The Assessment of Public Buildings with Special Architectural Features Using the Cost Approach. A Case Study: A Building Sold by EUR S.p.A. in Rome

Fabrizio Battisti(✉) and Orazio Campo

Department of Planning, Design, Architecture Technology (PDTA), Faculty of Architecture "Sapienza", University of Rome, Via Flaminia 72, 00196 Rome, RM, Italy
{fabrizio.battisti,orazio.campo}@uniromal.it

Abstract. The growing interest in issues to do with the administration, enhancement and sale of public building stock has increased the need for their valuation and, as a result, has increasingly highlighted the need to identify suitable methods for estimating value that take into account the peculiarities of public buildings. In Italy, public buildings often boast 'special' architectural features (interfloor distance, layout, finishings, type of wiring/heating systems, etc.) that render them 'extra-ordinary' assets; in some cases, these features also confer grand and/or historical importance to such buildings. Thus when carrying out valuation work in Italy, it is necessary to adopt suitable valuation methods designed for buildings boasting special features prior to drafting any administration plans, enhancement projects or even plans for the sale of public building stock. Given the lack of comparable examples or income-based parameters specifically concerning buildings with special features, the Cost Approach is the only method that can be used to estimate the market value of such properties. This paper aims to identify the ways the Cost Approach can be applied when estimating the market value of properties with special features that fall into the 'extra-ordinary' category. The theoretical part will be supported by a practical section where the Cost Approach will be used to estimate the market value of an extra-ordinary landmark building in the EUR district: the "Palazzo della Scienza Universale", previously owned by the EUR S.p.A. company (formerly known as the Ente EUR), which was recently sold (2015).

Keywords: Market value · Cost approach · Appraisal · Public real estate

1 Introduction

A substantial swathe of Italy's public buildings boast 'special' architectural features (interfloor distance, layout, finishings, type of wiring/heating systems, etc.) that render them 'extra-ordinary' assets; in some cases, these features confer a landmark 'monumental' importance to such buildings. According to traditional valuation sciences, such features are considered 'intrinsic positional features' and affect a building's market value [1].

© Springer Nature Switzerland AG 2020
O. Gervasi et al. (Eds.): ICCSA 2020, LNCS 12251, pp. 869–883, 2020.
https://doi.org/10.1007/978-3-030-58808-3_62

Nevertheless, when adopting property valuation procedures, it often proves difficult to estimate the market value of buildings with special features due to the lack of comparable buildings with similar characteristics (and known market prices). Even income data is often unavailable given that in Italy, unlike other countries, local authorities often use public buildings (with special and/or monumental features, for administrative or governmental ends) for free or at a cost that is well below the market price. The growing interest amongst legislators in issues to do with the administration, enhancement and sale of public buildings increasingly highlights the need to identify and establish suitable methods for estimating the market value of buildings that boast special features and are therefore considered 'extra-ordinary' [2, 3]. Such methods could be applied to the valuation of properties prior to drafting administration plans, enhancement projects or even before selling public building stock [4–8].

Given the lack of comparable examples and income-based parameters specifically concerning buildings with special features, the Cost Approach is the only method that can be used to estimate the market value of such properties. This is because the Cost Approach allows us to estimate the market value of a property whilst considering both the value of the land and the cost of its construction and/or reconstruction, taking into account any depreciation [9, 10]. We can be justified in applying the Cost Approach, even to buildings with special features with no comparable examples, because the value of buildable land, understood as being the value of building rights, is in no way influenced by the features (whether they be ordinary or special) found on a building. Moreover, when it comes to the cost, special architectural features can always be linked to technical elements or processes, which usually make it possible to infer data and parameters that render an estimate of the cost of reconstruction feasible. The Cost Approach can also be used to estimate the market value of monuments. In such cases, however, it does not calculate the marginal cost conferred by the historic and/or artistic characteristics of a monument (wherever present). The same can be said for buildings of particular architectural value. In this case as before, the Cost Approach does not calculate the marginal cost due to the particular architectural value of the building.

Generally speaking, the Cost Approach concerns the valuation of special buildings constructed, with either a small market or no market at all [4].

Thus if we want to apply the Cost Approach, we must: i) estimate the cost of the property with special features; ii) estimate the value of the land upon which the building stands.

