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Existing European Buildings and Cities: Economic Improvement and Evaluation of the Cost-Benefit Related to Lifecycle and Performance

Giampiero Bambagioni[1, 2]

1. European Real Estate Institute, Milano 20136, Italy;

2. Faculty of Architecture, University of Rome "La Sapienza", Roma 00196, Italy

Abstract: In this study, the interdependency is presented between the characteristics of the buildings and the relative economic value, in order to plan economic policies and preconditions for improving the quality of the European buildings heritage through access, by an holistic approach, to the necessary financial resources. The economic value of a real estate asset is closely connected to the construction features and their performance over time (lifecycle). Safer, more comfortable and productive buildings for inhabitants are at the same time more operationally efficient and economically convenient for the owners. Solidity characteristics and static resistance to earthquakes, eco-efficiency and other constructive qualities of the building will provide benefits in the long term, and they are directly related the LCC (life cycle cost) including specific construction and/or maintenance costs. Moreover, these characteristics have an impact on the "market value" and on the "mortgage lending value" of properties, as well as on the possibility of financing the purchase through access to more affordable mortgages, and to make really feasible conversions even in the absence of public financial resources. This study introduces a new approach for conversions involving whole buildings or city areas. This research identifies the economic sustainability of a project by combining principles and suitable methodologies, together with performance and other characteristics. These aspects constitute the essential prerequisite for obtaining mortgages from banks and/or financial resources from international investors.

Key words: Housing and land management, project evaluation, market value, appraisal and real estate finance, urban sustainability, risk assessment, smart cities.

1. Introduction

An increase in building efficiency reduces operating costs. Moreover, the reduction in the operating costs increases the gross operating income and the asset value.

The economic value[1] of a real estate asset is closely connected to the construction characteristics and their performance over time (lifecycle[2]). The concept of economic value cannot be superimposed with the concept of market value.[3]

Understanding the future "value in use"[4] of existing buildings as well as those to be carried out, is, at the same time, a necessity and an opportunity for property owners, developers, designers, lenders and banks, to assess the long-term sustainability, and offers

Corresponding author: Giampiero Bambagioni, M.Sc, MBA, economist, lecturer of appraisal and economic evaluation of projects, University of Rome "La Sapienza", and UNECE Real Estate Market Advisory Group (REM) Chairman; research fields: real estate finance, urban economics, and housing and land management. E-mail: giampiero.bambagioni@erei.org, giampiero.bambagioni@uniroma1.it.

[1]Economic value: the value of an asset calculated according to its ability to produce income in the future (Cambridge Business English Dictionary).

[2]The life-cycle stages of a building includes: (1) materials manufacturing; (2) construction; (3) use and maintenance; (4) end of life. AIA Guide to Building Life Cycle Assessment (2010), The American Institute of Architects, Washington, DC.

[3]For the definitions of "market value", and "mortgage lending value", see: Regulation (EU) No. 575/2013 on prudential requirements for credit institutions and investment firms (CRR).

[4]IFRS (International Financial Reporting Standards) definition from IAS 36: The present value of the future cash flows expected to be derived from an asset or cash-generating unit (www.ifrs.org/).

advantages rather than burdens to subsequent users.

The knowledge of the life cycle cost of buildings is also important for governments, agencies and institutions, interested into planning collective needs and increasing the citizens' quality of life through greater security and efficiency of services in the urban environment.

There are numerous research works that have dealt with the issues of sustainability in the building industry and the methods for evaluating project feasibility studies and building characteristics over the life-cycle in a later stage design to provide an indication of their performance. Among those authors who carried out a major study are: Fabrycky, W. J., Blanchard, B. S., and Negro, P., Tsimplokoukou, K., Lamperti Tornaghi, M., and Shen, L., Tam, V.W.Y., Tam, L., Ji, Y [1-3].

The new proposed model is based on a holistic approach that includes the correlation between economic value, building characteristics, construction and maintenance costs (life cycle cost), assessment of the economic, financial and environmental sustainability in the long and very long term.

