Green Energy and Technology

Stefano Stanghellini
Pierluigi Morano
Marta Bottero
Alessandra Oppio *Editors*

Appraisal: From Theory to Practice

Results of SIEV 2015

Springer

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Editors
Stefano Stanghellini
Università IUAV
Venice
Italy

Marta Bottero
Politecnico di Torino
Turin
Italy

Pierluigi Morano
Politecnico di Bari
Bari
Italy

Alessandra Oppio
Chief Editor of the Springer SIEV Series
Politecnico di Milano
Milan
Italy

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Foreword

Many times it has been noticed,[1] not only from our masters, but also recently, that Appraisal represents one of the most ancient cognitive activities, able to attribute opinion of values to scarce goods, available on the market, and to forecast cost and price dynamics in the context of both real estate properties and "intangible" goods. Moreover, Appraisal can interact with other techniques and disciplines for solving complex multidimensional problems as those related to territorial transformations and environmental valorization projects.[2]

The SIEV proposal of starting a debate on the issues of appraisal must be embraced from us, especially form young researchers, as a very useful opportunity for opening a stable discussion, that is directed towards an update—if it is necessary—of some fundamental aspects of economic evaluation.

Among the numerous open questions, four issues have emerged as crucial: Appraisal theories and models, Real estate economics, Appraisal and professional practice, Economic evaluation of territorial transformations.

It is possible (and also desirable) that, after this debate, new proposals would be originated, that will be based on more specific and articulated problems involving our discipline, such as the influence of the harmonization of account introduced by IAS (International Accounting Standards) on urban and real estate appraisal by means of the so-called "proportional tax".[3] In this context, it would be also interesting to analyze the impact of IAS on the different fiscal aspects involving not only buildings,

[1]See "Appunti per una discussione sull'Estimo" (editorial), in Valori e Valutazioni, 14, DEI, Roma 2015, from which the present document has been partially derived. See also R. Roscelli (edited by), Manuale di Estimo, UTET Università, De Agostini, Novara, 2014.

[2]R. Roscelli, "Valori economici e valori immateriali nella valutazione del paesaggio", in G. Deplano (Edited by), Paesaggi insediativi, EDICOM, Gorizia, 2009.

[3]See L. Ingaramo, R. Roscelli, S. Sabatino, "Risvolti estimativi indotti dal processo di armonizzazione contabile avviato a livello internazionale", in R. Roscelli (Edited by), Manuale di Estimo, cit. p. 155.

but also large industrial plants (for example, for energy production and management[4]) that have been recently relieved of the payment of the Municipal real estate tax in consideration of the inconsistency between a tax constant over the time and the progressive technical and functional obsolescence (which implies a devalorization) of the plants.

Also the topic of Real estate appraisal deserves an update in the light of the new forms of public/private partnerships, of the actual models for the calculation of the building rights, of the innovative monetization and valorization processes induced by urban plans, with specific attentions towards the large abandoned buildings and the collapsed parts of the industrial city and the metropolitan peripheries.

Moreover, the persistent global economic crisis forced to question some fundamental points of real estate markets, as for example the process of prices formation, not only at a national level.

Environmental Impact Assessment, Strategic Environmental Assessment, cultural and environmental economics are becoming very important nowadays, in the light of a national and European legislative framework more organized, which requires reports and monitoring programs for all the relevant projects and plans.

In this case, the relationships between the Appraisal science and the disciplines related to environmental, cultural and well-being economics have been modified, without recognizing yet univocal indications for the definition of (new?) parameters and evaluation models.

New research lines for the Appraisal science are represented by building process and the evaluation procedures for the estimate of the real rights, which have been changed by the introduction of the Expropriation Law in 2001. Mention has also to be made to the judicial estimation, not only in relationship with the expropriation procedures but also with reference to the estimation of the environmental damage.[5]

On these subjects—and on the related methodological and operational problems—I believe that we have to focus on our reflections and our research activities, which should be more continuous and better integrated among them, in a perspective able to maintain the unity of the discipline, as recalled by Enrico Fattinanzi in the introduction to the present book.

It is necessary to set up a very deep update of the discipline in relation to the issues that constitute the methodological and operational centers of gravity of Appraisal. We should decline those issues according to key topics, on which we could verify if our discipline is able to face the most recent questions.

A suggestion—essential for the schools of engineering, architecture and planning—that should be followed and better developed is to maintain the Appraisal science as a central discipline in the planning and design process.

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[4]R. Roscelli, L. Ingaramo, "La rendita catastale dei sistemi di produzione di energia elettrica: il valore medio costante", in G. Bonardi, C. Patrignani, Energie alternative e rinnovabili, IPSOA, 2010.

[5]The topic of the environmental damage is the theme of the annual SIEV conference that is scheduled for November 2016.

We have all the argumentations and the tools for recalling that in the absence of feasibility evaluation all the project remain only “drawings”, perhaps interesting from the artistic point of view but not viable from a concrete point, as it is too often evident in transformation processes at a building, urban and territorial scale.

In the current debate, relevant and innovative approaches are emerging, because they face actual themes (the environment, the quality of territorial transformations, the valorization of goods that are scarce and difficult to be maintained) and because they propose experimental and innovative methods based on sophisticated models coming from economics and operational research.

Very often in this context, decision-making processes are characterized by social and cultural impacts and high level of uncertainty.[6]

Sometimes these methods allow to take into consideration alternative projects, with the objective of selecting the best performing solutions on the basis of evaluation criteria that can be measured on different scales (cardinal, ordinal, nominal).

Hundreds of techniques are currently available and they face the same question: how is it possible to identify a system—a rational computation model—able to quantify nonhomogeneous variables for the evaluation of projects, plans and programs, with the aim of assessing the overall sustainability?

Important steps were taken towards this direction, considering the very rapid evolution of mathematical models and computational tools, which are able to treat simultaneously a very large amount of data and variables with the aim of evaluating and communicating the economic sustainability of projects.

Also in this context the theory and the practice of the appraisal are fundamental.

Torino, Italy Riccardo Roscelli

[6]R. Roscelli (Edited by), Misurare nell’incertezza, Celid, Torino, 2005.

Preface

This book *Appraisal: from Theory to Practice* introduces the series edited by the Italian Real Estate Appraisal and Investment Decision Scientific Society (SIEV). Since 2005 the SIEV takes together scholars and experts in the field of Appraisal and Valuation applied to several contexts, such as architecture; civil, building, environmental and territorial engineering; construction processes; territorial and urban planning; properties and infrastructural investments; real estate finance and development; cultural heritage preservation and management; landscape protection, management and planning.

The volumes of the SIEV series include a selection of peer-reviewed papers that emerge from the scientific debate within the SIEV community, addressed at discussing both theoretical issues and advanced applications among academics, experts, government bodies, public institutions and private economic actors.

Differently from the Appraisal and Valuation handbooks, the SIEV series focuses on relevant emerging issues in the context of the assessment of urban and territorial transformation processes, with the aim of providing an overview about different theoretical and operational perspectives.

Given the peculiar roots of the Appraisal and Valuation discipline in our country, compared to other traditions of studies, this volume and the future ones will represent the Italian research lines with respect to the international scientific debate.

This first volume opens the series by focusing on foundation issues of Appraisal. The need for a development of the Appraisal theory and methodology according to the current socio-economic conditions introduces new issues to be discussed and at the same time makes the traditional doctrinal background more complex. New questions arise on the definition of the subject of the Discipline even more than on its scientific limits. In this context it is relevant to review the Appraisals' theoretical principles according to the instances coming from the market investors (banking associations, homebuilders, public institutions, appraisal companies, etc.) and to the multidisciplinary character of Appraisals, capable of acting as a *trait d'union* with other sciences.

More in deep, starting from the idea of the original nature of Appraisals, as a methodology aimed at determining monetary value judgments, this volume traces its recent developments both on the side of theory and models and on the one of applications, namely in the fields of real estate economics and regional/urban transformations. The future perspective and challenges of the discipline are also discussed in the light of getting to an effective and coherent development of the Appraisal discipline.

The book is divided into four parts: 1) Theories and Models; 2) Real Estate Economics; 3) Applications; 4) Economic evaluation of regional and urban transformations.

Stefano Stanghellini
Pierluigi Morano
Marta Bottero
Alessandra Oppio
Chief Editor of the Springer SIEV Series

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Introduction

Predicting the future of Appraisal science in the present social and economic context means identifying the cultural domain in which the SIEV (Italian Real Estate Appraisal and Investment Decision Society) operates. First, it is necessary to define the fundamental roots of the discipline, the most important evaluation techniques that have been developed so far, and its mission in the future.

In the social and economic complexity of our society, evaluation approaches are considered more and more as tools that offer the possibility of knowing and interpreting reality, especially while paying attention to the creation of projects and plans. In this context, evaluation methods enable decision-makers to formulate their choices, taking into consideration the full range of aspects and elements that describe the aforementioned complexity.

For this reason, the demand for this type of skill is growing more and more, and there is a need for a professional figure of "general evaluator", who is able to play a horizontal role and to intervene in all the possible sectors of the evaluation.

But this "market perspective", which undoubtedly appears very attractive, should consider that the scientific community of the SIEV has been constituted by individuals operating in the domain of projects, plans, and programs aiming at the physical transformation of cities and regions. From this perspective, the evaluation is predominatey targeted at supporting projects/plans/programs for the development, valorization and conservation of the built environment.

We believe that this perspective embodies the structural character of the SIEV scientific community, and it represents a very important element able to distinguish Appraisal science in the professional and academic world of designers and planners.

We find that in recent years the demand for evaluations and estimations is getting more and more qualified and articulated, requiring the diffusion of specific and innovative methodologies. For this reason, we founded the journal *Valori e Valutazioni* with the aim of documenting this development.

Moreover, we think that one of the most important goals of the SIEV is to promote the diffusion of the evaluation and estimation culture within the university educational programs of architects, engineers, and planners.

The Teaching of Appraisal and Evaluation Disciplines

In our universities, in the faculties of engineering and architecture, it has been very difficult to include, in the educational programs of architects, planners and engineers, the teaching of specific tools to forecast and to control the results of projects/plans/programs in terms of costs, time, and performance.

This barrier has been created by the teachers of architecture and planning who are convinced that the final synthesis of a project or plan is the result of individual action, in a sort of "demiurgic way". For this reason, they tend to protect the project from potential interferences that can be introduced by other disciplines, especially by appraisal and evaluation.

It has to be acknowledged that very often this barrier has been accepted by a large part of the scientific community of appraisers and evaluators, who considered this obstacle a sort of guarantee for the integrity of our discipline, which has to be isolated from contamination with the complex problems of design and planning.

Undoubtedly, it is necessary to reconnect the teaching of Appraisal with the topic of real estate evaluation that constitutes its fundamental anchoring.

At the same time, appraisers and evaluators, especially those who are young and very sensitive to real problems, believe that this very important historic legacy should be revised and actualized. First, from a cultural point of view, it is necessary that Appraisal and Evaluation sciences take into consideration the most recent debates in the economic disciplines, which have introduced new elements about the structure and the functioning of the building and construction sectors and the real estate market.[7]

The Actual Role of Evaluation

In this context, it is particularly interesting to place into evidence the role that our discipline can play, actively participating in the solution of relevant problems that are affecting the construction of projects and plans in Italy. In this sense, it is clear that these difficulties are strictly linked to ethic and legal issues, which are worsened by a lack of professional competence and a skepticism regarding tools able to control costs and time of projects and plans and to guarantee the quality of the intervention in terms of functionality, durability, operation and management, safety, and structural stability.

We believe that it is not possible to exclude the existence of academic responsibilities: in fact, all the practitioners have been enrolled in our universities, and

[7]The need for a different methodological background in the context of economic theory and real estate evaluation has been developed by Edoardo Mollica in his paper titled "La valutazione di beni e di progetti in mercati di concorrenza imperfetta," *Valori e Valutazioni*, 3, DEI Tipografia del Genio Civile, Roma, 2009.

they have taken the courses about Appraisal and Evaluation. For this reason, the thought is that our scientific community should direct its efforts at the renovation of teaching methods in the discipline and, as a consequence, in the redefinition of its scientific and operating heritage.

We are aware of the fact that the reconfiguration of this role collides with the dominant components in the faculties of architecture and engineering related to communities of designers and planners. In fact, these communities have acknowledged the importance of our discipline, but they think that they can manage the Appraisal and Evaluation sciences in a sort of "autarchic" way, applying in a totally acritical way our disciplinary tools, as if they were "evaluation machines". Moreover, the largest part of the professors of design and planning ignore the evaluation dimension of a project.[8]

The European Directive

A very useful contribution to the scientific community of appraisers and evaluators is represented by the European Directive 2005/36 on the recognition of professional qualifications. In particular, according to this directive, the training of architects, which must be of university level, and of which architecture is the principal component, must maintain a balance between theoretical and practical aspects of architectural training and guarantee the acquisition of the following knowledge and skills:

(a) Ability to create architectural designs that satisfy both aesthetic and technical requirements;
(b) Adequate knowledge of the history and theories of architecture and the related arts, technologies, and human sciences;
(c) Knowledge of the fine arts as an influence on the quality of architectural design;
(d) Adequate knowledge of urban design, planning, and the skills involved in the planning process;
(e) Understanding of the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale;
(f) Understanding of the profession of architecture and the role of the architect in society, in particular in preparing briefs that take account of social factors;

[8]One of the most relevant exception to this position is represented by Prof. Franco Purini, who has demonstrated a deep interest in the problems related to projects evaluation. Further details on this position can be found in the interview between Fabiana Forte and Franco Purini published in 2014 in issue 13 of the journal *Valori e Valutazioni* and in the foreword to the book titled "Multicriteria Analysis between Evaluation and Decision" published in 2015 by DEI Tipografia del Genio Civile (Roma).

(g) Understanding of the methods of investigation and preparation of the brief for a design project;
(h) Understanding of the structural design, constructional, and engineering problems associated with building design;
(i) Adequate knowledge of physical problems and technologies and of the function of buildings to provide them with internal conditions of comfort and protection against the climate;
(j) The necessary design skills to meet building users' requirements within the constraints imposed by cost factors and building regulations;
(k) Adequate knowledge of the industries, organizations, regulations, and procedures involved in translating design concepts into buildings and integrating plans within overall planning.

The Alternatives for the Development of the Discipline

According to the aforementioned directive, the Appraisal and Evaluation disciplines are crucial in the education of architects and planners. In order to address this issue, there are two main alternatives for the development of our discipline:

- The first alternative considers the possibility of accepting a branching of the disciplines into two different paths, i.e., between the researchers and practitioners involved in the development of the "classical" Appraisal and those involved in supporting the construction of planning and design processes.
- The second alternative refers to the option of creating a unitary framework in which the two bodies of the discipline interact in a positive and synergetic way. This alternative would also enable reorganization of the traditional paradigms of the discipline and actualization of the operational tools.

The personal experiences of the larger part of researchers and practitioners demonstrate that the unitary of the discipline constitutes a value that has to be maintained, also with the aim of creating effective and efficient programs, plans, and projects.[9]

In this sense, it is worthwhile to focus our attention on the elements characterizing nowadays the construction process of plans and projects. In fact, we believe that the introduction of the issues pertaining to the evaluation of plans and projects in the methods for appraising the market value of real estate assets could contribute to enrich the estimation process that, at the moment, is mono-dimensional and unable to take into consideration the complexity of the value of a building.

[9]Further information can be found in various papers and editorials of mine that have been published in the journal *Valori e Valutazioni*, where I have presented the historical and scientific reasons that support the idea of the unity of the discipline.

The Fundamental Characteristics of Planning and Design Processes

The relevant characteristics of planning and design processes are related to the complexity that is growing ever more important. A first degree of complexity concerns the necessity of identifying the overall impact that a plan or project creates on the social and economic context. In this case, it is necessary to define the values and the reasons according which a decision maker considered for starting the operation. After this phase, it is necessary to translate those reasons into specific objectives and values that are useful for setting the requirements for the plan/project.

In this phase, it is also fundamental to examine the legislative and normative framework pertaining to the context under investigation. A second degree of complexity refers to the multidisciplinarity of the working group that supports the creation of a plan/project and that is constituted by numerous subjects with various skills and knowledge.

The planning and design processes are generally articulated according to three main phases.

In the *ex-ante* phase, it is necessary to define the objectives and the criteria that the plan/project has to satisfy. At this stage, the evaluator is asked to manage the dialogue among the stakeholders, the various practitioners, and the project team. In other words, the evaluator has the task of linking the preferences and the opinions of the various stakeholders (political, economic, environmental, bureaucratic, etc.).[10] In this phase, it is necessary to consider the opinions of the full range of actors involved in the process, including the promoters and the developers that pay attention to the economic resource and to the timing of the operation. Moreover, it is essential to support the transparency of the decision-making processes and the identification and the involvement of the decision-makers through the activation of participatory procedures.[11]

The *ex-post* phase refers to the end of the planning/design process. In this phase it is necessary to evaluate alternative proposals in order to select the best performing option: the objective is to establish the degree to which the criteria and objectives established in the *ex/ante* phase have been reached in the final version of the plan/project.

[10]A fundamental contribution to this topic refers to the editorial authored by Vincenzo Bentivegna published on the issue 15 of the journal *Valori e Valutazioni*.

[11]In order to better investigate the epistemological implications of this operation, it is possible to refer to the article by Enrico Fattinnanzi titled *Scienza e valutazione del progetto*, published on the issue 4/5 of the journal *Valori e Valutazioni* and the article by Gulio Mondini titled “La valutazione come processo di produzione di conoscenza per il progetto”, published on the issue 3 of the journal *Valori e Valutazioni*.

This reasoning can be summarized in the saying: the task of the evaluation is to define the spatial consequences of the socio-economic policies and, vice versa, to assess the socio-economic consequences of the spatial design strategies.[12]

Generally speaking, the *ex-ante* and *ex-post* evaluations take into consideration only the economic-financial, environmental, and engineering[13] factors, and the evaluators are not interested in the *in-itinere* phase, which is crucial in the definition of a plans/projects. This phase is considered as a black box whose mechanisms have not been investigated in detail.

We believe that the evaluators can play a very important role also in the *in-itinere* phase, supporting the overall planning/design process.

The Role of Evaluation in the In-itinere Step

In the transition from the *ex-ante* to the *in-itinere* phase, there is a kind of linkage. With respect to this passage, the general requirements of transformations should be identified in order that the objectives that have emerged in the *ex-ante* stage can be effectively achieved. These are steps aimed at establishing an explicit link between the design process and the different objectives, even the conflicting ones. For these reasons, the evaluator should define evaluation methods and criteria on the basis of the set of requirements previously identified and shared by the largest possible number of stakeholders and by local communities. These methods have to be necessarily based on a multidimensional methodological approach.

This stage should be followed by another one (which can be considered the starting point of the design process) in which the requirements and the criteria previously identified must be translated into a specific set of indicators and parameters to be considered by specific plan or project aimed at introducing spatial transformations, regardless of their size and main features. This kind of evaluation framework must be adapted to the evolving advancements of the design process, with the idea of supporting and controlling the initial settings and their subsequent changes.

Moreover, at this stage the key ideas that will inspire the entire design process generally emerge, first of all in the context of feasibility studies to be effective and detailed (independently by current regulations and procedural requirements). It seems well established that this evaluation could not ignore the specific settings initially adopted, thus preventing that feasibility be considered as a bureaucratic activity, usually developed according to parameters unable to explain the potential economic, social, functional, and symbolic impacts the development of the initial setting will certainly produce.

[12]We believe that it is necessary to extend the ex-post phase towards a monitoring program in order to evaluate the fulfillment of the initial objectives as defined in the ex-ante phase.

[13]See also the book titled “Misurare nell’incertezza” edited by Riccardo Roscelli.

The Interdisciplinary Context of the Plans' and Projects' Evaluation

The main disciplinary connotations of those evaluators who work in the field of spatial transformations are based on the management of this crucial operational step. Actually, the management of the relationships among different disciplines is an increasingly important issue.

Over time, given the growing specialization due to industrial and technological development, it has become more difficult to bring together the various aspects of knowledge regarding well-structured and shared goals. Knowledge is generally conceived of as a separate domain, characterized by its specific cultural roots, with peculiar, as well as, independent disciplinary statutes, which necessarily diverge from both conceptual and operational perspectives.

The "teleological" convergence of knowledge should be replaced by different and parallel disciplinary paths, although the difficulties of dialogue and of interactions remain. In any case, with respect to the current problems related to the growing complexity of the disciplines involved into the design and planning processes, Franco Purini points out that:

> A different view based on conflictual visions of the world induced by the multiplicity of the contemporary culture of multiplicity. …. through which the convergence is the result of a dialectic between a lost unity of thought and the will to rebuild it through oppositional fragments … In a kind of critical transience, by means of which this unit becomes intermittent, variable and conjectural.

These considerations seem to confirm the instance of moving the focus of the evaluation from the objects to be assessed to the processes by which those objects are defined and designed.

For these reasons, the first task of evaluators formed into design teams is to define a process divided into clear decisional steps and to identify the roles and responsibilities for each of them. Without deepening the notion of *project management* (Fattinnanzi 2008), it is useful to highlight some of the basic features that such an activity should have. First of all, it should be acknowledged as shared by the entire design team. It has to be as flexible and dynamic as to be reviewed according to the all phases of the design process. Finally, the *project management* should be supported by evaluation tools.

Given these premises, it is useful to focus on the role of the evaluator with respect to the project management team.

Generally, during the *ex-ante* and *ex-post* phases, the evaluators assume an external role. On the contrary, during the *in-itinere* step, it is crucial that evaluator works together with the design and project management team. In order to face this operational issue, it is relevant to start from the procedural nature of planning and design activities.

Design and Planning as Decision Processes

The final definition of projects and plans depends on several choices between different potential options, which, on one side, determine changes to the built environment, and, on the other set up the essential resources for their implementation. Under this perspective, projects and plans can be considered as decision processes: in every step the design or planning team has to face several problems and to select the optimal solution among several potential solutions to the same problem. The evaluation becomes essential in order to improve the robustness of those choices and to create a large consensus among the design and planning team.

It is a process that requires the use of tools for supporting the continuous interaction between intuition, evaluation, and control instances and for exploring potential results and impacts of projects and plans under investigation. Thus, it is important that the evaluators assume an active role in all the steps of the design and planning process. On this topic, Franco Purini affirms that evaluation should "*verify the choices once they have been defined…*" in order to point out *"the consistency of the initial intentions with the final results, the procedural correctness ..., the duration of the work to be carried... The evaluation cannot be considered by the designer as something next to the decision process, but as a set of choices integrated the creative process"*. In fact, the evaluation is *"…. a creative and knowledge horizon that address significantly the definition of the design phases. The evaluation interact from the beginning of the project with the design choices, including the more linguistic ones…"* (Fattinnanzi and Mondini 2015).

Starting from a short analysis of the steps of the design processes, the role of the evaluator and the evaluation tools will be further described.

First, the design team has to list and describe the available technical solutions to a specific design problem. The effectiveness of decisions depends on the quality and quantity of the potential alternative solutions and on the team's capability to explore their technical, production, and economic implications. Within this step, the skills of the design team are essential, as they also are in the software field. Among all the potential solutions, the ones that are consistent with the project's initial idea and general goal will be selected.

The selected alternative options will be evaluated in order to point out those most consistent with the project's objectives and with available resources.

The selected options, considered as adequate under the functional and the economic view, should be evaluated with respect to their degree of compatibility with the other options and their degree of consistency with the general project's concepts.[14]

It could happen that, among the potential solutions, none can be considered as adequate and satisfying. Thus the design team could search for innovative solutions or review the original ideas when the difficulties regard fundamental aspects.

[14]Innovation is provided by the redesign of known objects. See for these concepts applied to architecture Grassi 1980.

On the other hand, the design experience suggests that, when the project's development encounters increasingly difficulty, it is better to abandon the initial ideas and to formulate new ones, which would be more effective and able to propose again the most interesting elements of the initial ideas, overcoming at the same time the previous difficulties.

Conclusions and Future Research Perspectives

From the previous considerations becomes clear the procedural, iterative, and nonlinear nature of the design choices that flow and, gradually, define projects or plans. It is a complex process, characterized by phases in which knowledge and design/planning proposals interact continuously. These, in turn, are generated by inductive/deductive activities, which cause subjective insights to interact with multidisciplinary and, therefore, supra-individual elaborations. It is a gradual process, characterized by many feedback loops that sometimes may assume a radical character.

The awareness of this structural complexity generates the need for introducing specific evaluation methodologies into the design process. Given the nature of the objects to be assessed and the characters of the stakeholders, these methodologies should be both multicriteria and multi-objective in nature.[15] These kinds of methodologies entail very significant consequences: on the one hand, the evaluation tools generally used by designers and planners should be reviewed in light the current evaluation demand and instances; on the other hand, the traditional idea of a project or plan is going to change in order to be more flexible, due to the complex and iterative procedure, while also maintaining the quality and identity of the basic idea.

The Plan and the Project as Theoretical Hypotheses

In order to examine the future perspectives for the development of our discipline, we believe that it is necessary to recall some theoretical issues that have been investigated in various articles recently published in the journal *Valori e Valutazioni*.

First, it is necessary to go beyond the perspectives according to which the design process represents artistic/intuitive moments that follow rational/systematic moments. We believe that the design operation should be intended as a

[15]For the methodological and operational issues related to the application of Multicriteria Analysis techniques, see Fattinnanzi E., Mondini G. (Eds), *L'analisi multicriteri tra valutazione e decisione*, DEI, Roma, 2015.

somewhat cognitive operation, where several intellectual factors are included and interact: the intuition, the invention, the introspective reflection, the empirical observation, the abstraction, the systematic organization of the information, the capacity of formulating judgements, and of generalizing the results.

On the aforementioned basis, contemporary philosophy and epistemology have recognized that the scientific character of a cognitive operation is not related to the elimination of the subjective and intuitive factors. On the contrary, the latest scientific studies have demonstrated that the essential elements of a theoretical hypothesis (such as, for example, the Higgs boson, black holes, and gravitational waves) originally involved theoretical intuitions, that only later on have been confirmed by means of empirical observation through innovative experimental equipment.[16]

Following this reasoning, the scientific quality of a research operation does not regard the level of objectivity as the negation of the creative subjectivity, but it is related to what the philosophers call the "unmasking of the subjectivity". According to this position, the theoretical hypothesis is proposed by the individual to his/her scientific and professional community, which has all the instruments to accept or reject it. On the basis of these assumptions, the contemporary epistemology presumes the existence of a general homogeneity of the invention dynamics, considering both an artistic creation and the development of scientific theories.[17]

An intuitive process very often presents significant analogies to artistic creativity and activities that, though born from experience and knowledge of the real worlds (pre-existing to the experience of the subject), constitute a theory about a hypothetical reality or imagine a hypothetical object that, once realized, will insert itself in the real world. Such intuitive process will be inevitably destined to modify it, usually as to achieve objectives of both a practical and symbolic nature.

Once a theory has been formulated, the planner or the architect will organize data and available information, will select problems evaluating their relevance and pertinence, and will choose possible solutions evaluating their feasibility, coherence, and ability to solve problems. In particular, the planning or drafting process of a project, especially if innovative, builds a theory in which conditions are identified, knowledge is organized, and available resources are selected to transform the new or newly changed object from a state of theoretical hypothesis to a state of concrete reality able to modify the physical space.[18]

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[16]In 1935. Karl R. Popper, in his book "The Logic of the Scientific Discovery", criticized the neo-positivist and inductivist positions. He believed that, in real world problems, for the formulation of a theory scientists never start from facts; on the contrary, they try to resolve a knowledge problem proposing explanatory hypothesis that later on will be validated by means of critical logic and empirical investigations.

[17]See the contributions that have been developed by Umberto Eco, with particular reference to the book "On Mirrors and other essays" published in 1985.

[18]See the article by Fabiana Forte, "Il processo progettuale nell'approccio di Purini Thermes Architetti: il ruolo della valutazione", *Valori e Valutazioni*, issue 13, 2014.

This theoretical hypothesis assumes a scientific character when it provides pertinent validation criteria or falsification evidence.[19], [20]

We believe that the consideration of the project as a scientific process, by means of the evaluation tools, tends to modify the meaning of the project. According to Franco Purini, the evaluation paradigm should be considered as fundamental in the formulation of a project; in fact, this paradigm is able to modify and to redefine numerous issues and problems that are brought to the attention of the designer.

In light of these considerations, recent experience suggests a new conception of the design process, where the "generating hypothesis" of the designed and planned objects follows a proper model.[21] This model will enable the identification of a series of physical objects of different types, but with a uniquely fundamental basis. These hypothetical objects would be then selected, accepted, or rejected in the subsequent phases of the design process.

It is worth mentioning that the majority of the elements that structure the project/plan model enable the development of the evaluation of the quality of the results and of the resources needed for the construction. In this sense, the initial model, after the preliminary formulation of the initial theoretical hypothesis (that we called "generating hypothesis") and its progressive development, should include all the evaluation elements that will make possible accepting the idea or rejecting it.

We believe that the research into the Appraisal and Evaluation discipline should be directed towards the aforementioned direction. From this perspective, it is necessary to examine the existing evaluation methodologies and to consider them as tools able to support the qualified structuring of models for the definition of projects and plans.

We think that our discipline has a valuable and very rich background in terms of techniques and methods that could be efficiently employed for this purpose. In any case, it would also be possible to take this opportunity for creating new tools, thus enriching the discipline with yet more sophisticated and innovative approaches.

[19]According to Popper, in order to validate or to falsify a hypothesis, it is necessary to examine the consequences of the considered idea on the experience. The scientist should not judge his/her ideas as absolute but as simple working assumptions that have to be validated. In this sense, the research methodology should integrate the construction of specific tools able to confirm or falsify the initial hypothesis.

[20]See the contribution of Fabiana Forte in the book "Multicriteria Analysis between Evaluation and Decision" (op. cit.).

[21]In this context, we use the term "model" in the sense of the industrial production. According to this definition, different objects belong to the same model if they are produced following the same organization. The same model is thus able to generated different objects from a physical point of view. In this sense, projects can be of different type but they belong to same model. On this topic, it is possible to see the articles published on the issues 7 and 8 of *Valori e Valutazioni* about the construction of the SISCO system.

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Rome Enrico Fattinnanzi

The True Value. On Understanding Something

Salvatore Giuffrida

Abstract This contribution focuses on some issues of the evaluation discipline that, because of their generality, concern the practice of the value judgment. The value judgment, as it coordinates evidences, inferences and decisions, deals with epistemological, logical and ethical matters; therefore it connects knowledge with responsibility—personal and social—upon the allocation of the real rights and the transformation of the city and the territory which depend on the result of the evaluation. The value judgment mainly connects a factual realm with a value realm. The connection between these two spheres bases on argumentations concerning: the description of the characteristics of the economic goods involved, the definition of a causal relationship between these characteristics and their market appreciation, expressed by price; the placement of the good inside this relationship according to the described characteristics. This contribution discusses the elements of truth of this model, that in certain cases is very weak in epistemological and in logical terms as well, trying to stress the difference between "science of the valuations" and "estimation", therefore between a science of the interpretation of the values and a technique of simple observation and elicitations of occurrences by means of statistics procedures independent from the observer. In this sense it tries to compare some aspects of the theory of truth to the main elements of the theory of value we generally apply, but not always with full awareness. The contribution constitutes the initial part of a more extensive research. It analyzes some aspects of the relation between truth and value and highlights, on the grounds of the articulations of the problem of the trueness and the nature of the evaluative statement, some relevant operative issues of the discipline.

Keywords Truth theory · Axiological predication · Axiological truth · Linguistic approach · Capital asset semiotics

S. Giuffrida (✉)
Department of Civil Engineering and Architecture, University of Catania,
Via S. Sofia, 64, 95123 Catania, Italy
e-mail: sgiuffrida@dica.unict.it

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1 Introduction

Jorge Luis Borges (1926) defined language as “effective organizer of the enigmatic abundance of the world”. The same way the science of the evaluations, as discipline of economic policy, is committed to put into order the enigmatic abundance of the world of values of the real estate capital assets. As “abundance” we mean here the wide range of the territorial, institutional and juridical conditions inside which the reticulum of motivations for selling and purchasing and for transforming and preserving articulates. The science of evaluations utilizes the language of value to describe the capability of being worth of the economic goods.

If it is true that a function of language is to constitute the social relations concerning reality—Lewis 1968, argues: “we have created the word “hammer” so that we may say “pass me the hammer”—we can also accept the idea that the language of value establishes the social relations concerning “what really counts” about the destinies of our territory, our cities and the landscape. Whether the economic-territorial order is founded on the monetary language (Rizzo 2002, 2016) or on value (in Luhmann 1992 “code/program”) as language—mostly considered a feeble foundation—it is at the root of the issue of true value, that means that if as “true” we mean “real”, and as “real” we mean referred to things and facts, then legitimate doubts on the possibility to talk about “true values” arise. The observation of D’Agostini (2013) on the statement by Lewis—word “was born from the world, from how it is made, how it appeared to us, so it was consolidated by repetition, that created the linguistic convention” (p. 148)—opens, instead of closing, a wide and fruitful discussion the same author has extensively dealt with in *Introduction to trueness* (2011), to which this contribution systematically refers, being inspired by it.

The basic issue is this: what do we mean as “world”—as this world produces the evidences we organize through the interferences (the logical sequences) contained by the value judgment?

The recent and sudden extension of the operative contexts of the evaluation discipline has contributed to give a practical meaning to this world, taking demanding challenges in the very contexts in which “facts and values” (Putnam 2002) are more and more difficult to distinguish and therefore to connect by means of a quantitative measurement or a preference relation.

1. This application field constitutes the *horizontal dimension* of this “world”, the world of problems. As a matter of fact the following issues are involved:

   - a progressively wider range of subjective profiles participating to the process of formation of wealth, among which the one external to the social system, the environment;
   - a quicker dynamic of the dimension of the destructive variables of social and environmental wealth;

- a more and more effective system of intra-systemic communication through which the economic sub-system (Luhmann 1990) increases the income articulations and its dimension at the expense of the other distributive variables, originating alarming forms of concentration of wealth and social and geographical polarization;
- a more and more dispersed institutional apparatus of command and control that delegates to the market increasingly larger areas of the affirmation of rights;
- a more fragmented institutional apparatus inside whose network the judicial procedures get stuck.

All the above mentioned matters constitute the first level of the issue we, in synthesis, address as "the true value" and that, as will be subsequently explained, must be specified in its semantic aspects and its main uses.

2. The *vertical dimension* of this "world" is the inseparable unity of language and reality. Reality is organized as value by means of the language of evaluation, that allows us to say the truth, that means to attribute the "true value".

2 Three Values. Really?

One of the greatest difficulties the estimator encounters nowadays is the rarefaction of the factual and axiological referents of the evaluative process. Even in front of the most traditional evaluative question, that is the evaluation of the market value of an urban property, the double "being at large", (1) of the market and (2) of reality occurs.

1. The "being at large" of the market may be observed in the irreducible divergence of the three values: ask price; market value; bid price. The market is the place of the economic communication that coordinates the seller (that requires a certain amount of money) and the purchaser (that offers a different amount of money). The transaction is a communicative act consequent to the agreement of the two contracting parties on the mutual convenience of the transaction itself.

Several observations on this simplification might be carried out, but they would deal with other fields of study. On the grounds of the addresses of economic-evaluative semiotics outlined by Rizzo (1999), the "ask price" is attributed to the "intentional" signification, the "bid price" to the "real signification", while the market value to the "conventional" signification (ib., p. 330).

In the specific evaluative context, we should consider that:

- the real estate market is a market of capital assets instead of housing functions;

- the capital assets are *economic signs* whose physical reference is constituted by the housing functions just as the building itself;
- as they are economic signs, their value (significance) is the result of a process of signification;
- the capital markets are characterized as they coordinate the speculative activity;
- the real estate price results from the encounter (or collision) of two counter-posed speculative intentionalities, the bullish one (of those who intend to purchase) and the bearish one (of those who intend to sell).

The referential or utilitarian motivations may arise in borderline situations:

- at the bottom of a generalized "bearish" trend like the current one, characterized by the paralysis of the transactions, when people sell out of necessity capitalizing past capital losses;
- at the top of a "bullish" trend when people buy out of urgent housing necessities, capitalizing future losses of capital value.

In the periods considered stable, the three prices tend to coincide, while in periods of fluctuation: they discourage the purchases (lowering trend), and the market is nearly silent and not promising; they encourage beyond measure the purchases (raising trend) and the market "speaks aloud" and "shows off".

Ultimately, which are the prices that, in similar situations, should be assumed as significant? And, on second thoughts, even in the periods of flexibility of the market, in what sense may be assume as "true" a value calculated out of prices formed by the collision of speculative intentionalities? Which is the true value?

2. The "being at large" of reality concerns instead the difficulty to describe the economic goods from the point of view of the significant characteristics for the purposes of the evaluations:
   - the signifiers the significance connects with;
   - the syntactic ties delimiting the semantic chain (a market segment), and between them: the episodic nature of the transactions, the heterogeneity of the contracting parties, the fragmentation of the political—economic context.

If the above mentioned matters are valid for the real estate evaluations, even more so they are valid for the qualitative evaluations, and as a matter of fact:

The first ones refer to a consolidated system of exchange and use the monetary language, that has the maximum level of abstraction; the second ones are carried out without exchange and shared descriptive dominions, and by using a plurality of concrete languages that can more hardly blend and be merged in a unitary and robust expression.

As a consequence the question is: does the true value exist? If the answer wasn't positive the following paragraphs, and even this contribute, wouldn't be.

3 Structure of the Value Judgment: Real Evaluations or Real Values?

Judgment is a linguistic expression that unites an object and a predicate: the judgment of value connects an economic good (something that may be considered as being worth, then as existing in the economic communication) with an attribute of value (that constitutes the motivation because of which that good should be subject to higher or lower interest). In the analytic field, the value judgement is the assertion on the trueness of an evaluative statement. In strictly logic-linguistic sense, the judgment is distinguished from the statement by the "extolling strength" (Dummet 1978) with which it affirms that the statement is true (or false).

The statement is a set of propositions each with a content, and whose coordination constitutes the sense of the statement. The judgment, therefore, activates the cognitive and heuristic functions that coordinate the statements, in particular their sense, so that their contents are ordered in the sequence of the logic interferences suitable to affirm that "A is worth x" or that "A is preferable to B". Therefore the value is the "row material" of the evaluative statements, and the judgment oversees the truth of these statements. The evaluative statement consists of: (1) connecting a term of value with an object, that means selecting, defining and quantifying the properties because of which that object is important, preferable, valuable; (2) connecting the dimension of these properties with the quantitative-monetary measure of value or qualitative ranking.

The traditional discipline of estimation has specified the property "true"—enactment of the value judgment—in the requirements of generality, objectivity, ordinary nature, actuality, dependence on the aim (contextuality). It has also indicated the place of the "facts" that make the evaluative statement real: the market (actual or simulated, directly or indirectly questioned) or, more moderately, the preferences (detected or declared); this last matter concerns the issue of the "truth of value" instead of the evaluations, affirming that the market is the place where true values are formed. Finally, and above all, the estimation discipline has established the probabilistic approach as guarantee of truth of the evaluation (Locke delimits the significance of judgment to the faculty to use probable knowledge where certain knowledge is missing—Essay IV, 14, 3—Abbagnano 1998, p. 529), that implies another important assumption: the "intra-temporal prevision" about what would hypothetically happen at that definite moment in the facts (of the market). In synthesis, the judgment of value says: (a) which are the true evaluations, indicating the conditions of truth of the evaluative predication, that is a set of statements coordinated in the inferential form (if:…: then:…) of a logical sequence with a probabilistic value; (b) which is the real value, indicating it in the recursive behaviours observed in the practice of the market or the practice of the preferences.

Inside the evaluative statement, an issue that differentiates this simple and neutral correspondence between economic facts and probabilistic previsions is worth analyzing. The conditions of truth of the evaluative statement as here defined, can be discussed if we go beyond the limits of its validity, and we agree on these limits being indeed very restricted.

"Judgment of value" is a demanding phrase, in both terms, that refer respectively to the logical-linguistic and to the ethical sphere. The evaluative statement, that complies with the internal coherence of the evaluative process, is verified by the judgment. The judgment is a propositional structure that corresponds to a capability of humankind. By means of the capability of judgment choices transcend evaluations just as evaluations transcend observations: this ascent develops with the progression: "judgments of fact, judgments of value, judgments of merit". This originates a chain of responsibilities, first heuristic ones involving the evaluating subjects, then the moral ones involving those who make a choice.

The highest part of this ascent (evaluations-choices), supported more by the moral than by the heuristic responsibility, exceeds or transcends the simplistic correspondence between the evaluative statement and the facts of the market, defining a further space of values. Therefore in the context of the quantitative-monetary evaluations not only the actual prices (provided that they are known) will be relevant, but the supply and demand prices as well; in the qualitative evaluations the policies and a set of universal values will be relevant instead of only what people like.

The substantial difference between the estimation predication and the axiological predication is, therefore, that the first one is descriptive and assumes from the market and from the observed behaviours the references for judgment, while the second one, explicitly normative, is inspired by a theory of value.

It is also possible to synthesize with Celano (1999, pp. 281–84): passing from a positive approach to a normative one the adaptation direction changes, from word-world to world-word.

The axiological predication is the set of *context* (conventional) and *co-text* (conversational), inside which it is possible to define the lawfulness, the legitimacy and the justification of the evaluative predication, therefore the sense of the evaluative statement itself, its origin and its destination, ultimately in what sense and how to define the "real value".

4 Truth and Value

The estimation discipline bases the significance of the axiological predication on the convergence, coherence and integration between *ethical* and *epistemic* values.

One of the preliminary features of the relation between truth and value consists in understanding if and under which condition two conceptual categories, associable as both are super-concepts, are equal or the one may be subjected to the other (real values or good truths?).

First of all it is necessary to define the properties of the "super-concepts" or "transcendental" concepts. They are particular properties that don't allow to be denied or relativized. Truth is a condition of reasoning that guides thought and, derivatively, action (D'Agostini 2011, p. 84), and it is not possible to get rid of. Denying truth implies believing as true anyway that truth doesn't exist (arguments for confutation or "elenctic" in the Aristotelian logic) (ib). The same way, value, that means what is important and is tied to good (in the sense of what is good), is a condition for action: denying it means believing that doing it is good that means to implicitly admit it.

It may also be deduced that truth and value are properties (as in linguistic terms "real" and "good" are noun phrases) that mutually support each other in the axiological predication (the true value). The estimation predication (the real evaluation) is a different matter, that is ranked at a lower level than the transcendental concepts, in the sense that it is subject to logical (internal coherence) and factual (external coherence or correspondence) verification.

The axiological statement ("this is good") differs from the evaluative one ("A is worth x") in the fact that, while the first implies the transcendental "good", the second implies the transcendental "true" (it is true that "A is worth x") but it doesn't imply that "it is good to affirm it". "True" is the noun phrase that inside an evaluative judgment states the content of the estimation predication. In this case it may be observed that, while at the level of the estimation predication the judgment is a factual judgment on the truth/falsity of the evaluation statement, at the axiological predication level the judgment has as object the "truth of value", that means that the value is authentic and it is not reduced only to the contingent interest expressed by the estimation query, therefore that the evaluation is really impartial in the sense (apparently opposite) of non neutral. The axiological predication differs from the evaluation predication in being the result of a stance, therefore in being capable of "evaluating the evaluation", of expressing the *value of the values* involved in the evaluation. The value of values that distinguishes the axiological predication is the result of a "semantic ascent" confirming that "good" is an inferential and reflexive (it talks of itself) property common to "true". Are there good truths and less good truths? Are there true values and less true values? The question is not simple, and the affirmative answer that here for the moment is provided must be examined in depth.

There are redundant or a-contextual truths that means not coherent with the sense of the proposition itself or with the needs of the situation where they arise. This aspect recalls what has been said on the relation between contextual and co-textual dimension of the value of the evaluations. We can say: "we have been together for 30 years", that is true and relevant in contextual terms: or: "we have been together for 10.958 days", that is even more true concerning the correspondence to the facts (we kept into account the leap years) but it doesn't make any sense, therefore is irrelevant (we are not interested in this precision), redundant (we cannot immediately understand the duration of this experience) and therefore a-contextual, then in a certain sense erroneous even if true; moreover, we can say: "we have been together for an entire life!" that is false in the sense of the correspondence to the facts, but it makes a precise sense, represents an "axiological truth", a truth that is worth, a "true truth" as it expresses in depth the sense and the density of the experience of being together.

The same way, in the axiological field, we can employ different modes in which what matters arises (the use value and the exchange value) as evaluative material, and we can satisfactorily answer the specific question.

Nonetheless we shouldn't necessarily assume a critical position on the evaluation itself, in particular on its sense, and especially on which socio-economic and political-institutional context it intends to reproduce.

What has been proposed so far requires some clarifications. The first one concerns the sense of "true". Value is not a "truth bearer" in the proper sense; as a consequence, we can talk of authentic (aesthetic) or non authentic (contingent, hedonic) values. Assuming value as true means considering it as a criterion of judgment or of action and, as said, of truth as well: in case of doubt what we consider important prevails. Therefore, "the true value" is a phrase that, in a classical sense, it is more correct to attribute to the statement on the relation between a good and its capability of being worth inside a defined socio-economic context. In a wider sense this phrase concerns the adequacy and the completeness of the axiological material—values as criteria—involved by the inferences connecting the different facts through which value is experienced.

We may conclude that, while in the estimation predication the phrase "true" refers to the statement, and therefore it verifies in the proper sense its internal coherence, in the axiological predication "the true value" constitutes, from the exterior and broadly, the context of values inside which true (or false) evaluations of true (or false) values are carried out.

The other issue to clarify concerns just those facts, defined as "truth-makers" as they are recalled to make the propositions true, and as such constitute the extra-linguistic material (ib., p. 108) of the judgment of value.

This last issue is mainly linked to the diverse theories of truth.

5 Theories of Truth and Estimation Truth

The theories of truth involve the science of valuation in both estimation and axiological predication realms.

The theories of truth (ib., p. 41) are divided in:

- *robust* theories, that connect the noun phrase "true" with other concepts and predicates, and say how the proposition should be formulated to be true:
  - correspondence theory: the proposition is true if it corresponds with the facts;
  - coherence theory: the proposition is true if it is consistent with the most diffused opinion;
  - pragmatism: the proposition is true if it has predictive success, explicative effectiveness, if believing in it is useful for a purpose;
- *non robust* theories, in general referring to the theory of A. Tarsky expressed in the "diagram T": *the proposition "p" is true only if p*; this diagram represents

> the most common way we interpret truth. The diagram T originates different forms of *deflationism*, the tendency to reduce the importance of truth itself as actual and identifiable property (ib., p. 100); many deflationist theories end up by denying truth itself without escaping, if not in rare cases and only partially, from the auto-rebuttal implicit in any negative meta-theoretical position (ib., p. 135), appearing as a consequence irrelevant.

The theory of "alethic realism" is the most capable of giving scientific robustness to the common sense with which we mean "true", by implementing the Tarsky's diagram T in the following fashion: "a proposition is true is things are like it says". In his extensive and circumstantial exposition of this theory, F. D'Agostini shows it is the most capable of escaping from the Aristotelian rebuttal (*elencos*) and epistemic theory and anti-realism as well.

Epistemic theory (verificationist), implies the dependency of reality on the possibility to know it, "truth for us" (Quine): Dummett argues that while the idea of a reality independent from language and from knowledge focuses on what is true, epistemic theory concerns what "is said to be true" and therefore defines the "theory of comprehension of the significance" instead of the theory of truth (ib., p. 121).

Alethic realism doesn't imply metaphysic realism, because it doesn't say how the world is made, but assumes the way things are as term of verification of the cognitive entities we use in the experience of discussion. Whether the world is made of things independent from our cognitive experience (metaphysical realism) or a totality of perceptions, is a different matter that doesn't influence the meaning of "true". Alethic realism comprises metaphysical realism (reduction of mental reality into a physical reality) and epistemic theory (or idealism, reduction of physical reality into mental reality, ib., p. 123), in the sense that it doesn't say whether mind is dependent on reality and the world is dependent on language or not. In this case the expression "things are this way" should be considered.

Alethic realism, in synthesis, says that reality may be thought of only in terms of truth, and therefore *it is not true what is real but what is true is real*.

A very important issue on these acquisitions is that even outside the field of value and valuations, "truth", as presented in the T diagram, is a transversal function in between *language* ("p") and *world* (p). In this sense, this is one of the most brilliant parts of F. D'Agostini's treatise for the purpose of understanding something on the *true value*.

It is often argued that the estimation discipline is transversal as the value judgment is attributed to properties and projects dealing with different realms of experience where the economic value arises. Environment, territory and landscape are parts of reality whose knowledge is distributed between different disciplines that, in a certain sense, converge (from our point of view) in the property of value or in the capability of being worth, as the value function is characterized by many variables. But the teaching that comes out of the reflections on truth is different and, "2008" (De Monticelli 2008). The estimation discipline is transversal as the evaluation functions, in the two estimation and axiological articulations, coordinate different layers of being worth as experience and norm: in the estimation predication, the way things are and the attributes of value; in the axiological predication, the sense of the way things are in consideration of how it would be better they were. The value judgment as a whole coordinates language, world and determination. This issue complicates further the discussion on truth and true value, and refers to the kinds of statements participating in this double predication.