This paper aims to identify the ways the Cost Approach can be applied when estimating the market value of buildings with special features, i.e. buildings that are deemed 'extra-ordinary'. The method we propose, which is tailored to suit the Italian property market, will be organised in a way that makes it possible to adapt it to a number of different foreign legislative and regulatory circumstances and, in particular, allows it to be used by those local authorities that are called upon to manage, enhance and, above all, sell extra-ordinary public buildings.

The method proposed here involves estimating the value of the land and the cost of reconstruction, including any depreciation, in keeping with established methods of applying the Cost Approach, as codified in international field literature. Land value is estimated in accordance with the most common valuation methods codified by international standards. The most innovative part of the method we propose is the estimate

of the cost of reconstruction, including any depreciation, in that by taking as its starting point a sample of the special architectural features most commonly found in public buildings designed for the tertiary sector, it proves possible to estimate the impact that such features could have on the cost, thus investigating the relationship between cost and special features. By identifying the link, in terms of cost, between the ordinary and extra-ordinary features of a building, made clear by suitable correlation coefficients, it proves possible to estimate the cost of reconstructing an extra-ordinary building using a direct method, based on data regarding ordinary buildings; where necessary, it can then be depreciated in line with current international methods [10].

In order to test the operational validity of the model we propose, the Cost Approach will be applied to estimate the value of an extra-ordinary landmark property in the EUR district: the "Palazzo della Scienza Universale", previously owned by the EUR S.p.A. company (formerly known as the Ente EUR), which was recently sold (2015).

2 Context Analysis and 'Evaluative' Background

Among the issues recently debated in the property sector, those concerning the administration, enhancement, use and sale of public buildings have become particularly important. In many countries (the European Union, the USA and Canada for instance), property management models similar to those used in the private sector have been adopted in order to make the most of public assets. Such buildings are often owned by special-purpose entities (SPEs) almost entirely run by public organisations that, however, obey market principles [11]. Public buildings are usually rented to private organisations or local authorities at market prices. Such organisations use measures derived from private legislation in order to generate profit and increase public income, benefiting state coffers. To this end, e.g., the Public Building Service operates at a federal level in the USA, while Canada has Canada Lands Company Limited, Austria has the Bundesimmobiliengesellschaft, Germany has the Bundesanstalt fur Immobilienaufgaben and the UK has the Crown Estate, which manages the British crown's entire estate using trusts [12–15].

This issue has also become a high profile concern in Italy. A succession of new regulations have been drafted over the past 20 years. Articles 58 of legislative decree no. 112 of 2008 and 33 bis of law decree no. 201 of 2011 are particularly important, as they basically state that in order to renovate, manage or enhance the public property owned by regional governments, provincial governments, town councils or other local organisations, each organisation can make a list of the single properties found within its catchment area that are not needed to carry out its institutional functions and that could be enhanced or sold, and can draft a plan for selling or renovating such properties and attach it to its budget, with the support of the "Agenzia del Demanio" state property office [16], if it so wishes, to create a SPE. These new regulations stimulated the need to identify the market value of properties that could be managed, enhanced, used or sold.

Nevertheless, many public buildings boast 'special' architectural features (interfloor distance, layout, finishings, type of wiring/heating systems, etc.) that, *de facto*, render them 'extra-ordinary' assets. Thus it can prove difficult to calculate their market value

using a direct methodology (comparison approach), due to the lack of comparables upon which an estimate can be based. Even an income approach to valuation can prove difficult, if not impossible, to carry out due to the lack of comparables. It is only possible in cases where a building with special features makes an income in keeping with market forces. In such cases, the rental income allows us, on the one hand, to measure and assess the real cost of using such an asset (thus aiding the elimination of useless areas), whilst, should a public asset be sold, providing us with definite market-based information – rent paid by the tenant – that can be used to assess market value based on the capitalisation of income, in line with internationally accepted valuation procedures [17–19].

However, local authorities in Italy frequently have the right to use buildings for governmental ends free of charge, or in any case pay leases that are not in line with market rate [20]. In such cases, given the lack of information regarding income, the market value of a public property must be estimated without any information to support its valuation when it is sold.

Given that we cannot use either the comparison approach or the income approach to estimate the market value of an extra-ordinary building, we are forced to identify the features that confer extra-ordinary value and assess their impact on its value, compared to ordinary assets. This principle is also found in RICS valuation protocols, where aspects associated with the valuation of special features must be taken into account by valuers in order to establish what is known as its 'fair value' [19].