2. Holistic Approach to the Renewal of the Existing European Buildings and Cities

An intelligent promotion of the regeneration and renewal of the immense European public and private real estate heritage will promote a better quality of life for citizens and also a country's economic-social development. In this perspective, there are many institutions that promote regeneration and renewal of housing stock, among these the EU (European Union) and the UNECE (United Nations Economic Commission for Europe)[5] which has adopted the Geneva UN Charter on Sustainable Housing. The Geneva UN Charter, among other key points, underlines the importance of housing finance.

To plan and to implement complex programmes and appropriate and consequential actions requires a holistic approach that encompasses the following three phases:

(1) Phase One:

• monitoring of the characteristics of the existing buildings heritage: (1) privately owned buildings; (2) public buildings (social housing, etc.);

• implementing action to increase renovation and maintenance, the upgrade static and the eco-efficiency;

• creation of preconditions for the renovation of the building heritage;

(2) Phase Two:

• identification of financial resources needed to implement the refurbishment and upgrading projects;

• development of a rating system of a building's characteristics to promote financing and loans;

• involvement of stakeholders through initiatives in PPP (public-private partnership), etc.;

• analysis of benefits in the medium and long term;

(3) Phase Three:

• dissemination of output and value of benefits;

• innovative design;

• new or renovated buildings with greater energy efficiency, improvement of earthquake resistance and eco-efficiency;

• benefits in the spending of each individual country and advantages for the European Union's gross domestic product [4];

• holistic approach to the renovation of the characteristics of buildings and for development of the markets.

3. Economic Value, Sustainability and Building Characteristics

Solidity characteristics and static resistance to earthquakes, eco-efficiency and other construction

[5]Countries in Europe are facing enormous challenges in providing adequate affordable housing to all. To help the countries address these problems, 56 member states in the UNECE Region developed the Geneva UN Charter on Sustainable Housing, which was endorsed by the UNECE Countries in April 2016. Globally, in the General Assembly on September 25, 2015, the United Nations adopted the 2030 Agenda for Sustainable Development with a set of goals to end poverty, protect the planet, and ensure prosperity for all. Also the New Urban Agenda, adopted in the Habitat III Conference (2016), is focused on the achievement of sustainable urban development.

qualities of smart and green[6] building will provide benefits in the long term and they are directly related to specific costs of construction and/or to the maintenance costs (life cycle cost) [5-7]. Moreover, these characteristics—as summarized in Fig. 1 (overview of the main areas of action)—have an impact on the value in use and on the potential significant loss of the value over time.

An evolution of the current buildings' heritage to smart and green buildings and more livable cities is foreseeable, aimed at encouraging a better quality of life for citizens.

Green buildings are designed, constructed and managed in a sustainable and efficient manner; these buildings are characterized by energy efficiency, environmental friendliness, sustainability, recycling of building materials [8-12]. The proposed definition is the following: "*Green buildings are an integrated framework of design, construction, maintenance and improvement; the management of which, until the demolition practices, encompasses the environmental, economic, and social impacts of buildings*."

Smart buildings could be defined as "*assets that integrate technological systems and energy management systems, characterized by operational efficiencies and enhanced management*." The significant reduction of maintenance and management costs produces a better ROI.

For new construction and for the redevelopment and refurbishment of existing buildings, the benefits created by all the smart and green building characteristics can be integrated.

As mentioned previously, the economic value is the value of an asset calculated according to its ability to produce income in the future. The economic value is independent from the "market value", which is subject to market cyclicality in which the building property is situated.

Indeed, the economic value is based on: (1) management costs; (2) maintenance costs; and (3) adjustment costs. These costs are affected directly by the level of efficiency, or deterioration, as well as by the possibility (or not) of using of the asset in the long term. These elements includes "growth factors" in the value or "decrease factors" of the value, until demolition.

Whereby, the economic value of a real estate asset is closely interconnected between the construction features, the operating costs and the performance over time (lifecycle) as schematized in the figure on the "correlation between the value and characteristics of the property" (Fig. 2).

Safer buildings, more comfortable and productive for occupants, become more operationally efficient and economically convenient for owners. Indeed, an increase in building efficiency reduces operating costs. A reduction in the operating cost increases the return on investment for the owner/investor in order to increase the asset value [13-16].