6 Evaluative Statements: A Science of "Paranormal"?

For the present purposes it may be useful the definition of statement as "real segment of the discourse produced by the subject that makes the statement itself in a definite communicative situation: the subject that makes the statement differs from the locutor in assuming responsibility for the statement (Beccaria 2004, pp 281–3). The statement constitutes the minimum unity of the discourse (in this case, the value judgment), of which it is a segment delimited by a unitary communicative intention. Responsibility and intention form the base of the semantic value of the statement, the sense, that exceeds the semantic value of the simple sentence, the meaning (Simone 2005).

The statements constituting the value judgment are mainly of three *types: descriptive, evaluative, normative,* and they utilize a connective fabric of subordinate statements: hypothetical, doubtful and negative. The assertive strength of the meta-statement that affirms the true value is not in the sentences in themselves, but in the organization, coalescence and compliance (*concinnitas*) of their meanings, therefore of their overall "communicative conformity" (Beccaria 2004, ib.).

The *descriptive* statements are explicit and they are part of the estimation predication; the *normative* statements address the general premises of evaluation and are implicit if accepted and practiced, while they are made explicit whenever the evaluation intends to emend or subvert these premises: in between, the *evaluative* statements connect the two layers, and are preferably reinforced by a procedural redundancy that increases their robustness.

One of the critical issues on the truth of value and the evaluations is the fact that the above mentioned three types of statements escape, each its own way, from the classical logic based on the law of non contradiction and on the law of the third excluded, involving the well known "paracomplete" (A. "subdetermined" situations) and "paraconsistent" (B. overdetermined situations) logics, and deal with the problem of the violation of these two laws, emerging in the borderline cases of the paradoxes (D'Agostini, ib.).

(A) The solution admitting the violation of the law of the third excluded—not true and not false—is called "truth-value gap". This happens in case of:

- *Epistemic gaps*: the procedure is effective but we don't have enough evidences;

- *Category errors:* i.e. assuming, in imperfect markets, the approach based on the *most probable price* "violating the logical syntax of the *language*" (ib. p. 203) of *the money-goods* (Rizzo 1978);
- *Failed presuppositions*: i.e. procedures like the *residual value* and the *income approach* ones, with many variables on which the result is highly dependent;
- *Assertive failures*: observation without interpretation (meaning without sense) typical of the statistic models;
- *Contingent futures*: foresee the actual value instead of attributing the real one;
- *Normative* statements: they are declaratory statements concerning how the world should be made, and that define the ultimate end of the evaluation; they refer to conflicts on the common good; they impose a choice based on value connected with the facts of the world we know, and referring to which we imagine a better world (D'Agostini, ib., p. 322–24). Referring to the *three values* (§ 2) we observe that the disagreement between different points of view (purchasers and sellers) is not justified (ib., p. 331), and as a consequence the value judgment enacts the cognitive functions by means of which, on the grounds of the facts, the contrasting positions are justified and are finalized to the decisions to make according to reason and truth. For all these cases we may also talk of knowledge gaps (weak paraconsistency, ib., pp. 209 and 225) instead of truth, and therefore not of lack of a true value, but of difficulty of attribution.

(B) The solution admitting the violation of the law of non contradiction—"it is both true and false"—is called "truth-value glut" or "dialeteism". The case of the *three values* (§ 2) may also be interpreted in the sense of the admissibility of not consistent values; this "blows up" ("*ex contradictione quodlibet*" ib., p. 218) the estimation logic, that loses its relation to the true value: every evaluation is true (trivialism). As a consequence, the problem of a paraconsistent estimation logic is considering this overlapping saving the possibility to assert the true value. This is possible by admitting that some double truths may be acknowledged, but they concern knowledge and experience, not reality: it is a case of "evidences of not effective contradictions" (ib., p. 225); this type of contradiction concerns the stratification of the axiological layers (a good has an high market value despite it is affected by structural risks that the market doesn't see) and therefore between values and evaluations. The evaluations, in particular, are expressions confirmed by acknowledgments and evidences and therefore strongly oriented in epistemic sense ("true for us") instead of realistic sense ("things are this way"); the premise of epistemic theory is that the function of knowledge is to construct reality and select its part we can represent and then use; we experiment and accept that many phenomena cannot be explained because our conceptual structures are not up to this task, even more so when we have to deal with social facts. But not always not having evidences on the content of a proposition implies that the not verifiable proposition is false.

If the economic goods exist as representations in terms of properties or attributes, they are affected by the vagueness of the predicates expressing these properties, and as a consequence the economic behaviors on which we can infer preference functions will be influenced by it too. In particular, the Fuzzy logic attributes a graduated true value, supposing that a statement is partially true and partially false, and the two parts are complementary. The last fifteen years the estimation discipline has been practicing this approach as well, and in particular dealing with the segmentation of the urban real estate markets (Fuzzy cluster analysis), helping identify cases of sub-determination (*gap*: non belonging to any submarket) or over-determination (*overlap*: belonging to several submarkets) of the elements of the sample. The vague logic has the function to unveil the pretensions of absolute truth of the categorical predicates, and supports the non dogmatic discussion in favor of decisions.

The fuzzy logic implements, and in many cases replaces, the traditional inductive probabilistic estimation approach: "being the premises probable, so are the results" (ib., p. 248); the results depend on the articulation and completeness of the premises, and the probability calculation measures the value of truth of a statement of inductive type that is assumed as true if this measure is higher than the "epistemic standard" (preset acceptability threshold). But if from the *logic* point of view the value of truth in both approaches (fuzzy and probabilistic) is provided as a percentage, and the value of falsity is given by its complement, in *factual* sense the Fuzzy logic focuses on the phrases that may be vague (young *and* old), while the probabilistic logic focuses on the events (winner *or* loser).

7 Conclusions. Discussion-Based Truth for a "Paranormal" Reality

The axiological rationality inspired by true value connects the epistemic layer of the evidences with the *ontological* one of reality and the *logic* one of the interferences. The contradictory situations—the case in which similar goods are attributed different actual values (not compliant situation in correspondentist sense) or different appraisers estimate different values of the same good (non compliant situation in coherentist sense)—must be solved: the estimation practice choses the shortcut of eliminating the "inconvenient reality", that means the cases that obstruct the model: what is out of the relation characteristics/price is out of the logic of the market and the estimation discipline; the true in factual sense is not necessarily true in estimation sense.

But why exclude that what is not true from the point of view of the market and the evaluations might be true from the point of view of values? The space of values inside which the evaluations are justified and verified is a space of discussion where free thought and collective intelligence (Labinaz 2013) generate decisions (about method as well) leading to settle the logic contradictions and to deal with the inaccessibility of reality: evaluations exceed observations as choices exceed evaluations; decision (responsibility) is immanent in evaluation (interpretation) that is immanent itself in observation (information).

The orientation of this research and its developments is just this: the perspective of values overrules the practice of the evaluations: the theory of truth contains the scientific foundation of the above mentioned issue.

The encountering of the epistemic and logic difficulties in the description, interpretation and assertion of value, fosters the enactment of tools referring to the truth as primary constitutive term of reality.

The conclusion of these reflections follows the solution proposed by D'Agostini and here embraced in the broadened perspective of the "truth of value".

Value, like truth, is an undeniable concept and an indispensable reference for action; it is a transversal entity that—like truth, that connects language with the world—is one of the properties of the objects (the representation of the world) and the decisions on them (the construction of a better world); it defines a particular space of experience, the one inside which it is possible to compare behaviors, actions, decisions. In this sense, the true value—the true evaluation of true values—cannot be reduced to the response to a well formulated question, but includes instead the very method to formulate it. In this sense the axiological predication exceeds the estimation predication, like the end exceeds the means.

The complexity of contemporary societies concerning needs, perspectives, possibilities, and therefore options (with the related extension of the entity and the types of "*existential* cost-opportunities"), makes evaluation an omnipresent practice requiring an authentic axiology (system of values in sociology, theory of values in economy) and adequate tools. The fundamental elements of this axiology are just the super-concepts or transcendental (good, true, right, being) that, like "skeptical tools", enact free thought and contribute to build, restructure, demolish and rebuild the institutions accountable to affirm, defend and specify them.

Truth operates disregarding the rigidities of logic, the nihilistic closures, the mistrust of the neo-sophistic skepticism (De Monticelli 2010): "if many truths exist, truth doesn't exist, and reality itself is inaccessible and deceptive".

The strategies of a truth of value are characterized by two main issues: the first concerns facts: they are not limited to the physical world, but also comprise the "speech acts" connecting this world to language, and enrich the ontology of the objects we valuate; the second concerns the enlargement of ontology itself: "being may be predicated in several ways": there are not many truths, but many an ontology each assuming one and only one truth on value: one and only one evaluation.

The consequence of this second issue concerns the multidimensional extension of the approach to the evaluations, meeting the different types of ontology and the different methods of predicating the being, and that establishes the "multi-ontological evaluation".

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Appraisal of Manufacturing Buildings Through the Depreciated Replacement Cost Approach

Sergio Copiello, Valentina Cosmi and Stefano Stanghellini

Abstract It is well-known that the persisting crisis of the real estate market, in the wake of the large-scale financial and economic crisis starting from the year 2008, is leading to diminishing property values. An earlier and more pronounced effect lies in the lower number of transactions resulting in the scarcity of sales that characterizes several sub-markets, including the one concerning the manufacturing buildings. Within the real-estate appraisal discipline, the aforementioned framework entails growing difficulties—if not even the inability—to find an appropriate number of so-called comparables, to implement the market-value estimation process. This condition involves the need to identify alternative estimation procedures. Some specific features of manufacturing buildings pave the way to the adoption of the Depreciated Replacement Cost method. Indeed, due to the evolution of the construction techniques, the old factory buildings are frequently classed as 'out of production'. Meanwhile, the poor market conditions make them prone to be treated as out of the market. The depreciated replacement cost procedure has been debated occasionally within the literature, both national and international. Nonetheless, its application still deserves further research due to the fact that it entails several relevant issues. This study focuses on three of them. The first concerns the estimation of the useful life and the residual life of the buildings characterized by heterogeneous structures, finishes, and installations, due to their realization or replacement during different time periods. The second topic refers to the distinction between land value and improvement value. Finally, the third issue relates to the relationships among the results of the estimation procedure, the real-estate appraisal discipline as a whole, and the accounting principles, on which companies' balance sheets rely.

S. Copiello (✉) · S. Stanghellini
Department of Design and Planning, University IUAV of Venice,
Dorsoduro 2206, 30123 Venice, Italy
e-mail: copiello@iuav.it

V. Cosmi
Department of Architecture, University of Ferrara,
Via Della Ghiara 36, 44121 Ferrara, Italy

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Keywords Depreciated replacement cost · Generally accepted accounting principles · Land value · Improvement value · Manufacturing buildings · Repurposed buildings

1 Introduction

The intrinsically cyclic nature of the real estate market is well-known and widely-recognized by the literature (Wheaton 1999). According to a study developed by the Bank of Italy (Muzzicato et al. 2008), during the post-Second World War era, the Italian real estate market has experienced four major cycles. The last full cycle started with the peak of values reached in 1992. It was suddenly followed by a downward trend that continued until the second half of the 1990s, and a further nearly decade-long expansion (Gabrielli 2013): "Opening with the recession of the early 1990s, house prices declined, albeit with pauses, until the first half of 1999. In those 7 years, the fall in prices in the provincial capitals was around 10 percentage points smaller than the drop recorded in the same phase of the third cycle. With the start of Monetary Union, the decline in the cost of money and the recovery in households' purchasing power fueled a prolonged upswing in house prices, which began to show some signs of slowing at the end of 2006." (Muzzicato et al. 2008, p. 21).

Starting from the year 2008, the real estate market underwent a profound crisis (Taltavull de La Paz and Gabrielli 2015), as well as most of the other economic and financial sectors, thus marking the beginning of the fifth property cycle, which is currently still ongoing. The above-mentioned crisis revealed itself not exclusively by the decrease of prices, which indeed was initially anticipated by a remarkable slowdown of trades.

Let us consider a portion of the Po Valley, Northern Italy, embracing the provinces of Bologna, Forlì, and Ravenna (it is the area where the case study to be presented in the following Sect. 3 is located). According to the cadastral statistics published by the Italian Revenue Agency,[1] during the time span between 2006 and 2013, the number of real estate units grew for almost all types of building. For instance, the number of existing dwelling units increased by 9.7%, from about 913 thousand to more than a million in absolute value. Meanwhile, the number of manufacturing buildings showed a growth rate of 14.9%, from about 46 thousand to around 52 thousand units (Fig. 1). By cross-matching the data concerning the cadastral statistics and the data gathered from the Property Market Monitor,[2] we get some empirical evidence about the transaction slowdown during the same period.

[1]Please refer to the following web address, where the underlying data may be accessed: http://www.agenziaentrate.gov.it/wps/content/Nsilib/Nsi/Documentazione/omi/Pubblicazioni/Statistiche+catastali/.

[2]Please refer to the following web address: http://www.agenziaentrate.gov.it/wps/content/nsilib/nsi/documentazione/omi/banche+dati/quotazioni+immobiliari.

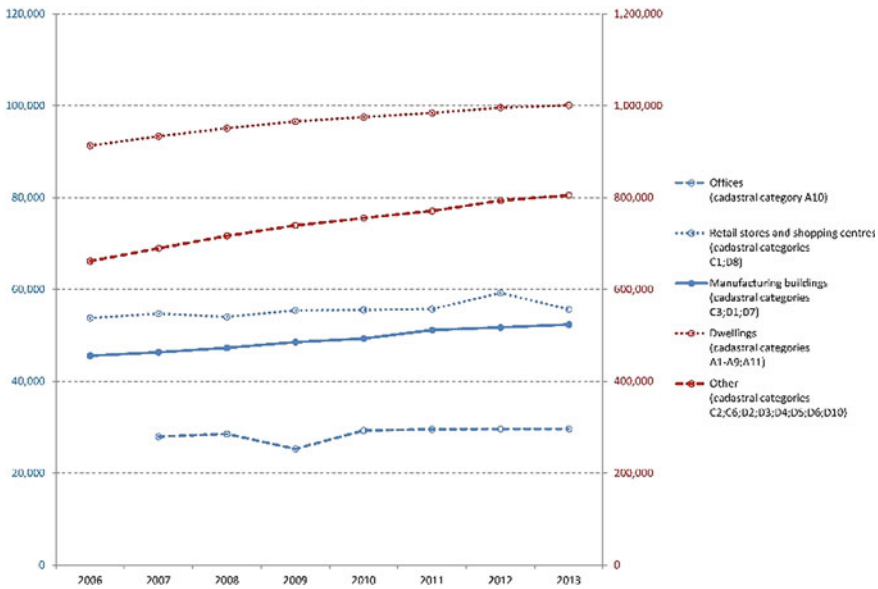

Fig. 1 Number of existing real estate units in the provinces of Bologna, Forlì, and Ravenna

Indeed, in 2006 there were about 32 thousand trades of dwellings, which fell to around 14 thousand seven years later, an overall decrease of 55%. The manufacturing buildings showed a similar trend: there were 697 transactions in 2008, falling to 387 in 2013, with a total decrease of about 45% (Fig. 2).

The aforementioned figures allow us to summarize two cornerstone remarks. In the reference area, the manufacturing buildings increased in number even during the crisis period; nevertheless, they represent less than 3% of the properties intended to be traded in the real estate market. Moreover, although the trade transactions of manufacturing buildings reached 1.5% of the building stock in 2008, they sharply decreased over the following years, so constituting no more than the 0.7% of the industrial building stock traded according to the latest data.

This study aims to provide several insights into three issues of disciplinary relevance that arise while we deal with the appraisal of manufacturing buildings under weak market conditions, particularly using as a last resort the depreciated replacement cost (DRC) method. The first issue concerns the estimation of the useful and residual life of the buildings characterized by heterogeneous structures, finishes, and installations, due to their realization or replacement in various periods. The second topic refers to the distinction between land value and improvement value, the latter meant as structural value. Finally, the third issue relates to the relationships between the results of the estimation procedure, the real estate appraisal discipline as a whole, and the accounting principles, on which companies' balance sheets rely.

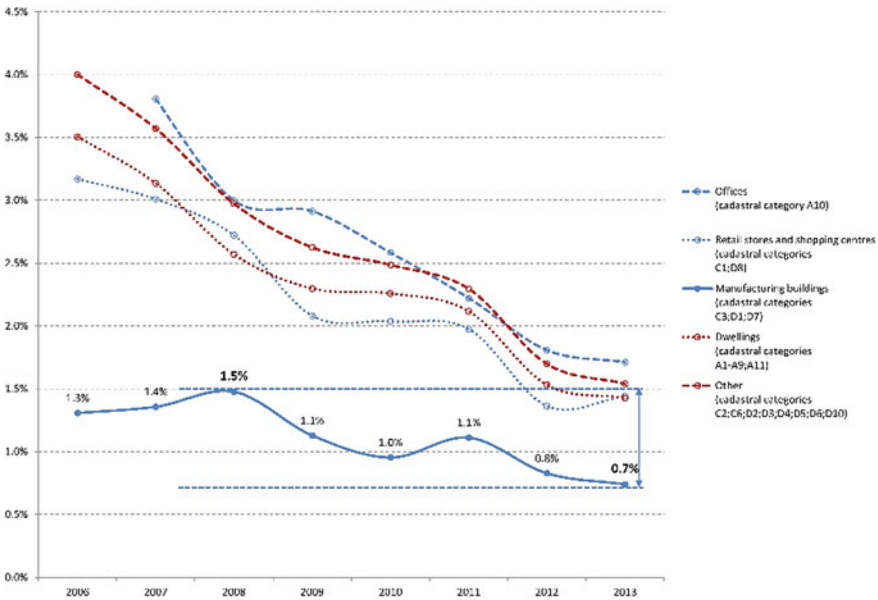

Fig. 2 Rate of sale of real estate units in the provinces of Bologna, Forlì, and Ravenna

This contribution is arranged as follows. Section 2 discusses the achievements of the background studies in research and professional fields. The following Sect. 3 presents, in brief, a case study used as a basis to discuss, in Sect. 4, those we identified as the disciplinary-relevant issues. Finally, Sect. 5 offers the main concluding remarks.

2 Background Studies

The literature already argued that manufacturing and industrial properties are not commonly traded (Michieli and Michieli 2002), which in turn makes their appraisal much more complicated in comparison to residential properties, also because the former are characterized by a considerable degree of diversification and heterogeneity. Overall, the absence of an active market for manufacturing buildings necessitates their estimation by exploiting the opportunities offered by alternative procedures, such as those based on the substitution value. This implies conceiving a replacement relationship of the building under appraisal with a different property (Michieli and Michieli 2002), intended for the same function, which should also be able to ensure the same level of utility on behalf of the owners or users (Realfonzo 1994).

The International Valuation Standards (IVSC 2001) classify the substitution relation, and its application by the DRC, as follows: "Although the majority of professional valuations […] involve Market Value, there are circumstances that call for bases other than Market Value" (IVSC 2001, p. 105). The same source states later that "Depreciated Replacement Cost (DRC) is considered an acceptable method used in financial reporting to arrive at a surrogate for the Market Value of Specialised and Limited Market properties, for which market evidence in unavailable" (IVSC 2001, p. 107). The above-cited sentences produce a paradox: does DRC provide a non-market-related value, or rather does it enables to identify the market value? The International Valuation Standards try to solve the issue by recalling the twofold nature of the items included in the estimate: on the one hand, the market value currently expressed by the land, and, on the other hand, the replacement cost of the asset once reduced due to physical deterioration, obsolescence, and optimization. Therefore, "the result combines market and non-market elements" (IVSC 2001, p. 107).

Nevertheless, it deserves mention that some literature includes the DRC among the non-market based values (Wyatt 2009), while other references offer arguments in rebuttal (French and Gabrielli 2007). The former author stresses the relevance of the methodological problems arising from insufficient market data, and even more from the dichotomy between the paucity of market inputs and the supposed market relevance of the output (Wyatt 2009). Instead, the latter authors contend that the DRC should be regarded as a method, or an approach, useful to assess exactly the market value of a property, regardless of the uncertainty and other estimation difficulties caused by the lack of market data (French and Gabrielli 2004, 2007).

Leaving aside the controversy about where the DRC fits within the disciplinary field of real estate appraisal, the literature and the practice agree about its rationale. It is well-summarized by the definition provided in the guidelines published by the Royal Institution of Chartered Surveyors: "The current cost of reproduction or replacement of an asset less deductions for physical deterioration and all relevant forms of obsolescence and optimisation." (RICS 2005, p. 1). In accordance with the limited role played by the DRC method, the high-level literature is quite scarce. It focuses mainly on the following topics: the assessment of the value of the land or site to which the construction belongs (Andrew and Pitt 2001; Boyd and Boyd 2012), the taxonomy of various kinds of functional or economic obsolescence (Mansfield and Pinder 2008; Grover and Grover 2015; Thomsen et al. 2015), and their implications on the depreciation function (Manganelli 2011).

3 Case Study

As far as the DRC is concerned, there are several cases eligible to be appraised according to the discussed procedure because they fall within the set of the so-called "specialized" properties (Wyatt 2009). Some instances of properties considered off the market found during recent years in Northern Italy are as follows: a movie theater embedded into the urban fabric of a historic city center, built in the early 1950s and transformed into a multiplex some decades later (Fig. 3a); a former

Fig. 3 Properties off the market, the *upper right image* is adapted from the book “Cento anni d’impresa”, edited in 2006 by Som—Società fra operai muratori del Comune di Cesena

theological seminary built during the late 1950s as an addition to a nineteenth-century building, subsequently abandoned due to the dwindling vocations to the Catholic priesthood (Fig. 3b); and a canteen into a logistics center, designed by the leading Italian architect Mario Zaffagnini (Fig. 3c).

Regardless of the cases mentioned above, which may be regarded as peculiar and extremely rare under the scope of the appraisal discipline, a more challenging task due to what has been argued in the introductory section is posed by the estimation of large manufacturing plants located in industrial areas. The case study considered here is an industrial compound designed for the manufacture of semi-finished and ready–to-use ceramic construction materials (Fig. 4). It is located

Fig. 4 Large manufacturing plants located in industrial areas within the Po Valley

in a small-sized town in the region between the cities of Bologna, Forlì, and Ravenna.

The selected case study is interesting because, somehow, it represents a quite common situation characterizing the Northern Italian model of industrial settlements outside the major cities, namely districts based on a "core" composed by a few important industrial plants, around which other ancillary firms were established over the course of time.

4 Relevant Disciplinary Issues

4.1 The Useful Residual Life of Buildings Characterized by Heterogeneous Elements

The first disciplinary issue arises from the fact that complex properties are not built in a day. Instead, they are more likely to be the result of continuous maintenance and expansion activities. Therefore, several sections of such buildings might be characterized by non-homogeneous construction costs, due to varying construction materials used in different periods. Furthermore, the same sections may have different expected useful lives, which in turn can be different for structures, finishes, and installations, at the least, and they may also be characterized by various functional forms of the depreciation rate.

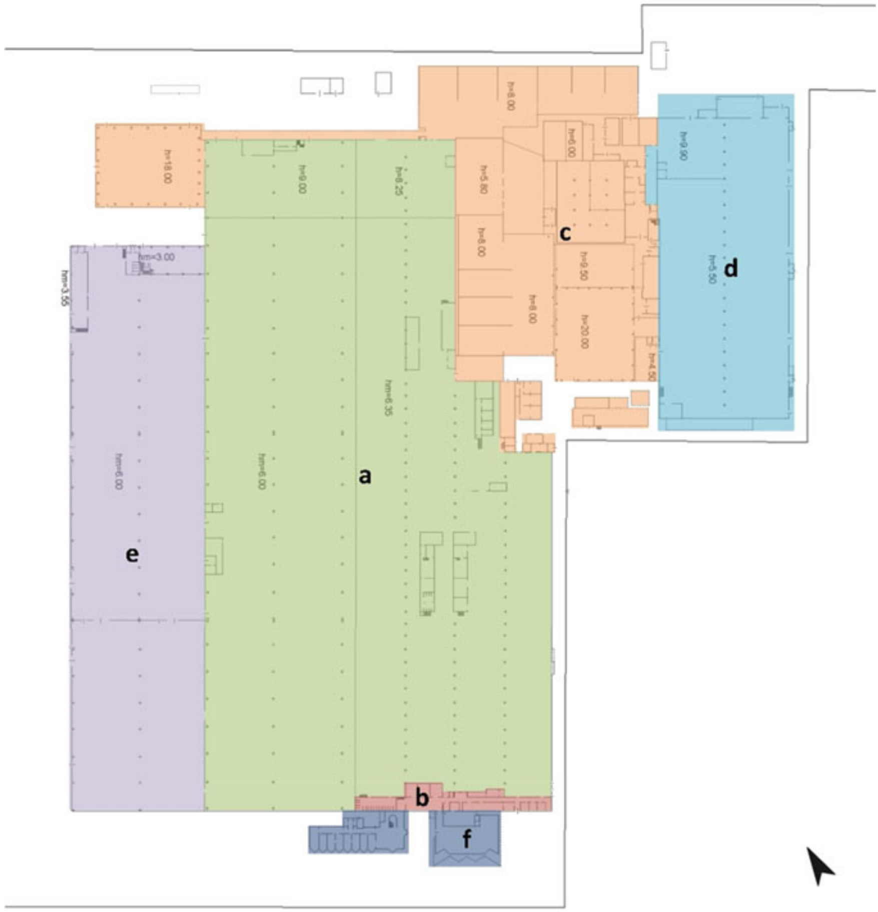

Fig. 5 The case study: a complex manufacturing building

The case study considered here is a suitable example of a complex building, deriving from the aggregation, during the time, of several additions to an initial core (Fig. 5). The original factory, built during the period from the 1960s to the 1980s, is characterized by beams and pillars made of prestressed reinforced concrete and by steel bracings (Fig. 5a). The building structure and the installations are well maintained, but the finishes are absent. The portion of the factory facing the main street is used for administrative offices (Fig. 5b), thanks to works carried out during the 1970s and the 1980s. The usable floor area has standard finishes: plaster, false ceilings, and aluminum window frames; but it is characterized by an accelerating degradation rate due to age. A major addition to the production floor area dates back to the 1980s (Fig. 5c), but the construction technology radically changed, being for the most part characterized by a steel support structure, with curtain walls and roof made of corrugated metal sheet. Two further buildings were added during the early and late 1990s (Fig. 5d, e, respectively). Moreover, another floor area designed for the showroom (Fig. 5f), made of a steel structure with high-quality finishes, was built on the front side of the factory.

In summary, different building sections should be characterized by diversified construction costs, expected useful lives, and depreciation rates. The DRC method enables dealing with this disciplinary issue. In the case study, it is applied with the aim to discriminate among different construction costs and to express them according to a threefold distinction between structure, finishes, and installations, to make use also of diversified functional forms of depreciation (Fig. 6). This is made possible thanks to the progressive spread of technical reports about the structure of construction costs for several building types (Collegio degli Ingegneri e Architetti di Milano 2014). Furthermore, the literature about the expected life of the buildings (Stone 1980) and their physical and functional elements (Flanagan et al. 1989; Gottfried 2003; Manganelli 2011) deserves to be mentioned. Notably, the last of the references above (Manganelli 2011) brings out the following remarkable dichotomy. On the one hand, we are facing long-lasting structures, up to hundreds of years, if they undergo to a continuous and proper maintenance. On the other hand, finishes and installations are mostly characterized by a short to medium lifespan, leading to the need for their replacement, sometimes in just a couple of decades.

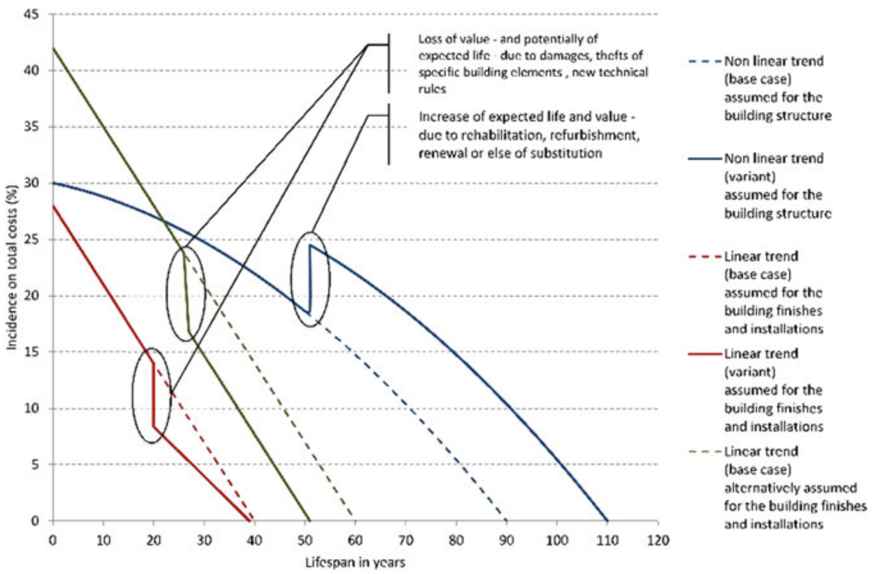

Fig. 6 Functional forms of depreciation

4.2 The Land Value and the Improvement Value

Krause and Bitter (2012) found evidence of an emerging research branch relating to land values, subsequent to the recent boom and bust cycle shown by the real estate market. This branch may be roughly divided into two related fields. The former pertains to the tracking of land price indices. Instead, the latter consists in the partitioning of the two components of the real estate value: the land value and the improvement value; the latter being precisely a depreciated construction cost (Davis and Heathcote 2007). An interesting empirical finding is that the higher the so-called land leverage, namely the ratio of land value to structural value, the more volatile are the property prices (Oliner et al. 2010; Bourassa et al. 2011).

In the analyzed case study, the estimation process was intended to provide a result to be recorded on the balance sheet of the company that owns the building. The changes made to the National Accounting Principle no. 16 requires distinguishing between the cost incurred to acquire the building's land, on the one hand, and the production cost incurred to erect the manufacturing building, on the other hand. The national accounting principles are drafted according to the International Financial Reporting Standards (previously International Accounting Standards). The Principle no. 16, mutually with the valuation criteria set up in the Section 2426 of the Civil Code, defines the rules governing fixed assets, otherwise known also as tangible assets, such as property, plant, and equipment. In agreement with the accounting principle, the latest tax regulations also mandate, to all the entrepreneurial legal entities, division of the value of their properties into two components: the land value, the former; the building value, the latter. Therefore, this issue became prominent in the appraisal discipline (Ingaramo et al. 2007). Within the scope of the case study, the issue has been addressed by referring to some pertinent information on the land leverage—also known as land value incidence in the Italian context—offered by the real estate market monitors, particularly the technical journals edited by the group Il Sole 24 Ore. Nevertheless, the available data are scarce, mostly limited to the main urban areas, and specifically focused on the residential real estate.

4.3 The Real Estate Appraisal Discipline and the Accounting Principles

The matter discussed in the previous paragraph paves the way to a third topical issue, which again ties together the real estate appraisal and the accounting principles. The national literature has long since hypothesized that the DRC method might be useful to solve the appraisal issues linked to the values to be recorded on the balance sheet, as well as on the profit and loss account (Forte and De Rossi 1974). Nonetheless, this research field appears to have been neglected, at least partly, in the Italian context.

On closer inspection, although the accounting standards do not perfectly match with the property appraisal fundamentals, a certain number of commonalities can be found. Within the scope of the estimation process required in our case study, such commonalities were arranged around three cornerstones. Firstly, the accounting of the production cost incurred to erect the manufacturing building may benefit from the appraisal of the building production cost, as the sum of construction cost and other related burdens. Secondly, the accounting concepts of time-limited use and potential residual use may match the ideas of expected useful life and residual life developed by the appraisal discipline. Thirdly, the accounting of the amortization of capital goods may be related to the building depreciation due to age and degradation resulting from use, as considered in the appraisal discipline.

Looking forward, an in-depth reasoning on how to reconcile the two disciplinary frameworks, to achieve more strict matches, can be useful to fulfill the appraisal needs that are currently expressed about manufacturing buildings. Nevertheless, it deserves mention that having recourse to the DRC method gives rise to other questions. For instance, the issue of the equilibrium between market prices and replacement costs needs to be disentangled (Schultz and Werwatz 2011), since it represents a source of concern in the field of financial accounting (Heald and Scott 1995).

5 Conclusions

In this study, we deal with the appraisal of manufacturing buildings. Due to a weak market, which usually shows few transactions in comparison to the size of the building stock, and even fewer transactions during the downward cycles, such an appraisal may benefit from the adoption of the Depreciated Replacement Cost approach.

Although DCR may be included among the well-established approaches within the methodology of the real estate appraisal, several relevant disciplinary issues need to be further considered. The three addressed here refer to the residual useful life of buildings characterized by heterogeneous elements, to the relationship between the value of the land and the value of the construction, and, in general, to the connection with the contents of the accounting principles.

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Do Real Estate Cycles Exist and, if so, Are They Predictable?

Francesca Leccis

Abstract A straightforward answer to the question comes from Lee's paper entitled "Real Estate Cycles: They Exist… and Are Predictable" (2011). However, this essay intends to be critical, thus it investigates the various schools of thought on property cycles aiming at determining if they exist and, in the case of positive evidence, if they are predictable. The paper is divided into five sections: the introduction, a general definition of cycles, an analysis of the two opposite academic views on cycle existence, an overview on real estate forecasts, including techniques, evaluation of methods and challenges, and a final section where the findings are summarized and a conclusion is drawn.

Keywords Real estate · Property cycles · Forecast · Predictability · Consensus

1 Introduction

The existence of property cycles is largely assumed as a postulate in much of the research publications. This paper questions this assumption by reviewing a number of academic studies that adopted different approaches to this issue and took opposing viewpoints. In order to comprehend the body of knowledge presented here, it is first fundamental to define property cycles and their characteristics. In addition, it is necessary to identify their linkages with the real economy and the money economy, since both the business cycle and the credit cycle influence the property cycle. The paper then discusses the various arguments that support either the existence or the non-existence of property cycles in order to pursue the first aim of the paper, which is to verify if the property cycle theory is validated or rejected. Once the evidence leads to the recognition of the succession of diverse cycles throughout the history of the property market observed, the paper investigates the

F. Leccis (✉)
Dipartimento di Ingegneria Civile, Ambientale e Architettura, Università degli Studi di Cagliari, via Marengo 2, 09123 Cagliari, Italy
e-mail: francescaleccis@unica.it

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regularity of cycles. Indeed, the second aim of the paper is to understand whether cycles are predictable or not. The academic community is split into two opposing positions: those who elaborate complex techniques to forecast cycles and those fully convinced that to predict them in a reliable and consistent way is not possible. Nonetheless, the literature reviewed presents some indicators and indexes that anticipate economic turns enabling for short-term predictions. However, it is acknowledged that cycle forecasts are difficult, to say the least, due to the complexity of mathematical models, data availability, and, most of all, investors' behavior and experts' reliability. This is illustrated by both the unpredictability of investors' reactions to market fluctuations and the role of consensus and smoothing in forecasting. In particular, it is shown that these aspects increase the uncertainty of forecast formulation. In order to obtain more accurate forecasts that take into account these critical factors, it is finally suggested to elaborate prediction models that integrate both behavioral and mathematical variables.

2 Property Cycle Definition

Property cycles are "international and global forces" constituted by "a logical sequence of recurrent events reflected in factors such as fluctuating prices, vacancies, rentals and demand in the property market" (RICS 2014). In particular, the physical cycles of supply and demand drive rents and affect financial cycles that in turn influence property prices through the capital flows to real estates (Mueller 1995).

Pyhrr et al. (1999) define real estate cycles as the interaction between the physical cycles of supply and demand. Physical cycles are local since the demand for space depends on the space needed for residential and business purposes, and the supply of space is determined by actual space, space under construction, and prospective need for space. The relation between supply and demand is defined through the definition of the occupancy/vacancy rate, which is a fundamental factor in affecting rents (Muller 2005). Typically, the rent cycle matches inversely to the vacancy cycle and is lagged by ¼ of the cycle periodicity, as shown in Fig. 1 (Wheaton 1987).

In Fig. 2, the intersections of the two curves represent the points of the equilibrium between supply and demand.

The general property curve is obtained by connecting these points, so that Bs constitute the peaks and As constitute the troughs (Jing 2010), as reported in Fig. 3. Mueller and Laposa (1994) identify four phases in the cycle: recession, recovery, expansion, and contraction. Investors indicate recovery and expansion as the up-cycle or the cycle upside, because the occupancy rate increases in these phases, whereas they label contraction and recession the down-cycle or the cycle downside, due to the fall of the occupancy rate. The equilibrium-rate line intercepts the curve at the inflection points where the curve changes its concavity and it marks the different positions and directions of the cycle (Pyhrr et al. 1999).

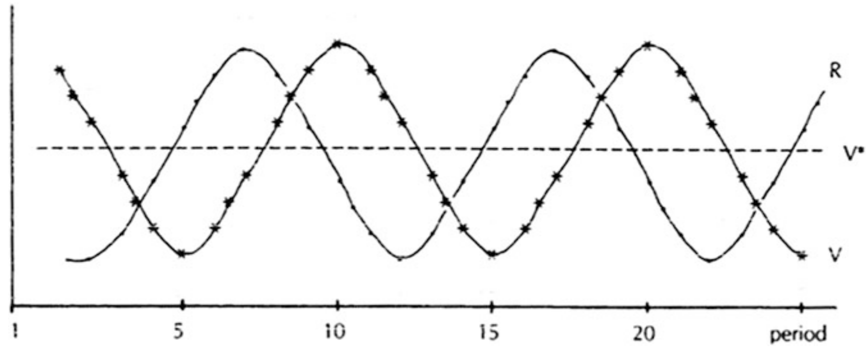

Fig. 1 Vacancy and rent cycles (Wheaton 1987)

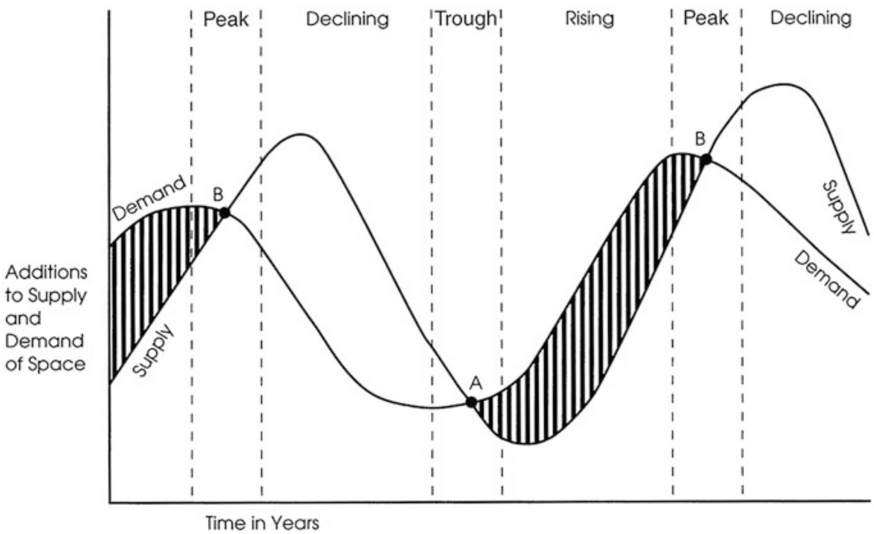

Fig. 2 Supply and demand cycles (Pyhrr et al. 1990)

However, the periodicity of the cycle is not always the same and Barras (1994) listed four types of property cycles identified by the literature: short cycles lasting for four to five years, long cycles lasting for nine to ten years, long swings lasting up to 20 years, and long waves of 50 years.

The conceptual model elaborated by Barras (1994) and reported in Fig. 4 shows how the property cycle is influenced by the business cycle in the real economy and by the credit cycle in the money economy. Indeed, real estate prices, and consequently total property returns, are mainly determined by capital flows. In particular, as capitals flow in prices increase (Muller 2005). In addition, interest rates have an impact on prices as well (Mueller 1999). Mueller (1995) refers to these movements as financial cycles. The distinction between physical and financial cycles is useful to

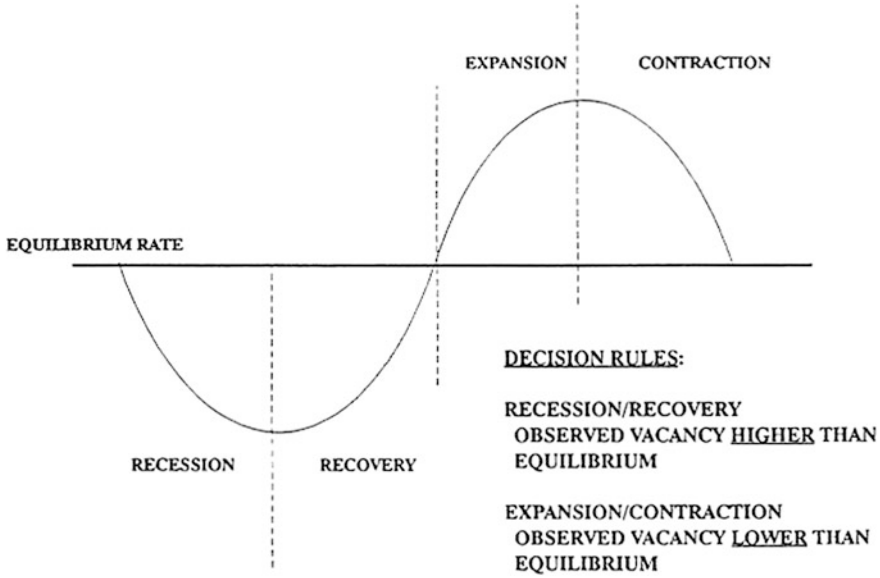

Fig. 3 General property curve (Mueller and Laposa 1994)

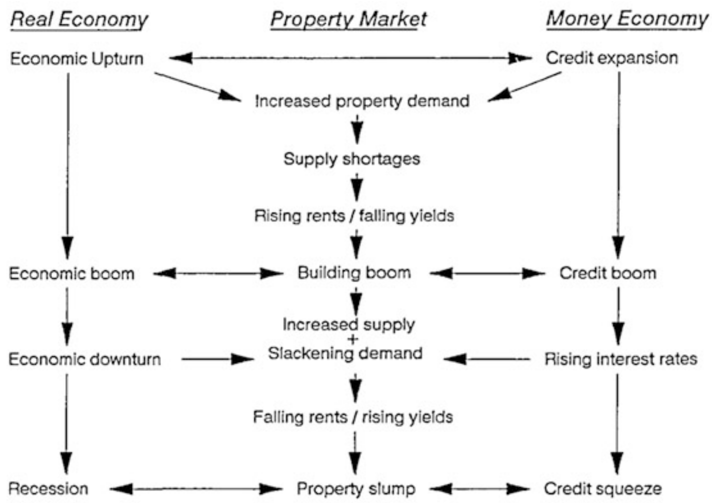

Fig. 4 Interactions among cycles (Barras 1994)

understand the lag between market movements and real estate prices (Mueller and Pevnev 1997).

When discussing cycles, real estate academics and practitioners identify three markets in which they occur: use, investment, and development. In this way, they distinguish the rental cycles, the yield cycles, and the construction cycles (Tiwari and White 2014). In this context, another useful definition considers cycles as the "tendency for property demand, supply, prices and returns to fluctuate around their long term trends or averages" (Baum 2000).

3 The Two Academic Positions

Even though numerous studies have been conducted on property cycles, there is considerable controversy about their existence in the academic world. It is possible to divide researchers into two opposing groups: one that is deeply convinced that cycles exist and that, by putting a sufficient effort, they can be predicted; and one that compares the reliability of forecasts to astrologers' reliability (Fama 1965) and the predictability of future trends to the predictability of the results of a fair roulette wheel or of the toss of a coin (Cootner 1962).

In the last group can be placed the studies conducted by socialist economists and reviewed by Allsopp (1971) that rejected the idea of natural periodicity of property cycles. Indeed, Nove (1967) sees the cause of cyclical effects in political and natural shocks, while Brody (1967) and Goldmann (1969) see the cause in planning processes and political pressure to over-invest.

Fama and Blume (1966) stated that price "changes are independent random variables" and thus supported the theory of random walks elaborated by Bachelier (1900) according to which future trends cannot be predicted on the basis of past series because fluctuations depend on innumerable factors including both earlier trends and actual market position. This model has been tested by numerous researchers through various different techniques. One of the most notable examples is Kendall's work (1953), which analyzed 22 price-series and experimentally proved that both serial correlation within series and lag correlation between series were low, which implies that forecasts cannot be inferred.

Nevertheless, Alexander (1961) re-examined Kendall's series and found confirmation of the theory of random walk over the time dimension, but not in the move dimension. Indeed, he verified that a move, once started, tends to persist. In addition, Hauthakker (1961) specify that randomness can only be disproved but not proved as tests can only detect the absence of specific researched patterns, but cannot exclude the presence of unknown ones.

Concerning the view that sustains cycle existence, Harris (2000) explained that cycles would not exist if a perpetual equilibrium between demand and supply could be maintained. However, the lag between the demand emergence and the supply availability determines the cycle's existence (Harris 2000).

Baum (2000) had no doubt in asserting that property cycles can be demonstrated both in UK and European real estate markets. Zarnowitz (1992) points out that after every crisis new theories on property cycles emerge in an attempt to explain the causes. The last one does not constitute an exception, so Jadevicius et al. (2010) stated that the existence of cycles both in the general economy and in the property sector is quite evident after the housing market crash of 2008 and the subsequent global economic crisis. Actually, it is possible to recognize cycles since the dawn of time. Sheppard et al. (1979) traced the building activity in London over the two-century period between 1714 and 1900, and they produced strong evidence for the existence of the classical pattern of property cycles characterized by the alternation of booms and busts, as illustrated in Fig. 5.

Later, McGregor and Schwann (1999) proved the presence of cycles and co-cycles in property markets in various British regions by analyzing the data from 39 of them. Simultaneously, Wilson and Okunev (1999) recognized the existence of property cycles thanks to the analysis of the assets through conventional spectral-analysis techniques. More recently, Brown and Liow (2001) investigated the office market and the property stock prices in Singapore through cross-spectral analysis and univariate spectral analysis and demonstrated the presence of an eight-year cycle in both markets. Wang (2003) applied the econometric procedures of cointegration and common trend to the analysis of data of the property and non-property sectors and highlighted the presence of cyclical patterns both in the property sector and in its relation to the other economic sectors.

Even though both positions presented have quite strong arguments to prove their validity, evidence leads to an assertion that property cycles exist. It has to be said that it might be easier to prove their existence rather than not, as their non-existence can only be disproved and not proved. Nonetheless, since a significant number of studies have demonstrated their presence through the application of different

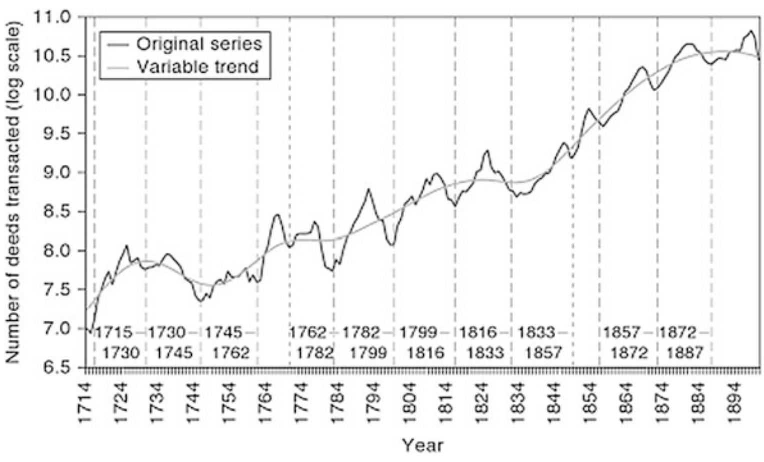

Fig. 5 London real estate market trends (Sheppard et al. 1979)

methods to various data, their existence has to be recognized. The following section will debate whether they are predictable or not, what are the methods adopted to forecast them, how forecasts are evaluated, and what are the limitations associated with forecasts.

4 Cycle Forecast

Forecasting the physical cycles is not very complicated, thanks to the abundance of data on both supply and demand. On the contrary, predicting the financial cycles is much more complicated because data on the property capital market is quite scarce, and the whims of investors have never been documented (Mueller 2005). Barras (1994) confirmed that research is able to forecast future demand, but cannot predict the competitors' reactions to this information. The physicist Isaac Newton, after a loss in the stock market, confessed that he could "*calculate the motions of heavenly bodies, but not the madness of people*" (O'Farrell 2007).

Barras (1994) highlighted that real estate booms tend to "*occur in every second long cycle of development and in every fourth short cycle of business activity*". Nevertheless, he also stated that this is just a tendency and specific economic and political conditions might alter it. Solomou (1998) illustrated that a long-run historical perspective is necessary in order to be able to sensibly predict future trends. However, he clarified that the usefulness of historical knowledge has not to be valued as an inescapable precedent, but rather in the explanation of the evolution of business cycles that make it possible to understand the mechanisms that determine the change and so lead to sensible forecasts.