In the European Union, valuation processes that take into account the specific characteristics of a building (including unusual features) are codified in documents concerning international valuation standards drafted, e.g., in the UK by the Royal Institution of Chartered Surveyors (the RICS). The RICS has standardised property valuation methods and techniques in its Red Book, which has been the benchmark manual for over 20 years now, and is also used to estimate the value of specific architectural features, including such an estimate within the concept of 'fair value' (see Sect. 4, RICS Valuation - Professional Standard, Red Book). In RICS protocols, the tangible features of buildings, whether they be ordinary or extra-ordinary, taken along with aspects associated with 'productive' features (limits to property rights), have an impact on a building's market value [19].

RICS principles have been adopted in Italian valuation practices as reproduced in Tecnoborsa's Italian Property Valuation Standard (the Codice delle Valutazioni Immobiliari), but there is no systematic treatment of extra-ordinary property valuation [21].

In the light of increasing interest amongst legislators in the sale of public buildings, given the particular nature of Italian public building stock, it becomes essential to establish a suitable valuation procedure that should be adopted before drafting plans to sell public buildings that are often of an extra-ordinary nature, despite the lack of comparables or income data. In such cases, the use of the Cost Approach becomes the only possible way forward.

3 Applying the Cost Approach When Estimating the Market Value of Properties with Special Features

The Cost Approach allows us to estimate the market value (MV) of a property by adding the market value of the land (MVland) to the cost of reconstructing the building, minus any depreciation that may have accumulated at the time of the valuation (CVdep) [22]. Generally speaking, it can be exemplified by the following formula:

$$MV = MV_{land} + CV_{dep}$$

The MVland estimate is included in traditional buildable land valuation methods (Transformation Value Method, Highest and Best Use) [23].

In order to estimate the CV_{dep}, as for the more common cost value, one can either adopt the direct or indirect methodology. However, the indirect methodology, which is carried out by drafting a bill of quantities and their unit prices, can prove difficult due to the complexity of this procedure and may not be possible at all should the special features be the product of unusual construction methods that do not appear on pricelists and thus make it difficult to formulate new prices [24].

When it comes to buildings with special features, valuers must take care when estimating the CV_{dep} parameter. The method we propose below (see Subsect. 3.2) suggests an innovation to the traditional Cost Approach that involves adding a step to the valuation of the CV_{dep} through an 'intermediate' way between direct and indirect method: i.e. detailing a comparison of the cost of reconstruction by applying corrective coefficients that can highlight the differences between an ordinary property whose cost of reconstruction is known and the property with special features that requires valuation. Should a building boast features of monumental, historic, artistic and/or architectural value, we can add a further element to the parameters mentioned above. Estimating such an element is undoubtedly complicated given the extremely variable nature of the concept of monumental, historic, artistic and/or architectural value and the importance of such qualities in properties, so it will not be taken into account below.

So let us move on to establish the methods for estimating the elements that form the Cost Approach when calculating the value of buildings with special features.

3.1 Estimating MV_{land}

The market value of buildable land can be generally estimated in two ways: i) using the direct methodology if information (known prices) regarding similar properties is available (same type of area, similar floor area ratio and purpose, a similar legislative/administrative context); ii) using the indirect methodology with a financial approach or using the Transformation Value Method (TVM) [25, 26], which can be implemented using the following equation:

$$MV_{land} = \frac{MV_{bl} - \Sigma K_{p}}{(1 + r')^{n}}$$

where:

MV_{bl} = is the market value of all properties that have been constructed and can be sold, added together;

ΣK_p = is the total construction cost (with reference to the properties constructed);

r' = is the capitalisation rate of the property transaction;

n = is the number of years required to complete the property transaction.

3.2 Estimating CV_{dep}

The cost of reconstructing an existing building (erected in the past) is calculated by adding together all the costs that a construction company would have to pay at the time of the estimate (present) in order to complete an identical or equivalent building during a hypothetical construction process, linked to market production costs and a particular timescale. In other words, the cost of reconstruction is the cost of constructing an existing building from scratch.

The cost of reconstruction includes the physical cost of reconstructing the building and the other costs that are payable to complete it. To be more precise, the main items included in the cost of reconstruction in the traditional system of organising such projects are the following [27, 28]:

- the physical cost of reconstruction, which in turn includes: a.1) the sum of labour costs, rental costs, materials and transportation; a.2) general costs; a.3) profit (of the construction company);
- bureaucratic/administrative fees;
- legal fees for reconstruction/construction (planning permission/town planning), if required;
- financial costs;
- profit (of the company overseeing the reconstruction project).