In terms of legislation, the objectives of sustainability are translated into standards, regulations, guidelines for the definition of methodologies and aimed at the harmonization of approaches related to the planning and design of building initiatives, assuming the principles of sustainability in economic, environmental, energy are observed.

4. Evaluation of Programmes and Projects (Feasibility Study)

Building construction and improvement of the characteristics of the existing buildings require a holistic approach that enables an overall valuation of the investment, also with regards to its town-planning/technical/economic aspects.

The valuation can be done ex ante through feasibility studies, which are explicitly provided in some national legislation (for example, in the Italian Public Contracts

[6] "Green buildings" are designed, constructed and managed in a sustainable and efficient manner; these buildings are characterized by energy efficiency, environmental friendliness, sustainability, recycling of building materials. "Smart buildings" are assets that integrate technological systems and energy management systems, characterized by operational efficiencies and enhanced management; the significant reduction of maintenance and management costs produces a better ROI (return on investment).

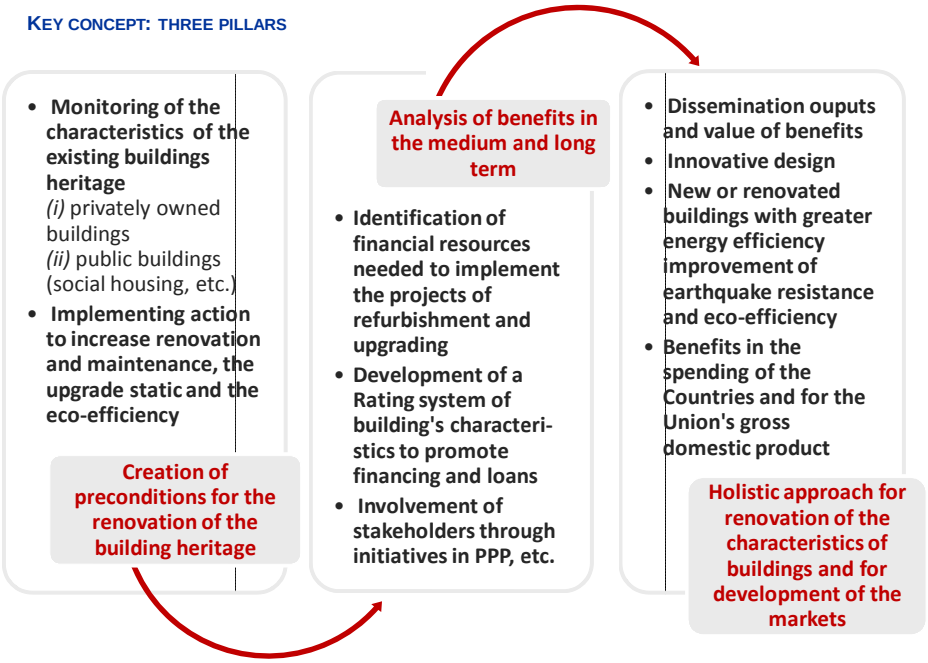


Fig. 1 Overview of the main areas of action.