Starting from this point, Achuthan and Banerji (2004) detailed that the difficult task is to predict turning points, because they do not occur in regulars intervals, and the simplistic projection of past cycles into the future leads to blunders as shown in Fig. 6. Tonelli et al. (2004) argued that, even though several econometric models have been elaborated to forecast cycles, to predict them in a reliable and consistent way is not possible yet.

Despite this, Wheaton et al. (1997) noticed a relationship between cycles and economic shocks. Coherently with this study, Achuthan and Banerji (2004) identified more than one hundred cyclical indexes that precede economic turns, so that it is possible to elaborate correct near-term predictions. Figure 7 shows how property cycles follow indicators cycles. Among these indicators, Festa et al. (2012) identified prices and the number of transactions.

Various quantitative models have been elaborated to forecast property cycles. In their book, Brooks and Tsolacos (2010) book provide a thorough explanation on many of them. Reid (1968) and Bates and Granger (1969) developed the first models that combine single forecasts techniques in order to achieve results that are more accurate. Since these studies, a lot of research has been conducted on this subject, and Clemen (1990) catalogued all the contributions, reaching the conclusion that a combination of forecasts ensure higher accuracy. Jadevicius et al. (2012)

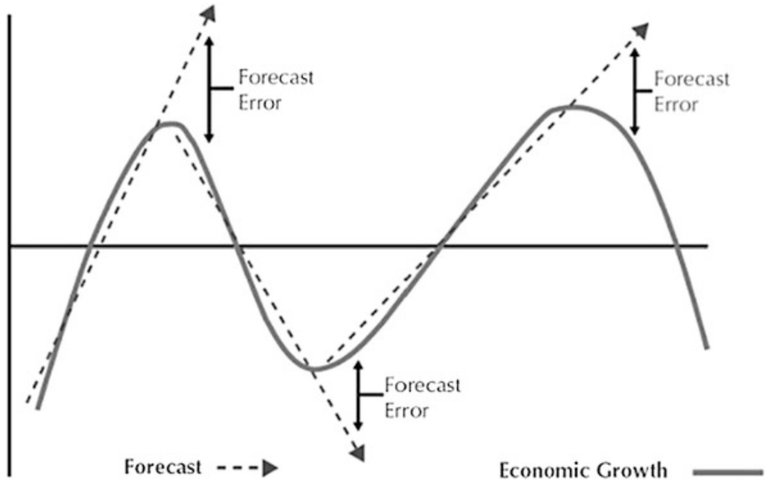

Fig. 6 Forecast errors (Achuthan and Banerji 2004)

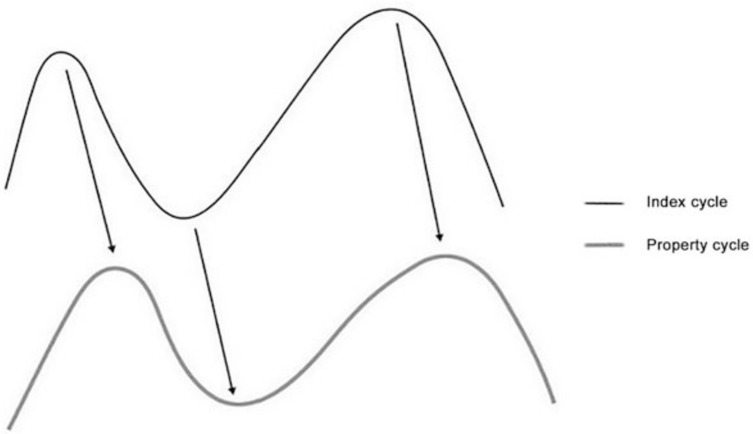

Fig. 7 Indicator cycles and property cycles (Achuthan and Banerji 2004)

tested the performance of a large number of single-forecast techniques and subsequently used simple averaging and regression to combine them in couples and verified that the accuracy is higher in model combinations than in single models.

Foldvary (1997) forecasted the recession of 2008 thanks to a prediction model that integrated the Austrian theory and the geo-economic theory of cycles. In 2007, he noticed that recessions and depressions start two years after the peak, and, since he identified the previous peak in 2006, he confirmed his prediction for 2008 adding that he expected a severe recession and depression due to the high rise of property prices and to the economic distortions caused by the growth of the money supply.

It is clear that mathematical approaches have enormously improved (De Gooijer and Hyndmanb 2006), but Barras (2009) admonished researchers for being too focused on theories rather than on reality, so that they tend to represent the reality they think should exist instead of the one they can observe. However, reality observation is quite difficult due to data availability and expert reliability (Dayananda et al. 2002). In addition, the forecasting process is further complicated by various influences that affect them. For example, Gallimore and McAllister (2004) highlighted the role of human judgment that leads forecasters to censor themselves in the name of reputation protection, forecast credibility, and acceptance among clients. The latter leads to forecast inefficiency, according to Nordhaus (1987). He suggested that efficiency probably exists in the original forecasts, but vanishes in the published ones due to the need to slowly prepare the public for the new reality in order to maintain the previously reached consensus.

Performances of forecasting methods have been evaluated over time through various accuracy measures (De Gooijer and Hyndmanb 2006). Among others, McAllister et al. (2008) measured the accuracy and disagreement among forecasts. They analyzed and compared the performances of various property and non-property forecasting organizations and they evidenced forecast consensus and smoothing. More specifically, their study suggests that forecasters tend to produce projections similar to each other and to limit the differences among them. In addition, forecasters restrain volatility by underestimating total returns in improving performances and overestimating them in deteriorating performances. The causes of homogenization in results are not clear and are supposed to lie in herding behavior among forecasters and in the use of non-property forecasts as inputs. Volatility limitation is ascribed by Nordhaus (1987) to the willingness to avoid big "jumps", and Gallimore and McAllister (2004) elaborated this explanation by attributing it to scepticism about big numbers.

Actually, informal conversations held with professionals working in real estate consultancies revealed that, by the time they write formal reports on future trends, they have already had contacts and exchanges of views with their colleagues in other firms. Consequently, it appears completely normal to them to publish forecasts that do not differ much from each other. However, this is not due to the willingness to present to the public a unique vision, but rather it is determined by group reasoning and discussion that smooth over the differences and lead to similar conclusions. According to them, a certain level of smoothing, consensus, and homogenization is unavoidable when data are analyzed in groups, since participants influence each other.

5 Conclusions

This paper is based on thorough research conducted on property cycles and presents a wide literature review, which identified different argumentations on both the existence and predictability of property cycles, aiming at validating or rejecting the property cycle theory and at determining if property cycles are predictable or not. It is divided into five sections: the introduction; a general definition of cycles; an analysis of the two opposite academic views on cycle existence; an overview on real estate forecasts; and this conclusion.

The introduction explains the starting point of the research, the aims of the paper, and both its content and structure.

The second section provides a definition and description of the cycles. It illustrates the four phases of the cycle and explains that the phases of recovery and expansion are also labelled the up-cycle because of the increase of the occupancy rate, whereas the contraction and recession phases are also called the down-cycle because of the fall of the occupancy rate. It also emphasizes that property cycles are not fixed cycles that simply repeat themselves over time. On the contrary, they are variable cycles influenced by economic and monetary cycles. In this regard, four main kinds of cycles are identified: short cycles lasting for four to five years, long cycles lasting for nine to ten years, long swings lasting up to 20 years, and long waves of 50 years.

The third section illustrates the two opposing positions regarding the existence of property cycles. On the one hand, there are the researchers who produced numerous studies that illustrate the presence of cyclical patterns in the real estate market. On the other hand, there are the scholars who assert the complete randomness of price fluctuations. Since the inexistence of cycles can clearly only be disproved and not proved, it might appear banal to share the first perspective, but the literature reviewed provides strong evidence in support of property-cycle existence by reporting numerous studies on various data analyzed through various techniques and methods.

The fourth section is the most complicated because it deals with numerous questions concerning the predictability of cycles. The main findings are the application of a historic perspective to identify signals for turning points and the formulation of constantly improved integrated techniques to predict cycles. In particular, more than one hundred cyclical indexes have been identified to elaborate near-term predictions, and it is seen that the combination of various single models ensure higher accuracy in forecast evaluation. However, two critical points are highlighted in this task: consensus and smoothing. It is reported that real estate professionals tend to influence each other and to censor themselves, causing inefficiency.

To conclude, it can be argued that property cycles exist and are predictable. However, even though very efficient mathematical methods have been elaborated for their prediction, forecast reliability might be compromised by the search for consensus, the fear of big changes and the consequent tendency to smooth over the results in order to obtain predictions closer to actual reality and easier to be accepted by clients. In addition, interaction among professionals from different firms influences data interpretation, so that they reach similar conclusions.

Consequently, it is recommended to develop new models that integrate mathematical and behavioral variables and to conduct further research to verify if they are able to provide more accurate forecasts.

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The Mass Appraisal Tool: Application of a Pluri-Parametric Model for the Appraisal of Real Properties

Leopoldo Sdino, Ferruccio Zorzi, Paolo Rosasco and Sara Magoni

Abstract Over the past few years, mass appraisals have been the center of attention within the national and international real-estate valuation context. The reason for this growing interest is mainly due to the increasing relevance of real estate within the global economy and the need for assessment tools that can support asset management and enhancement strategies at a decision-making level. Many owners have expressed a need for such valuation tools: lending institutions, real estate funds, insurance companies, and managers of public assets (municipalities, etc.). Because of those new valuation needs and the difficulty involved in applying existing models, a new appraisal model is proposed here; a pluri-parametric one that would allow rapid assessment of a large real-estate portfolio in various real-estate market segments. The model was tested on three large real-estate portfolios: *TQP property assets (Pension benefits of the staff of Bank of Italy*): the *Bank of Italy's district* in L'Aquila (Italy); and a portion of *Piedmont's ASL/ASO's assets*.

Keywords Real-estate · Appraisal · Hedonic price · Public assets

L. Sdino (✉) · S. Magoni
Department of Building Environment Science and Technology, Polytechnic of Milan, Milan, Italy
e-mail: leo.sdino@polimi.it

S. Magoni
e-mail: estimo.abc@polimi.it

F. Zorzi
Inter-University Department of Science, Design and Land Policies, Polytechnic of Turin, Turin, Italy
e-mail: ferruccio.zorzi@polito.it

P. Rosasco
Department of Architectural Sciences, University of Genoa, Genoa, Italy
e-mail: rosasco@arch.unige.it

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1 Introduction

Mass appraisal consists of the "evaluation of the most probable market value of a collection of assets, as of a given date, using common data, standardized methods, and statistical testing" (International Association of Assessing Officers 2013).

The need for tools that enable rapid and systematic appraisals of a large number of properties has emerged after the economic and financial crisis that affected the USA and many European countries during the last decade.

One of the main factors that triggered the crisis was the downturn in the prices of assets collateralizing mortgage obligations.

The fact that certain values had been initially assigned to those assets, but had not been updated over time meant that, in the event the assets were sold following the debtor's default, a market price much lower than the value initially booked would be realized, preventing the lending institution from recovering all of its principal.

This issue mainly arises as a result of a failure to keep the values of the assets current and the inadequacy of the methods used for their appraisal.

This is the reason why, in the European context, initially the Basel II agreements, and then the Asset Quality Review, carried out by the European Central Bank (ECB), have heavily focused on the appraisal of assets collateralizing mortgage obligations.

Mass appraisals also play a significant role in other contexts, such as evaluating many real estate assets at the same time to update and periodically verify the value of insured properties; evaluating assets transferred to real estate funds; evaluating and periodically reviewing properties' book value; verifying the results obtained through the use of different estimation procedures; and analyzing the effects of urban enhancement initiatives on property values.

Mass appraisals are also covered by the International Valuation Standards (*International Valuation Standard* and *European Valuation Standard* 2013) and by Tecnoborsa's *Code of Real Estate Valuations* (Tecnoborsa 2011).

2 Potential Applications of Mass Appraisals

An analysis of trends in the main indicators in the real estate market shows that values are cyclical (Fig. 1). Analyzing real estate cycles can be useful for updating and verifying previous valuations, enabling a smooth adjustment of values based on price variations recorded over the projection horizon.

Similarly, the "market effect" can also be used to project future trends in prices. In fact, by analyzing market phases, it is possible to anticipate the future value of a specific asset as of a given time (year); in this way, the valuation can also become a forecasting tool, although it must be used judiciously because of the possible combined effect of exogenous variables (such as taxation).

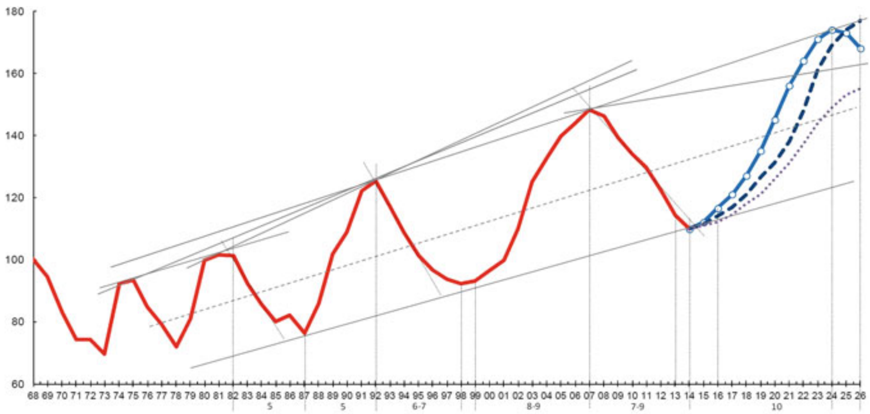

Fig. 1 Real properties prices index from 1969 to 2014 (1969 = 100) and a forecast of values up to 2026 (*source* Reddy's Group). Values adjusted by the change in real purchasing power of the average Italian employee

During the process of verifying the valuation, in addition to the "market effect", the "evaluating error effect" must also be taken into account.

This second effect is due to incorrectly measuring the surface area and incorrectly estimating the value of similar real estate units.

Tests carried out in 2014 by the ECB on the values of assets collateralizing mortgage obligations show that the combination of "market effect" and "evaluating error effect" resulted in an average asset devaluation that reached 38% for appraisals conducted in 2005 (European Central Bank 2014).

These tests were performed in two phases: initially with a re-indexation process and subsequently by revaluing the assets.

The re-indexation, where only the change in values caused by market cyclicality were taken into account, showed only the impact caused by the "market effect", which was 13% on average for appraisals conducted in 2005 (European Central Bank 2014).

The revaluation process, in addition to the effects on value caused by the "market effect", shows the consequences of the "evaluating error effect".

With this second phase, it can be inferred that the "evaluating error effect", net of the "market effect", resulted in an average devaluation for assets valued in 2005 of 26%.

After the emergence of a large number of non-performing loans, which were estimated by the Italian Banking Association (ABI-CERVED 2015) to amount to €300 billion in 2014, updating the value of assets collateralizing mortgage obligations became ever more essential.

For the public administration, mass appraisals are also useful for managing its large real estate portfolios.

In order to comply with the requirements imposed by the "*Public Administration's assets*" project, every public entity must report the values of its assets to the Ministry of Economy and Finance on an annual basis so that the state budget (which covers approximately 1,950,000 residential, office and other types of commercial units) can be prepared. The goal of these actions is to make public real estate management more efficient by identifying the assets that can potentially generate revenue by being redeveloped and sold.

For private parties, however, potential applications of mass appraisal are different based on the objective of the work being performed: for lending institutions, it enables the value of assets collateralizing mortgage obligations to be verified and kept current; for real estate funds, it allows monitoring of the total value of leased real estate assets and calculation of the annual dividends to be paid to shareholders, as well as the potential final payment from the fund; for private companies, it enables the book values of the assets to be periodically verified; and, for the professionals who work in the real estate valuation field, it permits pre-evaluation of the value of assets that will be assessed with other methods.

3 Estimation Models for Mass Appraisal

The number of technical and economical parameters utilized can be used as one criterion for classifying mass-appraisal methodologies: when only one parameter is used, the methods are called “mono-parametric”; otherwise they are “pluri-parametric”.

The use of mono-parametric methods is more common because they can be applied when few market data are available; however, they are not very reliable, especially for non-residential real estate and for individual housing units.

Pluri-parametric models are much more reliable, but, to be used, they require complex statistical and mathematical algorithms and large and homogeneous samples for estimation.

A large number of applications are described in the literature; the pluri-parametric model technique is used mostly for estimating purposes, in order to infer from the price of an asset the weight and economic value (hedonic prices) of spatial, productive, technological, and socio-economic characteristics.

Regarding those purposes, the already developed techniques can be classified as follows:

- *Hedonic prices method*, used mostly to quantify the effects on the value of the properties by social, urban, spatial, environmental, and economic factors (Emerson 1972; Blomquist and Worley 1981; Graves et al. 1988; Sirmans and Benjamin 1989; Adair et al. 2000; Fletcher et al. 2000; Janssen et al. 2001; Morancho 2003; Jim and Chen 2006; Brander and Koetse 2011; Antipov and Pokryshevskaya 2012; Kilpatrick 2011; Božić et al. 2013; Helbich et al. 2013; Hickman et al. 1984; Guntermann and Colwell 1983; Grieson and White 1989; Colwell et al. 1985; Waddell et al. 1993; Walden 1990; Smith 1993; Netusil 2013; Crompton 2001; Bowes and Ihlanfeldt 2001; Taltavull de la Paz 2003; Potepan 1996; Gibler et al. 2014; Kryvobokov 2007);

- *Artificial neural networks,* used mostly to predict real estate values (Borst 1991; Collins and Evans 1994; Bonissone and Cheetham 1997; McGreal et al. 1998; Cechin et al. 2000; Ge et al. 2003; Gallego 2004; Liu et al. 2006; Hamzaoi and Hernández 2011).

Because of the difficulty in collecting consistent data samples and the segmentation of the real estate market, mass appraisal is scarcely utilized in Italy. The experience has been primarily academic and focused mainly on the application of regression models and the study of hedonic prices (Simonotti 1991; Bravi 1994; Del Giudice 1992; Micelli 1998; Salvo 2001; Rosasco 2002, 2011; Palmisano 2005; D'Amato 2004, 2010, 2011; D'Amato and Siniak 2013; Morano et al. 2015).

Moreover, the applications have often been developed without the use of defined procedural protocols, with adverse effects on the quality and significance of the results.

Because of the lack of experience and a clearly structured operating protocol, a new pluri-parametric mass appraisal model has been applied; it fits into the techniques that are based on the hedonic pricing theory. This new model adheres to the requirements imposed by the International Valuation Standards (International Valuation Standard 2013, European Valuation Standard 2011; Red Book RICS 2014).

4 The REVC Model

This model was developed by Polytechnic of Milan's *Real Estate Valuation Centre* (REVC). From a methodological point of view, it follows the stream of pluri-parametric models based on the hedonic pricing theory, namely, the economic value of some assets' characteristics, which, by their nature, would be difficult to liquidate.

In the first phase, the features that are the most important to price formation were identified and selected by the real estate operators involved. They were identified in collaboration with several real estate market operators who based their proposals on their significant past professional experience. Those characteristics were then divided into four thematic categories:

(a) *Extrinsic characteristics* (K_e), related to building accessibility, social context, location, and services available in the neighbourhood (11 in total);
(b) *Intrinsic characteristics* (K_i), related to the type and condition of the building and the unit's structural components (10 in total);
(c) *Technological characteristics* (K_t), related to the type and obsolescence of the systems and other amenities (5 in total);
(d) *Productive characteristics* (K_p), depending on the asset's lease status and potential income; they are used only for leased properties (2 in total).

	a.1	a.2	a.3	a.4	a.5	a.6	a.7	a.8	a.9	a.10	a.11	b.1	b.2	b.3	b.4	b.5	b.6	b.7	b.8	b.9	b.10	c.1	c.2	c.3	c.4	c.5	d.1	d.2
a.1																												
a.2	2																											
a.3	1	0.5																										
a.4	0.5	0.5	1																									
a.5	0.3	0.3	0.5	1																								
a.6	2	1	3	3	4																							
a.7	1	1	2	2	4	2																						
a.8	0.5	0.3	2	1	2	0.3	0.3																					
a.9	0.5	0.5	1	1	1	0.3	0.3	1																				
a.10	0.3	0.3	1	1	1	0.3	0.3	1	1																			
a.11	3	2	2	3	3	0.5	0.5	3	3	2																		
b.1	0.3	0.3	0.5	0.3	0.5	0.25	0.25	0.5	0.5	0.3	0.25																	
b.2	0.3	0.3	0.5	0.5	0.5	0.25	0.25	0.5	0.5	0.5	0.25	2																
b.3	0.5	0.3	2	3	2	0.3	0.3	3	3	0.5	0.3	3	3															
b.4	2	0.5	1	1	1	0.25	0.25	2	2	0.5	0.25	2	1	0.3														
b.5	2	1	2	2	2	0.5	0.5	3	3	2	0.5	3	2	2	3													
b.6	3	2	3	3	3	0.5	0.5	3	3	3	0.5	3	3	2	3	2												
b.7	0.5	0.3	1	0.5	1	0.25	0.25	2	2	0.5	0.25	2	2	0.5	1	0.5	0.3											
b.8	0.5	0.5	3	2	3	0.5	0.5	3	3	2	0.5	3	3	1	2	1	1	3										
b.9	0.5	0.5	2	2	2	0.5	0.5	3	3	2	0.5	3	3	0.5	2	0.5	0.5	2	0.5									
b.10	0.3	0.3	1	1	1	0.25	0.25	1	2	1	0.3	2	2	0.5	2	0.5	0.5	2	0.5	0.5								
c.1	0.5	0.3	1	0.5	1	0.25	0.25	1	1	0.3	0.25	2	2	0.3	2	0.3	0.5	0.5	0.25	0.3	0.5							
c.2	0.5	0.3	2	2	2	0.3	0.3	2	2	0.5	0.3	2	2	0.5	2	0.5	0.5	2	0.3	0.5	1	2						
c.3	0.3	0.3	1	1	2	0.3	0.3	2	2	0.5	0.3	2	2	0.5	2	0.5	0.5	2	0.5	0.5	1	2	1					
c.4	0.3	0.3	1	2	2	0.3	0.3	2	2	0.5	0.3	2	2	0.5	2	0.5	0.5	2	0.3	0.5	1	2	1	1				
c.5	0.3	0.3	1	0.5	2	0.3	0.3	2	2	0.5	0.3	2	2	0.5	2	0.5	0.5	2	0.3	0.5	1	2	1	1	1			
d.1	2	0.5	1	0.5	1	0.3	0.3	2	2	2	0.3	2	2	0.3	1	0.3	0.3	0.5	0.5	0.5	2	2	0.5	0.5	0.5	0.5		
d.2	2	2	3	0.5	2	1	1	2	3	3	2	3	3	2	3	1	0.5	2	2	1	2	3	2	2	2	2	3	

Fig. 2 An example of the pairwise comparisons developed during the creation-process of the model

In order to determine the impact of each individual characteristic on the total market value, a multi-criteria analysis was performed. The pairwise comparisons method was used for this purpose.

Each market operator consulted was asked to weight the impact on the total of the characteristics on the total by expressing the significance of each feature in relation to the others.

This operation was carried out by matching those characteristics, two at a time, and by using a comparative voting system that assigned a score from 0.25 to 4 for each pair (Fig. 2).

A score of 1 indicates that the two characteristics being compared contribute equally to the determination of the value.

Increasing scores, 2, 3, and 4, indicate the increasing predominance of the first characteristic (the horizontal one) over the vertical one (2 = light predominance; 3 = average predominance; 4 = extreme predominance). Decreasing scores, 0.5, 0.3 and 0.25, indicate the increasing predominance of the second characteristic (the vertical one) over the horizontal one (0.5 = light predominance; 0.3 = average predominance; 0.25 = extreme predominance).

After those pairwise comparisons, the scores obtained for each characteristic had to be standardized and ranked in order to obtain their individual final weight on the total market value of the asset (Table 1).

Consequently, extrinsic characteristics (a), with an average total impact of 43.0%, are the ones that contribute the most to the formation of an asset's value; they are followed by intrinsic characteristics (b) with an average total impact of 27.6%; technological characteristics (c) with an average total impact of 19.5%; and productive characteristics (d) with an impact of 9.9%.

Unlike hedonic pricing models, which estimate the hedonic price of each characteristic by using a regression model, this model estimates the value based on the qualitative and quantitative status of the 28 real estate features weighted by their factors. Specifically, the score will be assigned by comparing the status of the characteristic of the asset being appraised with the average status of other assets in the same market segment for which unitary market values are already available (i.e., for which the transaction has already been completed).

This procedure can be applied for both analytical and synthetic appraisals. For synthetic appraisals, the valuation is conducted not by assessing each of the 28 characteristics, but rather the four main categories (K_e, K_i, K_t, K_p) at a non-specific level. In this case, the four categories will be valued cumulatively. This last procedure is appropriate when a large number of assets need to be appraised or when a quick estimate is needed.

Both the analytical and synthetic approaches yield a "K_s", namely, a cumulative weighting factor that encompasses the valuations performed for the 28 individual characteristics or for the four cumulative categories.

In addition, another weighting factor "K_m" is introduced to account for the impact of the characteristics that are peculiar to the specific market segment. Its value will be calculated based on an analysis of projected trends in the real estate market at the time of the appraisal, such as: price trends, amount of transactions, average time lag, average gap between value and price, and the Intensity of Real Estate Market index (IMI).[1]

To assess the most likely market value of an asset, those weighting factors, K_s and K_m, will be combined with the unitary market value. This value is determined for the specific market segment by analyzing data provided by direct (realtors, contractors) or indirect (real estate market observers such as Nomisma, Revenue Agency, Borsino Immobiliare, etc.) sources.

[1]Ratio of the value of normalized transactions (NTN) completed during the reference year to the value of assets that are available on the market (stock) (source: Revenue Agency-Real Estate Market Observatory).

Table 1 The 28 characteristics and their weights

Category and characteristics		Average (%)	Min. (%)	Max. (%)
a.	*Extrinsic characteristics* (K_e)			
a.1	Accessibility	3.4	1.9	6.0
a.2	Social context	3.9	1.0	8.8
a.3	Shops	3.1	0.9	6.2
a.4	Environmental pollution	5.6	3.3	8.4
a.5	Public transport	4.5	2.1	6.4
a.6	Free parking spaces (availability)	2.9	0.3	6.0
a.7	Private parking spaces (availability)	2.8	0.2	5.8
a.8	Floor, exposure and brightness	6.2	4.5	7.8
a.9	Public and private services	4.0	0.4	6.7
a.10	Public and private green areas	4.2	2.4	7.8
a.11	Closeness to natural and historical amenities	2.4	0.4	9.8
		43.0		
b.	*Intrinsic characteristics* (K_i)			
b.1	Units' total surface area	4.9	2.4	7.7
b.2	Location of internal common areas (building)	4.9	1.1	7.2
b.3	Common parts	1.2	0.2	3.1
b.4	Internal and external doors and windows	3.3	0.8	6.1
b.5	Common vertical structure	1.0	0.1	5.3
b.6	Common horizontal structure	1.1	0.1	5.3
b.7	Roof	1.7	0.4	5.3
b.8	External walls	2.0	0.6	5.2
b.9	Maintenance condition of common parts	2.8	0.8	6.8
b.10	Maintenance condition (building)	4.7	2.1	7.6
		27.6		
c.	*Technological characteristics* (K_t)			
c.1	Lift	3.7	1.7	7.2
c.2	Electrical system	3.6	0.1	6.3
c.3	Heating/cooling system	4.5	1.4	6.7
c.4	Auxiliary facilities (water, intercom, TV, etc.)	2.5	0.5	6.1
c.5	Maintenance condition (systems)	5.2	2.1	8.2
		19.5		
d.	P*roductive characteristics* (K_p)			
d.1	Lease status	4.8	0.1	9.0
d.2	Rent and potential income	5.1	0.9	8.9
		9.9		
		100.0		

5 Case Studies

The applicability and reliability of this model have been tested on three major portfolios: *Bank of Italy's TQP properties*, the *Bank of Italy district in L'Aquila* (Italy), and the *Piedmont's ASL/ASO's assets*.

Each one of these valuations was performed using a slightly different appraisal process. This variation was essential to adapt the model to each portfolio's specific goals, context, data availability, and asset characteristics.

The first case study addresses the determination of the likely market value of all of the *Bank of Italy's TQP properties*. It consists of 116 building units (437,240 m^2) distributed throughout Italy, with a significant concentration in the Lazio region, where 50% of those assets are located.

At the time of the valuation in 2013, the entire portfolio was being sold to SIDIEF (Italian Society of Building and Land Initiatives).

In fact, the reason for this valuation was to verify the sale value of the entire collection of assets.

Due to the availability of significant financial resources and time, a detailed appraisal could be made with on-site inspections to verify the surface area and characteristics of each unit. This appraisal was thus conducted parametrically using the drive-by evaluation procedure.

Since they were leased properties, both the REVC's pluri-parametric method and the Income Approach were used simultaneously for the appraisal, thus allowing comparison of the results produced by each method.

The most likely market value of the assets (average of the two values obtained) is €1,531,311,500.

It should be noted, however, that the difference between the value obtained with the pluri-parametric model (Market Approach) and that obtained with the Income Approach is very large, −51.7%.

The reason for this difference is due to the extremely low rents charged by the Bank of Italy for its assets that result in a very limited market value when calculated using the Income Approach (Table 2).

In the second case study, the REVC model was applied to the assets comprising the *Bank of Italy district in L'Aquila*; they consist of 680 housing units over 31,782 m^2. The purpose of the appraisal was to update their valuations. Because of the scarcity of available information, a desk-top appraisal was performed, synthetically, without any on-site inspections. As is well-known, there was a devastating earthquake in 2009, which had an enormous impact on L'Aquila's population and its housing stock.

For this reason, in addition to the REVC's pluri-parametric method, the Hope Value Approach was also used. In fact, some of the building units were not marketable at the time of the appraisal because of their condition, but they were still considered to be reparable; they were appraised based on their future value after renovation.

Table 2 Results from applying the pluri-parametric model to the Bank of Italy's TQP properties

MCA (V_{msd}) (€)	Income (V_{mr}) (€) limit	Difference ($V_{mr} - V_{msd}$) (%)	Weighted value (V_{weight}) (€)	2012 Balance ($V_{balance}$) (€)	Difference ($V_{weight} - V_{balance}$) (%)	Notes
250,584,500	214,826,500	−14.3	232,705,500	98,319,500	137.0	[a]
1,763,987,500	757,936,000	−57.0	1,260,961,750	416,453,000	203.0	
			24,386,500	16,570,000	47.0	
			2,097,000	1,999,000	5.0	
			1,298,606,000	435,022,000	199.0	
2,014,572,000	972,762,000	−51.7	1,531,311,500	533,341,500	187.0	[b]

[a]Before the transfer
[b]After the transfer

Table 3 Results obtained by applying the model to the Bank of Italy's assets in L'Aquila

Estimated market value (€)	Total difference (%)	Diff. % max[a] (−)	Diff. % max[a] (+)	% assets between ±10%	Valuation technique
26,483,500					Traditional (2013)
27,302,500					Mass appraisal (2015) (2013)5(2014)(2015)
	−3.1	−40.0	+52.0	60.0	

[a]For individual asset

The appraisal resulted in a total market value of €27,302,500.

This valuation can be considered reliable because it is consistent with the market value previously appraised before the sale of €26,483,500, which was performed using traditional techniques (Table 3).

Taking the values determined for the whole portfolio as a reference, the difference between those two valuations is 3.1%.

For individual real estate assets, however, the maximum difference fluctuated between −40% (underestimation) and +52% (overestimation); for approximately 60% of the assets (408 units), the difference between the two appraised values was limited to ±10%.

The third case study dealt with the determination of the likely market value of a portion of the *Piedmont's ASL/ASO's assets*; it consists of 116 residential and commercial units with a total area of 3,576,489 m^2.

The goal of the valuation was to verify, using the REVC model, the values determined previously with a different appraisal process that used traditional analytic techniques.

Since it was solely a review of an already completed valuation, the time and the financial resources available were very limited; this led to opting for a synthetic drive-by appraisal in which no inspections were made, and all the quantitative and

Table 4 Results obtained from applying the model to the Piedmont's ASL/ASO's assets

Estimated market value (€)	Book value (€)	Total difference (%)	Diff. % max[a] (−)	Diff. % max[a] (+)	% assets between ±10 %	Valuation technique
74,056,027	70,333,512					Traditional (2003)
75,847,414						Mass appraisal (2015)
		2.4	−84.0	+127.0	25.0	

[a]For individual asset

qualitative characteristics of the assets were taken from the more detailed previous traditional valuation.

The value of those assets as appraised with traditional techniques was €74,056,027; with the REVC model, the value was determined to be €75,847,414 in 2015 (Table 4).

From those results it can be seen that those two values are quite consistent.

The difference between them is approximately 2.4%, with overestimation and underestimation peaks for individual assets of approximately 84 and 127%, respectively.

6 Conclusions

The comparison of the results obtained by applying the traditional appraisal method and results obtained by applying the REVC's model shows that the latter can be reliably applied to appraise a large real estate portfolio.

The difference between those values, for the entire portfolio, are limited: they do not exceed 3% in absolute value. When considering the time needed to perform those two appraisal models (a few hours for the pluri-parametric model, several days for the analytical one), the usefulness of the model created by the REVC appears undeniable.

It is a tool that can satisfy the new appraisal needs being voiced by public and private market operators to effectively manage and enhance their assets.

It also reflects the operating characteristics needed to dynamically monitor market values over time: a feature needed primarily by lending institutions to keep the valuation of the assets collateralizing mortgage obligations current. Because of the different weights of the 28 characteristics, this model can also be used for valuations to calculate the change in values of assets caused by housing and urban redevelopment projects. For public entities, this tool would enable them to identify project solutions that will lead to the greatest increase of the market value of the asset involved (while also taking local real estate taxation into account) and identify the most satisfying solution based on its expected building and urban amenities.

Applying this model is reliable for appraising a portfolio of at least 25 properties; below this number, the estimation error is too large to be acceptable. This error is even greater for desk-top appraisals, where no inspection is made to verify the building and urban amenities of each asset. For this reason, the REVC model cannot be used to appraise an individual real estate asset; in that case, the appraisal should be performed using traditional methods that weight the unique characteristics of the asset and relate them to transaction prices within its segment of the real estate market. The reliability of the results of an appraisal performed using the REVC model can be increased further by controlling and verifying the dimensional factor to which an average unitary value is applied based on the nature of the asset. Applying the model has also shown that, for portfolios with a significant number of properties, correctly measuring each unit's area can reduce the error in the appraisal by more than 15% (with peaks of more than 25%).

This problem can be addressed by creating several databases structured according to measurement rules that are shared nationally and internationally and are updated over time.

This would enable individual and mass appraisal models to be applied more easily and reliably and would make them more transparent.

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New Bottom-Up Approaches to Enhance Public Real/Estate Property

Alessia Mangialardo and Ezio Micelli

Abstract The economic enhancement of public real/estate property has become a central theme in Italy. In recent years, public policies have been focusing on the supply-side of the real estate market, assuming that investors and developers could handle the value creation process of the abandoned and underused public real/estate property. More recently, with the decline of the investors' demand to develop public real-estate assets, new approaches to property-value creation have emerged. These new processes are focused on the demand side, through self-organized grass-roots participation using the assets for profit and not-for-profit purposes. The aim of the paper is to pinpoint some crucial conditions for these bottom-up processes to be effective through the analysis of fifteen bottom-up experiences in Italy. Five conditions emerged to reliably predict a fruitful outcome of bottom-up value-creation processes of abandoned or underused public assets.

Keywords Real estate valorisation · Urban reuse · Public real estate property · Temporary use · Grass-roots participation

A. Mangialardo (✉)
Dipartimento di Ingegneria Civile, Edile e Ambientale,
Università di Padova, Via Venezia 1, 35100 Padua, Italy
e-mail: alessia.mangialardo@dicea.unipd.it

E. Micelli
Dipartimento di Architettura Costruzione e Conservazione,
Università IUAV di Venezia, Dorsoduro 2206, 30123 Venice, Italy
e-mail: ezio.micelli@iuav.it

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1 Introduction

For many years, the issues related to the enhancement of public properties have been at the center of an important national debate involving the central administration and local authorities.[1] The subject has focused on the policies capable of increasing both the economic and financial value of public real-estate properties, working primarily on the supply-side of the market. All the instruments set by the legislation assumed a real estate market demand willing to buy abandoned or underused assets and ready to invest in refurbishments.

These expectations failed when the conspicuous debt crisis spread, due to the collapse of the global economy, also generating ample trouble within many municipalities. These economic conditions deeply changed the real estate market: the demand for assets to transform decreased to a great extent and innumerable real-estate developments stalled (Antoniucci and Marella 2014; Fabrizi et al. 2015; ANCE 2015).

As a response to the ineffective valorization procedures promoted by the administrations, new approaches have been recently been developed both in Italy and abroad (Inti 2011; Inti and Inguaggiato 2011). New demand is growing through self-organized participation of the local community, starting from the initiative of the citizenry. The new users of the abandoned public assets are no longer private investors, but groups interested in a large variety of activities. Cultural initiatives, profit and not-for-profit enterprises and social aggregation are the new key elements for alternative processes to enhance public real-estate property (Andres 2013).

The many positive experiences noticed in international and national contexts demonstrate that active participation of the citizenry in urban policies is significantly growing. Many abandoned areas were regenerated from the grass-roots participation transforming underused and abandoned public assets, with retrofit interventions enabling new functions (Campagnoli 2015; Finan 2014).

The aim of this research consists in analyzing the conditions in order to predict a fruitful outcome of the enhancement processes of the public real-estate property promoted by self-organized groups and communities. The research is structured into three parts. The first one presents the main features of bottom-up enhancement processes of public real-estate property. The second one shows the results of an empirical research on some relevant experiences in enhancing public properties based on grass-roots participation. Finally, in the third part, we interpret and highlight the conditions for bottom-up processes to be successful.

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[1]The value of Italian public real-estate property managed by the State Property Office and by all local authorities is about 60 billion euros. On 31 July 2015, a census of over 47,000 assets was conducted. Their value is respectively 54.1 and 4.78 billion. For the detailed list of these properties divided by province, we refer to the State Property Office database that can be consulted at the following website: http://www.agenziademanio.it/opencms/it/notizia/Parte-operazione-open-data-online-i-dati-sul-patrimonio-immobiliare-dello-Stato/. The economic value of the disposable asset is about 9.130 billion euros for the buildings and 10.000 billion euros for the properties. For the complete list, we refer to the following website: http://dati.agenziademanio.it/#/consistenzaevalore.

2 A Demand-Side Approach to Value Generation for Abandoned or Underused Public Real-Estate Property

For a long time, the national debate on the economic enhancement of the public real-estate property has been focusing on the supply side, assuming that it was necessary to simplify administrative constraints in order to create value and allowing investors and developers the flexibility they needed to find the highest and best use of the assets. Therefore, public policies were focused on simplifying patrimonial and urban-planning procedures in order to meet the private sector's requests (Agenzia del Demanio 2015; Camagni et al. 2014; Fusco Girard 2011).

The downturn of the real estate market dramatically weakened the demand for the real estate assets destined for development, with the consequence of having a large amount of stalled real-estate operations and forcing administrations to reconsider policies on this matter (ANCE 2015).

International and national experiences point out that the solution can be found on the demand side. In particular, self-organized groups appear to be capable to regenerate abandoned or underused assets with an effective bottom-up value-creation process as an alternative to the current supply-side based public procedures (Andersson 2009; Andres 2013; Colomb 2012; Inti 2011; Inti et al. 2014; Nèmeth and Langhorst 2014; Van Stein 2010).

The grass-roots participation has proven to be able to create value on the assets where the traditional public procedure failed, thus representing the response to countless initiatives launched by public authorities—for example, technical instruments adopted ad hoc, bidden auction or valorisation concessions—that did not encountered a positive market response.

In Italy, public policies have recently changed perspective. Following international cases, the government approved the clauses 24 and 26 of the so-called "Sblocca Italia" law. In these clauses, grass-roots participation was included to develop and manage the abandoned public real-estate assets, according to the priorities stated by the municipalities involved. The decree is not compulsory for local authorities: municipalities are free to promote or not bottom-up processes. Nevertheless, with such a law, traditional supply-side legislation is integrated with support for local authorities interested in new approaches for creating value on public real-estate assets through a specific class of new commons (Arena and Iaione 2012; Moroni 2015).

A flexible community, based on the associations (Branca 2011) or self-organized clusters (Finan 2014), promotes these social and economic processes. They employ the abandoned assets as a container of new functions in various domains: profit and non-profit entrepreneurial activities, artists' ateliers, start-ups, and places for creative industries. Through social innovation, bottom-up valorization processes have become a different response to traditional public policies.

In spite of the top-down approach of traditional public policies, based on the support of professional operators and specialized investors, these reuse interventions are generated by the initiative-e of an unqualified (at least in the real estate or construction industry) community with common purposes. The final users of the buildings create value along the way, without a prior well-established planning activity (Crosta 2011).

These initiatives also intercept the debate over temporary uses, considered as an intermediate step in the research of new permanent functions. More precisely, temporary uses can be useful to disclose new potential uses for the assets revealing hidden options and functions (Inti 2011; Inti et al. 2014; Rietveld Landscape 2010; Studio Urban Catalyst 2003).

The bottom-up valorization processes have radically changed the administrative procedures for the enhancement of public real-estate assets, favoring alternative economies through social cooperation and connections. Through the analysis of some relevant Italian experiences, it is possible to highlight the feasibility conditions of these processes in order to predict their successful outcome.

3 A Dataset of Bottom-Up Experiences

The regeneration experiences promoted by the grass-roots participation and self-organized processes to enhance public real-estate assets are relevant in number and quality. In more and more Italian cities, the citizenry supports valorization operations that revitalize abandoned properties. These initiatives often take place with the cooperation of the public authority, interested in the promotion of new urban functions with high potential cultural and social impact (Louekary 2006).

The aim of the research is to analyze the determinants of these bottom-up valorization processes, taking into account the most significant Italian bottom-up experiences. Fifteen case studies were examined. They were selected by their relevance, solidity, and the duration of the regeneration process. All the information was collected through systematic interviews, desk research, or fieldwork.

The following features of the case studies were considered: geographic position at the regional level, city size, the location of the building at different levels of centrality and accessibility, the architectural typology of the assets, their physical dimensions, their functions, the financing mechanism used to renovate the asset, and the contractual aspects of the owner/tenant relation.[2]

[2]The case studies are the following: "Mercato Metropolitano" and "Fabbrica del Vapore" in Milan, "Ex Distretto Militare Curtatone e Montanara" in Pisa, "Sale Docks" in Venice, "Progetto Nova Cantieri Creativi" in Santo Stefano di Magra, "Teatro Sociale Gualtieri" and "Spazio Grisù" in Ferrara, "Casa Bossi" in Novara, "Mercato Sonoro" in Bologna, "Sede Associazione Luna" in Genoa, "Centro Culturale Zo" in Catania, "Via Nola 5" in Rome, "Ex Stazione di Porto Empedocle" in Agrigento, "Ex asilo Filangeri" in Naples, "Ex caserma del Fante" in Livorno. Authors are available to share the data they did not present in the published paper due to length limits set by the editors.

The geographic position describes the regional location of the assets. To simplify the results, regions have been classified into three macro-areas: north, center and south. Cities have been classified by size: large cities (more than 50,000 inhabitants) or small cities (less than 50,000 inhabitants). Assets have been classified according to their level of accessibility: central, semi-central, or suburban position. The architectural typology indicates the previous function of the building, e.g., industrial building, barrack, theater or school. The dimensions estimate the surface of the asset: small size (less than 5000 m^2), medium size (between 5000 and 20,000 m^2), and large size (more than 20,000 m^2). The financing variable points out if the intervention in the building was self-financed or supported by other funding sources (e.g., public funding, cultural foundations) or both. Finally, the contractual variable indicates the legal solution adopted by the owner and the tenants to regenerate the asset.

All data have been re-elaborated by transforming qualitative data into quantitative data. When analyzing the basic statistics of the variables (Table 1), the dataset highlights significant patterns with relevant similarities.

These similarities reveal that these mechanisms do not operate equally over the various national areas: they need some conditions for a positive outcome. The majority (66.7%) of the case studies take place in the north of Italy, followed by the south of Italy (20%), and the center (13.3%). The value-creation processes involve almost always cities of medium or large size; the cases of Gualtieri[3] and Santo Stefano di Magra[4] are small cities but they are adjacent to larger ones. The majority of buildings are located in the city center, and there are no bottom-up experiences in the suburbs of cities. The architectural typology is quite varied: industrial buildings, barracks, theaters, schools, and covered markets. The dimensions of the buildings vary, but 60% of the assets present small dimensions (less than 5000 m^2), followed by medium size and large size. Another important feature coming from the analysis concerns the function of the assets: the totality includes—at least in a part of the building—the presence of cultural uses.

4 Five Condition for Bottom-Up Processes to Be Successful

The analysis highlights some conditions serving as predictors of many successful bottom-up public property valorizations. The research pinpoints five features that need accurate consideration.

Bottom-up self-organized property enhancements take place in large cities, where human and social capital are prevalent (Sdino and Castagnino 2014;

[3]To examine the case study, please refer to the official website: http://www.teatrosocialegualtieri.it/.

[4]For more information, see the official website of the association NOVA—Nuovo opificio Vaccari per le Arti: http://www.progettonova.it/nova-cantieri-creativi/.

Table 1 Frequencies of the characteristics considered (compiled by the authors)

North 66.7% Center 13.3% South 20%	Big cities 86.7% Small cities 13.3%	Center 93.3% Middle centre 6.7% Suburbs 0% Extra urban 0%	Small 60% Medium 26.7% Big 13.3%	Cultural center 100%	External financing 6.7% Self-financing 66.6% Both 26.7%	Loan for free use 46.7% No contractual formula 13.3% Rent regulated 40%

Putnam et al. 1993). The existence of a large and diversified community with an important civic sense and participative approaches represents a requirement for successful initiatives. Bottom-up processes need imagination, creativity, and innovation. These can only be expressed by an involved community, actively interested in local development.

In the presence of a strong social capital, self-organized processes may emerge even without administrative approval. In Italy, once the phenomenon had sprung up, many municipalities understood the great potential of grass-roots participation, drawing up specific guidelines for transforming real estate assets into commons.[5]

Nevertheless, a very different administrative approach can take place. In Pisa, citizens grouped in the association "Municipio dei beni comuni"[6] to reconvert abandoned public real-estate properties, with the aim to give them back to the local community for social and cultural purposes. Initially, the association squatted an old factory, successfully transformed into a laboratory for a large variety of cultural activities. The administration expelled the association from the occupied building, and so it moved into the formerly military district Curtatone and Montanara, against the will of the municipality. On the other hand, other municipalities—like the city of Bologna—have accepted these social and economic dynamics, transforming public properties into opportunities for self-organized associations demanding space for their projects and activities.

The second condition concerns the asset location. Self-organized bottom-up initiatives take place in the center of the cities where the interaction of competencies and knowledge are richer and where services and infrastructures are more significant. A city center is an ideal place because people have better opportunities to express themselves thanks to the vitality of different cultures and lifestyles (Drake 2003).

[5]So far, 153 Italian municipalities have drafted guidelines for commons, prescribing procedures and programs for the beginning of bottom-up processes. To check the updated list of municipalities that have promoted this document, please refer to this website: http://www.labsus.org/2015/04/i-comuni-de-regolamento-per-i-beni-comuni-di-labsus/.

[6]To examine the history of the association in depth, please refer to the official website of the association: http://www.rebeldia.net/.

The heritage of cities and territories is another relevant element related to bottom-up valorization processes. The center of the city possesses plenty of historical and artistic values. The Bossi house in Novara, "the most beautiful neoclassical building in Italy", represents a good example of such operations in the city center.[7] The Bossi house is a residential building, designed by the famous architect Alessandro Antonelli, with great historical and artistic value and a strategic position in the city center. In spite of its architectural value, the building was falling into disintegration. An association of Novara citizens engaged to save and to regenerate the site through direct involvement. In synergy with the municipality, they created a specific committee with the aim of pursuing the building's conservation and valorization. Through grass-roots participation and some external private funding, the building has now become a cultural center well-known at the national level.

The third point refers to the asset typology. The enhanced abandoned assets present such typical features as a limited dimension, a rather flexible plant, and an acceptable maintenance condition. The activities that take place in the buildings are often unpredictable and change over time. Furthermore, associations and groups can rely on limited financial and economic resources. For these reasons, users prefer sites in an acceptable state of conservation, not demanding too many resources to be refurbished, as well as flexibility to accommodate evolving projects and initiatives. Military barracks, old abandoned factories, and similar assets, in addition, enhance the typicality of the location (Drake 2003).