When calculating the cost of reconstruction, it may prove necessary to take into account the cost of demolishing, recycling and/or removing the rubble of the existing building, depending on the particular circumstances of each case and the reasons that led to its reconstruction.

Depreciation of the cost of reconstruction is calculated by taking into account, either directly or indirectly, the age of the building compared to its life expectancy.

In order to estimate CV_{dep}, we propose an 'intermediate' way that provides implementation of direct methodology cost estimate plus the application of corrective coefficients to compensate the differences between the assets considered comparable and the building that requires valuation. Special architectural features often make it impossible to find entirely similar buildings where recent prices are known for construction or reconstruction. It is therefore impossible to estimate the cost of reconstructing a building by comprehensively comparing it to assets considered comparable with known, comparable prices.

Thus the valuation of CV_{dep} must be carried out following the next steps:

1. Estimate of a technical unit cost value, reference for the estimate ($CVtu_{rif}$). In this first step must be identified a similar range (to the building being estimated) of recently constructed buildings (that can be considered comparable) whose

construction costs are known [29, 30]; applying the direct methodology we can estimate $CVtu_{rif}$. If the building being assessed is made up of non-homogeneous parts/surfaces, the $CVtu_{rif}$ estimation must be carried out for each of these; in general they are: i) primary areas: serving the building's main purpose; ii) secondary areas: supplementary functions found in lower ground floors or mezzanines; iii) the external area, grouped into the following categories: a) extensions: open spaces within a building (porticoes, balconies, cloisters); appurtenances: open spaces outside a building (courtyards, forecourts, parking spaces).

2. Identifying a specific technical cost value relating to the building requiring evaluation (CVtu). In order to compensate for the differences between the sample range of buildings considered to be comparable enough (due to specific morphological or technological characteristics, etc.) and the building requiring valuation (which could possess features that differ from those found in the comparable sample), and in order to ensure that the overall benchmark valuation figure is consistent with the specific characteristics (the special features) of the building requiring valuation, to extrapolate a CVtu we need to apply corrective coefficients to the abovementioned overall benchmark $CVtu_{rif}$ value considering: Location (ksite), Morphology (kmorph), Structure (kstru), Interior and exterior finishings (kfin), Systems (kimp), Interior and exterior windows and doors (kwind), Ceiling height multiplier (Khm). If multiple types of surfaces are present in the building requiring valuation, this operation must be repeated for each surface. When estimating the CVtu, the above requires the application of the following equation:

$$CVtu = [CVtu_{rif} * (1 + k_{site} + k_{morph} + k_{stru} + k_{fin} + k_{imp} + k_{win})] * K_{hm}$$

3. Calculate the depreciation of the specific technical unit cost value for the building requiring valuation ($CVtu_{dep}$). Having calculated the total physical cost of reconstructing a building with special features (CVtu), we then need to apply the depreciation coefficient, taking into account the building's remaining lifespan in order to estimate the overall depreciated physical cost ($CVtu_{dep}$); the percentage of depreciation therefore corresponds to the percentage of 'operational state' compared to its life expectancy.
4. Estimate the total depreciated cost of reconstruction (CV_{dep}). Having established the technical unit depreciated cost of reconstruction ($CVtu_{dep}$), we can then go on to estimate the physical cost of reconstructing the entire building, multiplying each figure by the single figure estimated for each part of the building. The total amount will be the total depreciated physical cost of reconstruction. Nevertheless, in order to calculate the cost of construction, we need to take into account the sum of the following: the physical cost of construction, bureaucratic fees, any legal costs payable for constructing or reconstructing a building (depending on applicable legislation), financial costs and the profit of the company overseeing the reconstruction.

4 The Case Study: Estimating the Market Value of Palazzo della Scienza, Sold by EUR S.p.A. in December 2015

EUR S.p.A. (90% owned by the Italian Ministry of Economics and Finance and 10% owned by Roma Capitale town council) is a property management and development company, founded in 2000 by the at the time called Treasury Ministes and converted from the "Ente Autonomo Esposizione Universale" di Roma world's fair organisation.

It boasts particularly valuable assets that are extraordinary due to the sheer number of grand architectural landmarks produced by Italy's rationalist movement, unique both in terms of their size and quality. EUR S.p.A.'s property assets also include 70 ha of parks and gardens that are open to the public and considered to be an extraordinary reserve of biodiversity.