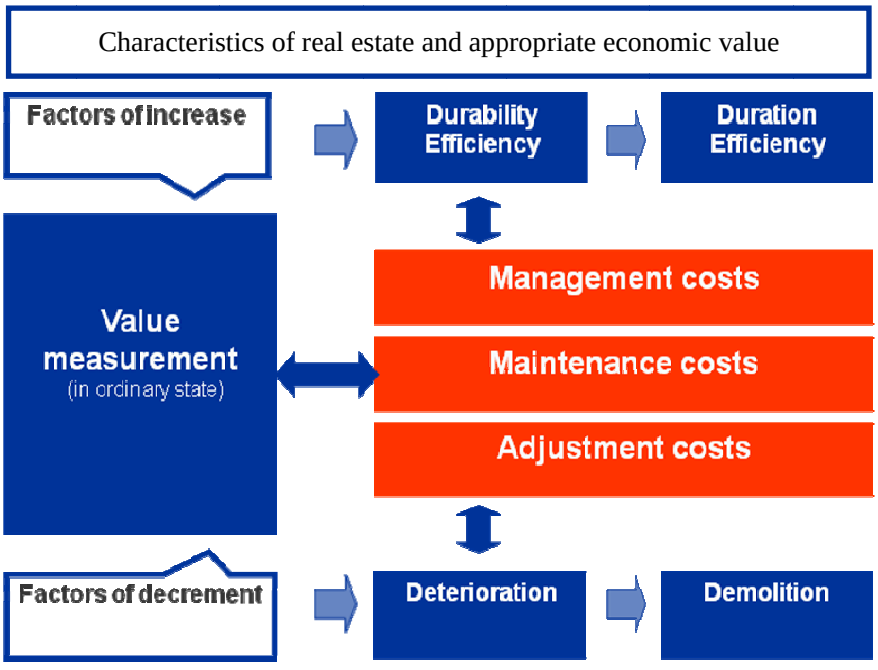
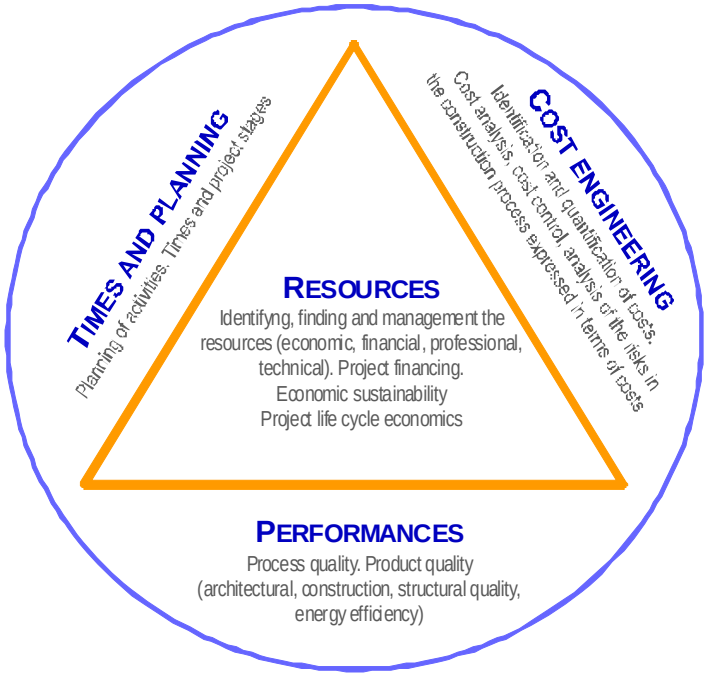


Fig. 2 Correlation between the value and characteristics of the property



The tetrahedron, or the four faces of a polyhedron, representing the synthesis of the criticalities implied in implementing a building project.
The outcome of a project (target) is subject to the correlation between a number of constraints: (1) Resources; (2) Time and project stage, (3) Cost Engineering, (4) Performance/quality.
The variation in one of the constraints interferes directly or indirectly on the others.

Fig. 3 Project constraints.

Code). To this end, it is necessary to harmonize the "project constraints" that take shape in four macro-areas:

- resources and economic sustainability;
- cost engineering;
- project times and planning;
- performance/quality.

Cost engineering involves the quantification of the WLC (whole life cost) [17]: acquisition, finance, business costs, disposal cost, and the life cycle cost (LLC).[7]

Life cycle cost involves project constraints (Fig. 3):

- Economic assessment of alternatives which considers all the significant costs of ownership (construction, maintenance, improvement, management) over the useful life cycles (reusing and demolition practices);
- The economic assessment involves: initial costs, financing costs, operational costs;
- LCC compares the estimated costs of different options taking into account both initial capital costs as well as costs that may be incurred over the life cycle.

There are three main levels in which the life cycle cost [18] is particularly relevant:

(1) Project investment planning—pre construction (feasibility study);

(2) During the design and construction phase—definition of construction characteristics and cost components and long-term performance;

(3) During use and management in the long term—post construction and beyond.

Standards for building economics includes: (1) LCC analysis; (2) cost-benefit analysis [19]; (3) IRR (internal rate of return); (4) net benefits; (5) payback

[7] Through life cycle cost, the initial costs of distinct construction strategies, conventional as well as adaptable, were put into a long-term perspective. By combining assessments of components, of structure and characteristics of building, it can be possible to detect the particular value of the buildings and the conditions under which buildings can increase their functionality and therefore the relative value in use.

period.