In Ferrara, grass-roots participation occupied and refurbished the fire-fighters' barracks. The plant features, typical for such a typology, were a problem for real estate developers, but turned out to be an opportunity for the cultural and entrepreneurial initiatives co-ordinated by the association Spazio Grisù that occupied the site.[8]

The fourth aspect refers to the presence of a sole administrator, appointed to manage the regeneration process, curating and coordinating the mix of the activities. Often this co-ordinator is represented by an association, with the task of assisting and coordinating the activities, providing the process with a common and unified perspective. The curator also facilitates the dialogue between local authorities (owner of the building and regulator) and the users and, finally, takes responsibility for everything happening at the site.

The curator of a creative space has to provide the conditions for the coexistence of various activities. He also has to lead the regeneration of the abandoned asset through time and through the evolution of the activities involved.

The cultural center Zo in Catania[9] is a relevant example of a successful initiative launched by a group of people that, at the beginning of the 1990s, decided to move

[7]It is one of the best examples of neoclassical architecture in Italy, designed by one of the most famous architects of that period. To examine in depth this case study, visit the following website: http://www.casabossinovara.com/portfolio/costantino-peroni-a-casa-bossi/.

[8]To learn more about the valorization process of Spazio Grisù, see the association official website: http://spaziogrisu.org/.

[9]To examine the dynamics of the valorization process of the cultural center Zo in Catania, see the official website: http://www.zoculture.it/.

back from abroad into their hometown. The aim of the project was to bring back culture and entrepreneurial innovation into a place lacking these immaterial assets. After negotiating with the local administration, the group obtained an old sulphur factory in Catania city center with a free lease. Today, the project promoters coordinate events, festivals, and commercial activities.

The success of the self-organized regeneration process relies on clear rules: the leading association curates the concept of the project, selects compatible functions capable of synergies, and mediates with the local authorities, thus providing a unique counterpart for the asset owner.

Finally, the fifth point refers to contractual conditions. Self-organized processes may start with illegal occupations of building and areas. Administrations may be either tolerant or strict in their attitudes. Independently of modalities that the reuse process has begun, in most cases local administrations juridically recognise the occupants by transforming them into temporary or stable tenants of the site.

In the majority of the case studies analyzed, the temporary loan for free use (*comodato d'uso gratuito*) represents the contractual frame that local authorities adopted, because it is flexible and advantageous for both landlord and tenants. On one hand, it permits the administration to easily withdraw from the agreement in case of need, i.e., an investor decides to develop the site. On the other hand, tenants have limited investments to carry out in refurbishing the asset and, if the entrepreneurial activities taking place fail, they can leave the site without sustaining any associated economic and financial burden, not paying anything for this option to abandon (D'Alpaos and Marella 2014).

In some cases, the local powers directly promote the occupation of the abandoned sites requesting projects and ideas, afterwards providing the juridical framework through the temporary or short-term lease and eventually some financial support. In the Puglia region, the program "Boiling Spirit"[10] incentivizes young citizens to launch initiatives in abandoned public real-estate property, making specific funds available to support the emerging local creative industry.

5 Conclusions

The bottom-up valorization processes for public real-estate property are a demonstration of the existence of alternative procedures effectively contributing to urban regeneration and to value creation in the public real-estate domain. The large number of stalled initiatives to regenerate abandoned or underused assets make clear that top-down procedures do not prove to be effective and new approaches, radically discontinuous, may contribute to public real-estate properties enhancement.

[10]Active since 2008, the project "Laboratori Urbani" has hitherto restored more than 100,000 m^2 of public real-estate property transformed into commons for young entrepreneurial citizens, with more than 54 billion euros of financial support.

The case studies analyzed in this research represent a fraction of the public real-estate assets regenerated through grass-roots participation with an important value creation effect. The research points out that these processes normally take place when some conditions subsist allowing a reliable prediction about the fruitful outcome of bottom-up valorization processes.

Bottom-up valorization processes take place in large cities, where significant human and social capital are largely available. They also happen in the center of the city, where the supply of such intangible assets is present to the highest degree. The regenerated assets feature relatively limited sizes, acceptable maintenance conditions, and a flexible plant open to changing uses and functions. The presence of a sole curator, appointed to manage and co-ordinate the interaction between the activities developed in the site and the relation with the local authorities, is likewise a relevant predictor for the outcome of the process. Finally, free short-term leases appear to be fundamental to sustain initiatives structurally undercapitalized, whose outcomes are highly variable.

Future studies may concern different aspects of the issue. The impact of these processes on a larger scale, assuming an urban perspective, represents an interesting issue in which to go into more depth, considering the contribution of bottom-up processes to broader regeneration strategies. On a micro scale, the evaluation of bottom-up value creation compared to the value generated by the traditional public procedures could broaden the choices of local and central administrations.

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Curricular Damage Estimation

Marco Clemente Basile

Abstract In qualifying the items of recoverable damages due to the unfair exclusion of a company from a tender, the so-called *curricular damage*, or rather the injury suffered because of a non-enrichment of the corporate curriculum, usually appraised in equitable terms, is generally recognized as a percentage of the economic offer made. The aim of the study is to offer a methodological contribution for the curricular damage estimation enabling overcoming the equitable approach. The *curricular value* of a company is a goodwill rate. It falls under the so-called *intangible assets*. It expresses the assets of the references acquired and is directly related to its skill level, ascertained by the *certification* of the certifying body S.O.A. (Società Organismo Attestazione). The real interest in acquiring certification categories has given rise to a true—though improper—market of qualification requirements with the exchange of the SOA certification through the transfer of the ownership of the business branch. This is because they make possible accessing more active market segments, or rather increasing the classification level held, in order to increase chances of awarding a contract. The analysis of the sales offers has enabled appraising the most likely exchange value of a business branch provided with a certification and hence tackling, in a more rigorous way, the subject of the curricular damage estimation, or rather the goodwill variation the company would achieve through the attainment of a higher classification, or rather the failed loss of the classification held. The estimation rationale identifies as complementarity the economic aspect to consider the curricular damage. It is methodologically quantifiable as the difference between the curricular value held by the company at the submission of bid in relation to category and classification of certification held, and the curricular value the company could attain thanks to the increase in the business turnover deriving from carrying out the tender, by acquiring a higher classification than the one held, or rather a failed decrease of the current classification. The amount of the curricular damage appraised with this approach is meaningfully lower than the one usually equitably acknowledged by administrative jurisprudence,

M.C. Basile (✉)
DICDEA, Second University of Naples, Via Roma 29, Aversa, CE, Italy
e-mail: ingmarcobasile@fastwebnet.it; marcoclemente.basile@unina2.it

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that does not take into account the capital alteration caused by the non-awarding of the said contract.

Keywords Public works · Curricular damage · Complementary value · Goodwill

1 Introduction

In Italy, compensation for damages for the unfair exclusion of a company from a public tender is regulated by art. 124 of the Code of the Administrative Procedure. The code prioritizes a specific form of protection with the taking over of the contract, after declaration of ineffectiveness of the contract unlawfully awarded to the third party by the public administration. It may be established, for example, that the compliance with overriding requirements linked to a general interest requires its effects to be maintained. In this case, should the contract remain effective, as a countervailing measure, protection by compensation for the damage *suffered and proven* by way of equivalent measures takes place (Lubrano 2013; Pellingra 2008).

Hence the compensation by way of equivalent measures has a subsidiary nature and may be both partially or integrally allowed, whether it aims at restoring a partial takeover in the contract for its residual duration, or rather failure to fully implement it.

In classifying the indemnifiable items of damage, administrative justice has generally depended upon the recognizability of financial damage. This is made up by the gains that the unlawfully excluded subject could have attained as a consequence of the full or partial implementation of the contract (Michetti 2014); U.S.G.A. 2014), and by the *curricular damage*. This is a specification of the damage for loss of opportunities, consisting in the injury suffered by the company because of the failed enrichment of the corporate curriculum as a consequence of the impossibility of using references deriving from the lack of implementation of the contract.[1]

On the contrary, according to the current trend, the damage for incurred costs for participation in the tender is not deemed to have been compensated. This is because the net asset subject to compensation by way of equivalent measures as a consequence of the unlawfully denied award does not include the expenses that would however fall on the bidder even in the event of winning the tender.[2]

Well, quantification of the *loss of profit* does not identify particular relevant aspects. Since the damaged party has to provide strict and specific evidence of the damage suffered, it may be easily parameterized in relation to the gain in value made clear in the economic offer presented at the tender chair This means that it may be parameterized to the gain the tenderer thought she could actually receive as

[1]Council of State, Sec. VI, 18 March 2011, nr. 1681.

[2]Council of State, Sec. V, 19 November 2012, nr. 5846; Council of State, Sec. V, 12 February 2013, nr. 799.

a consequence of the implementation of the contract,[3] or rather the average historical profit proven by the corporate balance sheets usually registered, however, taking into account the entrepreneurial hazard of its realization.

However, as far as the curricular damage is concerned, evidence of its existence is deemed to be found *in re ipsa*, i.e., as a direct, absolutely necessary consequence of the non-performance of the contract. On the contrary, most of the time, the deemed impossibility to prove the injury suffered in its precise amount leads administrative justice to appraise the amount of damages in equitable terms, pursuant to art. 1226 c.c., in a variable measure between 1 and 5% of the economic offer made during the tender, decreased by a reduction rate proportionate to the measure of the probability to obtain the award of the contract.[4]

This study draws its inspiration from a degree thesis carried out at the Second University of Naples. Its aim is giving a methodological contribution to the curricular damage estimation concerning companies of the building sector enabling improvement over the equitable approach generally used by administrative justice.

2 The Curricular Damage Between Consequential Damage and Profit Loss

It has been said that curricular damage is considered the injury suffered by a company because of a non-enrichment of the corporate curriculum. This results from the impossibility to use references deriving from the implementation of the contract, absent because of the unlawful conduct of the administration.

Hence, the failed implementation of the work the company has competed to acquire causes indirect damages: to the company's image (even in the form of commercial discredit because of an incorrect evaluation of the anomaly of its offer); to its taking roots in the market; and to the widening of the company's commercial or industrial quality, regardless of the injury of the general public interest to fair competition, as a consequence of the illegal strengthening of antagonistic companies working on the same market target, and illegally declared the awardee of the tender.

Based on this argument, it has been repeatedly stated by the administrative justice that the company unlawfully deprived of a contract may claim the loss of the real possibility to increase its goodwill related to the extent of its completed projects. The latter has to be considered as professional image and prestige. It may as well claim the loss of the increase in the specific requirements of classification and participation in tenders.

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[3]Council of State, Sec. IV, 20 June 2011, nrr. 3670; Council of State, Sec. V, 8 November 2012, nr. 5686; Council of State, Sec. V, 21 June 2013, n. 3397; Council of State, Sec. III, 25 June 2013, nr. 3437.

[4]Council of State, Sec. VI, 11 March 2010, nr. 1443; Council of State, Sec. VI, 27 April 2010, nr. 2384; Council of State, Sec. VI, 16 May 2011, nr. 2955; Council of State, Sec. V, 28 December 2012, nr. 6693.

So well, in general terms, *the damage compensation for default or delay shall include the loss suffered by the creditor* [actual loss] *as well as the lost profit* [loss of profit], *since they are its immediate and direct consequence* (art. 1223 c.c.).

Hence, according to the code-based definition, albeit in its unitarity, the compensation for default is made up by the actual loss and by the *loss of profit*. The former is the loss of goods or interests that had to be attained in order to form an asset of the creditor's patrimony, though it was not yet available to them. The latter is made up of the predictable future loss of wealth resultant from the failed use of the performance due by the debtor.

In principle, the jurisprudence of legitimacy has stated that *the chance to achieve a given good is not a mere expectation, but an asset juridically and economically susceptible of an independent estimation. Hence, its loss constitutes an injury to the integrity of the capital refundable as an immediate and direct consequence of the failure caused by the subject liable of the damage*.[5]

The nature of the damage caused by loss of opportunities (Iezzi 2008); Rossetti 2003) has been debated, and also the curricular damage constituting its specification. The debate concerned the issue whether the opportunity shall be referred to a real existing and certain actual loss that could be related to the loss of a favorable perspective already existing in the patrimony of the subject and not yet realized. Hence it shall be considered a susceptible good of independent asset evaluation (Maione 2012). On the other side, the debate was on whether it shall be considered in terms of loss of profit, i.e., the existence of a significant probability to realize a favorable result (gain). This is a right that has not yet been acquired in the patrimony of the subject, but is potentially attainable.

This is a major issue from the legal point of view, since it distinguishes the conditions of reparation of damage, while it has small relevance on the appraisal point of view in the business field. In both cases, the current effects of the event on the injured person's patrimony shall be appraised, and the subsequent variation in the asset value will be the synthetic expression of their different revenue capacities.

Hence, they represent two sides of the same coin to be identified in the goodwill rate. This is the intangible component of the company patrimony, constituted by the classification of the company that can be defined as "*curricular value*".

3 The Curricular Value as Goodwill Component

In relation to what has been argued before, the curricular value of a building company expresses the company assets of acquired references. Hence, it results being directly linked to its classification level, made clear by the *certification* issued by *Società Organismi di Attestazione* (SOA), that enables identifying if the

[5]Court of Cass. 13 December 2001, nr. 15759; comp. Court of Cass. 14 December 2001, nr. 15810.

company meets the legal organizational, financial, and technical requirements to be admitted to the implementation of public works through a series of assessments, evaluations, and controls.

Furthermore, for a goodwill company, the dynamic aspect of qualification gives capital gains that are made clear in the increase in the capacity of competing on the market and hence in the opportunities of winning further future tenders and to widen accessible market sectors. (Executing a public tender causes an increase in the company turnover, with the consequent possibility to acquire an SOA certification of higher classification than the one held or, at least, to consolidate the existing registration.)

On the contrary, a depletion of the curricular value can take place as a consequence of the loss of the qualification level held, or of the non-attainment of a higher classification, or rather for the failure to acquire a basic element of the specific technical capability, such as, e.g., prior experience in a particular merchant sector or of a territorial scope.

The financial asset represented by the curricular value falls under the so-called *intangible assets* of the company, i.e., of the factors enabling it to acquire a competitive advantage in the market as compared with competing companies and hence to achieve a profit surplus (Orefice 2000).

Generally speaking, the intangible factors of a company can be divided into two types. One type reveals a repeated usefulness during the years and constitutes a transferable share to third parties. Also called *objective* factors, they are susceptible to autonomous evaluation. The other type is composed of overlapping and inseparable factors and hence autonomously non-transferable for their *subjective* nature and formation of *goodwill*.

Among the former, there are industrial patents, intellectual property rights, software, trademarks, concessions, licenses, etc.; among the latter, there are quality of corporate management, reputation and business relationships, skills and qualifications of collaborators, technologies and know-how determining production quality, etc.

Goodwill constitutes an autonomous complementary economic asset of the company and can be assessed with an indirect procedure by calculating the difference between the global value and the current value of the business activities. It is clear that it may also assume a negative value (*badwill*), in case the sum of the value corresponding to the company assets turns out be higher than the company's market value.[6]

As to estimation methodologies, there is a wide set of cases proposed in the specialized literature, ranging from equity and profitability to combined methods (Lamanna 2010).

The method, which is here summarized, is variously called *equity* or *differential yield* or *autonomous estimation of goodwill*. It has the advantage of thoroughly

[6]Among the most frequently occurring causes, errors in operations, localization, or customer management can take place, leading to a deterioration of the business image, cessation of improvements in technology or marketability of products, or even temporary production downtimes.

formalizing the economic nature of goodwill as a surplus value of the intangible value (Clarelli 2011).

In fact, given [Vm] the company's market value, [K] its adjusted net value, that is the asset value represented by properties and rights held, and [G] the goodwill value, for what has been said we obtain:

$$\mathrm{Vm} = \mathrm{K} + \mathrm{G} \tag{1}$$

Indicating with [R] the net income produced by the goodwill company, with [r] the rate of return of the fixed capital, with [r′] the discount rate of the company's net incomes, with [n] the number of years of predictable duration of goodwill and with [q = 1 + r′] the binomial of interest, over-income accumulation, constituting the goodwill:

$$\mathrm{G} = [(\mathrm{R} - \mathrm{rK})(\mathrm{q}^{\mathrm{n}} - 1)/(\mathrm{r}'\,\mathrm{q}^{\mathrm{n}})]$$

results, and replacing in (1),

$$\mathrm{Vm} = \mathrm{K} + [(\mathrm{R} - \mathrm{r\,K})(\mathrm{q}^{\mathrm{n}} - 1)/(\mathrm{r}'\,\mathrm{q}^{\mathrm{n}})] \tag{2}$$

is obtained.

In case the duration of the goodwill is economically comparable to infinity, Eq. (2) becomes:

$$\mathrm{Vm} = \mathrm{K} + [(\mathrm{R} - \mathrm{rK})/\mathrm{r}']. \tag{3}$$

Indeed, this last formulation applies only for those residual cases where it can be assumed that intangible conditions have an unlimited duration.

On the contrary, in the literature under ordinary conditions, the predictable duration of intangible conditions generating over-income is considered between five and eight years, when *intangibles* arise from objective factors, while it is estimated to be between three and five years, when they are volatile, as a consequence of subjective factors (Balducci 2006; Viel et al. 1973).

4 Assignment of Qualification by Business Transfer

Market analysis of public contracts, periodically performed by the once-named Supervisory Authority (2008, 2012),[7] has consistently verified that the system of Italian qualified companies manifests some stable structural data over time, that is to say:

[7]Until 2012, the Supervisory Authority on public contracts of works, services and supplies (today, the National Anti-Corruption Authority) has performed market surveys on public contracts published in annual reports presented to the Parliament of the Republic.

- about 60% of companies having classification up to III-bis (1.5 million Euros), characterized by a strong specialization on a few processing categories (just under 60% of companies hold at the least two qualification categories; about 75% hold the maximum of three qualification categories);
- companies qualifying for higher amounts show a greater capacity of processing diversification: the average number of categories per company tends to increase with the growth of the maximum classification of registration;
- more frequently, the categories of qualification processing are OG1—Civil and Industrial Buildings (19.7%), OG3—routes, highways, bridges, viaducts, railways, subways (13.1%), OG6—aqueducts, gas pipelines, oil pipelines, irrigation and evacuation Works, (9.3%) and, for special categories, OS30—internal electrical, telephone, radiotelephone and tv systems (5%).

The offer provided by building companies is precisely calibrated to the demand coming from the contracting authorities.

In fact, according to the most recent data available, concerning 2012, about a quarter of the contracts awarded hold OG1 (Civil and Industrial Buildings) as a prevailing category, another 23% concern routes, highways, bridges, viaducts, etc. (OG3), about 9% is for aqueducts, gas pipelines, etc. (OG6), and just over 6% is related to maintenance and restoration (OG2), with an average auction value between 600,000 € and 850,000 €.

Furthermore, it happens that the average number of contracts awarded and the related average amount grow with the increase in the maximum registration classification held by the company. This means that the structured business subjects are those that are more successful, since they are more skillful in entering into all the market segments.

Hence, there is real interest by the companies to acquire certification categories enabling access to more active market segments, or rather increasing the level of classification held, in order to widen one's own offer and increase the possibilities of obtaining the award.

This has given place to a real market of qualification requirements with the—indirect—exchange of SOA certifications by the temporary or permanent transfer of the business branch's legal ownership (*functionally autonomous structure of an organized economic activity*[8]), enabling the new subject to *make use of the requirements held by the companies that have created it for qualification.*[9]

Indeed, acts of business transfer have often been found to have been merely a formal transfer of documented requirements related to previous experience, with no

[8]Art. 2112 of the Civil Code, as modified pursuant art. 32 of the Legislative Decree 10/09/03 nr. 276.

[9]*In case of taking over or of other operations involving the transfer of a company or of one of its branches, the new subject shall make use of the requirements held by the companies giving rise to it for qualification. In case of a business lease, the lessee shall make use of the requirements held by the leaseholder company, if the lease contract has a duration of not less than three years.* Regulation, Decree of the President of the Republic 5/10/2010, nr. 207, art. 76, paragraph 9.

substantial connotation of the truly transferred processing and managerial structure so as to lead the Supervisory Authority in 2008 to define business branch transfers as *a critical point of the qualification system*.

As a proof of the absolute topicality of the issue, *in the light of the pathological elements identified*, the National Anti-Corruption Authority ANAC (2014) has deemed it necessary … *to provide an interpretation of the present regulations effectively binding SOA to use objective assessment criteria of the transfer acts, reducing margins of discretion and standardizing assessment criteria regarding the size of the business activities transferred*.

In particular, ANAC has underlined the need for the correct definition of the object of the business branch transfer. It shall sum up tangible and intangible assets, jointly considered because functionally organized among them, as well as the personnel linked to the activity assigned, representing the most evident means of the know-how transfer necessary to maintain the qualification.

Hence, in providing directives to certification bodies, the authority has deemed it legitimate to transfer requirements for qualification following, the assignment of the business activities only when a processing capacity remains, enabling the successor to pursue the already started business activities, with no need to reconstruct them. It shall be assessed by appraising the following indicators:

- turnover of the assigning company based on the year prior to the act of business transfer;
- transfer of a minimum number of personnel linked to the specificity and to the size of the activities assigned;
- assignment of tangible goods, showing the company operating or the branch assigned;
- ongoing existing legal relationships at the time of the assignment and of the ongoing or recently concluded tender documents or having as their object processing related to the specific sector identified in the assignment.

Equal attention is given by the authority to the criteria and the modalities that SOA shall comply with, in the activities of issue of qualification certifications to the ceding companies using the corresponding requirements due within the ceding company to produce evidence of special order requirements held ex art. 79 of the Regulation, *identifiable within the goodwill linked to the branch that is the object of the transfer. It takes its form in the works carried out by the ceding company in the period which can be documented for the qualification of the ceding company, specifically identified in the assignment act and in the attached values of the costs related to equipment and to the yearly average number of staff effectively employed in executing the works transferred with the company activities or branch*.

From what has been said above, it is clear that the instrument of assignment of a company branch has constituted and constitutes recurrent modalities of transfer of the qualification level of building companies. The essential strictness introduced by the National Anti-Corruption Authority eliminates the mere formal transfer of requirements to take its form in the effective alienation of the goodwill of the company rate that is the object of the assignment.

5 The Estimation of the Assignment Value of the Company Branches

The interest in acquiring company branches is shown by the manifold sales offers that can be found easily on specialized Internet websites. Data about 690 sales offers have been found, over a recent five-year period. As a reference value, they use the qualification held, which is expressed in work category and classification number.

The analysis suitably ignored all the offers with several qualification categories and clearly anomalous data. It aimed at verifying whether there was a suitable degree of correlation between the price asked for the assignment and the registration classification held by the ceding company, in order to appraise the most predictable exchange value of a company branch having a certification.

A first element arising from the sample examination is that the most active qualification categories coincide with the categories that companies most frequently qualify with and that constitute most of the works awarded by public administrations (see par. 4): OG1 [*civil and industrial buildings*] with 100 data, OG2 [*restoration and maintenance*] with 31 data, OG3 [*routes, highways, bridges, viaducts, railways, subways*] with 41 data and OG6 [*aqueducts, gas pipelines, oil pipelines, irrigation and evacuation works*] with 20 data.

Table 1 schematizes the data collected related to the above-mentioned qualification categories more frequently offered to be sold, with the prices required for each classification.

In Figs. 1 and 2, minimum, medium and maximum values have been interpolated for each category analyzed and the area representing the price interval required at the variation of the classification at assignment.

The data analysis leads to some preliminary conclusion:

- the second-order polynomial interpolating curves represent very good correlation coefficients. Thus, variability functions, in particular those referred to the mean price demanded, seem to congruously interpret the offering market trend;
- being of equal classifications, the level of prices demanded increases for more specialist categories (OG2), opening the possibility to enter attractive niche markets;
- generally speaking, except for the case of the generalist category OG1 with qualification up to 2.5 million Euros, classification IV represents the threshold beyond which a sudden rise in the prices demanded is recorded. This indicates a squeeze in the assignment market for more firmly structured business branches.

Table 1 Prices demanded

Classification	Threshold amount	Category OG1			Category OG2		
		MIN	MED	MAX	MIN	MED	MAX
I	€258,228	€7,000.00	€10,714.29	€16,000.00	€14,000.00	€16,000.00	€18,000.00
II	€516,457	€7,000.00	€16,827.59	€45,000.00	€15,000.00	€27,500.00	€50,000.00
III	€1,032,913	€10,000.00	€25,684.21	€50,000.00	€24,000.00	€39,142.86	€60,000.00
III BIS	€1,500,000	€16,000.00	€27,200.00	€50,000.00	€45,000.00	€62,500.00	€80,000.00
IV	€2,582,000	€17,000.00	€39,125.00	€90,000.00	€50,000.00	€92,500.00	€150,000.00
IV BIS	€3,500,000						
V	€5,164,569	€25,000.00	€47,095.71	€100,000.00			
VI	€10,329,138						
VII	€15,493,707	€35,000.00	€55,000.00	€275,000.00			
VIII	ill.	€70,000.00	€185,000.00	€300,000.00			
Classification	Threshold amount	Category OG3			Category OG6		
		MIN	MED	MAX	MIN	MED	MAX
I	€258,228	€9,000.00	€13,833.33	€18,000.00	€5,000.00	€9,600.00	€14,000.00
II	€516,457	€12,000.00	€19,580.00	€45,000.00	€10,000.00	€16,666.67	€25,000.00
III	€1,032,913	€16,000.00	€29,500.00	€52,000.00	€25,000.00	€30,333.33	€40,000.00
III BIS	€1,500,000				€28,000.00	€34,500.00	€41,000.00
IV	€2,582,000	€45,000.00	€54,600.00	€70,000.00			
IV BIS	€3,500,000	€45,000.00	€57,500.00	€70,000.00			
V	€5,164,569	€45,000.00	€60,000.00	€75,000.00	€70,000.00	€80,000.00	€90,000.00
VI	€10,329,138	€200,000.00	€250,000.00	€400,000.00			
VII	€15,493,707						
VIII	ill.						

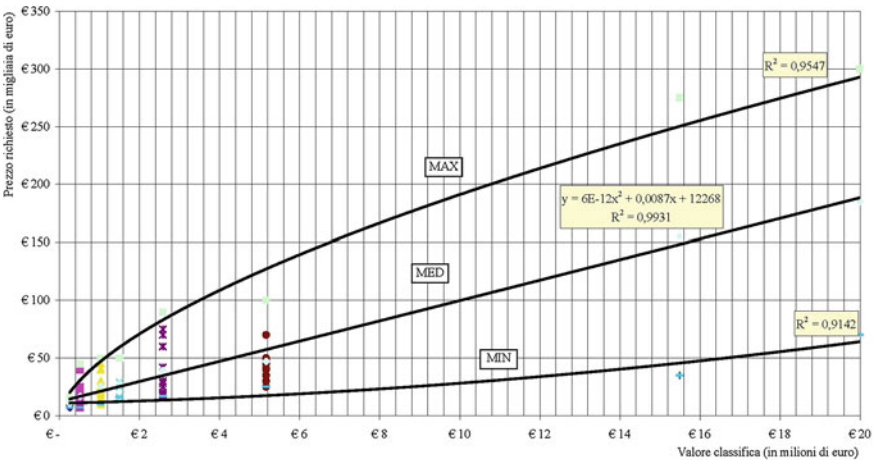

Fig. 1 Trend of prices demanded category OG1

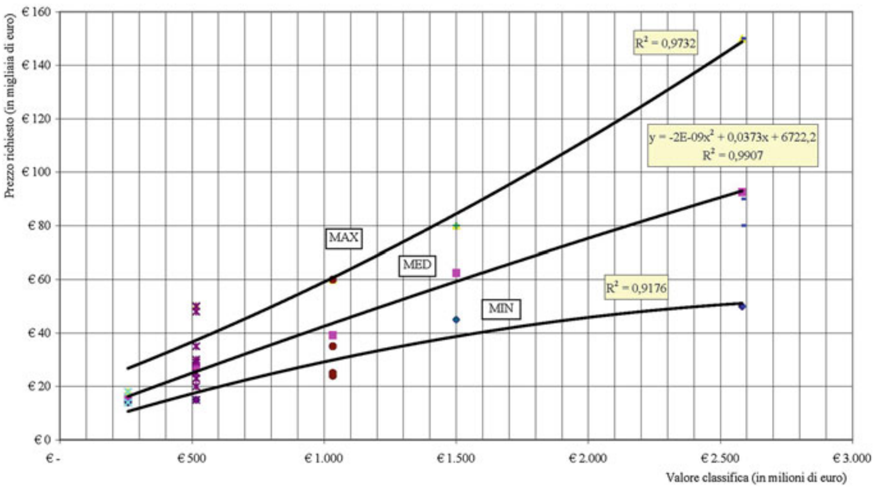

Fig. 2 Trend of prices demanded category OG2

At this point, using the threshold value of the classification of the business branch proposed to be assigned as a reference parameter, it is possible to set incidence rates of the mean price required (Table 2) and to analyze their variability (Fig. 3).

First of all, it has to be underlined that the significance of data is to be considered limited to classifications from I to V, i.e., for qualifications until five million Euros, taking into account a squeeze and peculiarity of offers for business branches with higher classifications, as already stressed.

Table 2 Incidence of the mean price required on the threshold value of classification

Classification	Threshold amount	Incidence			
		OG1 (%)	OG2 (%)	OG3 (%)	OG6 (%)
I	€258,228	4.15	6.20	5.36	3.72
II	€516,457	3.26	5.32	3.79	3.23
III	€1,032,913	2.49	3.79	2.86	2.94
III BIS	€1,500,000	1.81	4.17		2.30
IV	€2,582,000	1.52	3.58	2.11	
IV BIS	€3,500,000			1.64	
V	€5,164,569	0.91		1.16	1.55
VI	€10,329,138			2.42	
VII	€15,493,707	1.00			
VIII	ill.				

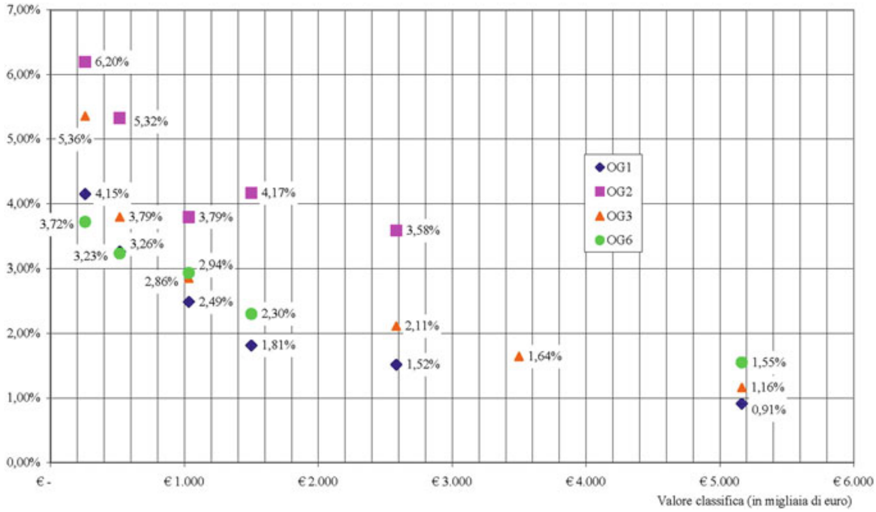

Fig. 3 Incidence of the mean price required on the threshold value of classification

Going into detail, from a qualitative point of view, confirmations of the reduction in the incidence of the mean price demanded with the increase of the assignment classification clearly appear. Considering equal categories, the mean price demanded has a greater incidence for qualification categories with higher specialization, i.e., ranging from OG1, to OG3 and OG6, and finally to OG2.

In quantitative terms, the incidence mean data enable defining the variability ranges of the price demanded. But, in order to be used for the estimation of the most likely assignment value of the business branch, they shall pay for the result of the standard commercial negotiation.

Table 3 Incidence of the assignment value on the qualification threshold value of the registration classification

Category	Classification			
	I (%)	II–III (%)	III BIS–IV (%)	V (%)
OG1	3.5	2.1–2.8	1.3–1.5	0.8
OG2	5.3	3.1–4.5		
OG3–OG6	3.2–4.5	2.4–3.2	1.8–2.0	1.0–1.3

In the absence of specific data on the sector, here a mean abatement of the purchase price of 15% can be expected, taking into account the instrumental nature of the asset assigned.[10] Hence, for estimation purposes, the value of the business branch to be assigned can be appraised by means of incidence rates on the qualification threshold value of the registration classification held by the assignor for categories of qualification (Table 3).

All things considered, the most likely assignment value of the business branch, corresponding to the curricular value, can be assessed as the product of the qualification threshold value of the registration classification held by the assignor for the corresponding incidence rate, that is:

$$Vc = \alpha V_{class}. \tag{4}$$

6 Curricular Value and Compensation Appraisal for Failed Awarding of Contracts

The appraisal of estimation values for the assignment of business branches of building companies makes possible more rigorously tackling of the issue of the curricular value appraisal. This is a component of the business goodwill to be linked to the compensation for the injury suffered by a company unlawfully excluded from a tender execution, for the failure to enrich their corporate curriculum. As it has been already said, it is generally appraised in an equitable way in court proceedings, as a percentage of the economic offer made during the tender.

In the case under study, the appraisal rationale identifies as complementarity the economic aspect to consider the appraisal of the goodwill variation that the company would attain by reaching a higher classification, i.e. the loss of the classification held. This can be actually expressed as the difference of curricular values deriving from the failed assignment.

Hence, from a methodological point of view, on one hand, the appraisal has to be made of the curricular value that the company held at the submission of the

[10]The percentage is derived by assimilation to that found in the instrumental building by NOMISMA.

tender, in relation to the category and classification of certification for which it was qualified [Vc_p]; on the other hand, the appraisal has to be made of the curricular value that the company itself could have attained as a consequence of the increase in the company revenues deriving from the execution of the rejected tender [Vc_d], by acquiring a SOA certification of a higher classification than the one held, or rather in the diminishment of the one held. Therefore, the damage for the loss in the curricular value [ΔVc] can be formalized as:

$$\Delta \mathrm{Vc} = \mathrm{Vc_d} - \mathrm{Vc_p} = (\alpha \mathrm{V_{class}})_\mathrm{d} - (\beta \mathrm{V_{class}})_\mathrm{p} \tag{5}$$

where [V_{class}] is the qualification threshold value of the registration classification and [α] and [β] incidence rates under the two conditions with and without awarding of the contract.

Compensation may correspond with the curricular damage in case of certain cases of rejected awarding to the applicant, or rather may constitute a rate proportional to the measure of probability that the unlawfully excluded competitor had to pursue it.

It is worthwhile underlining that considering the curricular damage as an expression of a complementary usefulness implies its extent to be meaningfully lower than the one usually equitably acknowledged by administrative case law.

In fact, parameterizing the damage at a rate of the economic offer made during the tender means parameterizing it as far as possible at the threshold value of the registration classification of the bidder, increased by 20%. This leads to acknowledgement of a compensation equal to the absolute value of the goodwill rate enjoyed by the company. But this means not taking into account that the failed awarding does not cause setting to zero the curricular value held but only that it is squeezed.

The following example makes the distinction clear.

The company Ω, qualified in category OG1 with classification IV (qualified to participate in tenders and to perform works in the limit of 2,582,000 €, increased by a fifth) is unlawfully excluded from a tender it would certainly have been certainly been awarded and for which it made an offer of 2,500,000 €.

In the light of what has been said, the minimum value of compensation for the curricular damage equitably acknowledged by the administrative justice, equal to 1% of the value of the offer, drops to: (€2,500,000 × 1%) = 25,000 €.

On the contrary, most of the damage actually suffered by the company Ω may consist of the difference between the curricular value it could have acquired and the one consequent to the declassing to classification III (with qualification until 1,033,000 €). The former would be obtained if it had acquired the right to a rise in the classification (IV Bis, with qualification until 3,500,000 €) by executing the tender, as well as the awarding of further works. It would be subject to a decrease in classification for the failure to maintain its turnover.

It follows that, applying Eq. (5), the curricular damage can be appraised as follows:

$$\Delta Vc = (1.0\% \times 3{,}500{,}000\ €) - (2.1\% \times 1{,}033{,}000) = 13{,}307.00\ €,$$

that is, equal to a little more than the half of the minimum damage equitably calculated.

7 Final Considerations

Curricular value of a building company can be defined as the falling goodwill rate in the so-called *intangible assets,* which expresses the assets of the acquired references. It is directly linked to its qualification level and finds its expression in S.O.A. certification.

Transfers of legal ownerships of business branches enable acquisition of qualification categories. In their turn, they allow accessing more active market segments and increasing the qualification level held. Their study has highlighted the existence of a meaningful degree of correlation between the price demanded and the registration classification. This has enabled appraising the curricular value, i.e., the most likely exchange value of a business branch holding a qualification, and has set incidence rates of the price on the threshold level of the registration classification. These rates are classified according to qualification categories.

Thus, it is possible to outline a different methodological approach for the compensation of the *curricular damage*, or rather of the injury suffered by a building company because of non-enrichment of one's own corporate curriculum due to an unfair exclusion from a tender. This enables improving on the equitable trend generally used by administrative jurisprudence that quantifies it as a percentage of the economic offer made.

In detail, the first step is identifying complementarity as the economic aspect for considering the appraisal of the curricular damage. This represents the appraisal of the goodwill variation that the company would obtain by attaining a higher classification, or rather the failed loss of the classification held. Then a methodological analysis can be performed by calculating the difference between: the curricular value that the company could obtain thanks to the increase in the corporate turnover deriving from the execution of the tender, by acquiring a higher classification than the one held, or rather in the failed declassing of the classification held; and the curricular value that the company had at time of the submission of the bid, in relation to the category and to the qualification classification held.

A concrete application of this method has enabled specifying that the extent of the curricular damage appraised with this approach is meaningfully lower than the extent usually equitably acknowledged by administrative jurisprudence. The latter, in fact, does not take the asset variation caused by the failed awarding into account.

It is suggested that the study proposed shall be further analyzed, in order to model an appraisal algorithm enabling differentiating the curricular value in relation to further parameters. These parameters characterize each building company in terms of additions or deductions to the mean capital value appraised by a direct approach.

Hence the spread of an approach of appraisal of the curricular damage, consistent with the estimation rationale and methodology, is desirable. This appraises the real injury suffered by a building company unlawfully excluded by the awarding of a tender.

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Valorising in the Absence of Public Resources and Weak Markets: The Case of “Ivrea, the 20th Century Industrial City”

Cristina Coscia and Rocco Curto

Abstract The extensive architectural heritage of Italy often finds itself in conditions of severe deprivation and neglect or inactivity. Moreover, such heritage is often located in contexts characterized by the absence of public resources and the presence of weak markets. Their valorisation is linked to the possibilities of re-use. The identification of new locations is often treated in a minimalist manner: contrasting with public use to that of private individuals and contradicting the criteria identified by the economy to define the public or private nature of the assets. In many cases, the approach to re-use is critical and incomplete due to the lack of an in-depth analysis of the economic and financial feasibility of the interventions. This paper reviews the traditional approaches regarding the enhancement of public and private properties, taking into account the theories regarding the value and economic evaluation tools. From this point of view, the case study—“Ivrea, the 20th century Industrial City”, nominated in the UNESCO Tentative List—is emblematic. The authors intend to support the Public Administration of Ivrea in the concrete actions of valorisation of heritage, including the revision of the Management Plan already presented. Its valorization potential departs from the imbalance between supply and demand issues of spaces. In conclusion, this paper succeeds in reporting on the strategic importance of when cultural heritage, both immaterial and material, should be used, regardless of the state of its use and conservation. Attention is focused on IT capabilities with respect to their ability to reconnect the individual assets to systems and involve new audiences.

Keywords Modern architecture · ICT for cultural heritage · Fruition · Investment evaluation · Ivrea

C. Coscia (✉) · R. Curto
Department of Architecture and Design, Politecnico di Torino, Viale Mattioli 39, Turin, Italy
e-mail: cristina.coscia@polito.it

R. Curto
e-mail: rocco.curto@polito.it

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1 Research Aims

The aim of the paper is twofold. The paper considers the issues of valorising cultural heritage in the contexts characterised by the absence of public resources and the presence of weak markets. These two coexisting factors induce scientific communities and operators to review the traditional approaches to enhancing public and private properties, specifically: (1) considering the traditional theories of value; (2) reinterpreting economic variables and the economic evaluation and assessment tools of the feasibility of the strategies. In many cases the approach to reuse seems to be critical and incomplete due to the lack of in-depth analysis of the economic and financial feasibility of the interventions. In this sense, the paper addresses the issue of the valorisation of architectural heritage, according to the mentioned twofold point of view. The first focuses on the reuse of assets that have lost their original purpose; the second deals with the use of cultural heritage, which is considered as an equally important element of economic valorisation. The main assumption of the line of reasoning is that—irrespective of the state of use and conservation—tangible and intangible cultural heritage must be used. Then attention is focused on IT potentialities regarding the ability to reconnect the individual assets into systems and to involve new audiences through diversifying the forms of direct and indirect, real and virtual use. From this point of view, the case study —"Ivrea, the 20th century Industrial City" (Ivrea Municipality 2015), nominated in the UNESCO Tentative List—is emblematic. The authors intend to support the Public Administration of Ivrea in the concrete actions of valorisation of heritage, including through the revision of the Management Plan already presented. New theories of value, in fact, induce to review the strategies to be adopted in valorising heritage. The paper is therefore divided into two sections. The first, a concise introductory part of a theoretical nature on the state of the art, on the disciplinary and regulatory debate, on the theory of value and the role of valuation (Sects. 3 and 4.1), which in the case of assets of historical interest, cannot mechanically change the tools made available by the same Anglo-Saxon literature (DCF). The next applicative part (Sects. 6 and 6.2) introduces the case of modern Olivetti heritage, with which the themes of reuse and valorisation are addressed, still specifying the tools deriving from Anglo-Saxon literature, which are reductive when applied to Cultural Heritage. Finally, two sections (Sects. 7 and 8) close the dissertation through a final analysis and several research perspective that recover the dimension of fruition in all its forms and articulations. Consequently, the paper shows how it is necessary to radically rethink the approaches and methodologies more than the operational tools in the strict sense in the valorisation of the heritage of "Ivrea, the 20th century Industrial City". The Cultural Heritage sector presents higher specificity and complexity to others because of the interaction of cultural and economic factors, which require further in-depth analysis.

2 Introduction

Italy's architectural heritage is considerable. Regrettably, many buildings of historical interest are degraded and unused. Their valorisation is closely linked to the possibilities of reuse; however, the identification of new locations is often treated in a minimalist manner. Generally, contrasting with public use to that of private individuals, contradicting the criteria identified by the economy to define the public or private nature of the assets, which are defined as "public" and not in relation to the property, but in the case in which the use by a select few does not conflict with its utilisation by others. Moreover, in most cases, reuse is treated without considering the merits of the economic and financial feasibility of the interventions. In the case of public locations, the actual availability of financial resources needed to carry out restoration work and to manage activities and public services is not considered. In the case of private locations, however, the actual condition of economic and financial feasibility of investors, measured in terms of opportunity costs, is often not assessed. While Italian legislation regarding cultural heritage protection is among the most advanced (Decreto Legislativo 22 gennaio 2004, n. 42), regarding valorisation as being affected by a certain reductionism (even concerning the theoretical and conceptual level) it completely ignores the contribution that a healthy and environmentally friendly economy can provide, concerning the issue of valorisation, partly as a result of the technology transfer processes under way in the Cultural Heritage sector.

3 The Theory of Value in Cultural Heritage and in Reuse Processes: An Overview

The theoretical paradigms identified to determine the value of environmental resources (Beinat 1997; Klamer 1997, 2002; Loomis et al. 2000; Turner et al. 2003; Zhongmin et al. 2003; Richardson and Loomis 2009; Tietenberg and Lewis 2012) can also be used to outline a new conception of the economic value of architectural heritage, based on the "Total Value", which consisted of more economic value components of diverse natures, measurable in monetary terms and whose influence may vary (Bowitz and Ibenholt 2009; Freeman 1993; Hutter 1996; Hutter and Rizzo 1997; Klamer 1997, 2002; Throsby 2001; Snowball 2007).

The Total Economic Value (VET in Italian), as defined for environmental resources, lends itself to be borrowed in order to explain the economic value of historical and architectural interest resources (Gruzinski 1993). The VET is credited with having introduced the "value of non-use" and to have disintegrated the "use value" (located at the base of the market value), more values (components of the value) differentiated in relation to the direct and indirect operating evaluation methods, and the specific types of users (direct, indirect, potential and future) (Vecco 2010).

In the following chapter "New Bottom-Up Approaches to Enhance Public Real/Estate Property" according to the paradigms of environmental economics, the architecture of the 1900s in Ivrea would have: (a) an existence value, which transcends its state of use and conservation, monetised by the market; (b) a use value and/or reuse potential (market and/or income), related to the possibility of being used for new functions; (c) more determined values by the possible indirect forms of use, whose influence in the determination of the VET is expected to grow, thanks to the opportunities provided by IT in expanding the real and virtual forms of utilisation. The VET has redefined the operational tools to estimate the total economic value, taking into account its multiple components (Conjoint Analysis-CA, Contingent Valuation-CV, Travel Cost-TC, Hedonic Price-HP). There is a wide range of literature that has experimented the different techniques and models (Merton 1981; Peacock and Rizzo 1994; Frey and Eichenberger 1995; Mason 2005; Rujgrok 2006; Choi et al. 2010). Specifically, CV or CA are not applied in the case study (that measure consumer utility), given the costs in terms of time and resources, considering the extension of the potential demand and not completely reliable results when the demand of a specific asset in a concrete case must be estimated.

4 Methodology Framework: A New Approach of Development Through Reuse

The methodological approach to the case study, which will be explained in detail in chapters "New Bottom-Up Approaches to Enhance Public Real/Estate Property", "Curricular Damage Estimation" and this chapter, takes into account the specificities of the valorisation process, in which the role of valuation is to perfect and revisit analysis, tools and methods (even traditional) in its different phases.

Generally in the case of valorisation (Sinou 1993; Cristinelli 2002) knowledge is nearly exclusively concentrated on the historical value of the assets and possibly on the state of degradation, as more attention is focused on restoration than on reuse and on the economic feasibility of the interventions. From this point of view, the same guidelines drawn up by UNESCO for the realisation of management plans (UNESCO 2005), recognise the role of territorial investigations in the knowledge for the purpose of valorisation. In fact, the possibilities of valorisation are closely linked—especially in the case of large assets—to the economic, social, cultural and administrative dynamism of territorial contexts (Mazzanti 2003). Although requiring further systematisation, it is necessary to highlight the methodological contribution of these guidelines in distinguishing between “static analysis” (descriptive) and “dynamic analysis” (probabilistic), and between those of a “micro” nature and those of a “macro” nature (for applicative detail, please refer to Sect. 6.1). Most of the time, in fact, knowledge, being aimed at protection, is abstracted from social and economic dynamics of territorial contexts.

4.1 A Role of Valuation in the Reuse Process for Cultural Heritage: Analysis and Application Method

Recently, the role of valuation, viewed in a perspective of project management (Brigato et al. 2014; Coscia et al. 2015) has taken on a strategic importance, even in the preliminary and briefing phases. For the case of Ivrea in particular, the dimension of the site to be reclaimed (70 ha) and the number of architectures to be valorised (28) (see Sects. 5.1 and 6.1), ensure that knowledge cannot only be aimed at restoration and protection, mainly focused on buildings. In particular, the economic and social analysis acquire a key role, as the revitalisation of the UNESCO site is strictly influenced by the degree of dynamism of Ivrea and its territory. Reuse cannot be regarded building by building, disregarding the assets system and favouring the project to plan and program urban valorisation/regeneration.

Specifically for the case study, the ability to valorise/reuse the assets of the 1900s in Ivrea, constructed during a phase of rapid industrial development, depends on the demands of public services and assets and private services that Ivrea and its territory can potentially express. The economic and social analysis carried out and highlighted in the macro data of the structural framework (see Sect. 5 and Fig. 1) have made it possible to show immediately that the territorial context of Ivrea is not able to guarantee the affordability of the conditions required to transform unused buildings, despite their great historical and architectural value. Ivrea presents critical phenomena, such as a high aging index, above the regional average. The creation of start-ups of young entrepreneurs in the biotechnology, ICT and tourism sectors, despite being numerically significant, is still too low compared to the size of the areas used in the past by Olivetti. The enhancement process for the Cultural Heritage must therefore also deal with those aspects of uncertainty (Loulanski 2006).

5 Case Study Characterisation

5.1 Presentation of the Case Study and Description of the Context

In 2012, UNESCO included “Ivrea, the 20th century Industrial City” in its Tentative List (https://www.comune.ivrea.to.it/scopri-ivrea/progetti-di-valorizzazione-delterritorio/architetture-olivettiane-candidatura-unesco.html), thus recognizing that it represents the expression of the extraordinary conception of the Adriano Olivetti community, materialised in buildings that have architectural as well as historical value (Ragghianti 1960; Zorzi 1977; Braudel 2001).

In fact, the community model (Boltri et al. 1998; Koenig 1970) is based on social cohesion and goes beyond the dichotomous division of society in which all the industrial companies were developed in the 1900s (Olivetti 1936; Kidder-Smith 1963; Berta 1980). The industrial city of Ivrea, comparable to a laboratory where planners and architects are compared, firstly presupposes exceptional relations between capital and labour, which exceed the economic and social theories at the basis of Marxism and Capitalism.