Its mission is to manage and enhance its assets in order to maximise their profitability whilst respecting their artistic and historical importance, working with Roma Capitale's heritage department and the Lazio region's office for cultural heritage and landscape.

In keeping with its social purpose and with what is stated in its charter, EUR S.p.A. carries out conservation work safeguarding its historic, artistic and landscape heritage, renting out renovated premises through its property management department. In contrast, its asset management activities involve the implementation of property development projects and urban improvements.

In the early 2000 s, EUR S.p.A. launched its new "La Nuvola" conference centre project; the cost of completing the project (still being defined due to reservations made by the construction company) about €350 million, led to a considerable level of debt, which EUR S.p.A.'s management decided to address by selling four building complexes to INAIL (the national institute for insurance against accidents at work): i) the State Archive buildings; ii) Palazzo delle Arti e Tradizioni Popolari; iii) Palazzo della Scienza Universale; iv) Palazzo della Polizia Scientifica.

The sale of these buildings to INAIL was worth approximately €297.5 million for roughly 92,000 sqm of primary gross floor area and roughly 46,500 sqm of secondary gross floor area. Taking into account the secondary gross floor area with a correlation coefficient of 25%, whilst ignoring the external areas, appurtenances and extensions, the total commercial surface area amounts to approximately 103,000 sqm, from which we can infer a price of roughly €2,900 per commercial square metre. The figures concerning the Palazzo della Scienza Universale building complex's proportions, which allowed us to apply the Cost Approach, were gleaned from publications regarding EUR S.p.A.'s assets (Table 1).

We therefore proceeded to estimate the MVland and the CVdep.

The MVland was estimated using the proposed method, by adopting the direct methodology. Data from 2015 provided us with a market value of buildable land in the EUR district of approximately €950 per sqm of possible gross floor area. Given that secondary areas and porticoes can be constructed without being counted in Floor Area Ratios, if we take the size of the building to be 24,996 sqm (primary and commercial areas), we end up with an MVland rounded up to €23,700,000.

Table 1. The Palazzo della Scienza Universale's proportions

The Palazzo della Scienza Universale building				
Proportions				
ID	Gross floor area	Purpose	Size	
A.1	Primary	Exhibition space, offices, conference hall, apartments	sqm	24,945
A.2	Secondary	Mezzanines, storage rooms, utility rooms	sqm	13,846
A.3a	Exterior: extensions	Porticoes[a]	sqm	2,421
A.3b	Exterior: extensions	Cloisters[a]	sqm	170
A.4	Commercial	Shops	sqm	51
A.5	Exterior: appurtenances	Courtyard	sqm	528
As	Total	(A.1 + A.2 + A.3a + A.3b + A.4 + A.5)	sqm	41,961
Av	Total (volume)		cm	223,000

[a]Approximate unverified data

We went on to estimate the CVdep, in keeping with step 1 of our proposed method, which involved the selection of a sample range of known prices, inferred from publications detailing EUR S.p.A.'s assets, regarding the construction of buildings (Building.n, acronym B.n) that could allow us to infer the basic single figure (CVturif) for our valuation. The single estimated figure of value (2015 data) Cvturif of the Palazzo della Scienza Universale building are: B.1.1. primary and commercial area: €/sqm 1,390; B.1.2 secondary area: €/sqm 1,080; B.2 porticos €/sqm 680. Having inferred the basic single value of each area, we went on to apply corrective coefficients (see step 2 of this proposed method for estimating CVdep); in the current application the corrective coefficients were inferred from EUR S.p.A. records (Table 2); the use of Building Information Modeling (BIM) systems can contribute to the coefficient formation process by highlighting the relationship between type of building work and range.

We then went on to estimate the CVtu of reconstructing the property (Table 3).

In order to apply the depreciation coefficient (step 3 of the proposed method for estimating CVdep) based on EUR S.p.A. records, we were able to infer that the building complex was in excellent condition from a structural point of view. As far as other construction elements were concerned, we calculated that those areas were at 75% of their life expectancy. We therefore proceeded to estimate the CVtudep on the basis of these coefficients.

$$k_{dep} = [(1/1) * 1/3] + [(0.75/1) * 2/3] = 0.84$$

Last but not least, we went on to estimate the CVtdep and other costs in order to come up with the CVdep. Depreciated Cost of Reconstruction (Table 4).