A standardized approach is focused on the present worth analysis. The principle of equivalence says that we can shift any sum to an equivalent sum at some other point in time. Present worth is the comparable equivalent value at the present time of a future amount (or set of amounts). Present worth is also called NPV (net present value), even if the latter term is more often used when referring to the total present worth of a series of amounts. Present worth and NPV can be regarded as the difference between a future set of cash inflow and cash outflow referring to the present moment. In the current worth analysis, we compare the net present value of multiple mutually exclusive options. Present worth analysis considers only future income and expenditures.

In order to achieve the goals of maximizing the benefits and minimizing the costs, financing and investment activities are considered as separate entities and consecutive to their relative NPVs combined.

Discounts all future costs and benefits to the present:

$$PW = FC + \sum_{t=0}^{t=n} pwf\,(MC + IC + FRC + UC) + PWF(S)$$

where, PW = present worth factor, FC = first (initial) cost, t = time period of analysis, MC = maintenance costs, IC = inspection costs, FRC = future rehabilitation costs, UC = users costs, S = salvage values or costs, and pwf = present worth factor.

Demonstrating the economic sustainability of a building project by combining principles and definite rules consistent with international best practices—even more so in the current international economic-financial situation—constitutes the essential prerequisite for raising resources, sometimes even among international institutional investors, that make it possible to develop all stages of the building process with continuity. An intelligent promotion and development of the immense national public real estate heritage will also promote a country's economic-social development.

In order to promote and rethink cities so that they become more inclusive, integrated and livable, in any case, the implementation of programs and sustainable projects requires appropriate strategies. These strategies will be aimed in particular at urban regeneration and enhancement of the characteristics of solidity and eco-efficiency of the existing buildings of the cities [20-22].

On one hand, designing and building smart buildings, and on the other hand, refurbishing, upgrading, renovating, modernizing, restoring and strengthening/stabilizing existing buildings is essential to improve the quality of people's lives and to really promote intelligent cities. Indeed, an appropriate definition of a smart city should also include special attention to the characteristics of the existing buildings of that very city.

In my opinion, an appropriate definition of a smart city could be as follows:

A smart sustainable city is an innovative city that uses modern infrastructures, ICTs (information and communication technologies) and other economic resources to improve quality of life by promoting smart and green buildings and efficiency of urban operation and services, competitiveness and sustainability, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.[8]

5. Interdependence between the Value of the Collateral and Possibility of Obtaining Mortgages

According to the definitions established by the Regulation (EU) 575/2013 on prudential requirements

[8]The definition of a smart sustainable city formulated by the author of this article is wider than the wording adopted by the United Nations Economic Commission for Europe and the International Telecommunications Union, because it includes specific reference to smart buildings and economic resources. Indeed, in the author's view, it is considered that there are no smart cities and networks of inhabited urban centres interconnected with the cities that could be defined as "smart land" without smart buildings (which includes also the characteristics of green buildings and low energy consumption) and a smart (circular) economy.

for credit institutions and investment firms (CRD IV), even the access to financing and mortgages (both for new construction and the upgrading and refurbishment of existing assets), depends on the market value of the property under guarantee and its mortgage lending value.

Moreover, the risk assessment, management and capital requirements for EU banking groups are directly linked to the value of properties, and the characteristics of the collateral of the mortgage (or the financing) over time. The management of these aspects involves, among other things, the need to adopt a real estate risk assessment (real estate rating) [15].

Therefore, all the following aspects are interrelated and interdependent:

- construction cost;
- management sustainability;
- maintenance costs;
- construction characteristics (also including the static soundness);
- energy consumption;
- present and long term market value;
- possibility to access mortgage funding.

Therefore, the possibility to access to mortgage and funding is interdependent and interrelated with: (1) cost of construction; (2) sustainability of the management and maintenance costs; (3) construction characteristics (also including the static soundness); (4) the energy consumption; and (5) the market value of the property in the present and in the long term.

In short, the sustainability of the WLC affordability and sustainability of financing is the essential prerequisites for the markets to function efficiently.

The main methods of real estate enhancement are constituted by FS (feasibility study) [2, 15, 23], and HBU (highest and best use) [14-16].

