added value, both technical and scientific, enabling them to: i) express a judgment on the economic and social desirability of these projects; ii) to establish a comparison between different design alternatives; and iii) encourage the practice of identifying and accounting costs and economic benefits, even if not immediately convertible into monetary units.
However, the application of the CBA in AH rehabilitation projects, requires rigor and methodological consistency. After the implementation of the CBA methodology proposed for AH, should carried out a final evaluation that allows a comparative analysis of the results and the initial forecasts. Thus, it becomes possible to introduce in future similar projects the decision-making experience and information acquired during this evaluation process.

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