Table 2. Corrective coefficients for estimating CVtu

The Palazzo della Scienza Universale building					
a) Primary area					
The application of corrective coefficients					
Elements	Indicators	Primary areas	Secondary areas	Porticoes	Commercial areas
		Corr. Coeff. (%)	Corr. Coeff. (%)	Corr. Coeff. (%)	Corrective coefficient (%)
Location	Access to construction site	1.50%	1.50%	1.50%	1.50%
	Logistics	0.00%	0.00%	0.00%	0.00%
	Planning restrictions	15.00%	15.00%	15.00%	15.00%
Morphology	Layout	4.00%	0.00%	0.00%	0.00%
Structure	Span between columns	5.00%	2.50%	5.00%	0.00%
	Number of floors	0.00%	0.00%	0.00%	0.00%
	Foundations	0.00%	0.00%	0.00%	0.00%
Finishings	Flooring	1.00%	−1.50%	0.00%	0.00%
	Interior finishings	1.00%	−1.50%	–	0.00%
	Exterior finishings	4.00%	−2.00%	4.00%	3.00%
Systems	Wiring	0.00%	0.00%	–	0.00%
	Plumbing/heating	0.00%	0.00%	–	2.00%
	Mechanical systems	0.00%	0.00%	–	−0.30%
	Air conditioning	3.00%	0.00%	–	0.00%
	Fire prevention	1.50%	1.50%	–	0.00%
	Other (TV, telephone, other cables)	0.70%	0.00%	–	0.00%
Windows and doors	Interior	3.00%	0.00%	–	0.00%
	Exterior	0.00%	0.00%	–	0.00%
C.1a	**Overall corrective coefficient**	**39.70%**	**15.50%**	**25.50%**	**21.20%**
C.2a	**Ceiling height multiplier**	**72.00% (average h = 7.5 m)**	**27.00% (average h = 5 m)**	**72.00% (average h = 7.5 m)**	**27.00% (average h = 5 m)**

By adding the MVland to the CVdep. we were able to calculate the MV of the Palazzo della Scienza Universale building, for an amounts of €129,463,000, which

Table 3. Estimated CVtu

The Palazzo della Scienza Universale building				
An estimate of the overall cost of physically reconstructing the building				
ID	Description	Source	Unit of measure	Value
Primary area (a)				
B.1.1	Overall estimated value inferred from comparables	From Table 2	€/sqm	1,390
C.1.a	Comprehensive corrective coefficient	Source: EUR S.p.A.	%	39.70
	Overall estimated value Surface to Volume Ratio 3.2 lm	B.1.1 * C.1.a	€/sqm	1,942
C.2.a	Ceiling height multiplier	From Table 2	%	72
CVtu.a	Overall physical cost of reconstruction	B.1a * C.2.a	€/sqm	3,340
Secondary areas (b)				
B.1.2	Overall estimated value inferred from comparables	From Table 2	€/sqm	1,080
C.1.b	Comprehensive corrective coefficient	Source: EUR S.p.A.	%	15.50
	Overall estimated value Surface to Volume Ratio 3.2 lm	B.1.2 * C.1.b	€/sqm	1,247
C.2.b	Ceiling height multiplier	Source: EUR S.p.A.	%	27
CVtu.b	Overall physical cost of reconstruction	B.1b * C.2.b	€/sqm	1,584
Porticoes (c)				
B.2	Overall estimated value inferred from comparables	From Table 2	€/sqm	680
C.1.c	Comprehensive corrective coefficient	Source: EUR S.p.A.	%	25.50
	Overall estimated value Surface to Volume Ratio 3.2 lm	B.2 * C.1.c	€/sqm	853
C.2.c	Ceiling height multiplier	Source: EUR S.p.A.	%	72
CVtu.c	Overall physical cost of reconstruction	B.1c * C.2.c	€/sqm	1,468
Commercial area (d)				
B.1.1	Overall estimated value inferred from comparables	From Table 2	€/sqm	1,390
C.1.d	Comprehensive corrective coefficient	Source: EUR S.p.A.	%	21.20
	Overall estimated value Surface to Volume Ratio 3.2 lm	B.1.1 * C.1.d	€/sqm	1,685
C.2.d	Ceiling height multiplier	Source: EUR S.p.A.	%	27
CVtu.d	Overall physical cost of reconstruction	B.1d * C.2.d	€/sqm	2,140

corresponds to an overall estimated figure of €4,550 per sqm, considering a correlation coefficient of 100% for primary areas and 25% for secondary areas. Compared to the actual sale price, from which we can infer an average MV (for the four buildings sold) of €2,900/sqm of commercial area, the application of the Cost Approach provides us with an estimated MV approximately 57% higher than the actual sale value.