In order to develop a real estate property and increase its current value, it is necessary to adopt a holistic approach when considering changes in functionality and market price, even if it is usually based on legal/administrative acts. This kind of approach includes a global analysis and valuation of the investment also in terms of the urban context and the technical-economical implications [24-27].

As illustrated in Fig. 4, the main methodologies of project evaluation include economic, financial, and

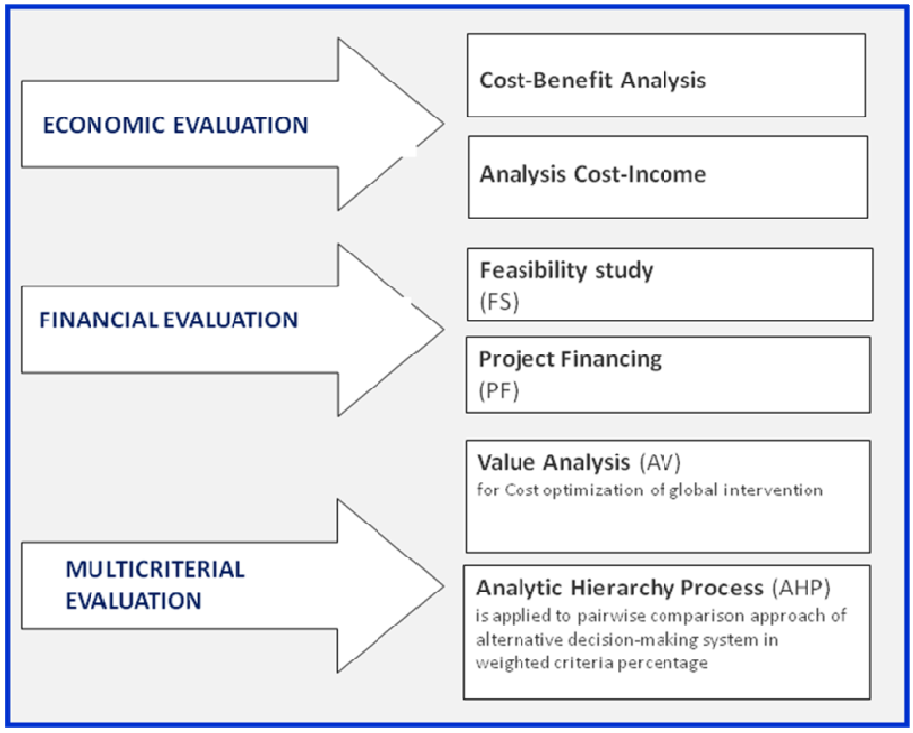


Fig. 4 Overview of the economic and financial evaluation methods.

multi-criteria parameters, which are based on recognized estimation procedures and financial statistics stated in the scientific literature and in the European and international valuation standards.

Moreover, the economic sustainability of the building development programmes and projects is the basic condition in order to find the necessary resources (not only the financial ones) for carrying out the building process.

The aim of the valuation is different according to the various stages of the decision-making process: *ex ante, in itinere, ex post*.

6. Conclusions

The economic and financial plan should demonstrate the financial sustainability of the project. Feasibility study includes analysis regarding the following:

- juridical areas (planning and building regulations);
- economical areas (cost analysis and revenue, financial sustainability and gross operating margin-EBITDA (earnings before interest, taxes, depreciation and amortization));
- technical characteristics (feasibility inherent building characteristics, structural characteristics, plant engineering, and the ability to fulfill the purposes for which the transformation project is designed and implemented).

Requalification and transformation require an ex ante evaluation of economic feasibility.

The possibilities for optimization of the processes in the refurbishment of the European housing stocks are applicable both to the buildings to be restored and improved, and to the efficient buildings in use.

An increase in the building efficiency reduces operating costs. A reduction of the operating costs increases the gross income and consequently the property value. Smart and green buildings are safer, more comfortable and productive for the occupants, moreover, they are more efficient and economically convenient for the owners because of lower running costs.

So, this study introduces a new approach to the transformation of buildings or city areas through the identification of a feasibility study, which should combine suitable methodologies including the evaluation of cost-benefit together with the performance and the lifecycle of the building.

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