Additionally, the entire City of Ivrea and its territory, which the industrial city is part of, retains the material traces of the momentous changes that preceded industrialization or that are subsequent to this. Both of them (city and territory) used to transferring the profound sense of long-term history (Braudel 2001), materialized through the testimonies of the political, economic, social and cultural systems that have taken place over the millennia: from the Roman era (explicit in the archaeological area and the amphitheatre) to the Middle Ages (transmitted by Via Francigena and the Castle itself, by the cathedral and by the ancient City of Ivrea), up to the modern age (explicit in the changes passed down in the agricultural landscapes and testimonies of proto-industry) arriving at the “interruption” produced by industrialization, evoked by the UNESCO website, and the current post-industrial era, transmitted by buildings built in the 1900s and today largely unused. Ivrea constitutes an actual case study to address the issues of protection and valorisation (Bonifazio and Giacopelli 2007). In fact, UNESCO selected these assets to be entered in the World Heritage List (WHL) evaluating operations (contained in the management plans) with which the proponent entities undertake to protect and valorize them.

In addition, the case of Ivrea allows us to refocus attention on the architectural heritage of the 1900s, which being more recent, subtracts itself more easily from being protected and whose value is not recognised today as it should be, if not by a very limited number of experts and specialists (Crespi 1957; Guiducci 1959, 1960; Tentori 1959; Cappai 1976; Savi 1980; Vidari 1980). Architectural structures have all—except for the Gardella Hospital (Gardella 1960)—high architectural value: they were designed by internationally renowned architects (Figini and Pollini, Gardella, Di Vittoria, Gabetti and Isola, Cappai and Mainardis) and cover all possible types (industrial buildings (Castellani Longo 1965), research centres, offices, social services, housing, etc.). Moreover, they represent a variety of expressions of the Modern Movement, which go beyond the International Style: in addition to the rationalist and organic architecture, we have one of the few examples of radical architecture that has great symbolic value, the Serra by Cappai and Mainardis (unfortunately it is not included in the core zones), an exemplary belowground architectural structure, the Talponia by Roberto Gabetti and Aimaro Isola and a testimonial, perhaps slightly forgotten, of brutalist architecture, the former Sertec, by Sgrelli, which in turn represents an interesting case of the transformation of an existing building, constructed with a real "brutalist" addition.

6 A New Approach of Development Through Reuse for the Case Study: Structuring of the Phases, Analysis and Evaluation Tools

The previously clarified theoretical-disciplinary issues (chapters "The True Value on Understanding Something", "Appraisal of Manufacturing Buildings Through the Depreciated Replacement Cost Approach" and "Do Real Estate Cycles Exist and, if so, Are They Predictable?") were assumed in applying analysis and evaluation tools. Two phases are highlighted in the study: the first phase is of knowledge and analysis (see Sect. 6.1), supported by the identification and selection of data sources, the structuring of a structural framework of analysis and mapping of several themes starting from the interpretation of the database; the second phase of an experimental nature, which tests the traditional tools of feasibility but which are applied to Modern Heritage (see Sect. 6.2), and highlights the importance of empirical and expeditious management controls, useful for the decision-making of the Public Administration and stakeholders (see Sects. 6.2 and 7.2).

6.1 Structural Data and Evaluation Gap: First Phase of Mapping

The methodology involved a preliminary monitoring phase of the sources, structuring and normalization of the data aimed at the support mapping, the strategic valuation and the subsequent phases of identifying sustainable scenarios and actions and valorisation strategies compatible with the development policies of the city of Ivrea and its territory (GGI and AASTER 2012).

The structural framework of the data was processed and summarized to make the SWOT analysis (Fig. 1). The model used shows several variations compared to the traditional one, in order to make the critical reading and the interpretation on an evaluative base of the data complexity more robust: the structure provides data analysis (related to the consulted direct and indirect sources) on a multi-level

Issue	*Strengths*	*Weaknesses*	*Opportunities*	*Threats*	*Sources*
Accessibility	*Macro:* Interventions made on the country roads by municipalities involved in order to relieve traffic on SS26 and to strengthen piedmont ridge (such as Quincinetto SP69). There is a variation in the built-up area of Baio Dora, in Borgofranco di Ivrea municipality; The territory is internally interconnected by a road transport IN.RE.TE service easily accessible from the main roads (highway, railway, Caselle airport) and located close to the major centers in Northern Italy; *Micro:* Car Sharing Service "Io Guido" is used in the city and even around;	*Macro:* The Chivasso-Ivrea railway line has a weak point in the network (with high level of commuting) that connects Valle d'Aosta to Turin; *Micro:* Bicycle mobility services is very limited in number and kind;	*Macro:* Forecast doubling of the tracks of the Chivasso - Ivrea railway; *Micro:* A cycle and pedestrian path/network that connects the historical city with the new city, crossing the Dora river and the railroad; "MOVIcentro", a new project for the reorganization of the urban and extra-urban transport of the City; Is in preparation the funding of the so-called "Peduncle-former SS228" a connecting road, aimed at relieving the congestion of the East entrance to the city;	The upgrade of the Chivasso - Ivrea - Aosta railway, already funded on paper, could be canceled due to lack of coordination between Piedmont and Valle d'Aosta regions;	Piedmont Region site. Province of Turin Site: Territorial Coordination Plan, Interventions road on set; General Municipal Regulator Plan; Ivrea Municipality, Prevision plan 2000; Former SS228 final project, Variant of Ivrea in the area between SS26 and the border of Bollengo; Public Relation Office of Ivrea, Regional Integrated programs for local development, Mountain Community Baltea Canavesana; Detailed Plan of former Montefibre Area.
Territory	*Macro:* Characteristic landscape of the Serra Moraine, historically cultivated with orchards and vineyards; Natural and eco-systemic areas protected by specific regulatory tools (Special Protection Areas(SPAs), Sites of Community importance (SCIs), etc.);	*Macro/micro:* Progressive conversion of cultivated areas in forest land and abandonment of the Serra terraces in favor of arable flat areas with mechanical tools; The land use appears diminished, but with predictions of future enlargements, although regulated by Town Plans: increase in land consumption by 9% (2000-2006) to 2.2% (2006-2010), with prevision not yet implemented of 24.3%;	*Macro:* Landscape and Cultural Identity Enhacement Plan "Pay–sage"; Integrated Plan for the development of cultural heritage, "The moraine amphitheater of Ivrea: landscape and culture" and "Canavese terra narrata", which involves the construction of a cultural, leisure and touristic route, made up of places and characters of the Risorgimento period in the Canavese area;	Segregation of wildlife in scenic areas; Loss of crop variety and the characteristic structure of "agro-mosaic" of Alto Canavese area, due to the conversion of the cultivated land in industrial and forestry areas; Loss of the traditional landscape of the foothills characterized by moraine terraces; Data analysis on land use suggests a decentralization of aging population and the risk of generate additional phenomena of urban sprawl;	Eporediese Area section of the Regional Landscape Plan 2011; Proceedings of the Conference "Territory: handle with care. The implementation of PTC2", 13/04/2012, Province of Turin; Piedmont region, Integrated Project of the Canavese and Biella area, 2004; Ivrea municipality. Projects for the development of the area;
Population	*Macro:* In the Eporediese area the population in 2012 stands at 90,750 inhabitants, against significant number of deaths, the age group between 0-14 and 15-64 remains numerous and representative; Foreign nationals increasing, with the exception of a fall in 2011, now in the recovery phase; *Micro:* Always positive net migration from 2002 to 2012 and growing rapidly in 2011-2012 period (from 215 to 673), reaching the values of the beginning of 2000s; Average income per capita growing in 2005-2007 period (from € 11,817 to € 13,124), and is stable from 2007 to 2010 (from € 13,124 to € 13,287);	*Macro:* In 2012, in the Eporediese area the age range distribution of population reveals that the death rate exceeds the birth one; *Micro:* From 2002 to 2012 the prevalence of deaths on births in Ivrea is even more accentuated than in Eporediese area. The most negative peak was recorded in 2009. Ivrea is characterized by aging phenomena of the resident population; Municipality aging index (1.8%) is higher than the provincial value (1.4%), regional (1.5%) and national (1.2%); High dependency ratio (0.52%) is higher than the provincial (0.48%), regional (0.49%) and national (0.46%) value; Average income per capita in 2010 stood at € 13,287, less than the provincial (€ 14,067) and regional (€ 13,577) values; The younger age groups are mostly commuters: they focus on school schedules around the station pole and at bus stops, with little relation with other part of the city;	*Macro:* "Local integrated security Pact", drawn up by the city of Ivrea and other 16 Eporediese municipalities, having € 535.000,00 of budget to carry out actions aimed at ensuring the safety of citizens; *Micro:* Participation of Ivrea and Strambino to the European call for the integration of foreign nationals, with a prize of EUR 3 million; Many initiatives conceived by organizations like Permanent Territorial Centre (site in the Olivetti High School in Bellavista) promoting the integration of foreign citizens;	*Macro:* Mass depopulation of the towns of the foothills (e.g. Nomaglio, Tavagnasco, Broseley, Meugliano and Trausella); *Micro:* An aging population trend is expected in Ivrea in 2012-2020 period, with an increase of the population over 65 y.o. compared to younger age groups. This is also supported by low birth levels;	Italian Municipalities 2002-2012; Demo.ISTAT 2005-2012 "La Sentinella" 2011; Ivrea Municipality and Province of Turin 2011; Invalsi 2013;
Heritage and Cultural activities	*Macro:* Fortified castles system around the town of Ivrea with an important landscape role (Ivrea Montalto Dora, Pavone Canavese, Quassolo, Caravino, Settimo Vittone, Albian, etc.); Proto-industrial heritage (mining in the foothills band: Quincinetto, Lessolo, Val Chiusella, etc.) and industrial (Olivetti in Ivrea) of different ages; Increase on the territory of widespread musealization (Piverone, Nomaglio, Andrate); *Micro:* "Museo a cielo aperto dell'Architettura Moderna di Ivrea (MAAM)" (Open air Museum Of Modern Architecture of Ivrea); Presence of cultural associations such as "Public-08", which are dedicated to cultural promotion starting from land resources (shows, events and research economic resources);	*Macro:* Land supply is very varied in terms of number of institutions, structures and activities, but often suffers from a lack of economic resources; *Micro:* Over the past 10 years, 60% of the contributions to achieve the Open Jazz Festival come from private sponsors	MAAM promote the enhancement program of Modern architecture of Ivrea linked to Olivetti; UNESCO candidacy of the City of Ivrea; Restoration campaign for the ecclesiastical heritage, with examples belonging to different currents and periods (Romanesque, Eclectic, etc.); Landscape and cultural identity enhancement Plan "Pay–sage"; Promoting Project "Morainic Amphitheater of Ivrea. Stones tell" (concerning the archaeological remains found); Polaris project: "Art Amphitheatre. The moraine amphitheater of Ivrea between nature and art, open air contemporary art itinerary"; The new Ivrea Reading Festival "The great invasion", for its first edition is free and aims to transform the city into a reading, music, cinema and theater workshop; Project in progress for the construction of the new municipal library in the former Cena Institute in Castello Square;	Risk of ghettoization of some urban areas (e.g. Bellavista district), which for current functions and uses see the influx of population groups considered "weak"; Risk of altering interventions for the renovation of Olivetti architectures in presence of little or no economic resources; Some cultural activities which had been realized in 2009, 2012 and 2013 were suspended for the cuts in funding of the culture sector;	Eporediese Area section of the Regional Landscape Plan 2011; www.Music-studio/Ivrea Jazz Club.it; Ivrea Municipality, MAAM and projects for the development of the area; Cultural Association "Public 08"; Unesco World Heritage List; Area integrated project of Canavese and Biellese, 2004, Piedmont Region; Cossano Municipality; Canavese, Polaris projects; www.lagrandeinvasione.it;
Citizens' and people's Services	*Macro/micro:* Is starting up the building of the new health center of Ivrea, a € 15-	*Macro/micro:* Currently, blood test centers and specialist clinics of Ivrea Health System are	*Micro:* "QBellavista Ivrea...a piede di anziano" is an ongoing project of the	*Macro/micro:* Needs analysis still so weak and lacking and the	Piedmont Region, ASL TO4; Area integrated Plan of IN.re.te. and C.I.S.S.A.C. consortium (2011-

Fig. 1 SWOT analysis of Ivrea and the Eporediese District: macro and micro levels. *Source* Author's work

territorial scale (micro and macro scale), that has enabled the identified themes (demography, economy, etc.) to be highlighted and compared, both of the municipal perimeter of Ivrea and Eporediese district in terms of both territorial marketing and Genius Loci. It is emphasized that some of the "sensitive" themes

Issue	*Strengths*	*Weaknesses*	*Opportunities*	*Threats*	*Sources*
	million facility, provided in the "former Montefibre" area; Both municipalities belonging to IN.re.te plan and CI.SSAC. consortium, have drawn up a 2011-2013 Area Plan based on care needs of children, adults, elderly and people with disabilities. The profiles for aid services shall be identified in Public health and employment sectors; A.L.T. project "Agriculture, Labor, Tradition", headed by the City of Ivrea for the years 2011-12, for the integration of young people (18-29) in different working in development sectors;	housed in the old town structures, creating problems of accessibility to users; The City of Ivrea has difficulties to have services for the young people groups both at macro and local scale: it is not yet focused the needs analysis for younger age groups, both in adolescence and working phases;	Municipality with "Casematte" Association in order to find solutions to adapt the living space to the needs of old people; The City of Ivrea has implemented several projects in the penitentiary sector, initiatives for social and work insertion of community service workers and ex-convicts (€ 60,000.00, financed by "Compagnia di San Paolo"); *Macro/micro:* Participation of Ivrea and Strambino to the European call for the integration of foreign nationals, with a prize of EUR 3 million;	insufficient supply of services for youth age groups, might increase the risk of land abandonment from this application target;	2013); Ivrea Municipality. Sub Local Youth Plan of Canavese 2013; Ivrea municipality. Town Planning Department; Press office ASL4; Casematte Association, QBellavista project; "La Sentinella", 2011;
Economy	*Macro:* <u>Primary sector:</u> the production of "Denominazione di origine controllata (DOC)" (European Union PDO) wines (Nebbiolo of Carema, etc.) is still carry on; <u>Secondary sector</u>: international importance of the biotechnology District (Bioindustry Park); there are at least 17 different sectors in the territory among which are the field of Electronics and Mechatronics of the Post-Olivetti and Informatics sectors; *Micro:* To encourage the creation of new businesses houses in the Adriano Olivetti Centre, it was set up a business incubator "Meeting Point" accessible via tender;	*Macro:* <u>Primary sector</u>: average age of farmers exceeding 60 years; <u>Secondary sector:</u> in the territory of Ivrea 20.7% of companies are in crisis. This is worrying, but it is still lower than the Provincial 23.5%; majority presence of small companies;	Ongoing project "A.L.T." (2013) for the insertion of young workers in the craft and agricultural enterprises located in the territory of Ivrea; Ongoing project "The Social Farm", aimed at training and providing employment for disadvantaged people through farming activities; Ivrea has relied on the fact that Turin would become the capital of biomedicine in 2014 by hosting the "Bio Europe Spring" one of the most important international events for companies, research centers, universities and technology parks of the sector of life sciences; E-commerce is a new local business development sector, in particular for craft companies and commercial activities, according to the approach adopted from "CNA Torino"; In the new project for the "former Montefibre" area are forecasting 25% m2 for offices, 8.8% m2 for trade, 13.3% m2 for manufacturing and 27.9% m2 for flexibles areas;	It is expected that the lack of labor force of the young age group in the agricultural field will exacerbate the progressive abandonment of the countryside in a few years; Regardless of the conversion of Olivetti structures, the city struggled to find a productive vocation; Risk of abandonment of some brownfield sites inserted in urban settings; Risk of further impairment of the landscape due to expansion of production areas;	Land Plan of Provincial coordination 2011; Consortium for the production facilities of Canavese; Bioindustry Park Silvano Fumero; Ivrea Municipality, work policies office; Sub Local Youth Plan of Canavese 2013; Copernico Consortium, Cascina Praie; Booklet "ABC Internet for Enterprise", CNA Torino;
Real Estate Market	*Micro:* In the municipal area there are 3,553 buildings, of which 96.2% is in use;	*Macro:* The "Osservatorio del mercato immobiliare – OMI" (Real Estate Market Observatory) in Territorial Note of the first half of 2015 cite the Eporediese like one of the macro-areas of Piedmont where the most significant losses both in terms of number of exchanges (NTN) and in terms of values are recorded: a significant drop in house prices (-13.90%) and a similar drop in the number of transactions - NTN (-13.40%); *Micro:* Ivrea decreases in trades (-14.80%) with average prices of € 1,300.00/m2; furthermore there is a significant price dispersion; 64.57% of the resident population is living in own houses while 29.3% is living in rental housing.	*Micro:* There is a substantial number of unused real estate assets; Three-year review of maintenance plan of the historical and social heritage;	*Micro* Unused heritage with scarce resources for routine maintenance; Large former IACP heritage with risk of degradation growth in the presence of little or no resources for routine maintenance;	OMI, Real Estate Report 2015. Residential sector. Regional data. Piedmont and Valle d' Aosta. http://www.borsinoimmobiliare.it/quotazioni-immobiliari/Piemonte/Torino-Provincia/Ivrea IMMOBILIARE.IT: http://www.immobiliare.it/mercato-immobiliare/Piemonte/Ivrea.htm l Turin FIAIP observatory: http://www.osservatoriofiaiptorino.it/provincia-di-torino/item/263-ivrea.html
Tourism	*Macro:* There is a significant and qualified offer of accommodation and catering, but demand is weak: visitors of castles and museums are falling, but the tourist flow has increased during 2012 (85.000 total attendance mostly Italian) as well as the average stay time (3.2 days compared to approximately 2 of 2011), after a period of decline in the last 4 years, for which the contraction is certainly because of the economic crisis; Concerning Hotels (1 to 4 stars) and others accomodation, in the period 2005-2010 has increased Italian tourists presence. In the same period increased also the presence of foreign tourists but not in hotels; <u>*Micro:*</u> The Tourist Office of Ivrea has promoted in 2012 the project "IVREA FOR ALL" for tourism development, through the creation of most disadvantaged users paths;	*Macro:* Concerning Hotels (1 to 4 stars), and others accomodations in the period 2005-2010 has decrease foreign tourists presence; Lack of beds and of differentiated and integrated offer among the different actors of the territory; Small number of tourist packages; <u>*Micro:*</u> Although the number of tourists visiting Ivrea and its territory has increased from 2000 to 2014, going from 32,134 to 57,952 visitors of the Morainic Amphitheatre of Ivrea and from 16,766 to 20,525 visitors to the city of Ivrea it cannot yet be defined as a city of "tourist attractiveness"; Numerous but not relied events and popular traditions are still present in the Ivrea area, living in the shadow of the historic Carnival of Ivrea; Poor promotion of events related to urban tourism causes an offer relevance decrease compared to the total supply; Currently, "Museo a cielo aperto dell'Architettura Moderna di Ivrea (MAAM)" (Open air Museum Of Modern Architecture of Ivrea) with its path that runs along two kilometers does not register big inflows of visitors;	*Macro:* Touristic offer throughout the territory in the planning stage point to a soft tourism, in line with the local economies, which, through the involvement of staff, facilities, materials and agricultural local products, may have a chance of development; For the year 2016 Ivrea and the municipalities of the pact are hoping for a positive pulse generated by the 2016 World Canoe Championship sites in Ivrea;	*Macro/micro:* The "Mediapolis" project seen as an example of a dynamics that moves local governance even further far away from Olivetti's idea of community and territory identity; Without an effective intervention on communication and systematic promotion of events, the risk of media dominance of the historical Carnival of Ivrea increases;	Piedmont Region. Tourism Observatory; National Atlas of Rural Territory. Local System of Ivrea 2007-2013; Ivrea Municipality. Tourism Sector; Consortium for the Technological District of Canavese, Touristic Scenarios, May 2006; "Pay–sage". Integrated plan about Serra Moraine Amphitheatre, 2006;

Fig. 1 (continued)

have been mapped, especially those regarding the consistencies, uses (original and current), the properties ad state of conservation (Figs. 2, 3, 4 and 5). For editorial space reasons, the analysis have been omitted and the most sensitive results have merged into a SWOT analysis (Fig. 1).

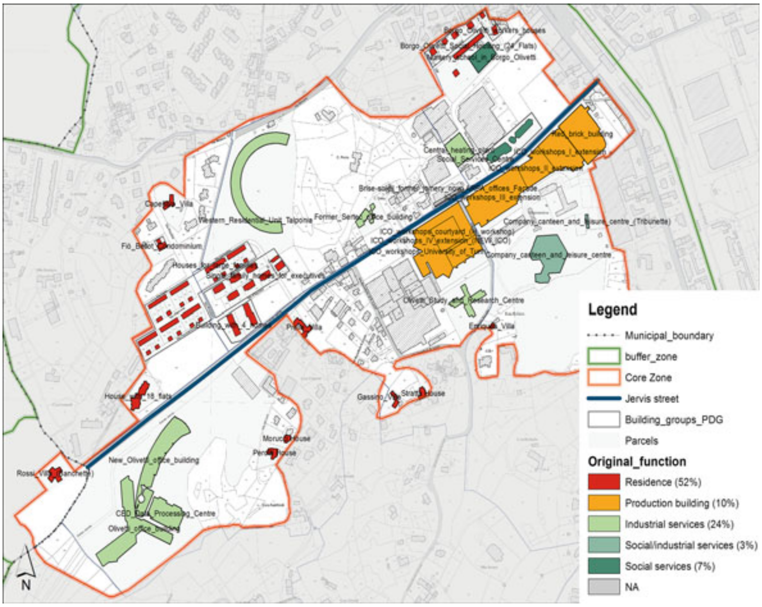

Fig. 2 The Core Zone: original functions. *Source* Author's work

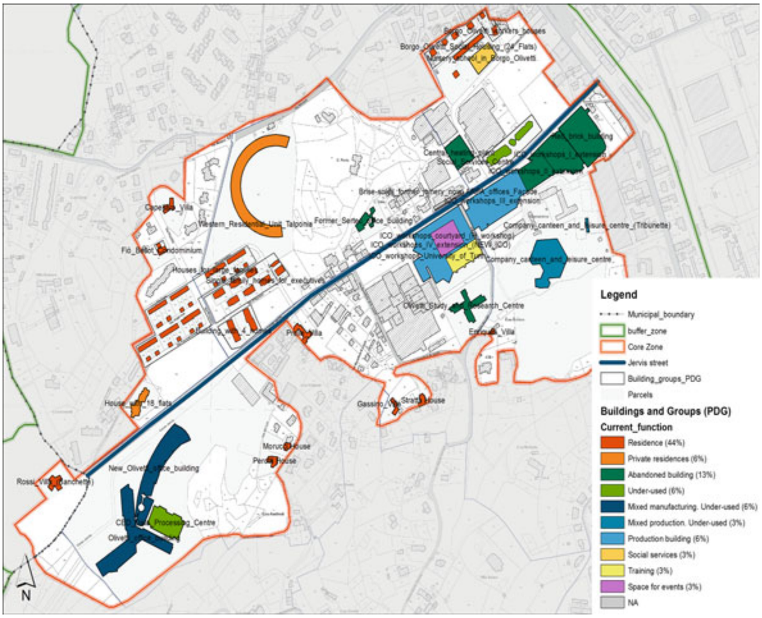

Fig. 3 The Core Zone: current functions. *Source* Author's work

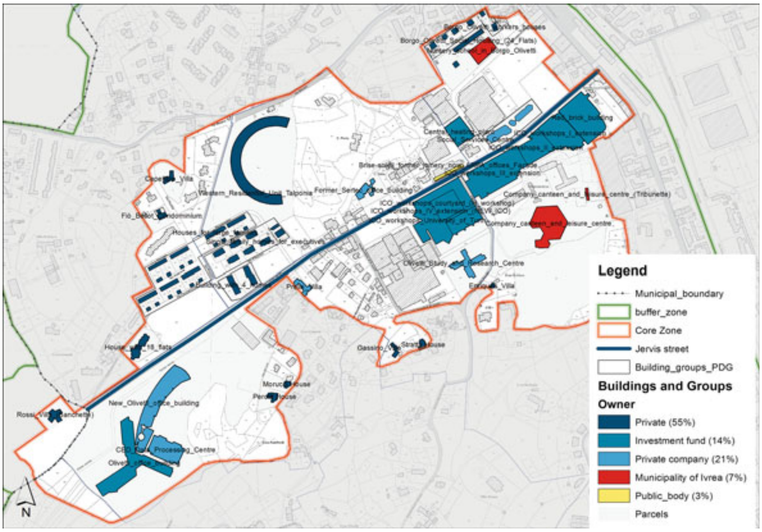

Fig. 4 The Core Zone: the owners. *Source* Author's work

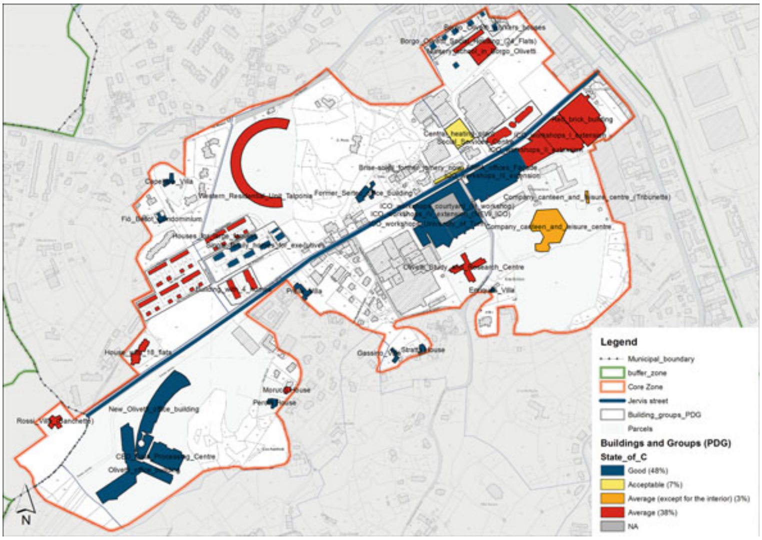

Fig. 5 The Core Zone: state of conservation. *Source* Author's work

The SWOT highlighting the huge gap between the surfaces to be reused, and the weakness of the socio-economic context, determined by structural and not only cyclical factors. In particular, the Core Zone:

– has an estimated surface of 121,063.87 m^2 of services and offices and 24,216.75 m^2 of houses (Fig. 5) 59% is used (65,359.30 m^2), while 41% is unused (46,254.14 m^2);
– consists of 28 fields, 27 of which are private and have strategic economic capabilities of diverse valorisations (individual owners, companies and asset management companies as SGR).

In addition, the reuse operations must reconcile two key aspects. Firstly, the necessary steps to adapt the existing buildings with the performance requirements of the new features that must deliver the original, architectural, construction and distribution characteristics. Secondly, they must be economically and financially feasible. While the compatibility of uses and assets can be resolved regarding the same project scale, the financial and economic feasibility is a little "trickier", as it depends on structural conditions, surmountable only by not diversifying locations and segmenting applications (Figs. 2, 3, 4 and 5).

6.2 *The Valuation Models: The Discounted Cash Flow (DCF) Method, Applied to the Reuse of Historical Heritage*

Since the majority of the buildings of the Core Zone consists of private properties (Fig. 6), whose aim is to maximize profit, several reuse scenarios have been prefigured, each of them evaluated with the Discounted Cash Flow Analysis (DCF).

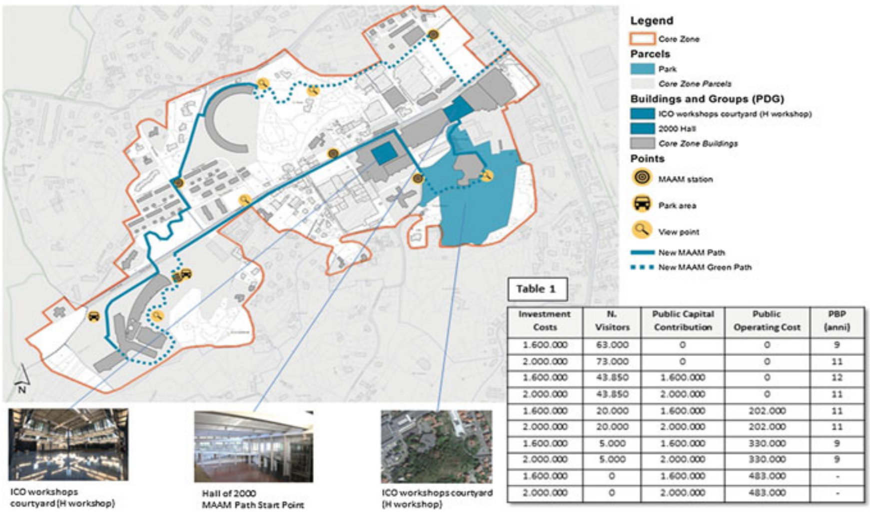

Table 1

Investment Costs	N. Visitors	Public Capital Contribution	Public Operating Cost	PBP (anni)
1.600.000	63.000	0	0	9
2.000.000	73.000	0	0	11
1.600.000	43.850	1.600.000	0	12
2.000.000	43.850	2.000.000	0	11
1.600.000	20.000	1.600.000	202.000	11
2.000.000	20.000	2.000.000	202.000	11
1.600.000	5.000	1.600.000	330.000	9
2.000.000	5.000	2.000.000	330.000	9
1.600.000	0	1.600.000	483.000	-
2.000.000	0	2.000.000	483.000	-

Fig. 6 The virtual MAAM proposal and Table 1—the scenarios of virtual MAAM. *Source* Author's work

The buildings of the private property Core Zone can be exploited economically and functionally using different transformation and valorisation models (Plaza 2010). It is known as the evaluation of the economic and financial viability of reuse interventions must always be measured using the appropriate evaluation tools, in terms of Internal Rate of Revenue (IRR) and Net Present Value (NPV) through the DCF (1).

$$\sum_{t=1}^{k} = 0; \quad \mathrm{VAN} = \sum_{\mathrm{t}=1}^{\mathrm{n}} \left[\frac{\mathrm{Revenues}}{(1+\mathrm{r})^{\mathrm{n}}} - \frac{\mathrm{Costs}}{(1+\mathrm{r})^{\mathrm{n}}} \right] \tag{1}$$

Each type of transformation is characterized by the specific items of financial income and expenses. We should always consider:

– the initial investment (made up of the market value of the actual state and the flow of processing costs);
– the cash flows generated as a function of specific locations;
– the risk/investment ratio;
– the residual value of assets considered at the time of disinvestment, in some specific cases.

An overview on the theory of achievable reuse by private owners, considering the architectural characteristics of the assets and the demand expressed by the economic and social context, basically provides three models, explained below. Private owners can choose whether to put the assets on the market or allocate them to economic activities to be managed.

1. HOUSING AND/OR OFFICES
   1.1 The Trading Market. Reuse interventions have a high market risk, determined by the imbalance between supply and demand for almost non-existent spaces. In the central area and/or near the centre of Ivrea, the market values of existing buildings range from a minimum of €400/€500 per m^2 to a maximum of €900/€1000 per m^2, while the values of restructured assets vary between €1600/€1800 and €2000/€2500 per m^2. The threshold of the maximum values of restructured assets is too low for the profitability margins of existing heritage asset transformation interventions.
   1.2 The Rental Market. We must consider the residual value of the building at the time of divestment. It may be useful to break down the “rate of return” in the “rate of return of the capital” and the “rate of return on the capital”. In the case of Ivrea, the risk of vacancies is very high.

2. ECONOMIC ACTIVITIES, CONSUMPTION OR PRIVATE SERVICES.
   Architectural structures and expressions of the Modern movement are essentially considered as pure operating assets. As a result, their value depends on the profitability generated by the cash flows of economic activities for which they are intended. One can distinguish 3 different modes.

2.1 Direct management. The IRR and NPV are determined by cash flows (positive and negative) generated by the initial investment (value of the asset and restoration/reuse/construction costs), the costs and revenues related to the economic activities and finally the residual value of the asset, incorporating the value of the said asset at the time of divestment. In the case of Ivrea, the risk is high, due to the fact that the internal aggregate demand for consumption is largely met with the current offer, since it is unable, at its current capacity of attraction in Ivrea, to generate more significant demands.

2.2 Rent paid by business managers. The return on the investment is fully comparable to that envisaged for the rental market.

2.3 The concession of the asset. It stipulates that the manager of economic activities and services must be responsible for restoration and reuse intervention costs, when faced with the possibility of having to use the property for a defined period of time and the payment of any fees, both of which are to be determined. The convenience of the owner is always evaluated in terms of IRR and NPV, using the DCF. The return on investment depends largely on the residual value of assets and the absence of the initial investment costs due to restoration and reuse works. The profitability, assessed against anyone who assumes control of the asset in concession is related to the flows generated by the economic activity itself and the investment costs of the transformation.

3. PUBLIC USE: CONSUMPTION AND CULTURAL SERVICES

3.1 Museum locations are among those most frequently considered, despite the feasibility clashes with the availability of funds needed to achieve the restoration and management of exhibitions. The Cost Benefit Analysis (CBA), which constitutes the most appropriate assessment tool, in fact, cannot be applied, since it assumes the availability of public resources for investment. In the case of Ivrea, we will use the analysis of a Break-Even Point (BEP), to verify the MAAM digitation project: a technique that is particularly useful when it is difficult to anticipate service and activity demands and in cases where it is necessary to determine the price of the activities and services themselves.

As already highlighted, the surfaces of the Core Zone buildings to reuse are completely out of scale regarding demands that the socio-economic context of Ivrea can express. Without significant public funding, the reuse of the ICO industrial complex by private owners has high risk levels, both of a systemic and specific type, determined by the socio-economic context (Fig. 1).

At the moment, there is no Master Plan (MP) that only optimises the current use and reduces the scope for conflict/competition among the various owners' funds.

Due to the size, typological and structural characteristics, the buildings used for services can have more reuse potential in the medium-term (Figs. 3, 4 and 5). In particular, they lend themselves to intercept consumption requests—recreational, culture, leisure—expressed by the youngest and most dynamic social strata, or to experiment with innovative forms of social and territorial welfare which is increasingly necessary due to the generalized weakening of the population that is a by-product of the globalization of the economy. From this standpoint, the Canteen and the Social Services Centre (Figs. 3, 4 and 5) enable us to propose activities consistent with their original designations, revised on the basis of equally innovative functional models. For example, the Canteen may be given in concession (at least partially) for activities related to "food services" considered as the hub of a "space dedicated to leisure" organized in the realm of cultural related activities and recreational fun (see point 2.3 The concession of the asset). The social services Centre, then, could be used for health/specialized care services (such as those for the treatment and care for Alzheimer patients), in low cost medical outpatient clinics for motor rehabilitation and physiotherapy and/or senior citizen housing, also complemented by innovative forms of home care.

The neighbourhoods and residential buildings, however, do not present problems of reuse, but require interventions to improve their energy output. Simulations have shown that it is possible to pass from the lower classes, which are generally prevalent (F and G) to the upper classes, to B if not to class A, as in the case of Talponia.

The re-use of these areas—chosen for their intrinsic public vocation—presupposes that the actions of stakeholders converge on the common objective of maximizing the VET of the industrial site. In fact, if action is taken on all its components (VET), it is possible to reconcile the conveniences of private owners with those of society. The identification of the "point of balance" between the many interests involved assumes that this is not left to pure-negotiation but measured by using the most appropriate valuation techniques, compared with alternative scenarios and on the basis of specific design simulation. The conveniences of the private—quantifiable in monetary terms in the form of the TIR (Internal Rate of Return) and the NPV—shall be related to the conveniences of the community accounted for in the form of opportunity costs and/or social and cultural benefits, including those produced by the preservation of the industrial site for the benefit of present and future generations.

7 The Preliminary Results for the Public Administration

The results have strongly underlined the necessity to reconsider the fruition as a separate aspect to the restoration and reuse of assets (Loulanski 2006). In fact, took note of the real difficulties in reusing the existing assets, the authors give priority to work on the MAAM (Open-Air Museum of Modern Architecture, see Sect. 7.1): the support of new technologies could facilitate the use of the heritage of the modern and consequently have a positive effect on the attractiveness of Ivrea, making it become a formidable tool that would attract new audiences. The above questions are addressed in the two following paragraphs.

7.1 The Potentialities of the Valuation Through the Reuse and IT (Virtual MAAM)

Among all the actions, the valorisation of MAAM (Open-Air Museum of Modern Architecture) can be considered as a priority for its strategic value (Fig. 6). Created in 2001 by the City, the MAAM has a small number of visitors, almost entirely made up of experts and specialists. Its lack of attractiveness is partly due to the shortcomings of the current path and to the fact that "modern architectural structures" are not recognized today for their historical and architectural value, as they are overshadowed on the one hand, by the most ancient architecture, and on the other by the more spectacularization of contemporary architecture. The digitation of the MAAM has been identified by the City of Ivrea as an action of the PG to be developed in partnership with the Politecnico di Torino, which is described on the occasion of a notice of the Fondazione Telecom (Telecom Foundation: http://fondazionetim.it/bandi/progetti-diretti). This action deserves to be developed regarding the effects which are able to produce on both an attraction and use level of the Olivetti assets, regardless of conservation interventions.

In particular, the valorisation of the MAAM requires three different interventions to scale, although integrated with one another:

– the creation of an "indoor museum space", conceived as the "head" of the open-air museum, to be placed, for example, in the Salone dei 2000 (Salon of the two thousand), which, inside the industrial complex, has a high symbolic value, and a strong potential to be reused as a multi-purpose covered square. The Salon, realized when Olivetti had 2000 employees, can house permanent collections; temporary exhibitions use multimedia tools to introduce visitors to the route from the heart of the factory.
– the creation of a new pedestrian walkway (the current one being obsolete) and a cycle path, so as to connect the architectural structures of the modern movement according to a "common thread reworked in terms of content" which in turn can become the nerve centre on which to articulate the redevelopment of those in-between spaces;
– the modeling of Modern architecture, designed to valorise its use in all of its real and virtual forms, and connect Olivetti architectural structures, on one hand, with the other routes and on the other hand, with cultural resources of the territory (Castles, Churches, Via Francigena, etc.) and, secondly, with Olivetti architecture scattered throughout the world and with those implemented by the modern movement in Europe and worldwide.

The three actions respond to the common goal of improving the use of the UNESCO website potential in all direct and indirect, real and virtual forms, in an integrated manner, using IT technologies as cultural and social innovation tools.

The 3D model of the MAAM must revive the 20th century industrial city. Therefore, it must be navigable and interactive, built in such a way as to allow visualization in an intuitive manner through the use of all its materials. The 3D models of each building, including 3D interior models, should also be explored through Virtual Reality (VR), using all the available digital technologies: they must transmit, in such a captivating and engaging manner, the cultural content which has for far too long remained a heritage for experts and specialists only.

This model assumes the responsibility of the construction of a “content” (or knowledge) database (DB) that contains materials and data from various sources, present in the city’s archives and, in particular, in the Olivetti historical archives, which for the most part, have already been digitized. The DB, designed as open data, requires a multi-layer configuration: (a) on buildings and in particular, on the interior, which over time has been modified and, as much as possible on the people who lived there (photographs of the interior, photographs of parties, of families, books, drawings, paintings, letters, textual descriptions, etc.), (b) the activities that took place during that period (productions, social services, leisure and recreational, etc.); (c) regarding the industrial city (city maps, views, plans, economic, social, demographic data, etc.).

The 3D model and the DB must in turn be integrated with a semantic GIS to an LIS (Land Information System) supported by a more complex management system. The MAAM can thus be connected both locally and internationally to other digitized pathways, so as to promote the influx of the visitors, the attractiveness of Ivrea and the surrounding area (Fig. 6).

The itinerary leaves the Core Zone and focuses on the Serra, representing the meeting point with the historic city, while the virtual point of the Acropolis of the Castle signals the end of the circuit.

7.2 Emerging Aspects of Feasibility in Management: The Break-Even Point Scenarios

The City of Ivrea would be well equipped with an exceptional “real” and “virtual museum”, constituted by the Salone del 2000, integrated to the pathway leading to the open-air museum of modern architecture, translated into a navigable and interactive 3D model, both on site and remotely (Fig. 6). The investment can be largely explained by the multiple effects that the already called project is able to generate:

– the Salone del 2000 could be leased in a non-burdensome manner due to its property holdings (real estate funds);
– the construction costs of multi-functional space, the construction of the pathway (both pedestrian and bicycle) and the creation of navigable and interactive 3D models could be supported by the Municipality and/or special funding.

An aspect to be addressed is the identification of a reliable demand curve. As it is a concrete case and considering the time, it was decided to use a known but effective technique regarding the specific case, which raises the question of covering any management costs by the PA, in line with the conditions of local funds. This extremely empirical model enables the identification of the extent of contributions that the PA must budget, based on different demand scenarios starting from the Break-Even Point (BEP).

Taking into consideration the fixed operating costs (human resources and utilities), the analysis of the BEP permits the identification of the price and the required number of visitors so that they reach the break-even point between the fixed costs of management and financial returns, even considering those inherent additional economic activities (bookshop, catering, guided tours, etc.).

Just for simulation purposes, we carried out economic and financial analysis with DCF, which enabled the creation of different scenarios based on the number of visitor hypotheses, assuming a ticket price of 8 Euros. Considering an investment of a minimum of 1,600,000.00 to a maximum of 2,000,000.00 Euros, including the restoration, fitting out and the technological infrastructure, the assumptions about visitors would be as follows (Fig. 6, Table 1).

(1) the range from 63,000 to 73,000 visitors makes it possible to achieve a self-sustaining museum on the investment and operational and management costs, with a 9 to 11-years Pay-Back Period (PBP);
(2) 43,850 visitors would cover operating costs and require a 100% capital contribution of the investment cost and a balanced management without contributions in the income statement, with the achievement of a 12/11-years PBP;
(3) some 20,000 visitors would require a capital contribution equal to 100% of the investment and in the income statement contribution of around 200,000.00 Euros per year to cover budget losses, with the achievement of an 11-years PBP.

8 Conclusions and Future Developments

Some value paradigms (VET), developed in the environment area of interest, can be reconsidered in the CH field. They consent to redefine the enhancement issues and to systematize methodologies and decision-making support tools, as well as cultural policies at national and local level by following a new approach.

The Ivrea case study highlights how an enhancement project can be reached by means of focused, diversified and integrated actions, by going beyond the actual economic reductionism. Indeed, in weak territorial contexts characterized by the absence of public funding, the enhancement of the architectonic heritage has to be pursued by means of both restoration (refurbishment and redevelopment) and use.

From this point of view, the "Ivrea, 20th century industrial city" candidacy permitted us to study the CH enhancement issues by analyzing a real case study, since UNESCO considers it as one of the fundamental prerequisites in order to enter into the World Heritage List.

The Municipality arranged with the PG (Piano Regolatore Città di Ivrea 2006) all possible necessary tools to guarantee the complete protection of the Core Zone and identified the actions related to its enhancement; this is difficult to achieve as, it is influenced by structural factors and by the absence of public funding. On the basis of a new theoretical-methodological approach—defined thanks to the VET requests and redeveloped for the CH field by considering the IT potentialities—it has been possible to change, reinforce and integrate the actions related to the enhancement project and expected by the PG.

Concerning the redevelopment, the design simulations and the economic and financial feasibility studies (not reported herein), highlighted how the redevelopment is influenced by the risk deriving from the existing gap between spaces demand and supply. The three design projects developed on public areas (Parco della Mensa, Salone dei 2000 and Officine H) are related to this aspect: they symbolise a different relationship between public and private bodies and they are coherent with the PRGC modifications, expected by the Municipality with great lucidity.

By analyzing instead the use and the Ivrea case study, the use has to be put before the redevelopment and it has to be considered priority. Considering the VET, the actual MAAM redevelopment into a virtual museum, both open-air and integrated into the "Salone dei 2000" (Salon of the two thousand), has a great importance at national level. This project could obtain extraordinary public funding, if we consider the attraction potentiality at international level, related to the possibility to connect the buildings in Ivrea to other modern buildings in Italy and all over the world (Fig. 6).

Definitively, the enhancement of the Core Zone pursued through the re-use of existing buildings requires a long time and should be considered in a wider urban project, which would be the focal point of a regeneration plan for regional and metropolitan scales. The action pursued by the city of Ivrea to revise the plan as the creation of a PRGC Variant, must be strengthened and supplemented by others, as well as focused to encourage the reuse of existing assets.

In summary, there may be the followings strategic actions (Fig. 6):

1. the acquisition by the Municipality of the private property annexed to the Canteen according to the defined modality, with the aim of making it accessible and usable by the community;
2. the sale/concession to the general public of the "Salone dei 2000" (Salon of the two thousand), whose dimensions and construction characteristics lend themselves to becoming the covered area of the Museo a Cielo Aperto delle Architetture Moderne (Open-Air Museum of Modern Architecture) (see Sect. 7.1);
3. the valorisation of the H Workshops of the new ICO (albeit considered to be the alternative to the first two actions).

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Technical and Economic Evaluation of a Building Recovery by Public-Private Partnership in Rome (Italy)

Maria Rosaria Guarini, Claudia Buccarini and Fabrizio Battisti

Abstract The purpose of this article is to present the assessment procedure developed and operatively applied to verify the technical, regulatory, and financial conditions for implementing an intervention for the regeneration of a public buildings through a public/private/partnership operation. The proposed procedure aims to represent a methodological approach to support a public administration in: (i) defining the compatibility and sustainability of repurposing public buildings; (ii) proposing actual sustainable projects for private financing; (iii) assessing the soundness of the potential offers by private parties. Operatively speaking, the procedure was applied to the possibility of transforming a school (owned by the Province of Rome), located in Rome's Testaccio neighborhood.

Keywords Building recovery · Public/private partnership · Appraisal · Financial sustainability · Multi-criteria analysis

1 Introduction

Rome's historic urban fabric (as in many other Italian cities, large and small) has a large number of publicly-owned buildings that are no longer used, or are underused, because they are no longer consistent with the original purposes and/or with the needs expressed by society at large in that given local setting. At the same time, in those same urban settings, it may be necessary to locate new essential functions/services to meet the needs of the local population or of society at large.

M.R. Guarini (✉) · C. Buccarini · F. Battisti
Department of Architecture and Design (DIAP), Faculty of Architecture, "Sapienza" University of Rome, Via Flaminia 359, 00196 Rome, Italy
e-mail: mariarosaria.guarini@uniroma1.it

C. Buccarini
e-mail: claudia.buccarini@uniroma1.it

F. Battisti
e-mail: fabrizio.battisti@uniroma1.it

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The repurposing of unused public buildings may present an opportunity to avoid further appropriation of land and to meet certain societal needs, as well as to implement processes to capitalize on the asset.

The chronic shortage of public resources to carry out interventions to maintain and/or capitalize on these buildings makes it necessary, more and more frequently, to assess whether to rely on forms of public/private partnership (PPP), in order not to waste this asset or lose it altogether. However, in Italy, the PPP initiatives embarked on by public administration have a high "mortality" rate; many of the concessions put up for bidding are never even awarded. The following are the main causes for this "failure" (Gori et al. 2014):

- Reliance on PPP to replace the traditional procurement contract solely so as to not impact on the level of indebtedness, or to avoid the expenditure restrictions imposed by the domestic stability pact;
- Weakness of preventive analyses aimed at verifying the actual: (i) identification of an intended use that can generate income; (ii) compatibility of the new intended use identified with the characteristics of the building and of the setting, and with the needs expressed by society at large; (iii) financial sustainability of the initiative; (iv) appropriateness of the private operator in taking on all, or part of, the execution of the project and the management of its operational phase.

The aim of this work is structure an evaluation process which identifies all the decision-making variables and benchmarks that characterize the planning and design stages upon which the quality of interventions of building recovery depends.

Hereunder, while complying with the required length of this text, a brief description is first made of the processing operations to be performed in the various phases comprising the methodological approach, followed by a narrative illustration of the results of applying the methodology to the case study: the transformation of a school building, located in Rome's Testaccio neighborhood (owned by the Province), into a youth hostel through a PPP operation, and lastly the conclusions.