Table 4. The CV_{dep} of the Palazzo della Scienza Universale building

The Palazzo della Scienza Universale building – Estimated cost of reconstruction				
Id.		Source	Unit of measure	Value
As	Total gross floor area	From Table 3	sqm	41,961
Av	Total volume		cm	223,000
A.1	Primary areas (exhibition spaces, offices, conference hall, apartments)		sqm	24,945
A.2	Secondary areas (usable mezzanines, storage rooms, utility rooms)		sqm	13,846
A.3a	Extensions (porticoes)		sqm	2,421
A.3b	Extensions (cloisters)		sqm	170
A.4	Commercial areas		sqm	51
A.5	Appurtenances (courtyard)		sqm	528
$CVtu_{dep}$.a	Overall Physical Cost of Reconstruction: primary areas	CVtu * k_{dep}	€/sqm	2,800
$CVtu_{dep}$.b	Overall Physical Cost of Reconstruction: secondary areas		€/sqm	1,330
$CVtu_{dep}$.c	Overall Physical Cost of Reconstruction: extensions (porticoes)		€/sqm	1,230
$CVtu_{dep}$.d	Overall Physical Cost of Reconstruction: commercial areas		€/sqm	1,800
Cea	Cost of renovating exteriors	Source: EUR S.p.A.	€/qm	61
ID	Cost entries	Source	Amount	
CVt_{dep}	Physical Cost of Reconstruction	(A.1 * CVtudep. a) + (A.2 * CVtudep. b) + (A.3a * CVtudep. c) + (A.4 * CVtudep. d)	€	91,310,000
K.1	Cost of renovating exteriors	(A.3b + A.5) * Cea	€	43,000

(*continued*)

Table 4. (*continued*)

The Palazzo della Scienza Universale building – Estimated cost of reconstruction					
Id.		Source		Unit of measure	Value
K.2	Bureaucratic fees	5%	of CVtdep + K.1	€	4,570,000
K.3	Financial costs	5%	of CVtdep + K.1 + K.2	€	4,800,000
K.4	Profit of company overseeing the reconstruction	5%	of CVtdep + K.1 + K.2 + K.3	€	5,040,000
CV_{dep}	**Total**	**CVt_{dep} + K.1 + K.2 + K.3 + K.4**		**€**	**105,763,000**

5 Conclusion

When we lack comparables and/or income data, we can still estimate a property's market value thanks to the Cost Approach. The Cost Approach was adjusted to estimate buildings with special features. The crucial step when using the Cost Approach to carry out a valuation of such buildings is the estimate of its CVdep. Further improvements to our proposed method could therefore aim to identify coefficients concerning differences in the cost of various construction elements that are 'ordinarily' present, based on a sample of relevant data taken as a benchmark, perhaps using multiple regression models or tools for checking the cost of construction work involving BIM processes or patents such as the SISCO [31, 32]. Other developments could involve the inclusion of the element of value linked to historical importance in our proposed procedure.

While we may well believe that this proposed procedure requires further work, the results it produced when applied to the Palazzo della Scienza Universale building complex have been interesting; compared to the actual sale price, the Cost Approach generated a significantly higher market value. Such results support our belief that the Cost Approach for estimating the market value of buildings is particularly useful when selling public buildings that boast special features.

References

1. Forte, F.: Appraisal and evaluation in the production of works for the transformation of the contemporary city (2017). https://doi.org/10.1007/978-3-319-49676-4_10
2. Guarini, M.R., Chiovitti, A., Battisti, F., Morano, P.: An integrated approach for the assessment of urban transformation proposals in historic and consolidated tissues (2017). https://doi.org/10.1007/978-3-319-62398-6_40
3. Manganelli, B.: Real Estate Investing: Market Analysis, Valuation Techniques, and Risk Management, pp. 1–210 (2015). https://doi.org/10.1007/978-3-319-06397-3
4. Yeh, I.C., Hsu, T.K.: Building real estate valuation models with comparative approach through case-based reasoning. Appl. Soft Comput. **65**, 260–271 (2018)