2 Methodological Approach

The assessment procedure adopted to verify the technical, regulatory, and financial conditions for implementing the recovery/repurposing intervention, starting from a design idea of transforming/capitalizing a building that is or about to be unused, is organized in the following phases (Fig. 1):

1. Defining the knowledge framework (identifying, gathering, and processing the data needed to define the inputs to be considered in order to pass from the design idea to the definition of the types of intervention to be performed, and of the design solutions to be adopted) regarding: (1.1) the building being transformed/capitalized on (*Local classification/localization historical evolution and size of the building*); technical elements characterizing the building

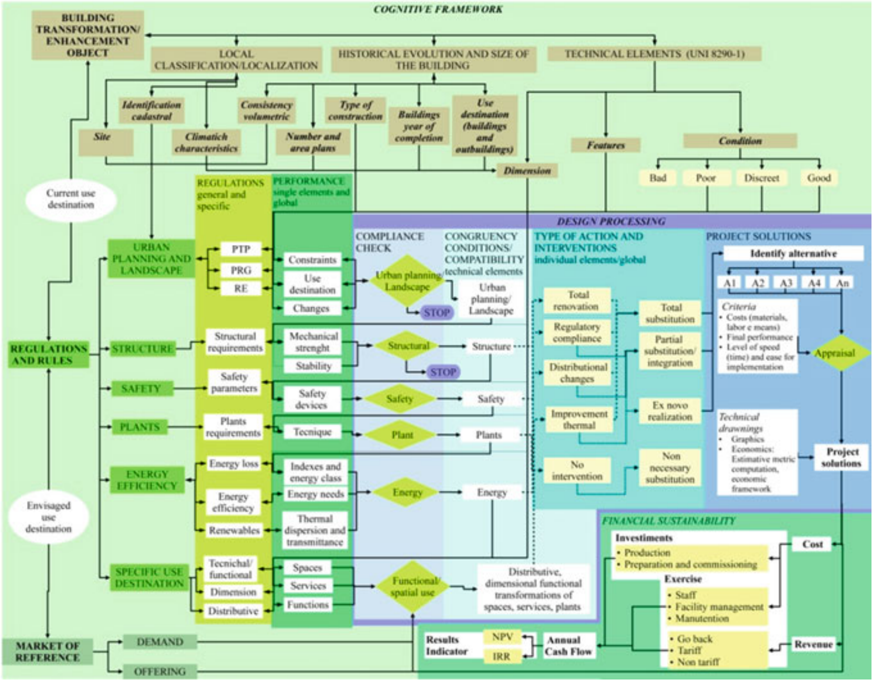

Fig. 1 Cognitive framework

(regulation UNI 8290-1.); (1.2) Provisions of law and regulations: urban planning, environment, and construction (of a general nature), structural (technical regulations for constructions), efficiency and containing energy use, supply and services systems, safety systems; assumed intended use (of the construction and specific functional type); (1.3) Market of reference: with regard to the assumed intended use, collect and analyze information on: supply and demand characteristics and basin (identify the variables explaining demand and supply), tools for quantifying the variables; historic trend of supply and demand; quantify the current needs of supply and demand (determine actual current demand and compare it with the actual current supply, quantify the imbalances and need, estimate the potential demand, estimate the potential demand potential that can be satisfied with the intervention), define the period of the project's economic lifetime (period in which the performed intervention can remain in operation without becoming economically obsolete).

2. Design processing: (2.1) assessments of consistency/compatibility; (2.2) identification of the types of actions and interventions; (2.3) definition and choice of design solutions.
3. Financial sustainability: estimate and describe the distribution of the facility's costs and revenues in the time frame of reference; define how costs are covered;

calculate the two chief summary financial indicators: Net Present Value and Internal Rate of Return (Tajani and Morano 2015).

The construction of the knowledge framework of reference is aimed at identifying and surveying the data needed to measure (with respect to the indicators) and to assess (with respect to the thresholds) the criteria to be complied in developing the design, through verifications of compatibility and consistency; the compatibility and consistency assessments give rise to indications on the types of action and intervention to be implemented for the building's renewal/recovery; consequently, after identifying the various alternative solutions that may be adopted, design solutions may be chosen that are suited to and adequate for responding to the needs that were identified, by specifically assessing the working operations to be implemented, and the consequent costs (Bravi and Rossi 2012). The choice of design solutions will be arrived at by specifying the sub-criteria that enable comparing the alternatives and their working operations on the basis of construction, operation, and maintenance cost, procedures and times for implementation, and the different performance levels that may be achieved (Guarini and Battisti 2014). The procedure is structured in accordance with a logical process that makes it possible to capture the deeper analyses and the assessments to be made in the design's development; it thus has the objective of "codifying": the operations of breaking down or re-composing the elements to be considered, and the assessments to be made in their mutual relationships, using a system of multi-criteria matrices (to be constructed with reference to the assumed intended use of the building being transformed/capitalized on) aimed at producing mutually consistent input/output data by means of an interactive process of design elaboration for the development of initiatives that are: (i) compatible with the regulations in force; (ii) environmentally sustainable; (iii) capable of participating in active markets, and consequently of producing adequate business income capable of mobilizing capital in the construction transformation activities (Morano et al. 2015).

The structure of the operations of breaking down and re-composing the elements to be taken into consideration is also aimed at the implementation, within the BIM, of the system of multi-criteria assessment matrices provided for in the procedure (Nesticò and Pipolo 2015).

The definition of the assessment procedure was structured with particular reference, in accordance with the provisions of art. 3 of the Decree of the President of the Republic no. 380/2001, to interventions of: (i) renovation without demolition and rebuilding (paragraph d, first section); (ii) extraordinary maintenance (paragraph b); (iii) restoration and conservation (paragraph c). It is not considered applicable to all the interventions involving demolition and reconstruction of the building. Since, by law, the considered types of intervention necessarily also involve the energy upgrading of the building being capitalized on, this aspect was given particular attention in describing and developing the procedure. For the time being, the assessments of compatibility and consistency have not gone into detail with regard to those aspects for which verification of the technological components' state of conservation makes it possible to immediately determine (and to exclude in this step in the procedure's development) the intervention actions connected with a significant or complete replacement of the structural-type and/or safety-related technological elements. Indeed, this verification at any rate makes it possible to take into account—in the phase of determining the working operations to be performed, and the consequent costs—modest and immediately identifiable adjustment jobs for that which concerns both portions of structural elements and the fire-protection system.

3 Application of the Procedure to the Case Study: Genesis of the Design Idea

The case study for applying the proposed assessment procedure was the building where the school complex of the "Edmondo De Amicis" Professional Institute for Craftsmanship and Industry, located in Rome at Via Galvani 6/8 and owned by the Province of Rome in 2015. The design idea of purposing the Via Galvani school complex as a youth hostel arose from the closure, in 2011, of Rome's chief youth hostel, located in a building designed by the architect Del Debbio at Foro Italico. This hostel, the only one of these facilities in the capital enjoying a central location, was operated directly by the Italian Youth Hostel Association (Associazione Italiana Alberghi per la Gioventù—AIG) and belonged to the Italian and worldwide hostelling network (IYHF—International Youth Hostel Federation, to which AIG belongs). Also worth pointing out, with reference to the (planned) closure of the current building that is the object of the proposed repurposing as a hostel, is the gradual decline in the number of students enrolling in secondary schools of this kind.

4 Knowledge Framework

4.1 The Building Under Investigation

The building is located in the 1st municipality of the city of Rome, and in particular in the Testaccio neighborhood (Rione). It is registered in the cadastre under folio no. 516, parcels 148, 149, 150. The building is strategically positioned both with respect to Rome's main monuments and with reference to the main road arteries, to the airports and to the railway stations, as shown by the verification made by calculating, in relation to the infrastructure and the means of transport present in the vicinity, the travel times (considering the most appropriate means of transport as the case may be: on foot, by bus, on the underground, etc.) between the building and the points of greatest tourist interest and infrastructure accessibility. This is a strong point for the new facility, considering the city's strong emphasis on tourism. In terms of climate, the building is located in climate zone D.

The property consists of: (i) a main building (Building A), originally (1908) purposed as an elementary school, to which, over time, a series of adjacent buildings were added; (ii) another building (Building B), detached from the first; and (iii) large open spaces and yards between the two buildings, which are a factor of additional quality of the building complex and, in environmental terms, for the entire Testaccio neighborhood. The main building, despite the enlargements and transformations it has undergone, has substantially maintained its original functional and stylistic character unaltered; on the exterior, it is structured in accordance with a very simple classical scheme, with ashlar pilasters, articulated stringcourses, and windows with cornices. U-shaped, it is organized on three storeys above ground and a basement which occupies only a part of the building's footprint. In particular, over the years, the interior and exterior of building A has seen a succession of five phases of construction transformation/enlargement in order to build additional classrooms and laboratories (in 1935, 1936, and 1963), the gymnasium (1941), and a snack bar (1990). Each storey has a useful height of 3.50 m. Table 1 shows the technological elements that characterize the building, the analysis of the state of conservation, and the actions and types of intervention to be implemented. On the whole, the state of conservation of the main building's facades is good, as an extraordinary maintenance intervention was carried out in 2013. The systems possess various states of conservation, depending especially on the year they were made, and for the most part do not comply with current energy-efficiency criteria.

4.2 Rules and Regulations

Examination of the urban planning and construction rules and provisions made it possible to determine as follows: (i) with regard to the regional landscape plan (PTPR), that the area belongs to a Landscape of Urban Settlements (Table "A—Landscape Systems and Settings") and is not subject to landscape protection restrictions; ("B—Landscape Assets"); (ii) with regard to the general urban plan (PRG) (2008), that the complex is located in the setting of the "historic city," and in particular within "fabrics of nineteenth/twentieth-century expansion in blocks (T4)." These fabrics (art. 29 of the PRG's technical implementation regulations) also permit renovation with a change of intended use. Moreover, the building is registered (in the "Quality Paper") among "buildings with a special construction type, in serial arrangement." In line with the municipal regulations in force, since the building has particular urban-planning, architectural, archaeological, and cultural value to be conserved and capitalized on, the design solutions will necessarily have to comply with intervention actions that do not alter the building's external appearance; (iii) with reference to the specific intended use of the intervention, the regulation of reference of the Lazio Region for non-hotel hospitality facilities is dictated in regional Regulation no. 16 of 24 October 2008 and subsequent

Table 1 Technological elements of the building

Technical elements	Classes of technological units	Classes of technical elements	Building A				Enlargement			
			Type	State	Interventions		Type	State	Interventions	
					Action	Type			Action	Type
1. Bearing structure	1.1. Founded	1.1.1. Direct	Dry	G	RA	PI/S	Reverse beams	G	RA	PI/S
		…								
	1.2. Elevation	1.2.1. Vertical	Bricks in tuff blocks	P	RA	PI/S	–	–	–	PI/S
		1.2.2.a Horizontal	Floors in profile of steel and clay	P	RA	PI/S	Floors in brick and cement	P	RA	PI/S
		1.2.2.b Inclined	Floors in profile of steel and clay	P	RA	PI/S	Rampant slabs in reinforced concrete	P	RA	PI/S
2. Closures	2.1. Vertical	2.1.1. Vertical siding	Bricks in tuff blocks	P	IT	PI/S	Bricks box-type	D	MT	PI/S
		2.1.2. Vertical window frames	Iron	B	RC	CS	Iron	G	RC	CS
	2.2. Horizontal lower	2.2.1. Ground floor	Profile of steel and clay	P	IT	PI/S	Bricks and cement	P	IT	PI/S
		…								
	…	…								
	2.4. Higher	2.4.1. Covers	Profile of steel and clay	P	IT	PI/S	Bricks and cement	P	IT	PI/S
	…									

(continued)

Table 1 (continued)

Technical elements	Classes of technological units	Classes of technical elements	Building A				Enlargement			
			Type	State	Interventions		Type	State	Interventions	
					Action	Type			Action	Type
3. Interior partitions	3.1. Vertical	3.1.1. Vertical inner walls	Hollow bricks	P	DC	PI/S	Hollow bricks	D	DC	PI/S
		3.1.2. Vertical interior fixtures	Wood	B	RC	CS		G	RC	CS
		…								
	3.2. Horizontal	3.2.1. Floors	Profile of steel and clay	P	DC		Bricks and cement	P	DC	
		…								
…	…	…								
5. Supply and services plants	5.1. Air conditioning	Absent	–	–	–	RX	Absent			RX
	5.2. Sanitary	5.2.1. Connections	ns	G						
		…								
		5.2.4. Heaters	Cast iron	B	RC	CS	Cast iron	G	RC	CS
		5.2.5. Cold water distribution plus taps	Galvanized pipes	B	RC	CS	Galvanized pipes	G	RC	CS
		5.2.6. Hot water distribution plus taps	Absent	–		RX	Absent	–		RX
		…								
		5.2.8. Toilet	Bad quality porcelain	B	RC	CS	Bad quality porcelain	G	RC	CS
	5.3. Disposal networks (liquid)	Disposal rainwater network	Plastic/sheet	G	–	NO	Plastic/sheet	G	–	NO

(continued)

Table 1 (continued)

Technical elements	Classes of technological units	Classes of technical elements	Building A				Enlargement			
			Type	State	Interventions		Type	State	Interventions	
					Action	Type			Action	Type
		Disposal water network	Lead	P	RC	CS	Lead	P	RC	CS
	5.4. Disposal networks (gaseous)	Secondary ventilation network	Lead	P	RC	CS	Lead	P	RC	CS
	…									
	5.6. Gas distribution plants	Connections	–		–					
		Distribution networks	Galvanized pipes	B	RC	CS	Galvanized pipes	G	RC	CS
	5.7. Electric plants	Connections	–		–					
		Electrical equipments	Not standardized	B	RA		Not standardized	G	RA	
		Distribution networks plus plugs	Corrugated	B	RA		Not sliding	G	RA	
	5.8. Communications plants	Connections	ns	G						
		Equipments	Not standardized	B	RA		Not standardized	G	RA	
		Distribution networks plus plugs	Not standardized	B	RA		Not standardized	G	RA	
6. Impianto sicurezza	6.1. Antifire plants	Connections	ns	B	RA		ns	G	RA	
		Fire detection equipments	Not standardized	B	RA		Not standardized	G	RA	
		Distribution networks and plugs	Not standardized	B	RA		Not standardized	G	RA	

(continued)

Table 1 (continued)

Technical elements	Classes of technological units	Classes of technical elements	Building A				Enlargement			
			Type	State	Interventions		Type	State	Interventions	
					Action	Type			Action	Type
		Alarms	Not standardized	B	RA		Not standardized	G	RA	
		Facility	Not standardized	B	RA		Non a norma	G	RA	
	6.2. Grounding electrical plants	Sinks	Stakes copper	B	RA		Paline in rame	G	RA	
		Collection network	Inadequate	B	RA		Inadequate	G	RA	
	6.3. Lightning protection plants	Catchment network	Atman network	G	no					
		Network	Copper	G	no					
		Sinks	Stakes copper	G	no					
	6.4. Antitheft plants	Absent	–	–		RX	Absent	–	RX	

State: *B* Bad, *P* Poor, *D* Discreet, *G* Good
Action of intervention: *RC* Rebuilding complete, *RA* Regulatory adaption, *IT* Improvement thermal, *DC* Distributional changes
Type of intervention: *CS* Complete substitution, *PI/S* Partial integration/substitution, *NO* Non intervention, *RX* Realization exnovo

modifications and supplements, “regulation of non-hotel hospitality facilities.” This regulation defines “youth hostels” as “hospitality facilities equipped for the sojourn and overnight stay, for limited periods, of youths and any parties accompanying youth groups. Parties d with purposes of social, cultural, sport, and religious tourism may also be accommodated. In any event, the sojourn and overnight stay may not exceed sixty days.” Art. 4, paragraph 2 of the regulation indicates the minimum functional and structural requirements of the environments, of the hygienic/sanitary services, of the common spaces, of the furnishings, and of the services offered.

4.3 Market Analysis

With regard to the formulated design idea (connected with the tourism market) data were gathered and processed, with reference to 2007–2011, with regard to: (i) the trend in tourism flows, in the structure of arrivals by origin, type, length of stay, and presences in hospitality establishments by country of residence of the customers, on the national level, the regional level, and in the city of Rome (demand); (ii) the capacity of the hospitality establishments, the total and specific number of hospitality facilities present in Rome and in other European cities (supply). In contrast with the increase in hostel-type hospitality facilities between 2008 and 2011, since then, with the closure of the Foro Italico hostel, the supply of hostel-type hospitality facilities in the city of Rome numbered 23 establishments, totalling 978 beds, all located in highly marginal areas of the city. This supply is less than that present in other European capitals that boast a higher number of such facilities and beds (Madrid: 35/1,512; Amsterdam: 45/2,116; Berlin: 83/4,840; Stockholm: 30/1,218; London: 73/4,553; Paris: 128/6,842). The insufficiency of supply was objectively worsened by the closing of the Foro Italico hostel which, before closing, absorbed, with 334 beds (rooms with 2–6 beds, and separate dormitories by sex), a demand of 90,000 overnight stays at the facility a year (85% foreigners, 50% of whom were European and 35% from overseas). Considering that the unsatisfied demand may be estimated at about 300,000 overnight stays per year, the lack of a hospitality facility, also for the Holy Year (2016), is greatly damaging to Rome’s image and economy. This shortcoming has already been known for a number of years: to meet the ever increasing flow of tourists heading to the capital, the Lazio Region approved, with Regional Council Decision no. 2/2010, a Three-Year Plan for tourism development (2011–2013) indicating an expansion of hostels. Therefore, in addition to the need to offset, to the extent possible, the shortcoming that had been worsened after the closure of the Foro Italico hostel, the need arose to raise the offerings of these facilities in the Italian capital on a par with those in other major European cities. With the proposal that was formulated, it is believed that about 73% of this demand (65,520 overnight stays) and about 20% of Rome’s overall needs, can be reabsorbed.

5 Design Principles and Features

The data on the current state of the Via Galvani building were compared with those obtained from the provisions of rules and regulations on the European, national, regional, and municipal levels of reference for the criteria identified in this assessment procedure. The consistency assessments showed that, to reach suitable level of energy efficiency and profitability of the building, in compliance with the regulations and the urban-planning/environmental regulations in force, it is necessary to proceed with a building renovation aimed at replacing all the building's technological components, except for the structures, slabs, and vertical perimeter walls that are in a good state of conservation.

The definition of the new arrangement of internal spaces [54 rooms (46 normal, 8 for handicap) for 182 beds; 2 tv rooms, 2 restaurants, 1 library] to accommodate the functions of the new intended use as a youth hostel was formulated by taking into account the regulations of regional reference.

Based on the survey of the climate data and of the building's size data, the following was calculated, for the purposes of the building's energy performance in its current state: dispersing surface area (S) equal to 6,881 m^2; gross heated volume (V) equal to 18,095 m^3; and shape ratio (S/V) equal to 0.285.

A special program ("TERMUS") was used to determine the energy class of building A (class F) and of building B (class E) in the current state (ante operam). These values exceed the maximum limits provided for by the regulations in force in the matter of the energy consumption of buildings (compatibility verification). Then, the same program was used to calculate the transmittance and heat dissipation of the technological components of the envelope (walls, slabs, door, and window frames).

Analysis of energy dissipation found that most takes place through door and window frames. These are in fact old-generation frames, in iron, with single 4 mm panes (transmittance equal to 6,389 W/m^2 K), with a performance incompatible with what is required by regulations, and they are thus to be replaced.

The consistency verification of the heating system showed that the heating plant (consisting of two methane gas heat generators, "Biasi 350" model) present in the building fails to meet energy-efficiency criteria; it is thus to be replaced.

The design choices to reduce the building envelope's thermal dissipation, in compliance with the dictates of urban planning (exterior prospects cannot be modified) will have to be made with reference: (i) to exterior coverings, identifying intervention procedures and techniques to be implemented on the internal parts of the building, in order to lower transmittance; (ii) to exterior door and window frames, using new-technology materials with low heat dissipation, but similar in appearance and color to existing ones.

By assessing the possible alternatives, based on criteria related to cost, to the determined final performance, to the degree of ease and rapidity of installation, and to the solution's durability, the choice was made to adopt solutions to:

- Reduce the dissipations through the building envelope: (i) replace existing windows: new-generation frames (Finstral top 90 twin-line classic), triple pane, in PVC and aluminum, with shutter integrated into the panes (total transmittance from 0.90 to 0.98); (ii) insulation of walls: spray insulation to be applied inside the building on the exterior walls, as needed, in different dosages (insulation of exterior walls: Puretan 30; of floor slabs: Puretan 70). This solution has a number of advantages: easy, quick installation, considerable reduction of noise transmission, great ability to adhere physically to almost all construction materials. It is to be pointed out that, as a disadvantage, this solution does not make it possible to eliminate the thermal bridges of the slabs between the stories, and involves the risk of formation of interstitial condensation, due precisely to its application from the inside; (iii) use of high-efficiency systems: replacement of old heating plant (consisting of two methane gas heat generators, "Biasi 350" model), with two new-generation condensing boilers ("Biasi RC3S-510" model), 540 KW each, to heat the environments and for the provision of ACS in building A, and the installation of a new boiler (model "Biasi Multiparva cond 55 SV") in building B.
- Use of renewable sources: recovery of rainwater through the building of a collection, filtering, and storage system in tanks, permitting subsequent use.

To verify the design choices connected with the energy upgrade, the post-upgrade energy class was recalculated (building A: class C; building B class D), and the compliance with the values provided for by the regulations of reference was then checked.

A comparison of the heat dissipation data before and after the upgrade shows a significant reduction (on the order of 1/5) of energy dissipation as a consequence of the design choices that were made. In detail, a total energy dissipation through the walls fell from 10,011.13 W prior to the upgrade to a post-upgrade value of 2,124.78 W.

6 Financial Sustainability

The amounts of the investment costs (total: €3,453,764.60) were estimated as equalling: for construction cost (as per the Bill of Quantities), €2,417,119.10; for building production, €2,777,873.50; for setting up and placing in operation, €273,826.77. The estimate of operating costs took the following into account:

- For the personnel cost (net yearly amount equal to €494,528.00): (i) number of beds: 182 (max. supply, as per the design document); (ii) overnight stays per year (as per the demand estimate), considering the structure's use percentage >80% of the maximum supply of beds in the month of January, in the months between May and October, and the month of December; (iii) number of employees: 15 permanent and 4 seasonal (based on an industry survey by Federalberghi (2013), considering, in terms of employees: permanent: a minimum employee/bed ratio needed for the hostel to operate = 12.5; seasonal: a 20% increase in personnel in the periods when estimated overnight are >80% than the maximum supply; (iv) cost of employees: permanent (€2,400.00/month) and seasonal (€1,954.16/month) determined through a direct survey (2013) on a sample of similar hospitality facilities, considering an average remuneration;

- Operating costs for: (i) maximum number of rooms (104); (ii) monthly operating cost (€/room) determined by a direct survey (2011) at non-hotel hospitality facilities, considering fixed and variable costs (utilities, consumables, insurance, taxes, etc.);
- Ordinary maintenance costs (€9,475.00 per year): the type and cost of the interventions needed to maintain: the efficiency of the systems and the state of decorum and hygiene of interior environments (interior works) and of exterior spaces (exterior works).

In determining the yearly revenues, account was taken of income determined by: (i) overnight stays (direct revenue); and (ii) leasing of commercial premises (indirect revenue). The yearly revenue derived: (i) from overnight stays (€1,760,521.70) was estimated by assuming: (i) number of overnight stays per year (from an estimate made on the yearly distribution of the number of overnight stays supposed for the facility); (ii) average price per overnight stay per person (€30.73), determined considering average prices charged by similar facilities in other European capitals (Madrid, Amsterdam, Berlin, Stockholm, London, Paris); (iii) from the leasing of commercial premises (€161,183.40) was determined by taking account of: the average monthly rent for the leasing of premises (€/m^2 21.30) estimated through a direct survey; m^2 of commercial premises (as per the design document: eight shops all on the ground floor of the building, with sizes varying between 44 and 166.52 m^2). Based on the investment costs, the costs of operation and of ordinary maintenance, the returns and the financial coverage plan, the NPV (€5,833,550.90) and SRI (29.90%) were determined, which are suitable for attracting private resources in real estate re-conversion operations.

7 Conclusions and Further Developments

The proposed assessment procedure, supporting the decisions on reconverting/capitalizing on an obsolete building, enables the technical feasibility and the financial sustainability of the intervention to be verified based on an integrated process of assessments that, with respect to the assumed intended use of the building, takes into account, at the same time: (i) the dynamics of real and potential supply and demand; (ii) formal aspects, morphological constraints, technological components, and state of the building being capitalized on; (iii) regulatory aspects; and (iv) possibility of obtaining energy efficiency, structural adjustment, etc. The "coding" of the operations of breaking down/re-composing the elements to be taken into consideration and the assessments to be made is useful for the development of building transformation initiatives, with a higher possibility of success, giving the obsolete building new uses required by the market. The proposed procedure is structured to permit its future use in the BIM.

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A Strategic Environmental Assessment of a Possible Direct Road Connection Between Veneto Region and Central Europe

Giovanni Campeol and Nicola Masotto

Abstract This paper deals with the general issue of the economic evaluation of territorial transformations and is part of an applicative land valuation, whose objective is to evaluate the social and economic impact of the transformations on a population and on the territory where it lives. These considerations are contextualized in a territory, especially in the Belluno province, in which debates have been going on for decades about the opportunity to realize a major road system for improving connections with Northern Europe. The province of Belluno is the largest area in the Veneto region (Italy), but at the same time it is also the least populated. Its territory is predominantly mountainous and, as a consequence, road connections are not easy because of an infrastructural deficit as regards transport and mobility. This research is about transport, through the application of strategic environmental assessment models in which much importance is given to the existing relationship between territorial economy and road infrastructures, focusing attention on:

- the issue of accessibility;
- the valid road options;
- the national and international scenarios;
- the theory and literature pertinent to the evaluation.

Keywords Deficit accessibility · Infrastructure · Competitiveness · Population

G. Campeol
Department of Design and Planning in Complex Environments,
University Iuav of Venice, Venice, Italy
e-mail: giovanni.campeol@iuav.it

N. Masotto (✉)
Department of Civil, Architectural and Environmental Engineering,
University of Padua, Padua, Italy
e-mail: nicola.masotto@dicea.unipd.it

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1 Genesis of European Mobility

The development of European economies and cultures has always been influenced by the geography of mobility, in the past by sea and over land and at present also through the air.

In order to understand the transformation of Europe, it is first necessary to observe the network of land communications as it arose from the road distribution at the greatest extent of the Roman Empire. The stability, time span, and cultural quality of the Roman Empire have been deeply influenced by the extraordinary ability to realize not only the port system, but also a road network of enormous length and technological quality.

2 Trans-European Transport Networks (TEN-T)

The TEN-T European geography points out Italy's outstanding role, thanks to its strategic and central geographical position, as a historical "bridge" between the Mediterranean Sea and Central Europe, with the Alpine region in the center. In fact, four European corridors out of nine, following the latest EU formulation, cross Italy; this confirms its international strategic position, also after the Suez Canal expansion. The TEN-T planning logic is to strengthen the European communications vertically and horizontally, believing that only through a fast and efficient exchange of people and goods may the whole European economy grow.

The corridors are the hubs for development of the Core Network, but the Trans-European Transport Network is also composed of the Comprehensive Network, which represents all the infrastructures for access to the Core network from all the other European areas with a time horizon of 2050. Therefore, this extraordinary infrastructural system (especially roads) offers great development opportunities, yet causes critical phenomena of territorial disparities, due to the higher attractiveness of the areas crossed by corridors rather than those areas lacking them. Paradoxically, the TEN-T European policy has reinforced the strong territories on one hand, but it has weakened those already weak.

3 Veneto Region and the Province of Belluno. A Geographic "Cul-de-sac"

In this European transport context, the area of the Belluno province can be geographically defined as a "marginal area", situated between two important infrastructures of road and rail traffic that connect the north-east of Italy with Europe, through Austria along the Brenner and Tarvisio alpine road passes.

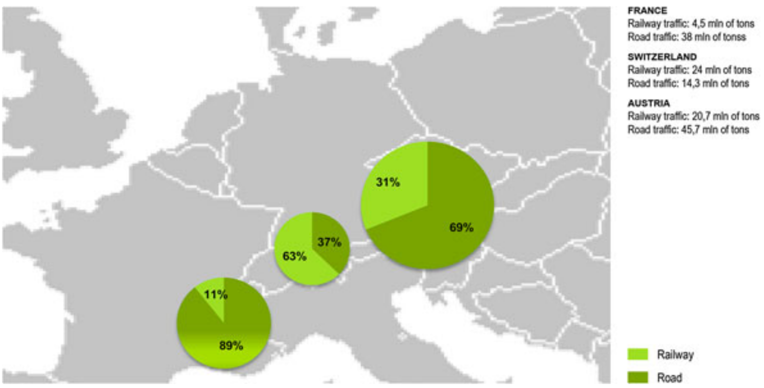

Fig. 1 Trade trends in the alpine region (CERTeT 2012)

The globalization of European markets, also following the fall of the Berlin Wall, has led to a strong demand for goods in the former Soviet Bloc and has thus determined the need to exchange goods at the fastest rates. These political transformations have caused a change of the axis of goods exchanges in the alpine region (Fig. 1), leading to a strengthening of the North-East direction.

3.1 The "Dolomite" Colonies: the Belluno Province

The economic weakness of the Belluno province, caused by the absence of an alpine road pass, has triggered very strong competition from the autonomous provinces of Trento and Bolzano, and partly from the provinces of Pordenone and Udine, directed at the province of Belluno, through a real "geographic conquest" of this territory. In fact, also thanks to the inappropriate use of the state's economic resources, allocated to these two autonomous provinces that manage them, many municipalities bordering these two autonomous provinces are strongly motivated to abandon the Veneto region (Fig. 2) (Campeol and Masotto 2015).

The conquest of the high lands in the province of Belluno would lead the autonomous provinces of Trento and Bolzano to take possession of most of the UNESCO Dolomites serial site, thus depriving the Belluno province and Veneto region (Fig. 3) of a very strong potential source of wealth coming from wise and careful planning of the tourist attractions (as established by UNESCO strategies and as the UNESCO Dolomites Foundation, especially created, should do) (Campeol and Masotto 2015).

Hence the need, in the case study of the Belluno province, to start two transport strategies: the first, by realizing new primary alpine "routes" (vertical) that shall complement those already existing; the second, by building new secondary alpine

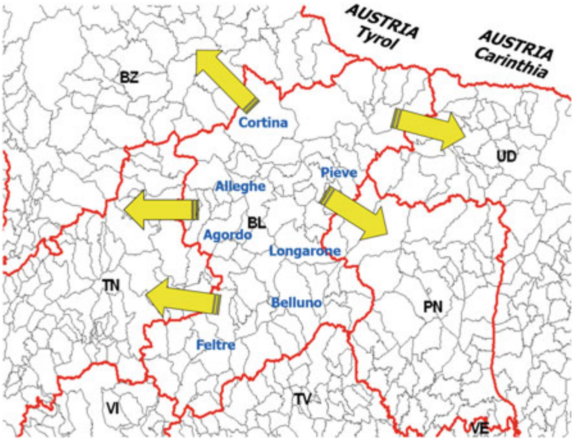

Fig. 2 The *cul-de-sac* of the Belluno province and the territories recently leaving it (Campeol and Masotto 2015)

Fig. 3 The geographic conquest of the Belluno province by Trento and Bolzano (Campeol and Masotto 2015)

routes (horizontal) to establish direct connections with the existing vertical corridors.

This system of new infrastructures, which can be defined as "networking" (Fig. 4), would permit to overcome the phenomenon of "linear electromagnetic" attraction (produced by the primary infrastructures of the European corridors), thus giving opportunities also to the neighboring marginal areas.

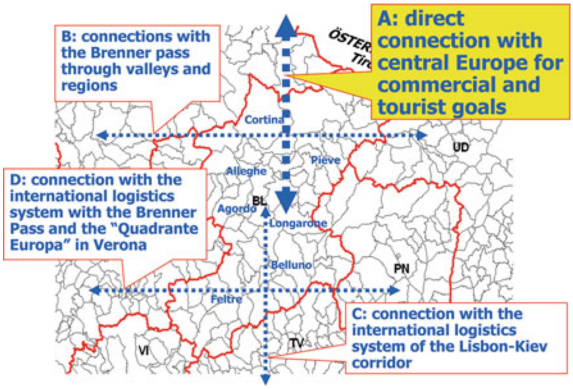

Fig. 4 Infrastructural networking of the Belluno province (Campeol et al. 2015)

3.2 Traffic Scenarios for an Alpine Road Pass in the Belluno Province

Today the need for a motorway extension is fundamental not only for the Belluno province but also for the Veneto system, which has in the hub port of Venice a strategic link for trade between the north and the north-east of Europe (Fig. 5) and which is supported by the main stakeholders (industrial firms and transport operators) on regional and local (Belluno province) levels.

Veneto region, as aforesaid, is the only Italian territory of the alpine area without a road pass; with the realization of a motorway northwards (Fig. 6), it could significantly increase its general competitive potential and strengthen the still marginal area of the Belluno province.

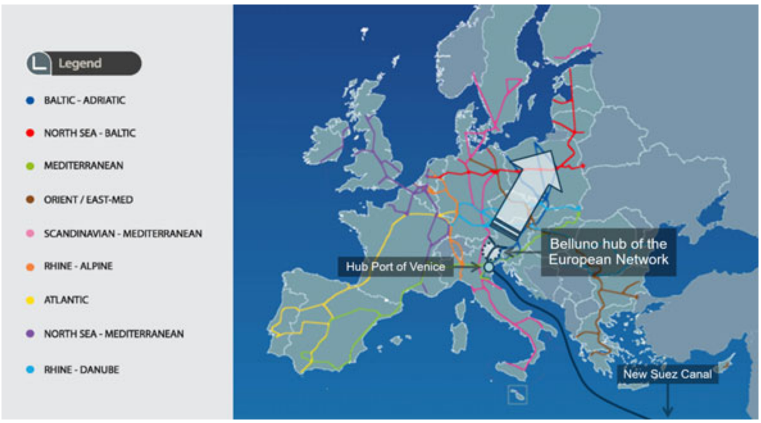

Fig. 5 The Belluno province and the TEN-T

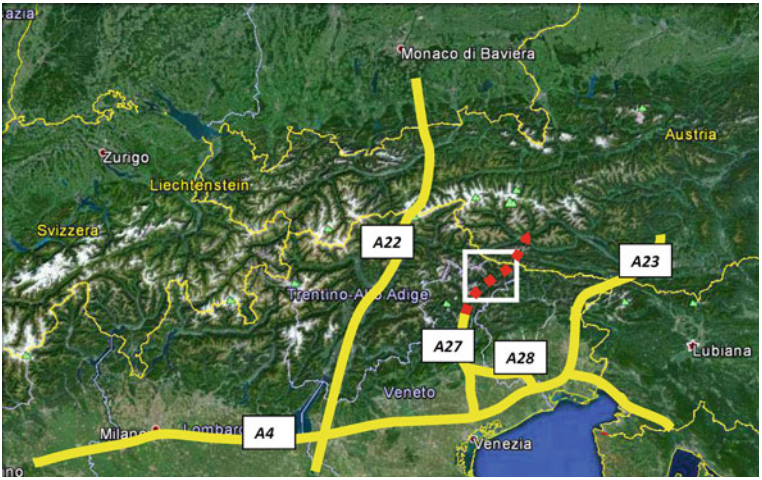

Fig. 6 The extension of the A27 motorway (Campeol et al. 2015)

Table 1 Table of performance (Campeol et al. 2015)

Indicators	Geographic corridor		
	Route A 1960s	Route B 1986–1989	Route C 2005–2011
1. Geographical interferences	Austria and Province of Bolzano	Austria	Friuli Region
2. Geographical length of the corridor from Pian di Vedoia to arrival point in Austria	183 km to Wiesing (A)	119 km to Lienz (A)	–
3. Distance and time from arrival point in Austria to Munich (D)	126 km (1 h, 22′ via A12 e A8)	220 km (2 h, 56′ via A8)	–
4. FUTURE distance and time from Pian di Vedoia (BL) to Munich (local economies)	309 km (3 h e 5′)	339 km (3 h e 23′)	–
5. PRESENT total distance and time from Pian di Vedoia (BL) to Munich (local economies)	639 km (6 h, 26′)	639 km (6 h, 26′)	–
6. % reduction of time and distance	-52%	-47%	–
7. FUTURE distance Venice-Munich (regional economy)	411 (4 h, 7′)	441 (4 h, 25′)	–
8. PRESENT distance Venice-Munich (via A22 of the Brenner Pass)	543 (5 h, 21′)	543 (5 h, 21′)	–
9. Construction costs	Very high	Medium	–
Performance	**Low**	**Very high**	

Plans for this motorway infrastructure have been available since the 1960s, and nowadays there are three main "routes" planned for the A27 extension northwards, but only two present interesting environmental performances, the "A" route and the "B" route (Table 1).

The “C” route has not been taken into consideration, because as regards transport, it is more a theoretical[1] aberration than a possible objective project.

This first level of evaluation shows that the “B” route may be the best option for the realization of infrastructures, also in view of the recent launch of EUSALP (EU Strategy for the Alpine Region).

4 The Strategic Environmental Assessment (SEA)

The definition of traffic “routes” and their infrastructures is a programming and planning activity of the territory transformation that finds, in the SEA, the most suitable evaluation model to verify the environmental sustainability of the identified choices. The SEA model is an internal procedure whose methodology, laws, and regulations are justified by the European Directive 2001/42/EC, in the Italian DLgs 152/2006 and DLgs 4/2008, as well as in many regional laws.

The issuing of the European Directive about the SEA (2001/42/CE) finally completes the cycle of the law definition of procedures for the environmental assessment in order to carry out a sustainable development. The European trend has then been aiming at a total assessment of the effects that the plans and programs for the territory can have on the environment, with an approach related to the assessment procedures.

The concept of sustainable development was introduced by the reflections made at the Club of Rome in 1970 and by the Report of the Massachusetts Institute of Technology (MIT) in Boston, “*The Limits of Growth*” (Meadows et al. 1972), which identifies the limit of further, not only economic, growth and expansion of the system considering scarce and exhaustive resources.

Various strategic aspects to measure sustainable development have been identified. Pearce et al. (1989) quote, for example, the per capita income, health, and education conditions, the access to the resources, the distribution of opportunities, and the rise of freedom. These factors are related to the three considerable dimensions to define the sustainable development (Giaoutzi and Nijkamp 1993) as follows:

- the economic dimension (durable development);
- the ecological dimension (environmentally friendly development);
- the social dimension (public-participated development).

The approval of the European Directive about the SEA introduced a change of perspective in the approach to the regional and urban planning, thus improving on the merely constraining regime, which showed all its limits, and involving the

[1]This theory was developed not “to disturb” the two Autonomous Provinces of Trento and Bolzano.

environmental assessment over all the temporal phases of the “process” of the plan/program.

In the SEA, there are two important aspects, namely, the environmental verification of planning/programming alternatives; and the *ex-post* environmental monitoring in relation to the plan/program.

From the methodological viewpoint, the most efficient way to develop the SEA is to make it asynchronous in relation to the elaboration of the plan/program, i.e., it is important that the SEA shall start much earlier than the plan/program, so that it may contribute very efficiently to the elaboration of the preliminary document of the plan/program. After the approval of the plan/program, it shall continue to verify, through monitoring, its effective achievement of the targets of environmental sustainability. The schematic diagram (Table 2) well represents the asynchronous process between the elaboration of the SEA and that of the plan/program.

From the viewpoint of the evaluation technique, the most important tool is the “Operating Sheet” (Table 3), which enables organizing the trend of the different environmental indicators in a logical, rational, consistent, and historical way.

It is characterized by four fundamental parts:

Table 2 Conceptual diagram of the asynchronous process between SEA and the plan/program

Ex-ante SEA stage	*Ongoing* SEA stage Preliminary	*Ongoing* SEA stage	*Final* SEA stage	*Ex-post* SEA stage
	Environmental report of the plan/program preliminary	Environmental report of the plan/program	Environmental report of the plan/program with the monitoring plan	Application of the monitoring plan
	preliminary of the plan/program	*Progress of the plan/program*	*Approval of the plan/program*	*Implementation of the plan/program*

Table 3 Conceptual diagram of the Operating Sheet

Indicators	Historical trend indicator	Planning actions arising from the indicator				Actions of the Plan/Program			
		Policies	Planning laws	Public works	Implementing processes	Policies	Planning laws	Public works	Implementing processes
BENZENE (traffic)						Verification of the ***consistency*** between the Planning actions arising from the indicator trend and the actions of the Plan/Program			

- the panel of indicators, analyzed following the historical trend, to be associated with the relevant pressure source;
- the sustainability objectives clarified for the four levers of urban planning (policies, planning laws, public works, and implementing processes);
- the activities established in the plan/program, always specified for the four levers (policies, planning laws, public works, and implementing processes);
- the verification of the consistency between the sustainability objectives arising from the indicator analysis and the actions of the plan/program.

4.1 The Analytic Hierarchy Process (AHP) in a Stage of the SEA Process

In view of the first results of the environmental pre-feasibility study (Table 1) concerning the comparison between the two alternatives (of the three identified) roads—i.e., routes “A” and “B”—and the realization of the other transport option of the railway, a complex decision-making problem has emerged, and it can be characterized by a variety of important aspects. In order to help decision-making (overcoming the emotional and self-referential approach), it is necessary to develop an evaluation approach that shall be logical, rational, and consistent, for using a Multi-Criteria Method Decision (MCMD) system, able to compare the various alternatives.

The multi-criteria analysis aims at providing support to the decision-maker to realize an acceptable compromise among the different objectives to reach, which have been previously transformed into criteria. The obtained criteria will enable the comparison between the various options present in the problem. The identification of the objectives and the criteria is a very delicate stage: it is necessary to specify the objectives and criteria with different levels of details, as the analysis results could implicitly be affected (Campeol et al. 2015).

A discipline of the MCMD, aiming at supporting the decision-maker confronting numerous and conflicting evaluations, is the Multi-Criteria Decision Analysis (MCDA), which makes possible obtaining a compromise solution through a clear process (Mocenni 2010). The MCDA system of measurement is among the most widely used that enable solving these kinds of problems, and, therefore, we have chosen to implement a variation, called Analytic Hierarchy Process (AHP). It is a hierarchical, analytic process that enables us to make a decision among different options, when there are multiple criteria (Campeol et al. 2015).

Taking as a reference point Saaty’s hierarchical model (Fig. 7), it is possible to identify the characteristics of the “project” scenarios to submit to an environmental assessment, by using the AHP methodology.

The AHP is a technique that can be easily applied; it is flexible in the choice of inputs and permits assigning priorities to a set of alternative decisions, relating qualitative and quantitative evaluations otherwise not directly comparable, by

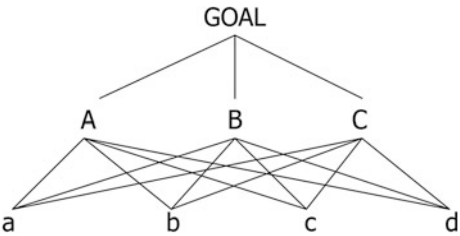

Fig. 7 Diagram of dominance hierarchy (Saaty 1980)

combining multi-dimensional scales of measurements into a single priority scale. These factors have been essential in the choice of this methodology so that it may be used to identify the performing territorial scenarios for the Belluno province (Campeol et al. 2015).

In considering the SEA process, the application of the AHP methodology could be performed in the preparatory phase of the elaboration of the preliminary document of a plan/program. This technique could also lead, through the opinion of experienced professionals of knowledge, to the identification of the possible scenarios within a definite frame of environmental reference.

Finally, the AHP methodology could be useful to monitor the results of the implementation of these planning instruments (plans/programs).

5 Conclusions

The definition of the "routes" of the new road infrastructures is a programming and planning activity of the territorial transformation that applies the SEA evaluation methodology, namely, that assessment process of an environmental kind which is able to compare alternative planning scenarios and points out the most general implications. It deals with a decision-aiding evaluation, which can use various application techniques, among which is the AHP methodology that was coherently identified to be used in this survey, as it is adaptable and easily applicable.

In the Veneto territory, especially in the Belluno province, the connections and transport are suffering because of the infrastructural deficit that heavily affects the whole social and economic context. Consequently, it is necessary to devise the possibility of realizing an important road system in order to improve the connection between the hub port of Venice and the north and north-east of Europe, through the province of Belluno.

The geography of mobility has always influenced the social, cultural, and economic development of Europe, and this can be understood by observing that, already during the Roman Empire, the road network for land communication was well developed. The road network produced trade exchanges between the different geographical areas that could not communicate before. However, there are still territories that, due to their morphological conformation, were not crossed by

Roman roads and, maybe also because of this, they could not develop appropriately so becoming marginal in relation to the connected territories. This situation still exists in Italy because of the absence of cross-border road passes within the alpine region. With the definition of the TEN-T by the European Union, the challenge is to strengthen the role of transport as a decisive factor for broad and local economic development. Studying this new geography of European communications, which is being configured, is thus a fundamental step to understand the social and economic development opportunities on an international level.

Geographically, in the European transport framework, the province of Belluno can be defined as a "marginal area" as it is in the "stranglehold" between two axes with big transport infrastructures (railways and roads), one reaching the Brenner road pass and the other the Tarvisio pass. This weakness of the Belluno province, caused by the lacking of direct connections (e.g., a road pass) with Austria, has triggered from neighboring provinces (Trento, Bolzano, Udine, and Pordenone) a very strong competition through a real "geographic conquest" of this "marginal" territory. Therefore, it is necessary for the territory of the Province of Belluno to start infrastructural "networking" aiming to produce development opportunities. This results in the idea that the possibility of a motorway extension is crucial not only for the Belluno province but also for the Veneto system. In this study, for identifying the most significant "route", a first level of evaluation has been elaborated with the goal of determining a simplified performance of the different "routes" (A, B and C). This first evaluation level identifies in route "B" the possible infrastructure which may be best realized. This analysis of environmental pre-feasibility, also followed by the consideration of possible railway infrastructures, has highlighted a complex decision problem, characterized by a variety of important aspects.

Therefore it is necessary to prepare for the evaluation through the AHP methodology, which is able to compare various proposed alternatives and is going to be included in the SEA process.

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Appraisal and Evaluation in the Production of Works for the Transformation of the Contemporary City

Fabiana Forte

Abstract The article develops a series of reflections on a specific theme which, regarding the economic evaluation of the territorial transformation, remains, especially in Italy, particularly critical: the production of the territorial works and services, with specific reference to the public works (the new urban facilities). The subject, involving the Appraisal and Evaluation disciplines, allows us to highlight their fundamental contribution both at the operative/professional level as well as at the formative one. In order to develop the reflections, a comparison between two emblematic cases seem to be particularly effective: the Euskalduna Conference Centre in Bilbao (1999) and the new Conference Center, in Rome (2016). The other Italian events of the unfinished works, the issue of the executive phases in the design process and the fragmentation of the responsibilities, in addition to the continuing absence of a culture of the "project management", allow to underline the important role that the Appraisal and Evaluation disciplines are called upon to play in the production of works for the transformation of the contemporary city, also in the perspective of the new Italian Procurement Code.

Keywords Urban project · Public works · Evaluation process

1 The Objects of the Evaluation

Evaluation has nowadays become a process at the root of all the fields of theoretical and practical knowledge; in particular, in the field of the physical transformation of the cities and the territories, evaluation deals with *objects*. This peculiarity, which distinguishes and strongly characterizes our disciplines form other, deserves some specifications.

F. Forte (✉)
Department of Architecture and Industrial Design "Luigi Vanvitelli",
Second University of Naples, Via S. Lorenzo ad Septimum, Aversa (CE), Italy
e-mail: fabiana.forte@unina2.it

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First of all, it would be appropriate to underline that this objects are the product of a *project*, in the overall sense of a program, a plan or a design. Although the notion is "polysemantic", the thematic of the project seems to be an indispensable reference point inside all the reasoning on the urban action.

Among the several definitions, one of the most effective describes the project as a *démarche d'action*; this means, in the urban field, that the project has become a different model of actions on the city and its spaces (Arab 2001).

This approach, beginning from a critic of the classical urban planning regulatory system, refers to the "productive" dimension which, nowadays, characterizes the urban action: this implies responding to the needs and expectations, mobilizing resources, managing constraints, assembling competences, meeting budget and times, combining performances criteria, controlling the risks, etc. This productive dimension allows us to define the Urban Project (in the overall sense of programming, conception, design, realization and management) as «a program which, in a city, pursues the realization of an organic set of actions and works» (Fattinnanzi 2012).

Furthermore, the above objects are strictly related to their territory and are immovable properties—or real estates—, sometimes unjustifiably expensive and needing very long time to get up to speed.

Regarding the relationship with the characteristics of the specific context (physical, cultural, environmental, functional, etc.), these objects are the products of urban projects which, due to their physical and economic dimension, are destined to affect significantly and for a very long time the urban environment. In this perspective the evaluation process becomes determinant and its task is complex. On one hand, the evaluation should increase the quality of the decisional process—both technical and political—in term of resources allocation (monetary, human, territorial, etc.) and in terms of effects or impacts. On the other, the evaluation influences the efficiency of all the programming, assuring a rational basis for the use of the resources to be deployed in the implementation. Then, for an efficient evaluation process, it is necessary, first of all, that the object of the evaluation and the relationships with the context where it is inserted, are well identified.

Regarding the times and costs, the 2014 Report by the Italian Department for the Economic Development and Cohesion (DPS), concerning the times and expenditure of the infrastructure investments, highlights that the times for the realization of the works are very long and they are frequently associated with an increase of the costs. According to the report, if the interventions of an amount inferior to 100 million euros are completed in 2.9 years on average, the works of an amount greater than 100 million euros, take more than 14 years. Specifically, the weight of "crossing times" (the time necessary to pass from a procedural stage to the next one) is particularly relevant (DPS 2014).

This framework emphasizes one of the main problems of the Italian system of production of public works: the low attention to the design phase.

As shown in Fig. 1, inside the whole Life Cycle of the building (divided into the phases of: programming, concept, design; construction; use and maintenance) the

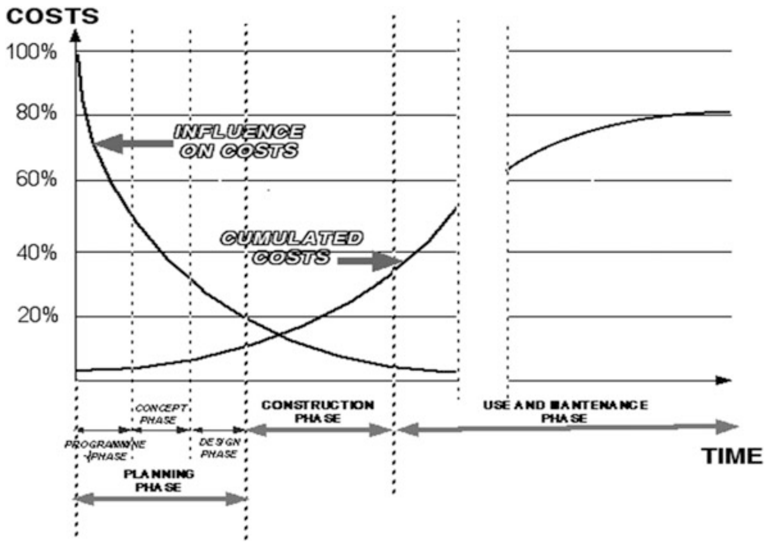

Fig. 1 Influence of design decisions on the *Life Cycle Costs* (modified from Kohler and Moffatt 2003)

early stage of design has a very high potential in influencing the full life cycle and its costs, which decreases over the years.

In that same phase a huge amount of information has to be processed quickly and crucial decisions must be taken. About the 75 % of the costs of the building product are already fixed during the planning/design phase and, in this same phase, it is possible to make corrections. From here, the importance of a continuous and interactive evaluation process to assume performances measurement and indicators to verify the project and elaborate alternatives, emerges.

2 A Comparison Between Two Emblematic Objects (in Bilbao and in Rome)

In order to develop our reflections, we will focus on the specific sector of the meeting industry, one of the fastest growing segments in business tourism (Bensi et al. 2016), which has seen the production of two urban facilities, for different reasons, particularly emblematic: the Euskalduna Conference Centre in Bilbao (1999),—a virtuosos case—and the new Conference Center, the so called "Nuvola", in Rome (2016), inaugurated in July 2016. Both the cases, have been compared and evaluated, offering the opportunity to highlight some critical aspects in the Italian context of the production of public works.

2.1 The Palacio Euskalduna in Bilbao

Starting from the Basque case, *Palacio Euskalduna*. S.A. is a publicly run company owned by the Provincial Council of Bizkaia; the building was designed by the Spanish architects Federico Soriano and Dolores Palacios to look like a ship under construction, because it stands on the site formerly occupied by the Euskalduna shipyard. The architectural works has been conceived, together with the other urban projects (as the near Guggenheim Museum), inside the Regeneration Plan of the waterfront area of Abandoibarra, which is located in a prime location in central Bilbao (Fig. 2).

This area of 35 ha formerly occupied by harbor activities, shipbuilding and transport infrastructure had been a physical barrier cutting off much of central Bilbao from the river. The decision to regenerate the site was made in the mid-1980s.

Since the 1990s an ad hoc public company, Bilbao Ria 2000, became responsible for the reclaiming and valorization of the site; the company, financed by the central Government and the Basque authorities, was created to realize some regeneration urban projects. The investment cost of the Euskalduna Conference Centre was €81,000,000; in 1992 an ideas competition was held; in 1994 the works began and the building was inaugurated in 1999.

Just four years later, the building was designated the World's Best Conference Centre 2003; its economic impacts well demonstrate the success both of the architectural work, which became a landmark of the city as well as the management of the center.

As shown in Table 1, in the first years of activities, the generation of the GDP amounts to 2.6 times the costs sustained for the realization of the work; in the first ten years of activities the production of GDP is equivalent to 7.5 times the investment on the construction. Even after the economic-financial crisis, the generation of GDP, for each year, exceeds the construction costs of the work (Euskalduna Memoria 2015) in a city, Bilbao, which in a period of recession, is the only one, in Spain, with a positive GDP; it is crucial to highlight that only the 6% of

Fig. 2 The Euskalduna Conference Centre in Abaindoibarra (Bilbao), *source* www.euskalduna.eus

Table 1 The economic impacts of the Euskalduna Conference Centre (elaboration of the author, *Source* Palacio Euskalduna S.A., Memoria, 1999–2015)

Years	GDP	Employment	Revenues
1999–2003	€212,383,000	1.059	€21,35,000
1999–2008	€612,694,120	1.162	€52,971,258
2007–2010	€370,486,233	1.441	€28,880,440
2011–2014	€335,664,289	1.321	€26,441,442

the induced an the taxes comes back to the Central Government, the rest is reinvested for the city.

2.2 *The Nuvola Conference Center in Rome*

Regarding to the Italian case, the so-called *Nuvola Conference Centre* in Rome's southern suburb of EUR, has finally been brought to completion, after 18 years of controversy and €467 million (approximately the double of the initial investment cost).

The work, designed by the Italian architect Massimiliano Fuksas, includes a 9000-m^2 plenary hall which can host up to 6000 people, a 7000-m^2 forum area and an auditorium that can host around 1800 people. Its design comprises 20,000 tons of steel and 58,000 m^2 of glass.

In 1998, one year before the completion of the Euskalduna Conference Centre, the city of Rome, together with EUR S.p.a (a private company with public capital, which is the owner of the EUR district and its buildings, controlled mainly—90%—by the Ministry of Economy and also—10%—by the City of Rome) launched an international architecture competition for the preliminary design of the new Conference center. The urban project was conceived as part of the redevelopment plan for Rome's EUR district; the winner was the project of Fuksas, with an initial cost of 130 million euros.

Despite the jury, chaired by the worldwide famous architect Sir Norma Foster, recommended «also considering the modalities of financing (50 % private resources), a control process aimed to guarantee the compliance with the estimated budget and including a concrete evaluation of the management costs» (Ghio and Tonelli 2000), the events characterizing the "production" of the Conference Center denies this recommendation. Indeed, between one contractor and the other, the project began only in 2007, with ten variants in 6 year, doubling the costs (AVCP 2014).

For what concerns the variants, some of them are attributable to the lacks in the redaction of the executive project which, as in the AVCP document "… they could've been avoided with a greater analysis and knowledge and the necessary integration among the several components of the project (architectural, structural and plant design); this factors have determined an ongoing design revision, that, surely, has penalized the times of implementation" (Fig. 3).

Fig. 3 The new Conference center “Nuvola” (Rome), *Source* EUR S.P.A

In the design process of this important urban project, the lack of any “culture” of evaluation emerges, and, especially during the initial phase of the construction of the design idea (Forte 2015), when decisions are made which will affect all the main part of the production process (as showed in paragraph 1) the absence of a structured and systematic evaluation process, capable of supplying articulated information regarding economic and extra economic aspects, is not more acceptable.

2.3 Deductions

Even though it is still early to know the impacts of the new Congress Center in Rome, despite there being an accurate economic and financial evaluation elaborated in 2013, in a mutate context toward the scenario of conception of the project (Scandizzo et al. 2016), the comparison with the Euskalduna Palace in Bilbao, allow us to frame some inefficiencies, typical of the Italian system.

With specific reference to the architectural work, it is appropriate to remember (Forte and Fusco Girard 2009) that the disciplinary statute of the Architecture forecasts that just by making itself, it solves the problems of the people, not only that of the taste, but the problems in general sense; and here it means talk about functions but, above all, about the relationship with the city and its community. The Architecture stands and affirm itself not only when it is pure form but when it is able to enter and participate into the program of the city, into the project/strategy of its overall development (economic, social, cultural, etc.).

In the case of Euskalduna Palace, the urban project was conceived in the aim of responding to a need: it is what was needed and is part of the program of the city (the Plan of Regeneration of Bilbao). In this program, all the goals have been identified and a precise strategy was drawn up; the resources and the actors were known a priori. For the implementation of the program two ad hoc management tools were instituted (Bilbao Ria 2000 and Bilbao Metropoli 30). A continuous and participated evaluation process has supported all the project phases, with the result of the production of an high-quality architectural work.

In the case of the new Conference Center in Rome, what was the need? How has it been identified? What was the overall program for the EUR area in which the urban project was conceived?

From the beginning, this urban project has been programmed without any certainty of the resources and has been characterized by the uncertainty of the expectations (as for hotel The "Lama" annexed to the New Congress Centre, which even sold yet by EUR Spa to some investment fund whom competes the completion of the work and the commitment of the management to an hotel chain). In addition, the project was conceived in spite of the motivated oppositions of the residents, in absence of any participative process. In Italy, the above aspects highlight as the production of the territorial works and services again represents a uneasy problem to solve, not only for cultural and political reasons (Bentivegna and Fattinnanzi 1981), but also for that concerning the technical aspects and the relationship between the design and the evaluation process.

3 The Role of Appraisal and Evaluation Disciplines

The case of the New Conference Center in Rome, together with many others, allows to underline how, in Italy, the Public Administrations continue to avoid to formalize an evaluation system, adequate to their decisions (Stanghellini 2012). From a general point of view and in a context of recession of the Italian economy, where the trend of the construction sector remains dramatic (in the last eight years the resources for the realization of new public works has decreased of the 45%, ANCE 2014), there is no doubt that the excessive bureaucracy makes the process of production of public works extremely difficult. As documented in the DPS report (2014), most of the delays in the completion of works are caused by the weight of the "crossing times", that is the times of ordinary bureaucracy employed in the passage from the several phases of design and realization; from a public Administrations to another; from an advise to another.

Moreover, the normative dysfunctions, as the neat division among the program and the design phase and the design phase and the implementation, contributes to prevent the integration of knowledge, by now indispensable in each kind of project, avoiding the fragmentation of the responsibilities.

This is one of the main reasons why, in Italy, as well testified by Franco Purini (Forte 2014) the specificity of the designer (Architect or Engineer) as the "creative propulsor" of the overall building design process, fails, unlike other countries where, the designer, is recognized as the figure of "designer" and, together, the "coordinator" of the specialized contributions, in a well-established culture of "project management". It is well-known how at the basis of any building design process there are increasingly complex needs (sustainability, maintainability, comfort, efficiency, social and cultural needs, etc.) which require a teamwork.

This, inevitably obliges the designer to interact with the several specialized knowledge together with elaborate all the possible alternative hypothesis, to be analyzed and submitted to a continuous and systematic evaluation process. In Italy, the separation between the project and the realization contributes to removing the designer from the implementation process and, then, from the operative knowledge as well as from the updating of the executive techniques.

From the appraisal and evaluation point of view, even if, since the year 1990, the numerous normative and regulation dispositions provide the elaboration of *feasibility studies* (Copiello 2011), a lacking culture of the programming carries on causing wrong expenses provisions.

Then, starting from the normative level, it is necessary to valorize the project and to acquire that culture of "project management" for the control of times, costs and quality, by now consolidated in other countries, but not in Italy (Fregonara 2011).

Regarding the valorization of the project, the recent new Italian Public Procurement Code, the Legislative Decree n. 50/2016 (which, in its implementation, "should" guarantee the administrative simplifications, transparency, contrast to the corruption and high quality standards), substitutes the "preliminary project" with the new *technical and economic feasibility project*. The other two levels—definitive and executive—maintain, substantially, the characteristics of the previous legislation, representing now, the *executive* level, the planning standard for all bidders (while, before, contracting authorities could proceed with the tender on the basis of the definitive project).

The technical and economic feasibility project «identifies, among multiple solutions, what presents the best costs benefits ratio for the community, in relation to the specific needs to satisfy and performances to provide» (L.D. n.50/2016, art.23). This first level of the project seems mainly focused on the concrete impact of the work and on its consequences not only in economic terms.

It should contribute to the auspicated evolution of the traditional "certification" role of the feasibility study, towards a really «comprehensive evaluation process, able to simultaneously deal with many different points of view and focus on the intertwining between the different specialized evaluations, therefore providing the decision makers with a help to make informed and effective decisions and ensuring the stakeholders that the whole design not only some of its aspects support the common interests» (Bentivegna 2015).

In this perspective, it must be emphasized that one of the important innovations introduced by the new Procurement Code is the *transparency into the participation of the stakeholders and the public debate* (Art.22) for the relevant infrastructural and architectural works, as an "obligatory" phase into the decision making process. The demand of the evaluation into the participative decision making process can founds, in the appraisal and evaluation disciplines, the scientific and systematic support, as in the Multicriteria Analysis (Berni and Oppio 2015).

Another innovative element introduced by the New Code, becoming a proper evaluation criterion for the individuation of the most economically advantageous tender, is the *Life cycle costs* (Art.96. DL 50/2016). This marks the passage from the logic of the lower realization price to an approach more careful to the technical and technological choices of the project and to its overall quality, with all the positive consequent effects regarding the maintenance, management and dismissing costs.

The article, implementing the European Directives 2014/24/UE (Art.68, Life-cycle costing), within the notion of "life-cycle cost" extents the "cost" dimension at the environmental and the social costs. Indeed, according with the Art.96, the life cycle costs include: (1) the costs related to acquisition; (2) the costs of use, such consumption of energy and other resources; (3) the maintenance costs; (4) end of life costs such as collection and recycling costs; (a) the costs imputed to environmental externalities linked to the product, service or works during its life cycle, provided their monetary can be determined and verified; such costs may include the cost of emissions of greenhouse gases and of other pollutant emissions and other climate change mitigation costs.

The attention to the "external costs" and to the method used in their assessment, represents another important element of innovation. In accordance with the European normative, it needs of a rigorous assessment approach, which, although consolidated in the appraisal and evaluation disciplines (Società di Estimo e Valutazione, Rivista 2012), poses further interesting challenges.

4 Conclusions

Many others essential aspects of the new Italian procurement code, which are waiting further specifications by the implementing rules (as example, the introduction of the Building Information Modeling for the rationalization of the design phase, or the role of the Project Manager for specific complex projects), stimulate a final consideration on the role of the appraisal and evaluation disciplines at the formative level.

The theme of the internationalization of the profession plays nowadays a crucial role. In Italy, the prolonged crisis of the building sector is constraining the designers to an increasing specialization; the same design activities have progressively decreased in favor of specialized activities (evaluations, appraisals, energetic certifications, etc.). In this perspective, it seems to be useful to refer the Directive 2013/55/EU on the recognition of professional qualifications, regarding the training of Architects (art. 46). Many points of the Directive allow us to highlight the several contributes which the appraisal and evaluation disciplines are called upon to offer.

As in the *demand analysis* expressed at the point a. of the Directive: "ability to create architectural designs that satisfy both aesthetic and technical requirements"; or in the *formulation of value judgments* (point e. "understanding of the relationship between people and buildings, and between buildings and their environment, and of the need to relate buildings and the spaces between them to human needs and scale"). Furthermore, in the *exercise of the profession* (point f. "understanding of the profession of architect and the role of the architect in society"); although the "Appraisal and Professional Exercise" has unfortunately disappeared from many degree courses, an efforts with regards to the comprehension of what the profession of Architects means nowadays, even in the perspective of the “project manager”, should be made. In the *appraisal and evaluation methodologies* (point j. “the necessary design skills to meet building users’ requirements within the constraints imposed by cost factors and building regulations”), nowadays called to face with the “global cost” (the *Life Cycle Costs*, as in the Italian Public Procurement Code), inevitably. The “necessary design skills” means also the ability in the management of the complexity of the project, interacting with the several specialized knowledge together with elaborate all the possible alternative hypothesis, through a «comprehensive evaluation process» (in this perspective, in the Schools of Architecture a different interrelation between the designers and evaluators should be implemented).

The final point k., “the adequate knowledge of the industries, organizations, regulations and procedures involved in translating design concepts into buildings and integrating plans into overall planning” allow us to catch the signals of an actual demand ever more conscious which, for the designer, is necessary to acquire the knowledge of the economic-productive process in the specific sector of the building production (Fattinnanzi 2015).

In this perspective, we would like to conclude with a quotation of an article written by Carlo Forte exactly 50 years ago, on the contribution of the Urban Economics in the urban programming: «…In this specific field of investigation the theoretical enunciations of the Economic Science should be concretized in the practice, identifying the functions of the building constructor on the track of those generically defined for the entrepreneur, the company, the firm» (Forte 1965).

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Market Prices and Property Taxation in Italian Real Estate: A Turin Case Study

Rocco Curto, Elena Fregonara and Patrizia Semeraro

Abstract The aim of the paper is to address the issue of social inequity in Italy due to property taxation. The European Union has declared the fact that cadastral values used to define property taxation in Italy do not reflect market prices. In this paper, we analyze the discrepancies between cadastral values and listing prices. Furthermore, we find empirical coefficients to apply to current cadastral values to reduce the spread between current cadastral values and market prices. The procedure used is very simple and could easily be applied by local public administrations in order to correct the inequity produced by the current property taxation system within the same city and among various cities.

Keywords Property taxation · Property cadastral value · Property cadastral rent · Listing prices · Hedonic models

1 Introduction

In Italy, property taxation is based on property cadastral values, which are computed using cadastral rents defined by the Italian land registry, dating back to the 1950s and 1960s. The land registry defined the cadastral rents still used today, across large geographical areas. These cadastral rents were defined empirically using a property classification that was based on physical features of properties,

R. Curto · E. Fregonara (✉)
Department of Architecture and Design, Politecnico di Torino,
Viale Mattioli 39, Turin, Italy
e-mail: elena.fregonara@polito.it

R. Curto
e-mail: rocco.curto@polito.it

P. Semeraro
Department of Mathematical Sciences "Giuseppe Luigi Lagrange",
Politecnico di Torino, Corso Duca degli Abruzzi 24, Turin, Italy
e-mail: patrizia.semeraro@polito.it

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which no longer reflect the real estate market. Cadastral rents rely on the number of cadastral rooms. Cadastral room sizes belong to a predefined range rather than having a fixed number of square meters. The first cause of inequity of taxation is that they represent location using a geographical segmentation into large census zones, which no longer reflect real estate submarkets. For this reason, property location has a negligible impact on cadastral rents, although the impact of location on prices is well known (Bourassa et al. 2003, 2007; Goodman and Thibodeau 1998). The second cause of inequity of taxation is the use of cadastral rooms rather than actual sizes in square meters. Because of this, properties with different numbers of square meters can have the same number of cadastral rooms. Consequently, the householder of the smaller property pays the same taxes as the householder of the bigger property.

The aim of this paper is twofold: on one hand, we empirically measure the discrepancy between current cadastral values and market values, which is a measure of social inequity. Using a traditional hedonic approach (Rosen 1974), we identify the main factors that explain the spread between market and cadastral values, based on a case study. On the other hand, we propose a methodology to update current rents to match them more closely to market prices, while awaiting the next phases of the land registry reform, which will be a long process. The case study is Turin's real estate market.

The paper is organized as follows. Section 2 introduces the empirical methodology used. Section 3 presents the case study and the databases used for the analysis. We discuss the empirical results in Sect. 4, and conclusions are presented in Sect. 5.

2 Empirical Analysis Design

The land registry defined cadastral values (CV) using the income approach (*Regio Decreto Legge* n. 652 of 1939 and Law no. 1142 of 1949). The benefits of property ownership were measured to define the cadastral rent (CR) of assets, which were divided into different categories (from category A to category F) according to their use. The biggest category was A, which includes ordinary assets and residences. Accordingly, cadastral rents were defined for assets in category A, while, for assets in other categories, the appraisal was performed case by case. In this study, we consider residences, which are assets belonging to category A. For assets in category A, cadastral rents (CR) are defined across census zones. Assets in the same category and census zone are divided into classes, according to their physical features. Then, for each class the cadastral rent by cadastral room, which we call unit cadastral rent (UCR), is defined. Finally, a property CR is the product of UCR and the number of the property cadastral rooms. Cadastral values (CV) are obtained using some coefficients defined by law, which are not connected with the interest rate. Formally, CV can be deduced by CR by the following:

$$\mathrm{CV} = \mathrm{CR} * 126 \tag{1}$$

Notice that CV is a linear transformation of CR. Indeed, we work directly on CR whenever this is possible. As discussed above, the low contribution of location to CR and the use of cadastral rooms as a proxy for size are the main factors that contribute to increasing the difference between cadastral values and market prices. Accordingly, we focus on these two aspects. With respect to location, there are some studies (Goodman and Thibodeau 1998; Bourassa et al. 2007) that conclude that geographical housing submarkets are more important in predicting house prices than the spatial statistics approach (Bourassa et al. 2003, 2010). Coherently and in accordance with the presidential decree 138/1998, we use Microzones to model location. Their importance for Turin real estate is also empirically supported in Fregonara and Semeraro (2013). Since, in Italy, information on market prices is not public and is difficult to retrieve, consequently we use listing pricing (LP) to proxy market prices (Taltavull and McGreal 2009; Curto et al. 2015), where listing prices are used to analyze the real estate market. Listing prices can be used to proxy market prices for the analysis of the two aspects considered in this paper: location and size. In fact, the explanatory power of location on listing price could be considered as a proxy for the explanatory power of location on market price, as empirically shown in Fregonara and Semeraro (2013).

The analysis performed in this work is developed in two steps. The first step aims to show that location and cadastral rooms are the main factors influencing the discrepancies between cadastral values and market values. The second step proposes an empirical procedure to update cadastral values to reduce the discrepancies with market prices.

2.1 Factors Influencing Spread in Cadastral Rents and Asset Prices

The first step of analysis is performed using a traditional hedonic approach. We specify hedonic models to explain the two dependent variables: listing price (LP) and cadastral rent (CR). We focus on the explanatory power of Microzones, number of rooms and size measured in square meters. The variable Microzone is a nominal variable with disordered modalities: the attractiveness of each Microzone depends on the subjective perceptions of sellers and buyers. Therefore, Microzones are specified by dummy variables. We empirically computed the coefficient of determination corresponding to linear regressions to explain listing prices, cadastral rents, and the differences between listing prices and cadastral values (DP):

$$\mathrm{DP} = \mathrm{LP} - \mathrm{CV}. \tag{2}$$

We considered two hedonic models, corresponding to two sets of explanatory variables. Formally, the first model is:

$$Y_j = \alpha_{j0} + \sum_{i=1}^{n} \alpha_{ij} X_{ij}^{CR} + \varepsilon_j, \quad j = 1, \ldots, k = 1, 2 \tag{2.1}$$

where $Y_{j,}$ j = 1, …, 4 are LP, CR, and DP, respectively, and the explanatory variables $X^{CR}{}_{ij}$ are the variables defining cadastral rents: category, class, and number of cadastral rooms. The hedonic weight α_{ijk}, j = 1, ... n_i, i = 1, ..., n assigned to each variable is equivalent to the contribution level of these characteristics to the price values (Rosen 1974); α_{j0} is the model intercept; and ε_j the error term. The second model is:

$$Y_j = \alpha_{j0} + \sum_{i=1}^{n} \alpha_{ij} X_{ij}^{LP} + \varepsilon_j, \quad j = 1, \ldots, k = 1, 2 \tag{2.2}$$

where Y_j j = 1, …, 4 are LP, CR, and DP, respectively, and the explanatory variables $X^{LP}{}_{ij}$ are the main factor influencing market prices: Microzone, quality of the building, and size (Curto et al. 2015). The hedonic weight α_{ijk}, j = 1, ... n_i, i = 1, ..., n assigned to each variable is equivalent to the contribution level of these characteristics to the price values (Rosen 1974); α_{j0} is the model intercept; and ε_j the error term. The hedonic weights in Eqs. (2.1) and (2.2) are estimated using traditional least-squares estimates. The coefficient of determinations (R^2) of the two regression models measures the proportion of variation of the dependent variables (LP, CR, DP) explained by the model.

2.2 Operational Proposal

The second step of analysis proposes a methodology to adjust CR across Microzones to introduce cadastral rents per square meter. We introduce a *location-adjustment coefficient* for each Microzone to apply to CR—and CV—as follows. If P_i is the sample mean of assets prices in the Microzone, i = *1*, …, N, where N is the number Microzones into which the area under appraisal is divided, the coefficients c_i are defined by:

$$c_i = \frac{P_i}{\frac{\sum_{i=0}^{40} P_i}{N}} = \frac{NP_i}{\sum_{i=0}^{40} P_i} \tag{2.3}$$

Hence, each coefficient is the ratio between the mean listing price observed in the Microzone i, i = 1, …, 40 (P_i), and the arithmetical mean of P_i, i = 1, …, N, *i.e.*,

$\overline{P} = \frac{\sum_{i=0}^{40} P_i}{N}$. Then, the adjusted rent ACR_j (I) of a property I located in Microzone j, j = 1, …, N is given by:

$$ACR_j(I) = c_j CR_j(I) \tag{2.5}$$

where $CR_j(I)$ is the cadastral rent of property I. The relationship between the adjusted rent ACR_i (I_i) and ACR_j (I_j) of two properties I_i and I_j, belonging respectively to submarkets i and j, depends only on the mean prices in the two submarkets (Curto et al. 2014).

The second proposal to update CR consists of defining a rent per square meter (square meter cadastral rent, *SMCR* for short), according to actual rents per cadastral room (UCR). In that, we assume the value as unit rent of asset I to be:

$$SMCR(I) = \frac{UCR(I)}{s_{middle}(I)} \tag{2.7}$$

where $UCR(I)$ is the rent per cadastral room of asset I and s_{middle} (I) is the arithmetical mean between the minimum size and the maximum size per cadastral room of asset I (the range of the number of square meters per cadastral rooms are provided in Table 4). Then we can find recalculated cadastral rents (*RCR*) of asset I by multiplying $SMCR(I)$ and property size, and we obtain:

$$RCR(I) = SMCR(I) * s(I) \tag{2.8}$$

where $s(I)$ is the size of asset I measured in square meters. Recalculated cadastral rents (*RCR*) are compared with current rents. Finally, we apply the location coefficients c_j, j = 1, …, n also to *RCR*, to analyze the distribution of rents across Microzones after the introduction of SMCR and the application of location adjustment coefficients.

3 The Case Study

We perform the empirical analysis on a case study of the city of Turin. Turin is divided into four census zones and forty Microzones. Microzones were defined by Politecnico di Torino in 1999, using a territorial information system and performing a factorial analysis and a cluster analysis. The factors considered include price level, building characteristics, accessibility, presence of services, and green areas, as provided by the law 138/1998. Microzones are numbered from 1 to 40, fanning out from the center of the city to the suburbs. Figure 1 compares Microzones with the four census zones in which Turin is divided.

As one can see in Fig. 1, the census zones are big areas that do not reflect local amenities. In the same census zone, there are heterogeneous assets. In particular, in

Fig. 1 The four census zones and the 40 census Microzones of the city of Turin

census zone 1, one can find prestigious assets as well as low-quality assets. Coherently, people living there belong to various social status. Instead, Microzones are a geographical segmentation, and they are able to explain almost 40% of market prices, as empirically measured in Fregonara and Semeraro (2013), and of listing prices, as shown in Curto et al. (2015).

3.1 Data

The analyses use two separate property databases of the Turin Real Estate Market Observatory (TREMO). TREMO was founded under an agreement between Politecnico di Torino, Turin's Municipality, and Turin's Chamber of Commerce, with the institutional aim to collect and analyze data from the real estate market. We consider the TREMO sample of assets on sale in 2013, which consists of 566 properties, and we call it the TREMO sample. For each asset, we consider the characteristics: Microzone, size (measured in square meters), and building quality. We defined five building quality levels, which consider several building characteristics, such as building materials, age of the building, and also cadastral category and class. The highest level corresponds to attractive properties while the lowest corresponds to council houses. We used dummy variables to model the quality-of-building levels. Descriptive statistics for each Microzone are provided in Curto et al. (2014). The second database is the property of Turin Municipality, and we call it CDB (cadastral database). The CDB contains information on each asset in the Land Registry. Information collected for residential assets are cadastral rent, category, class, number of cadastral rooms, and location, which is provided through map sheets, the number, and the subdivision. Unfortunately, the identification code used by TREMO does not allow for a one–to-one association between the TREMO and CDB databases, since address codes identifies buildings and not apartments.

Nevertheless, the CDB sample consists of 49,305 data and includes the assets with the address codes sampled in TREMO sample. Descriptive statistics for the CDB sample are provided in Curto et al. (2014).

To analyze discrepancies between CR and LP, we link the two databases using address code and floor. We found one-to-one correspondence for 129 data, which we collect in a new sample named BDM. The sample of 129 properties provides information from the two databases TREMO and BDC. Despite the small sample size, the statistics in Table 1 highlight the need to update current rents and include the marginal contribution of location on property value. Table 3 includes Microzones with at least three observations; Microzones with at least seven observations are in bold.

Table 2 provides the mean and the range of size across properties with different numbers of cadastral rooms and exhibits a large variability of size in correspondence to the same number of cadastral rooms. From this, cadastral room number seems not suited to be a proxy for size. In this sense, descriptive statistics seem to justify our approach.

4 Empirical Results

This section presents the results of the empirical analysis performed. Firstly, we analyze the main factors explaining CR, LP, and the difference between LP and CV, i.e., DP. Secondly, we update the current cadastral rents and discuss the results.

4.1 Factors Influencing Cadastral Rents and Market Prices

This section analyzes the main factors explaining LP and CR. Results of hedonic analysis are provided in Table 3a, b. Table 6a explains CR, LP, and DP using factor defining cadastral rents, i.e., category, class, and cadastral rooms. It shows that the factors defining rents are not able to fully explain LP, while they contribute 37% to explain the difference between CV and LP.

Table 3b explains CR, LP, and DP using the main factor influencing LP, i.e., size, Microzone, and building quality, which explain 87% of LP. These factors are able to explain only 37% of CR, and they are responsible for the difference between CR and LP ($R^2_{adj} = 0.85$). These results highlight the fact that location and size are able to explain the current spread between CR and LP. We also split the above regression into two separate regressions to measure the impact of location and building quality on LP and CR separately. The first regression has Microzones as an explanatory variable, and we found $R^2_{adj} = 0.49$ for LP and $R^2_{adj} = 0.22$ for cadastral rents. The second regression has building quality as explanatory variable and we found $R^2_{adj} = 0.45$ for LP and $R^2_{adj} = 0.23$ for cadastral rents. These results

Table 1 Sample JOIN: listing prices and cadastral values—under the assumption of residence—mean values for Microzones

Microzone	Sample size	RC mean	LP mean	ULP mean	UCV mean	M	Sample size	RC mean	LP mean	ULP mean	UCV mean
1	1	5	180,000	3829	14,641	23	3	881	753,333	178	111,113
2	3	62	503,333	3400	186,381	**24**	**9**	**46**	**651,556**	**3400**	**139,582**
3	2	1597	719,500	4831	201,320	25	3	58	374,667	129	173,909
5	3	28	426,333	166	83,186	26	2	781	220,000	2004	98,504
6	1	1224	900,000	4205	154,224	27	3	1322	194,333	88	166,696
7	5	29	319,600	119	87,491	28	4	774	285,750	82	97,610
8	3	70	678,333	178	210,675	**29**	**10**	**28**	**184,000**	**94**	**83,326**
9	3	48	451,666	3207	146,198	30	1	17	168,000	2584	52,709
10	4	15	252,250	119	45,632	31	4	18	143,250	83	54,743
11	5	37	345,800	134	113,032	32	1	28	159,000	95	84,595
15	**7**	**39**	**410,428**	**3206**	**116,621**	**33**	**12**	**22**	**211,083**	**90**	**65,819**
16	2	559	1,025,000	248	70,523	34	2	11	121,000	1360	32,455
18	3	950	651,333	151	119,789	**35**	**8**	**31**	**139,125**	**84**	**92,282**
19	4	1077	265,750	93	135,800	36	4	21	113,750	1425	62,308
20	3	30	204,666	77	92,024	37	1	27	125,000	80	80,854
21	**10**	**25**	**129,690**	**1407**	**76,754**	40	1	322	200,000	2000	40,671
22	3	1428.87	433,666	3230	180,037						

Table 2 Sample JOIN: size for given number of rooms statistics

Number of cadastral rooms	Minimum size	Mean size	Maximum size	Size st. dev.
1.5	47.00	98.50	150.00	72.83
2.5	50.00	96.43	140.00	34.24
3	45.00	105.45	270.00	62.63
3.5	50.00	82.55	130.00	24.17
4	30.00	103.29	260.00	61.68
4.5	50.00	98.33	230.00	52.90
5	40.00	88.25	130.00	25.13
5.5	60.00	122.22	250.00	58.69
6	65.00	166.29	300.00	77.56
6.5	83.00	145.75	175.00	30.69
7.5	75.00	130.83	170.00	43.75
9	180.00	200.00	220.00	28.28
9.5	125.00	140.00	155.00	21.21

Table 3 Hedonic regression analysis

Variables	Rents		Listing Prices		DPrices	
	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)
(a)						
(Intercept)	1353.07	3.77E−12	611,669	0.00258	441,182	0.02821
A01	Omitted		Omitted		Omitted	
A02	−1143.18	5.65E−12	−219,193	0.19,823	−75,153	0.65,814
A03	−1714.33	<2e−16	−470,500	0.00641	−254,495	0.13581
A04	−1812.51	<2e−16	−444,841	0.01378	−216,465	0.22603
A05	−1783.31	1.23E−10	−483,268	0.0948	−258,571	0.36938
A06	−692.81	0.000455	435,224	0.04907	522,518	0.0186
A07	−47.8	0.849328	870,867	0.00293	876,890	0.00275
A10	412.87	0.0436	−58,183	0.80138	−110,205	0.63393
C02	-1317.42	8.77E−07	23,488	0.9353	189,483	0.513
CLASS01	Omitted		Omitted		Omitted	
CLASS02	37.06	0.532505	−55,157	0.41571	−59,828	0.37756
CLASS03	163.52	0.004,449	−75,411	0.243	−96,014	0.13795
CLASS04	305.34	2.96E−06	−77,124	0.27821	−115598	0.10529
CLASS05	230.33	0.002342	−72,719	0.39061	−101,740	0.23051
CLASS06	19.17	0.893226	−90,889	0.57718	−93,305	0.5672
Rooms	196.56	<2e−16	39,805	0.00717	15039	0.3031
Adjusted R-squared:	0.9267		0.5403		0.3638	
p-value:	<2.2e−15		3.45E−16		5.43E−09	
F-statistic on 14 and 113 DF	115.7		11.6		6.187	

(continued)

Table 3 (continued)

Variables	Rents		Listing Prices		DPrices	
	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)
(b)						
(Intercept)	−820.343	0.22015	−370,830.8	0.008212	−267,467.5	0.03352
size (square meters)	4.685	0.00057	3118.2	<2e−16	2527.8	<2e−16
Microzone 1	Omitted		Omitted		Omitted	
Microzone 2	1678.053	0.01883	274,364	0.06128	62,929.3	0.63144
Microzone 3	2935.267	0.00126	640,902.7	0.000671	271,059.1	0.10227
Microzone 4	2213.997	0.00556	296,948.1	0.068101	17,984.4	0.90172
Microzone 5	696.896	0.34115	421,178.6	0.00624	333,369.7	0.01603
Microzone 6	325.348	0.6913	199,264.2	0.240337	158,270.3	0.30142
Microzone 7	820.649	0.23667	258,130.4	0.072828	154,728.7	0.23147
Microzone 8	1637.114	0.03182	462,995.1	0.00363	256,718.7	0.06993
Microzone 9	1203.476	0.10984	288,298	0.064164	136,660	0.32792
Microzone 10	681.417	0.35344	308,501.6	0.04373	222,643	0.10566
Microzone 11	1095.636	0.12861	297,671.9	0.046514	159,621.7	0.23386
Microzone 15	1193.283	0.0915	311,055.1	0.033915	160,701.5	0.22107
Microzone 16	1208.137	0.09524	872,938.4	6.53E −08	720,713.2	5.68E −07
Microzone 18	651.676	0.36579	288,660	0.054257	206,548.8	0.12583
Microzone 19	1232.164	0.09208	186,938.9	0.213956	31,686.3	0.81482
Microzone 20	851.237	0.28019	222,164.4	0.172965	114,908.6	0.43356
Microzone 21	906.166	0.20282	180,626.2	0.218603	66,449.4	0.61505
Microzone 22	1588.928	0.03667	360,780.3	0.021872	160,575.3	0.25322
Microzone 23	879.486	0.2514	572,350.1	0.000459	461,534.8	0.00164
Microzone 24	1117.491	0.1264	430,140.9	0.005029	289,337	0.03488
Microzone 25	1627.614	0.03361	380,987.8	0.016359	175,908.4	0.21416
Microzone 26	1035.523	0.18974	238,952.4	0.143131	108,476.6	0.45974
Microzone 27	1405.582	0.11252	312,740	0.087507	135,636.7	0.40896
Microzone 28	812.92	0.27653	139,159.8	0.366319	36731.8	0.79135
Microzone 29	1027.019	0.14053	266,092.2	0.065259	136,687.9	0.29129
Microzone 30	859.481	0.3246	311,679.6	0.085294	203,384.9	0.21197
Microzone 31	891.86	0.22228	285,132.6	0.060198	172,758.3	0.20494
Microzone 32	1089.115	0.21322	287,088.7	0.112908	149,860.2	0.3573
Microzone 33	853.678	0.22325	271,153.4	0.062391	163,590	0.21075
Microzone 34	644.529	0.41862	203,399.2	0.217378	122,188.6	0.41086
Microzone 35	1181.046	0.09368	278,338.6	0.05622	129,526.8	0.32158
Microzone 36	908.045	0.22467	250,153.2	0.106253	135,739.5	0.32957
Microzone 37	1157.496	0.19082	293,149.1	0.109344	147,304.7	0.37066
Microzone 40	599.954	0.49495	234,543.3	0.197701	158,949.1	0.33282

(continued)

Table 3 (continued)

Variables	Rents		Listing Prices		DPrices	
	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)	Estimate	Pr(>|t|)
Building Quality 3	74.644	0.59,882	24,469.6	0.40398	15,064.4	0.56908
Building Quality 2	Omitted		Omitted		Omitted	
Building Quality 1	−606.11	0.44328	−46,772.7	0.774085	29,597.2	0.84061
Building Quality5	716.332	0.06314	404,276.4	1.60E −06	314,018.5	2.75E −05
Building Quality 4	167.938	0.44848	149,837.6	0.001438	128,677.5	0.00238
Adjusted R-squared:	0.3765		0.8712		0.8536	
p-value:	1.16E−05		<2.2e−16		1.16E−05	
F-statistic on 38 and 88 DF	3.002		23.43		20.33	

Dependent variables CR, LP, and DP, i.e., listing prices-cadastral values

Table 4 Adjusted rents by Microzone

Microzone	CR mean	c_2013	AR mean	Microzone	CR mean	c_2013	AR mean
2	1479.22	1.38	2041.32	21	609.16	0.52	316.76
5	660.21	1.13	746.03	22	1428.87	1.02	1457.44
7	694.38	0.92	638.83	23	881.85	1.13	996.49
8	1672.03	1.44	2407.72	24	1107.8	1.15	1273.97
9	1160.3	1.17	1357.55	25	1380.23	0.82	1131.79
10	362.17	0.86	311.46	27	1322.99	0.69	912.86
11	897.08	0.85	762.52	28	774.69	0.67	519.04
15	925.57	0.94	870.03	29	661.32	0.68	449.7
18	950.71	0.87	827.12	31	434.47	0.66	286.75
19	1077.78	0.7	754.45	33	522.38	0.7	365.66
20	730.36	0.82	598.89	35	732.4	0.57	417.47
				36	494.51	0.49	242.31

underline that factors which influence current market prices do not influence cadastral rents.

The next section proposes a simple methodology that could be applied by local administrations to update CRs; it relies on a redistribution of CRs across Microzones and on the introduction of unit CR per square meter to overcome the drawbacks of cadastral rooms as a proxy for size. We notice that also building-quality classifications should be updated to redefine cadastral categories and classes; nevertheless this action requires a long process, which is part of the Land Registry reform and is beyond the scope of the present paper.

4.2 Rents Adjustment

Following the procedure outlined in Sect. 2.2, we compute the *location-adjustment coefficient* c_i, $i = 1, \ldots, 40$ in Eq. (2.3), where P_i, $i = 1, \ldots, 40$ are the mean *LP* for the 40 Microzones. The *location-adjustment coefficients* are provided in Table 4. Then, for each asset in the CDB sample, we obtain the adjusted cadastral rents (AR) by applying Eq. (2.5).

In Table 4, we provide the mean values of CR and of AR for each Microzone.

Notice that, in the Microzones with the *location-adjustment coefficients* greater than one, the adjusted rents would increase as opposed to those with the *location-adjustment coefficients* smaller than one. Following the procedure in Sect. 2.2, we computed SMCR for each asset in the BDM sample using Eq. (2.7), and then we computed the recalculated cadastral rents RCR for each asset in the sample using Eq. (2.8). Table 5 provides statistics of RCR across Microzones. Recalculations yield result higher than current rents, suggesting that everybody declares the minimum admissible number of cadastral rooms per property.

Finally, we apply the *location-adjustment coefficient* to RCR of each Microzone to re-distribute RCR across them. Table 6 exhibits, for each Microzone, sample statistics for final cadastral rents (FCR), obtained applying location coefficients to RCR.

Notice that the application of the *location-adjustment coefficient* to RCR leads to FCR, which are higher than current rents in the most desirable Microzones and lower that current rents in the less attractive Microzones.

5 Conclusions

This paper analyzes discrepancies between current cadastral values, which are defined by Land Registry and are used as a base for property taxes, and market prices, which are represented by listing prices. We focus on two main aspects: location and size. These two aspects are proven to be the main factors influencing the discrepancy between cadastral values and listing prices. In fact, using hedonic approach, we show that location has a negligible impact on current cadastral rents and explains the differences between cadastral rents and listing prices. We then propose a simple methodology to update rents, which makes it possible to incorporate the value of location and to overcome the current use of cadastral rooms as a proxy for size. The methodology proposed could be applied by local administrations while waiting for Land Registry reform, in accordance with the recent regulation provided by Legislative Decree no. 23 of 11 March 2014. We show that

Table 5 CR recalculated using UCR per m^2

Microzone	Min	Mean	Max	St. dev.	Microzone	Min	Mean	Max	St. dev.
2	757.71	1906.22	2629.5	1005.74	22	748.13	1909.47	3434.44	1379.58
3	664	2218.46	3772.92	2198.34	23	405.79	1843.26	2619.18	1246.2
5	796.83	1053	1434.28	336.63	24	379.6	2305.79	5417.06	1441.56
7	611.14	1068.37	1373.77	336.63	25	392.51	1641.96	3668.31	1770.71
8	980.41	2145.72	2986.61	1041.7	26	472.19	1030.58	1588.96	789.68
9	1571.75	1875.06	2071.72	266.51	27	442.67	1080.13	2167.64	946.46
10	276.67	665.68	1012.26	335.51	28	735.09	1351.39	2143.29	628.67
11	542.28	1058.59	1668.16	475.92	29	568.1	981.17	1285.98	233.19
15	686.89	1367.83	3346.64	918.74	31	447.6	532.77	664.02	93.77
16	981.27	1209.98	1438.68	323.44	33	433.82	844.68	1845.47	456.71
18	1275.65	1724.73	1958.4	389.02	34	547.8	557.95	568.1	14.35
19	590.49	1453.52	3426.33	1328.09	35	433.28	747.68	1071.65	277.19
20	686.89	1154.29	1832.68	601.33	36	149.41	649.39	1344.51	522.62
21	299.72	898.97	1717.59	448.27	Torino	73.8	1141.48	6210.64	1101.29

Table 6 Final rents: descriptive statistics

Microzone	Min	Mean	St. dev.	Max		Microzone	Min	Mean	St. dev.	Max	
2	1048.22	2637.06	3637.65	1391.33	1	22	766.25	1955.72	3517.63	1412.99	1
3	822.43	2747.80	4673.17	2722.88	1	23	457.91	2080.04	2955.64	1406.29	1
5	901.23	1190.96	1622.19	380.74	1	24	435.21	2643.58	6210.64	1652.74	1
7	563.73	985.49	1267.20	310.51	0	25	320.36	1340.16	2994.06	1445.24	0
8	1408.30	3082.19	4290.08	1496.34	1	26	302.46	660.12	1017.79	505.82	0
9	1838.33	2193.09	2423.11	311.71	1	27	305.44	745.29	1495.66	653.05	0
10	236.99	570.20	867.07	287.38	0	28	491.06	902.76	1431.76	419.96	0
11	458.74	895.52	1411.19	402.61	0	29	386.31	667.20	874.47	158.57	0
15	644.49	1283.39	3140.04	862.03	0	31	296.49	352.90	439.84	62.11	0
16	1792.05	2209.72	2627.39	590.68	1	33	304.03	591.97	1293.34	320.07	0
18	1115.96	1508.83	1713.24	340.32	0	34	384.30	391.42	398.54	10.07	0
19	414.43	1020.15	2404.77	932.12	0	35	245.75	424.08	607.83	157.22	0
20	565.18	949.76	1507.95	494.78	0	36	73.80	320.78	664.16	258.16	0
21	154.63	463.79	886.13	231.27	0	Torino	36.46	1175.60	7234.28	1484.01	

The right-hand columns indicate the Microzones where final rents are higher than CR (1) and the Microzones where final rents are lower than CR (0) updated rents could be better as proxy listing prices and that they can reproduce the variation of prices across spatial real estate submarkets.

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An Integrated Model for Ex-ante Evaluation of Flood Damage to Residential Building

Marco Mancini, Gabriele Lombardi, Sergio Mattia, Alessandra Oppio and Francesca Torrieri

Abstract The paper presents a new integrated model for the ex-ante evaluation of flood Expected Annual Damage (EAD) with specific reference to the direct damage to residential buildings. Starting from the analysis of an existing flood-damage model developed in other contexts, we propose an integrated evaluation model based on the definition of an analytic "stage damage curve" for different typology of residential buildings. The model is based on the integration of hydraulic model, combined with an ex-ante damage evaluation model, as a decision-support tool for sustainable risk management. Finally, combining hazard and vulnerability levels by using a GIS-based toolbox, the EAD to an urban area is obtained. The proposed model is then tested in a residential urban area of the municipality of Olbia in Italy, which was damaged by the extraordinary flood on November 2013. The comparison, between the ex-post assessed damage and the ex-ante evaluation based on the application of the model, enables to verify high reliability of the results obtained.

Keywords Integrated model · Ex ante evaluation · Hydrogeological risk · Expected annual damage

M. Mancini · G. Lombardi
Department of Civil and Environmental Engineering, Politecnico di Milano, Piazzale Leonardo da Vinci 32, Milan, Italy

S. Mattia · A. Oppio
Department of Architecture and Urban Studies, Politecnico di Milano, via Bonardi 3, 20133 Milan, Italy

F. Torrieri (✉)
Department of Industrial Engineering, University of Naples Federico II, Piazzale Tecchio 2, Naples, Italy
e-mail: francesca.torrieri@unina.it

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1 Introduction

Ex-ante evaluation of flood damage is a strategic activity for risk management. The European Flood Directive (2007/60) introduced a new approach to risk management, which not only referred to the implementation of an emergency plan, but also to the design of a risk management plan based on structural and non-structural mitigation measures, with the aim to reduce the impact of floods on population, on physical assets, and on the environment (JRC 2013; ISPRA 2012; Krysanova et al. 2008; Merz et al. 2004). The "flood risk" is defined (art. 2) as the combination of the probability of the event concurrency and the potential negative consequences on human health, the environment, cultural heritage, and economic activities. From this perspective, the risk is not only a function of the hazard, but also of the vulnerability and the economic values of the exposed elements. Other definitions of the same concept available in the literature agree, "flood risk is the probability of a certain flood event, in combination with its impact" (DEFRA/EA 2006). Therefore, flood impacts are a crucial part of the flood risk equation.

Especially in urban areas, forecasts of the event intensity and the knowledge of the complex value of the territory at risk can represent a useful support to design risk maps as a tool to define a plan of the measures to safeguard the territory and mitigate the risk (Kubal et al. 2009).

A first analysis of the international model developed shows the difficulty to define and apply reliable and standardized tools for the ex-ante damage evaluation, due to the complexity of various territories, each characterized by specific characteristics, and the multidimensional nature of the damages incorporating not only economic damage assessed in monetary terms, but also, social, and ecological impacts (Haque and Etkin 2007). Particularly the latter are frequently omitted due to a lack of suitable data (Ebert et al. 2009). In particular, in Italy, an organic framework is missing today to generate ex-ante estimates of damages as data are collected empirically after flood events. The data are often unreliable, as they are reported by the owners of properties, and are difficult to control. Therefore, in many cases, direct damages are overestimated, and intangible values are not considered at all (ISPRA 2012).

Although the first research initiatives started operating in this field almost forty years ago (Penning-Rowsell and Chatterton 1977), there is still a lot of work related to this issue to do. All approaches of flood damage analysis contain uncertainties due to the inaccuracies and generalizations used (Meyer et al. 2009; Messner et al. 2007). The lack of data aggravates this problem, making the results of estimation methods very rough.