5. Connellan, O.P., Britton, W., Crofts, M.K.: The Cost Approach to Valuation: A Research Report for the RICS (1991)
6. Guo, J., Xu, S., Bi, Z.: An integrated cost-based approach for real estate appraisals. Inf. Technol. Manage. **15**(2), 131–139 (2014)
7. Huber, W.R., Messick, L.P., Pivar, W.H.: Real Estate Appraisal: Principles and Procedures. Educational Textbook Company (2006)
8. Artemenkov, A.I., Mikerin, G.I., Artemenkov, I.L.: Professional valuation and investment-financial valuation: distinctions in valuations for private and public markets. Appraisal J. **76** (4) (2008)
9. Langston, C.: Life-Cost Approach to Building Evaluation. Routledge (2013)
10. Baxter, J., French, N., Gabrielli, L.: Market value and depreciated replacement cost: contradictory or complementary? J. Property Invest. Financ. (2007)
11. Chinloy, P.: Real Estate: Investment and Financial Strategy, vol. 1. Springer Science & Business Media (2012)
12. https://www.big.at/
13. https://www.gsa.gov/about-us/organization/public-buildings-service
14. https://www.bundesimmobilien.de/
15. https://www.thecrownestate.co.uk/
16. https://www.agenziademanio.it/opencms/it/
17. Lundström, S., Lind, H.: Valuation of public real estate: context and concept. J. Property Valuation Invest. (1996)
18. Yeh, I.C., Hsu, T.K.: Building real estate valuation models with comparative approach through case-based reasoning. Appl. Soft Comput. **65**, 260–271 (2018)
19. Royal Institution of Chartered Surveyors: RICS Appraisal and Valuation Standards. RICS, London (2017)
20. Vermiglio, C.: Public property management in Italian municipalities. Property Manag. (2011)
21. Giammaria, V., Bambagioni, G., Simonotti, M., Tecnoborsa & Associazione Bancaria Italiana: Codice Delle Valutazioni Immobiliari: Italian Property Valuation Standard. Tecnoborsa, Roma (2018)
22. Burada, C.O., Demetrescu, T.C.: Historical real estate valuation by cost approach. In: Applied Mechanics and Materials, vol. 880, pp. 371–376. Trans Tech Publications (2018)
23. Morano, P., Tajani, F.: Break even analysis for the financial verification of urban regeneration projects (2013). https://doi.org/10.4028/www.scientific.net/AMM.438-439.1830
24. Ashworth, A., Perera, S.: Cost Studies of Buildings. Routledge (2015)
25. Acampa, G., Giuffrida, S., Napoli, G.: Appraisals in Italy identity, contents, prospects [La disciplina estimativa in Italia Identità, conoscenza, prospettive]. Valori e Valutazioni (20), 13–32 (2018)
26. Battisti, F., Campo, O.: A methodology for determining the profitability index of real estate initiatives involving public-private partnerships. A case study: the integrated intervention programs in Rome. Sustainability (Switzerland) **11**(5), 1371 (2019). https://doi.org/10.3390/su11051371
27. Battisti, F., Campo, O., Forte, F.: A methodological approach for the assessment of potentially buildable land for tax purposes: the Italian case study. Land **9**(1) (2020). https://doi.org/10.3390/land9010008
28. Campo, O., Rocca, F.: The parameterization of physical quantities in the definition of parametric costs the legislative decree n. 50/2016 on public works design. Valori e Valutazioni **19**, 3–9 (2017)

29. Guarini, M.R., Buccarini, C., Battisti, F.: Technical and economic evaluation of a building recovery by public-private partnership in Rome (Italy) (2017). https://doi.org/10.1007/978-3-319-49676-4_8
30. Guarini, M.R., Battisti, F., Buccarini, C.: Rome: re-qualification program for the street markets in public-private partnership. A further proposal for the flaminio II street market (2014). https://doi.org/10.4028/www.scientific.net/AMR.838-841.2928
31. Giovanna, A., Crespo Cabillo, I., Marino, G.: Representation by drawing against simulation by BIM systems. opportunity or threat for architecture [Representación del dibujo frente a simulación de los sistemas BIM. oportunidad o amenaza para la arquitectura]. Archit. City Environ. **14**(40), 111–132 (2019). https://doi.org/10.5821/ace.14.40.6689
32. Acampa, G., García, J.O., Grasso, M., Díaz-López, C.: Project sustainability: criteria to be introduced in BIM. Valori e Valutazioni **2019**(23), 119–128 (2019)