Nevertheless, a lot of flood-damage models have been created recently for the assessment of damage in urban areas, aiming at improving the calculation of impacts in both qualitative and quantitative ways (Jongman et al. 2012).

Among the evaluation methods used in different international contexts, stage-damage curves represent the instrument most widely used for the ex-ante estimate the flood damage. They relate the intensity of the flood event (hazard) and the resulting damage of a certain type of assets exposed to risk.

Starting with an analysis of case studies conducted in different international contexts, this study proposes a methodology of ex-ante evaluation of the damage based on analytic stage-damage curves as the most trusted and reliable forecasting tool estimation of the expected damage.

To this end, the work implements a prototype model able to calculate the damage both at punctual level, namely on a single asset within a flood area, and its integral value over an area of the most representative blocks of similar assets. In particular, the dynamic of flooding areas will be factored in and its effects on the degrees of vulnerability of buildings in these areas.

The proposed model is then tested in an urban area of the municipality of Olbia that was damaged in the extraordinary flood of November 2013.

2 International Studies: A Comparative Analysis

There are many models that are used in the literature to estimate ex ante of flood damage (Excimap 2007; FLOODsite 2007; Riskmap 2011) and CONHAZ (Meyer et al. 2009; Bubeck and Kreibich 2011; Przyluski and Hallegatte 2011).

The most widely used method is the “stage damage curves” method. The damage curves are functions that relate the intensity of a hazardous event (hazard) and the resulting damage to a certain type of assets exposed (Molinari et al. 2014; Kreibich et al. 2010).

The extent of the damage, however, does not depend only on the peculiarities of the event, but also on the strength characteristics of assets at risk, and, consequently, many curves take into account the strength of these objects via vulnerabilities.

These functions can be built in two ways:

- empirical curves built on the basis of field surveys, looking at the effects of past flooding events (see, e.g., Merz et al. 2004; Thieken et al. 2008).
- engineering curves based on the estimates made by experts. According to this approach the damages are assessed by type of standardized elements, considered pro-prototypes of types of collateral exposed elements.

The curves can then be differentiated into two further categories:

- absolute curves that provide directly the value of the expected damage on the element exhibited;
- relative curves that express the damage as a percentage of the total value of the exposed element. While these curves have the advantage of being less dependent on the environment for which they were created, however, they presuppose knowledge of the total economic value of the object to estimate the monetary value of the damage.

In this paper we have analyze and compare case studies developed in various international contexts, in order to determine a classification of the scale, the typology of assets, and the area analyzed and evaluate the degree of uncertainty and variability of the results obtained in different contexts for the same types of buildings.

Table 1 summarizes the studies reviewed, classified according to the level of details analyzed (mesoscale, microscale), the type of exposed element, the location and land use, and the damage measured on absolute or relative scale.

Table 1 International studies

Model	Scale	Typology	Damage	Location	References
Atlante del Reno	Mesoscale	Residential building and content Industrial structure and content Road Agriculture	Relative	Germany (Urban and agricultural area, woodland)	de Moel and Aerts (2011)
Beam	Mesoscale	Res and Ind_Struct, Res_cont, Ind_cont, Agr_struct, Agr_cont	Relative	Europa (Urban and agricultural area, woodland, infrastructures)	Progetto Europeo SAFER—
Hazus	Microscale	Multiple	Relative	USA (Riverine and coastal flooding, urban area)	FEMA (2003, 2009)
FLEMO	Microscale	Public and private building, industry, corporate services, commercial building	Relative	Germany (urban area, agricultural and natural area)	Thieken et al. (2008), Kreibich et al. (2010)
MCM	Microscale	Residential	Relative	UK (urban area)	Penning-Rowsell et al. (2010)
Damage scanner	Mesoscale	Surface area	Relative	Holland (urban area, nature forest, grassland, arbor, zero grazing, arable land, infrastructure)	Vanneuville et al. (2006)
JRC model	Mesoscale	Surface area	Relative	EU	Huizinga (2007)

A first comparison shows that the curves that have a lower variance are relative to residential ones or multi-storey buildings refer to the microscale. The large-scale curves, especially those relating to industrial buildings and crops, are rather less comparable.

While existing models are generally based on statistical data, in some cases (e.g., Hazus) is an engineering analysis of the individual components of damage performed. This leads to a high degree of uncertainty in the estimate and difficulty in controlling the reliability of the obtained data (Table 2).

The four types of curves have been compared graphically in order to evaluate the variability of the results obtained (Fig. 1):

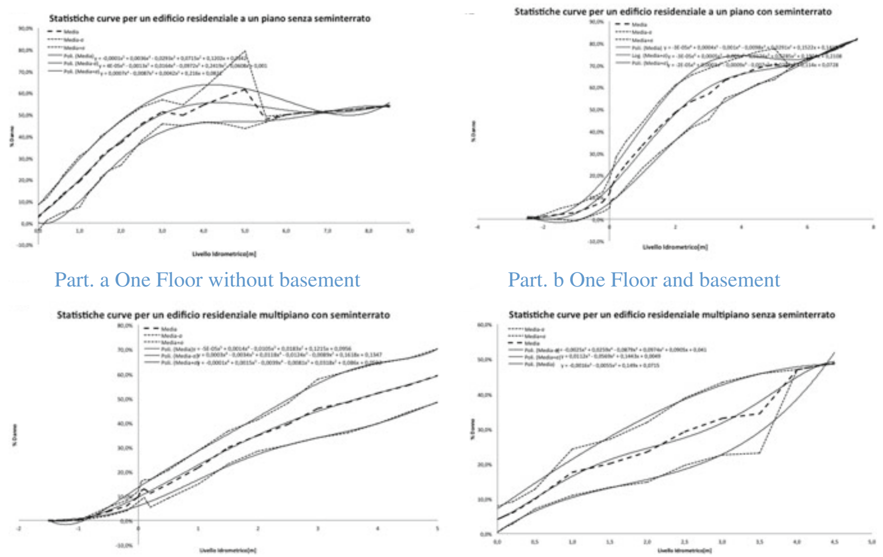
- damage curves of a residential building block of one floor without basement (Part. a)
- damage curves of a residential building block of one floor with basement (Part. b)
- damage curves for a multi-storey residential building with basement (Part. c)
- damage curves for a multi-storey residential building without basement (Part d).

The graphs below show the average curves for each type of building analyzed and the descriptive statistics of the range of results.

For all four cases, the variation of the percentages of damage is high enough, assuming values of variance around 10% with a value of the vulnerability that swings from maximum values of 82%, in the case of one-floor buildings with

Table 2 Statistics on case study

	I floor no basement		I floor basement		Multifloor no basement		Multifloor basement	
Weather depth (m)	Mean (%)	Standard deviation	Mean (%)	Deviazione standard	Mean (%)	Deviazione standard	Mean (%)	Deviazione standard
0.01	12	7	19	12	20	7	12	4
1	34	10	33	9	47	0	30	6
1.5	42	12	37	10	49	0	35	9
2	49	13	46	8	0	0	39	12
2.5	54	12	51	6	0	0	46	13
3	57	12	50	5	0	0	48	12
3.5	63	8	54	8	0	0	52	11
4	66	8	58	13	0	0	55	11
4.5	69	7	62	18	0	0	59	0
5	70	7	48	1	0	0	0	0
5.5	69	0	50	0	0	0	0	0
6	73	0	51	0	0	0	0	0
6.5	75	0	52	0	0	0	0	0
7	78	0	52	0	0	0	0	0
7.5	82	0	53	0	0	0	0	0
Max	82	13	62	18	49	7	59	13
Min	12	0	19	0	0	0	0	0



Part. a One Floor without basement

Part. b One Floor and basement

Part. c Multiple floors without basement

Part. d Multiple floors without basement

Fig. 1 Comparison among different type of curves

basements and height of water of 7.5 m (extremely rare), to amounts equal to 49% in the case of multi-storey buildings without basements.

As the value of the vulnerability in many cases is not estimated for all water levels, as Table 2 shows, the lack of data makes unreliable the average-value estimates in a comparison of the several curves.

The results from a comparison of different flood damage models conclude that some more improvements are required in this field, with the final goal to produce a European framework that applies best practices from existing models while taking into account the regional characteristics of each area.

3 The Case Study of Olbia in Italy

3.1 Introduction

On 18 November 2013, the island of Sardinia was affected by a meteorological event that caused exceptional rainfall. The height of the water level reached in the municipality of Olbia was 2 m, causing extensive damage to buildings. After the flood event an accurate census was conducted with the aim of estimating ex post the total damage to the housing stock. The census reported an estimated damage to the buildings of approximately €100 million.

The case of Olbia seemed, therefore, an interesting case study in order to test the methodology for the ex-ante estimation of the damage in a real case, enabling comparison of data estimated ex post with those predicted by the model.

In the following paragraphs, the methodology adopted and the results obtained are described.

3.2 *The Methodological Approach*

For the case study of Olbia, we have implemented a model for estimating the expected damage based on the integration of different estimation models that meet the definition of risk, understood as the combination of the probability of occurrence of a flood event and of the impact on the value of the elements exposed.

In particular, the model has been developed using a Geographic Information System in GIS (ArcGIS10) in order to compare the data relevant to the buildings (height, super-surface, position, and presence of the basement) with water heights for different recurrence times (25, 50, 100, 200, and 500 years, and for the event of 18.11.2013) with the aim to estimate the Annual Expected Damage (EAD) in urban areas. The methodology is shown in Fig. 2.

As the figure shows, the proposed methodology is structured into several modules:

Module 1: Identification of hydraulic hazard maps for different return periods, on the basis of a hydrodynamic simulation model and a definition of the area and the height of the flood.
Module 2: Classification of the elements at risk, by type and land use according to the regional 3D cartography.
Module 3: Identification of the vulnerability function, which is one of the crucial aspects of the task. It is developed using an analytical approach requiring division of the building into significant components and identifying the vulnerability of each part (Table 3).

The function of vulnerability is identified by type and elements-at -risk class detected in the sample and evaluated according to a discrete analytical approach of the loss percentages that individual constituent component of a building (Table 3) suffer as a function of the dynamics of the motions of the flood. The analysis was conducted as a function of water depth.

The damage curves are based on the assumption that it is possible to measure the economic value of the damage expected on the basis of the vulnerabilities of exposed elements, and the water level in the flood. Therefore the total damage (DT) will be a function of the economic value of the asset and its level of vulnerability. In formal terms:

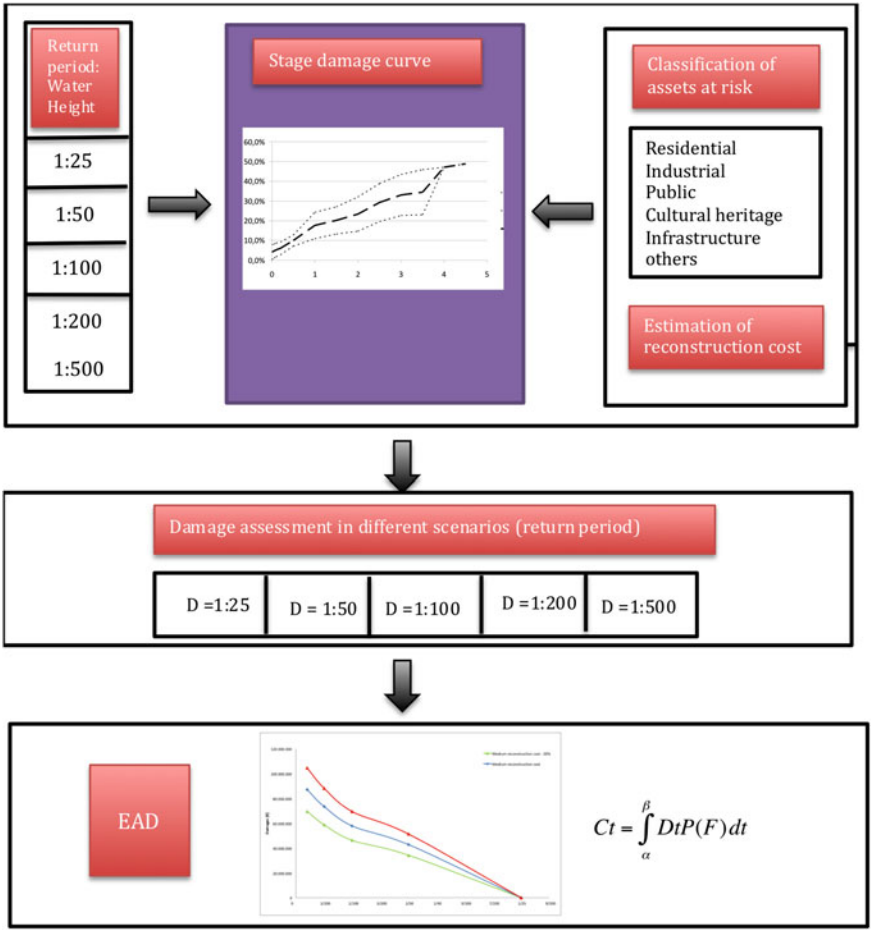


Fig. 2 Methodology for ex-ante evaluation of flood damage

$$DT = \sum_{i=1}^{n} \sum_{j=1}^{m} \mathrm{Vij} \times \mathrm{vulnerability} \tag{1}$$

where V is the value of the asset, i the typology of the element at risk, j the entity.

Module 4: Estimate the value of asset on the base the “depreciated reconstruction cost” method for each damaged item, only considering direct physical damage caused by the event (Manganelli 2011).

Direct damage to the buildings was estimated by employing the water height function, the vulnerability of the building elements to the hydrostatic actions, and the average cost of reconstruction of each damaged building element.

Table 3 Principal components of a residential building

	Component
Structure	Foundation
	Pillar
	Walls
	Crawl space
	Roof
	Horizontal structures
Installation	Heating
	Water and sanitary system
	Heater
	Boiler
	Electrical system
Fixtures	External plaster
	Internal plaster
	Ceramic floor
	Wooden floor
	Ceramic baseboard
	Wooden baseboard
	Decorative element
	Door
	Window frame

By correlating the potential damage estimate in different scenarios of hazard and the probability of occurrence of each scenario, it is possible to construct a probability curve of the expected damage (EAD).

The damage is a function of the probability of the occurrence of events or hazard, so the total cost of a flood at time *t* is formally expressed by the following relationship:

$$Ct = \int_{\alpha}^{\beta} DtP(F)dt \tag{2}$$

C*t* Total costs at time *t*
α Annual flooding probability
β Threshold value
D*t* Expected economic damage
P(F) Probability function.

The result obtained of the EAD has been representing, using a GIS toolbox, on a municipal-level map indicating the total damage values by type of exposed elements.

In the following section, we report the first results obtained from the application of the model to the flood event of November 2013 in Olbia.

3.3 Conclusion and First Results

The application to the case study of Olbia of the proposed methodology has enabled us to estimate the average expected damage (EAD) to the residential buildings located in the area exposed to the inundation of November 2013.

The vulnerability functions for each typology of building are reported in Table 4.

Figures 3, 4 and 5 depict instead reported examples of the flooding area in one scenario, the level of water, and the location of damaged building.

Figure 6 shows the expect annual damage (EAD), considering not only the function estimated on the basis of an ordinary reconstruction costs, but also the associated variance.

Table 4 Vulnerability function by type of building

1–2 Floor building no basement	
Media $-\sigma$	$D = -0.00002 * h^6 + 0.0003 * h^5 - 0.0009 * h^4 - 0.007 * h^3 + 0.0297 * h^2 + 0.114 * h + 0.0728$
Media	$D = -0.00003 * h^6 + 0.0004*h^5 - 0.001 * h^4 - 0.0098 * h^3 + 0.0291 * h^2 + 0.1522 * h + 0.1418$
Media $+\sigma$	$D = -0.00003 * h^6 + 0.0005 * h^5 - 0.001 * h^4 - 0.0126 * h^3 + 0.0285 * h^2 + 0.1904 * h + 0.2108$
1–2 Floor building with basement	
Media $-\sigma$	$D = 0.00004 * h^6 - 0.0013 * h^5 + 0.0164 * h^4 - 0.0972 * h^3 + 0.2419 * h^2 - 0.0608 * h + 0.001$
Media	$D = -0.0001 * h^5 + 0.0036 * h^4 - 0.0293 * h^3 + 0.0715 * h^2 + 0.1202 * h + 0.0342$
Media $+\sigma$	$D = 0.0007 * h^4 - 0.0087 * h^3 + 0.0042 * h^2 + 0.216 * h + 0.0821$
Multiple-floor building with basement	
Media $-\sigma$	$D = 0.0003 * h^6 - 0.0034 * h^5 + 0.0118 * h^4 - 0.0124 * h^3 - 0.0089 * h^2 + 0.1618 * h + 0.1347$
Media	$D = -0.00005 * h^5 + 0.0014 * h^4 - 0.0105 * h^3 + 0.0183 * h^2 + 0.1215 * h + 0.0956$
Media $+\sigma$	$D = -0.0001 * h^6 + 0.0015 * h^5 - 0.0039 * h^4 - 0.0081 * h^3 + 0.0318 * h^2 + 0.086 * h + 0.0592$
Multiple-floor building with basement	
Media $-\sigma$	$D = 0.0112 * h^3 - 0.0569 * h^2 + 0.1443 * h + 0.0049$
Media	$D = -0.0025 * h^5 + 0.0259 * h^4 - 0.0879 * h^3 + 0.0974 * h^2 + 0.0905 * h + 0.041$
Media $+\sigma$	$D = -0.0016 * h^3 - 0.0055 * h^2 + 0.149 * h + 0.0715$

Fig. 3 Flood area

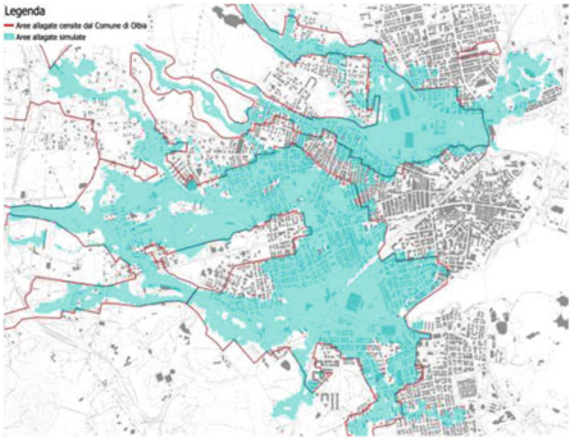
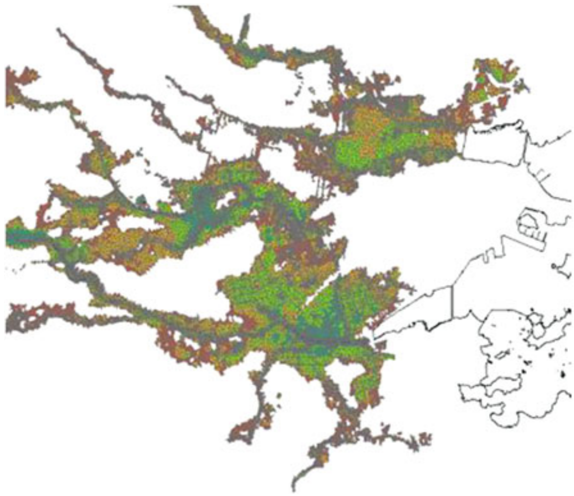


Fig. 4 Water heights



The EAD is assessed as the integral value of curves shown in Fig. 6 are reported in Table 5.

As Table 5 shows, the present value of the EAD calculated, considering an average reconstruction cost and applying a capitalization formula using an interest rate of 2.5%, is 94.733.940,91 €, almost similar to the value estimated after the census made by the municipality.

The results obtained seem to confirm the reliability of the methodology proposed.

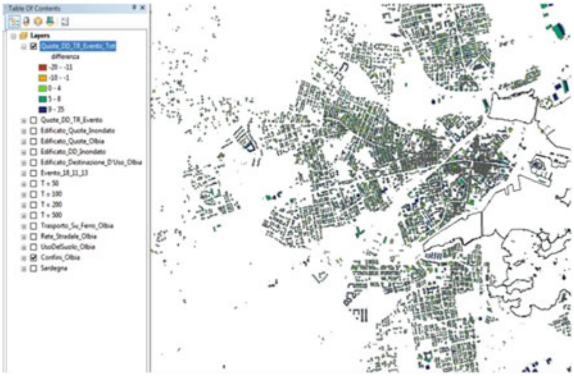


Fig. 5 Locations of residential buildings

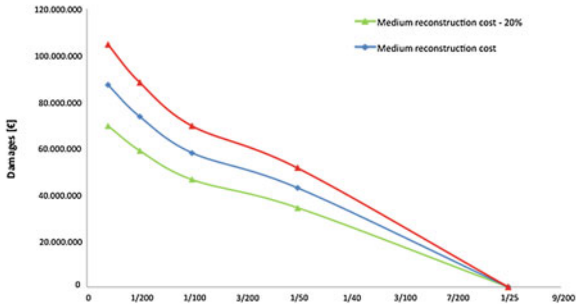


Fig. 6 Expected Annual Damage

Table 5 Expected Annual Damage

		Total damage		
	1/TR	Average reconstruction cost −20%	Average reconstruction cost	Average reconstruction cost +20%
TR 500	0.002	69.616.162,56	87.020.203,20	104.424.243,84
TR 200	0.005	58.833.161,68	73.541.452,10	88.249.742,51
TR 100	0.01	46.258.855,34	57.823.569,18	69.388.283,02
TR 50	0.02	34.196.078,91	42.745.098,64	51.294.118,37
TR 25	0.04	0.00	0.00	0.00
EAD		1.894.678,82	2.368.348,52	2.842.018,23
Present value		75.787.152,72	94.733.940,91	113.680.729,1

4 Conclusions

The paper presents an integrated methodology for the ex-ante evaluation of flood damage in urban areas. The methodology proposed is developed using a GIS toolbox and integrating various models: a simulation hydrological model to forecast the hazard, stage-damage curve to evaluate the vulnerability of the building exposed, and the depreciated reconstruction cost approach to estimate the value of the damaged assets. The results obtain by the EAD seem to reliably address the ex-post evaluation operated by the municipality. Nevertheless, many efforts seem to be necessary to extend the application of the methodology proposed to other typologies of assets, namely industrial buildings, public buildings, cultural heritage, and the environment.

Further research developments should therefore be directed in those directions in order to implement a support tool to facilitate implementation choices concerning the various different circumstances in the territory.

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A Few Considerations on the Comparison Method in Appraisal

Marta Berni

Abstract The paper has a theoretical and methodological content and is focused on the comparative method as Appraisal rational. Even though many scholars have strong prejudices against comparison as a research strategy and hold that it should be substituted by a "more scientific" statistical one, the paper holds that to increase the scientific content of appraisals does not require to change the method of inquiry but to replace the "impressionistic" comparison with "scientific" comparison. Consequently, the paper presents some relevant achievements in comparison theory and illustrates the connected concepts of similarity and classification. Finally, the paper recognizes that even though "scientific" comparisons" are methodologically feasible, at the operational level they are not yet available, this exhorts the appraisers' community to a deep and thoughtful reflection and further researches.

Keywords Methodology of appraisal · Scientific approach · Comparison · Similarity · Classification

1 Introduction

According to the Italian school, Appraisal[1] is not only or primarily a professional practice but it meanly is an autonomous scientific discipline endowed with its own distinctive method, set of principles, and its own specific areas of expertise. Of course, these distinctive elements are continuously evolving: the philosophy of science and each scientific discipline develop dealing with the real world that nowadays is more and more uncertain and complex. Therefore, language, methods,

[1]The paper strictly concerns comparison in Appraisal, whereas comparison in real estate evaluation is not faced.

M. Berni (✉)
Department of Architecture (DIDA), University of Florence,
Via S. Niccolò 93, Florence, Italy
e-mail: marta.berni@unifi.it

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and principles of Appraisal cannot be regarded as immutable and it is legitimate to rethink and update them through an in-depth critical process that may result in a partial revision or even in a complete reformulation. Simply ignore the problem can be risky because the breaking off of its historical roots can weaken the present and future developments of the discipline.

Due to the scientific evolution of Appraisal (depending on the enlargement of its areas of interest, the enrichment, and complexification of the tools, etc.) and not forgetting the theoretical and methodological foundations of the Italian school, the next paragraphs are concerned with the comparison principle as the rationale of Appraisal.

2 Appraisal as a Scientific Discipline

According to Medici (1953) Appraisal can be considered a scientific discipline as even «if appraisal has not a code of statistic laws derived from the scientific observation of facts, it *has a method which teaches the procedures to be followed* whereby to establish the equivalent monetary value of specific economic goods».

Medici (1953) underlines that «the foundation of the doctrine of appraisals is its method» and, as a consequence, «Herein resides the rational and scientific character of appraisal, vainly would one seek for it those laws which form the basis of a science similar to natural science», in other words, appraisal is a social science.

As a scientific discipline Appraisal is «devoted … in large part to the study of the methods and rules of … real estate valuation» (Medici 1953), that is in its own methodological aspects «Appraisal … has as its main object, study of the method which enables the appraiser to express judgment on the value of goods perfectly defined in their technical substance and economic aspect» (Medici 1953).

The methodology of Appraisal is the set of principles (postulates) and rules which allow a scientific assessment of complex assets (usually real estates) in a limited market. The postulates of Appraisal are those propositions not proved, but believed true according to real evidences, knowledge, experience and common sense, that are the foundations of any appraisal and that can never be contradicted (Simonotti 2006).

Following Forte (1968), such principles can be summarized in the following six simple points[2]:

1. The value depends on the purpose of the appraisal judgment;
2. The forecast is immanent in the appraisal judgment;
3. The price constitutes the foundation of every appraisal judgment;
4. The appraisal method is unique as it is exclusively based on comparison;

[2]The same postulates (with minor differences in wording and/or listing) are present in all the most relevant Appraisal handbooks, e.g.: see Medici (1953), Simonotti (2006) Polelli (2008), Michieli and Michieli (2002).

5. The appraisal judgment must be objective and generally valid and thus, must be formulated on the basis of the theory of ordinariness;

The principle of comparison as the rational of the “unique” appraisal method is the central concern of the paper.

3 Why Comparative Method in Appraisal

The comparative method is the rationale of Appraisal discipline due to three main reasons:

– The value of the good depends on the context;
– The analysis is case-oriented (casuistic nature);
– Appraisal has an interpretative approach;

About the dependence of the estimated value on the context, Forte (1968) holds that the “value” is not an intrinsic attribute of economic good, but it quantitatively depends on external circumstances and varies with the “market”, even if it differs, in the same circumstances, according to the different characteristics of the good. Such characteristics are attributes whose species are fixed but whose extent can vary.

Also Giuseppe Medici, repeatedly arguing that an appraisal judgment is always the result of a comparison exercise, states that “the prices paid depend on causes peculiar to the case in point” (Medici 1953) so that he recommends a detailed knowledge of “the basis of the physical characteristics” of the real estate, but also of “the socio-economic conditions” influencing the market prices. Medici (1972) in his book “Principi di Estimo” better develops this point recommending that Appraisal should be based on «an exhaustive inquiry into the market situation and how the market relates to the characteristics of the asset to be estimated»[3] and asks for “an in-depth report” (i.e. a thick description in terms of the comparative-qualitative approach) where «the analysis of demand and supply is highly relevant in order to identify the economic agents’ specific behavior as well as the reasons for it. In this way, the appraiser should produce a sound assessment and, at the same time, the report reader should be able to find the proper justifications of the results» (Medici 1972). As a consequence the method of appraisal can be considered a scientific one as it is transparent, communicable, controvertible, and then falsifiable.

Forte (1968) underlines also another aspect of the context-dependence of Appraisal stating that «if the value judgment should be determined by the market, the estimated value may, in turn, determine the market value itself, as we should admit not only an influence of market-prices on estimated values but also of estimated values on market-price», so that «In any judgments of value … the estimated values generally become actual market realities, often transforming the economic

[3]All the translations from Italian are by the author.

directions in economic transactions. If the expected estimated convenience [or value] is operationally confirmed this evidently means that the different evaluations contributing to the appraisal judgment coincide with the "real values"».

The "casuistic" nature of Appraisal is clearly stated by Medici (1953): «when the theoretical process is completed and the practical process begins, appraisal becomes necessarily *casuistic*. Going deeper, one could make a distinction between *appraising casuistry*, in the correct and narrow sense characterized by the study of separate and specific cases of appraisal, and a *group casuistry*, consisting of the examination of numerous cases of a similar nature—which are thus in group form —wherefrom can be deduced rules common to all cases of the kind». He also adds that the first kind, «true casuistry, studies the case and arrives at a solution passing through each phase and overcoming each difficulty, and therefore has the didactic efficacy proper to that which I would call the *operative method*. The second, group casuistry, represents the specification of a method common to groups of cases».

About the interpretative approach of Appraisal we should always remember that to make a judgment means to "interpret" data, events, phenomena, etc. because, as Medici (1953) states, «In the case of a valuation, the appraiser finds himself in a similar position to that of the doctor confronted by a clinical case. Both must express an opinion, and to this end they both make use of all the varied elements of their experience, and "accumulated experience", which is offered respectively by the doctrine of appraisal and by medical science, is of the highest importance».

It is key to note that, in facing real cases, an explanation of events—correctly based on a deep knowledge of the theory and the method of appraisal—provides the expert with a control on facts (Medici 1953, 1972): «When the appraiser has a profound knowledge of the appraisal method and an intimate understanding of its logical nature, any variation in the market or social conditions, … will not find him unprepared; in every instance he will be able to give a correct answer to the appraisal problem with which he is confronted».

Following this direction Forte (1968) holds that an appraiser should be considered someone able to "interpreter" the market, rather than simply provide—like a thermometer—measurements.

Forte and Medici are also both concerned about the drift of Appraisal towards a mathematical formalism and warn against the tendencies to reduce Appraisal merely to its financial arithmetic calculating dimension, as «the cloak of algebraic exactness veils the reality … instead of helping … to discern it» (Medici 1953).

Carlo Forte's distrust (1968) to formalistic approaches in Appraisal is evident when he asks for «a critical examination of the calculation procedures and a revision of choreographic mathematical formulas that often not properly fit in Appraisal's methodology». Sharing the same precautionary position Medici (1953) highlights the risk of the oversimplification and mechanization of Appraisal analysis as follows: «these formulistic decorations, ofttimes artificially complicated, … prevent a rapid perception of the concrete problem. Furthermore, they incline one to mechanize a problem, which, by its nature, does not have, nor should have anything mechanical or predetermined. In fact, the answer to a query depends upon a correct basis being given to the valuation problem, which finds solution in the judgment of appraisal». The problem becomes especially relevant when not-trained people are involved: «The danger of an arithmetical bias in valuation has been, and is, a serious one, particularly for young students who, unused to meditation, and lacking the maturity which is acquired by experience, seize gladly these formulas, which give them a sense of security but which bear only the fruit of delusion» (Medici 1953).

4 Comparison Method in Appraisal

As Medici (1953) stresses, notwithstanding the apparent diversity of the various methods (analytical, synthetic, comparative, etc.), the appraisal method is essentially only one, and it consists of a procedure to be necessarily followed because, being logically accurate, it is the sole rationale of any appraisal. Such a procedure establishes the comparison between the good to be assessed and other similar known-priced goods or between the project to be evaluated and other buildings or interventions, having similar characteristics and known costs, is the rationale of evaluation (Simonotti 2006).

Definitively, any appraisal judgment requires to «(1) form a scale of prices (2) select the level of the scale at which to place the object that is to be appraised» and only «As a final act, a synthesis of the entire process, the appraiser delivers his judgment on value»[4] (Medici 1953).

Within the appraisal judgment, these two coordinated phases have a different nature. The construction of the "scale of prices" is the "objective" moment of the procedure because it is the result of a statistical observation of the market prices of the similar goods (i.e. real estates). As a consequence, it is one only, even though the accuracy and completeness of the result depend on the number of analogous cases observed and their similarity. The selection of the level of the scale at which to place the object to be appraised is the "subjective" moment of the procedure, because at this moment the appraiser make a synthetic judgment comparing the technical and economic features of the good to be assessed with the ones of the goods included in the different steps (or classes, or categories) of the "scale of prices" and finally bestowing the good to the most suitable class. The result of this phase, of course, strongly depends on the appraiser's technical and economic knowledge, skills, and abilities (Medici 1953).

Clearly, from the methodological point of view, the fundamental element in this procedure is to establish the "similarities" between the object to be estimated and the other comparable one/s, that are identified taking into consideration the most relevant elements or characteristics of the object. In real estate appraisal, the

[4]In his *Principles of Appraisal* Medici (1953) provides an exhaustive presentation of the procedures to construct the price scales according to each of the five economic aspects (market value, cost value, substitution value, transformation value and complementary value) of the object to be appraised.

comparison mainly refers to technical and economic characteristics of the goods (Simonotti 2006).

5 The Need of Scientific Comparison in Appraisal

Unfortunately, we can often verify a gap between how comparison should be performed according to the theory and how it is actually performed in professional appraisals resulting in poor quality level esteems[5] due to an inaccurate methodological support. As a matter of fact, in appraisal judgments only generic and vague references to market researches—adopting wording like "according to a careful market survey" or "according to an inquiry among experts"—are mentioned and no elementary historical data are produced. As a consequence, neither the appraisal procedure nor its result meet the scientific standards of the appraisal logic.

Due to this widespread inadequate methodological support, many scholars have been persuaded to question the scientific nature of the comparative method and to adopt the statistic approach on the "naturalistic" assumption that large-scale studies are more scientifically reliable (Lor 2012).

The paper supports that to replace the comparative method with the statistical one is not a suitable solution to the need for an increase in the scientific content of Appraisal method because the choice of the method of inquiry actually is «a matter of logic (the logic of causal inquiry,[6] and empirics (the investigation of the empirical world[7])» (Seawright and Gerring 2008), it depends on the specific characteristics of the inquiry at stake and on what conditions must be accomplished in order to ensure the reliability and validity of results. As a consequence, when Appraisal is concerned with problems (as in cadastral and other similar fields) where many data are available and the main goal is to define probabilistic tendencies, the statistical method represents a suitable solution, but when Appraisal is concerned with estimating the "only-most likely" value—depending on many factors (like location, quality, technology, legal constraints, etc.)—of a "unique" real estate (as in architectural heritage field) and only a small number of empirically observed data is available, we cannot rely on the statistical method.

In this latter case, to overcome biases against approximation and subjectivity often affecting judgments of appraisal we should not give up the comparative method, but to use it appropriately as «the issues [is] in making systematic scientific as opposed to impressionistic comparisons» (Lor 2012).

This means that we must turn our attention on the logical basis of the main methods of inquiry and especially on comparison.

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[5]See, e.g. Farinelli (2016) "La razionalità della stima dei beni storico storico-architettonici: le Ville Venete" Tesi di dottorato. Scuola di Dottorato di Ricerca in Ingegneria Gestionale ed Estimo.

[6]That is, their capacity of testing rival explanations [note added by the author].

[7]That is, the difficulty in acquiring the data needed to employ the method [note added by the author].

6 Main Methods of Inquiry

Any strategy of research aims at scientific explanation. According to the Encyclopaedia Britannica, «the structure of a scientific explanation is that of a valid deductive argument whose conclusion is the event to be explained. Some of the premises of this argument will be factual statements of the antecedent circumstances, while the others will be the scientific hypotheses offered as a way of linking those circumstances to the outcome stated by the conclusion». The fundamental methods of research are the experimental, the statistical, the comparative and the case-study.

According to the experimental method, the researcher can manipulate the independent variable (the cause), and at the same time, all other variables are controlled in the laboratory (the environment in which the experiment takes place).

The experimental method has the merit of providing strong criteria for eliminating rival explanations through experimental control (Collier 1993) but—even though it is considered as the norm which other methods should try to approximate—unfortunately, it cannot be applied in social sciences because of practical (it is impossible to generate appropriate experimental data) and ethical impediments (it divorces a phenomenon from its context).

In social disciplines (Kothari 2004), that usually rely on observation rather than experimentation, the researcher has no control over any of the variables in play, and as a consequence, he/she—following the positivist (and post-positivist) or the interpretivist visions of science respectively—may adopt an extensive or an intensive approach.

In extensive research, the dominant strategy to collect empirical data is large-scale statistical surveying. In this case, the main goal is to understand and explain the phenomenon through data aggregation (by means of aggregating data) and producing information about frequency distributions and relationships.

These "variable-oriented" studies are focused on a limited number of variables which are abstracted and removed from the concrete reality and context by means of simplifying and homogenizing assumptions. As a consequence, they tend to "eliminate complexity instead of deciphering it" (Lor 2012; Ragin 1987, 2000).

The statistical method may be considered as an approximation—not the equivalent—of the experimental method. It has the essential logical functions of experiment in inquiry, but it cannot control for all variables, merely for the key variables that are known or suspected to exert influence (Lijphart 1971).

The statistical method has the merit of assessing rival explanations through the weaker but still valuable procedure of statistical control—founded on partial correlations—unfortunately, it is often not feasible to collect a sufficiently large set of reliable data to do this form of analysis (Collier 1993).

Nevertheless, in recent decades statistical methods have become prominent in social sciences as well as in Appraisal, this is probably due to the width of extensive statistical analysis that makes for a high level of external validity.

In the literature you can find at least three kinds of critiques of the use of regression analysis in social sciences, the most well-known is the methodological[8] one which relates to the so-called "small-N problem." Since in social science we normally have only a limited number of cases, the assumptions of regression analysis are very difficult to meet (Rubinson and Ragin 2007).

On the other hand, intensive comparative research considers social phenomena complex and difficult to disentangle not simply because «there are too many variables affecting them … but because different causally relevant conditions can combine in a variety of ways to produce a given outcome» (Ragin 1987).

To embrace complexity, we have to resort on the comparative "case-oriented" studies which «keep cases, not the net effects of variables, at the forefront of their analyses» as «they perceive that it is not variables but cases that have relationships with one another» (Rubinson and Ragin 2007), as a consequence they use "thick descriptions" focusing only on a handful of specific instances—studied in detail in their own specific context—and considering many separate variables (Lor 2012; Ragin 1987).

The comparative method shares the same logic of the experimental method and resembles the statistical method in all respects except for a crucial difference, that is, the number of cases it deals with is too small to permit systematic control by means of partial correlations. There is no clear dividing line between the statistical and comparative methods, the difference depends entirely on the number of cases, we should resort to the comparative method whenever the number of cases available for analysis is so small that a credible statistical control is not feasible. This, of course, does not mean that comparison may be regarded neither as "the social scientist's equivalent of the natural scientist's laboratory nor as an adequate substitute for experimentation in the natural sciences (Lijphart 1971).

Due to the lack of experimental control and the problem of many variables and small N, the comparative method, provides a weaker basis than the experimental or statistical method for evaluating hypotheses. However, given the scarcity of time, energy, and financial resources, an intensive comparative analysis of a few cases if appropriately and systematically utilized, may be more promising than a more superficial statistical analysis of many cases (Collier 1993; Lijphart 1971).

The main strength of the intensive comparative "case-oriented" studies is the depth of analysis that makes for a high level of internal validity.

7 The Comparative Method

The word "comparison" comes from the Latin word "comparare", which means "to pair, match" and in the everyday language comparison is "the act of looking at things to see how they are similar or different" (Merriam-Webster 2006).

[8]According to Rubinson and Ragin (2007), the other critiques are epistemological and theoretical.

First of all, we should clarify that in this paper the comparative method should be intended as a general research method,[9] not a narrow, specialized technique.[10]

The comparative method—also referred to as the method of "controlled comparison"—is a fundamental and powerful tool of analysis and one of the most powerful tools used in intellectual inquiry: it sharpens our power of description, and plays a central role in concept-formation by bringing into focus and emphasizing suggestive similarities and differences among cases (Collier 1993).

Comparison is aimed to verify or falsify relationships between two or more phenomena (that may be both concepts and objects) its main goals are: (1) the systematic examination of covariation among cases for the purpose of causal analysis; (2) the examination of a number of cases for the purpose of the parallel demonstration of theory (i.e., showing. that a particular model or set of concepts usefully illuminates these cases); (3) the examination of two or more cases in order to highlight how different they are, thus establishing a framework for interpreting how parallel processes of change are played out in different ways within each context (Collier 1993).

The comparative analysis is specially suitable for those disciplines that rely on observation, rather than experimentation,[11] as in this case the researcher, having no control over any of the variables in play (Peterson 2005) must pay a special attention to all the possible sorts of intended and unintended discrepancies between the cases that are being compared (Collier 1993).

In comparison, the central concern is how to address the "many variables, small N" problem.[12] According to Lijphart (1971) we can take four possible directions:

1. Increase the number of cases (geographically or longitudinally through a cross-historical extension);
2. Reduce the property space (combining two or more variables, expressing a similar characteristic, into a single variable);
3. Focus the comparative analysis on "comparable" cases (in this context comparable means "similar" in a large number of variables);
4. Focus the comparative analysis on the "key" variables (according to a general commitment to theoretical parsimony).

We will focus the attention on the third alternative because the fourth is especially relevant in scientific political comparative inquiries, but not in Appraisal

[9]Research methods may be understood as all those methods that are used for conduction of research. Research methods refer to the behavior and instruments used in performing research operations (selecting and constructing research technique).

[10]Research techniques refer to the behavior and instruments used in performing research operations such as making observations, recording data, techniques of processing data and the like.

[11]It is the case of social sciences like anthropology, sociology, education, and political sciences, but also of astronomy.

[12]The paper mainly relies on the theoretical and methodological development of the comparative method and other related concepts produced in social science and especially in political science, psychology, etc. that have been largely and deeply confronted with these problems.

where the analysis is usually restricted to the key variables, whereas the first and the second ones are not operable in Appraisal. As a matter of fact, due to the strict dependence of real estate prices to the specific market, any geographical or historical enlargement of the number of cases is not advisable.[13] Finally, also reducing the property space is inappropriate as it sacrifices a part of the available information.

A comparative analysis performed focusing on "comparable" cases renounces to enlarge the number of cases aiming to identify similar cases in which many variables are constant so that the number of operative variables can be considerably reduced allowing the analysis of their relationships under controlled conditions (Lijphart 1971).

Even if there are several kinds of comparison—e.g.: similarity,[14] analogy,[15] juxtaposition,[16] metaphor,[17] and allegory[18]—here we are interested in cases that are similar in a large number of important characteristics (variables) which the analysis considers as constants, but dissimilar in those variables that the analysis wants to relate to each other. Such "comparable" cases allow the establishment of relationships among a few variables while many other variables are controlled offering particularly good opportunities for the application of the comparative method (Lijphart 1971).

In this case we clearly refer to John Stuart Mill's (1872) methods of agreement,[19] difference,[20] and concomitant variations[21] that is considered the first systematic

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[13]As Medici (1953) states, «The prices collected should refer to a fairly uniform area as to make comparison easier and less arbitrary» and that «The prices collected should be recent ones, as their indicative value diminishes with time» and «in any case current prices … are of fundamental importance».

[14]Similarity compares two things with the conjunction "like" or "as," or "such as." It may refer both to the quality or state of being similar and a comparable aspect.

[15]Analogy infers that if two or more things agree with one another in some respects they will probably agree in others.

[16]Juxtaposition places two concepts, characters, ideas, etc., near each other so that the reader makes comparisons between them and perhaps contrasts them as well.

[17]Metaphor uses a word or phrase literally denoting one kind of object or idea in place of another to suggest a likeness or analogy between them.

[18]Allegory is an extended metaphor that represents symbolical (fictional) figures and actions of truths or generalizations about human existence.

[19]The method of agreement is regulated by the following First Canon: «If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree, is the cause (or effect) of the given phenomenon» (Mill 1872).

[20]The method of difference is regulated by the following Second Canon: «If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or an indispensable part of the cause, of the phenomenon» (Mill 1872).

[21]The method of concomitant variations is regulated by the following Fifth Canon: «Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation» (Mill 1872).

formulation of the modern comparative method as it does not merely observe the presence or absence of the operative variables, but it also observes and measures the quantitative variations of the operative variables relating them to each other (Lijphart 1971).

According to many scholars (e.g.: Gentner and Merkam 1994; Goldthorpe 1997; Lijphart 1971; Przeworski and Teune 1970, etc.) comparability is not an inherent property of any set of objects; rather it is a quality imparted to them by the observer's perspective, depending on some specific interpretation and/or the analytic concepts available.

In replaying the question: "what is comparable?" Sartori (1970) states that «If two or more items are identical, we do not have a problem of comparability. On the other hand, if two or more items have nothing, or not enough in common, we rightly say that […] cannot be compared … we obtain comparability when two or more items appear "similar enough", that is, neither identical nor utterly different». This means that we must discover deeper or fundamental similarities among the items under consideration, so the next step is to investigate the concept of similarity.

8 Similarity

Similarity may be considered as an organizing principle by which individuals classify objects, form concepts, and make generalizations, which plays a fundamental role in theories of knowledge and behavior (Tversky 1977).

There is a general consensus that similarity between two objects increases with its commonalities[22] and decreases with its differences.[23]

According to Sartori (1970) to compare requires a substantive understanding of the thing we have to compare in order to be able to distinguish between what is homogeneous—i.e., comparable—and what is heterogeneous—i.e., non-comparable depending on a taxonomical treatment, that is the belonging of things to "the same genus". Unfortunately, the taxonomical requisites of comparability are currently neglected, if not disowned (Sartori 1970).

Even if the comparison process that determines similarities phenomenologically is an intuitive, holistic and unstructured process (Sun 1995), Tversky (1977) proposes a theoretical approach to similarity based on features matching expressing the

[22]The commonalities are simply the elements of the matching representational structure (Genter and Markman 1994).

[23]The differences may be of two types: "*alignable differences*" those related to the common structure and "*non-alignable differences*" those independent of the common structure. In the similarity relationship, as well as in comparison, alignable differences are considered more important than no-nalignable differences because alignable differences are related to commonalities but non-alignable differences are not (Genter and Markman 1994).

similarity S(a, b) of the element "a" to the element "b", as a weighted difference of the measures of their common and distinctive features by the following contrast model:

$$S(a,b) = \theta f(A \cap B) - \alpha f(A - B) - \beta f(B - A)$$

where

S	is an ordinal scale of measure of similarity;
f	is a monotonic function;
a and b	are two distinct elements;
$A \cap B$	are the features common to a and b;
$A - B$	are the features that belong to a but not to b;
$B - A$	are the features that belong to b but not to a;
θ, α, β	are non-negative parameters[24] that determine the relative weights of the three components of similarity.

According to the contrast model, similarity may be defined as "an increasing function of common features, that is features in common to the two objects, and as a decreasing function of distinctive features, that is features that apply to one object but not the other" (Heit 1997).

It is key to note that the function f measures the "salience" or prominence of a particular set of features that is, the contribution of such (common or distinctive) features to the similarity between objects. According to Tversky the salience of features—and hence the similarity of objects—is influenced by two factors: intensity and diagnosticity (strictly dependent on the context). The intensity of a feature refers to its physical salience and other inherent, stable aspects. As a matter of fact, it is determined by perceptual and (relatively stable across contexts) cognitive factors. Whereas, the diagnostic factors refer to the effects on salience due to the influence of the context in grouping objects. As a consequence, diagnostic factors are highly sensitive to the particular object set under study and change with the context.[25] It is also key to note that diagnostic factors, being strictly related to the classificatory significance of features, highlight the relation between similarity and grouping (Tversky 1977).

According to Sartori (1970) «the background of comparability was established by the per genus et differentiam mode of analysis, i.e., by a taxonomical treatment». As a matter of fact, «When faced with a set of objects, people often sort them into clusters to reduce information load and facilitate further processing (Tversky 1977).

[24]For example, if $\theta = 1$, and α and β vanish, then S (a, b) = f($A \cap B$) that is, the similarity between objects is the measure of their common features. If $\alpha = \beta = 1$ and θ vanishes, $-S(a,b) = f(A - B) + f(B - A)$; then: that is, the dissimilarity between objects is the measure of the symmetric difference between the respective feature sets (Tversky 1977).

[25]On this point, we can quote Medici (1953) who says: «there is no limit to the number of groups to be classified as the factors affecting prices are extremely numerous, their importance varies widely, and the combinations to which they lend themselves are many».

Moreover, categorization facilitates a number of cognitive abilities and functions, one of the most important of which is inductive inference that is based on the human capacity to project information from one category to another, similar category[26] (Heit 1997).

In the taxonomical process «Clusters are typically selected so as to maximize the similarity of objects within a cluster and the dissimilarity of objects from different clusters» (Tversky 1977) so that «the class provides the "similarity element" of comparability» (Sartori 1970) while «the "differences" enter as the species of a genus, or the subspecies of a species—and so forth, depending on how fine the analysis needs to be» (Sartori 1970).

9 Classification

According to the logic of classification building, «Classes are required to be mutually exclusive, i.e., class concepts represent characteristics which the object under consideration must either have or lack. Two items being compared must belong first to the same class, and either have or not have an attribute; and only if they have it, the two items can be matched in terms of which has it *more* or *less*. Hence the logic of gradation belongs to the logic of classification. More precisely put, the switch from classification to gradation basically consists of replacing the signs "same-different" with the signs "same-greater-lesser," i.e., consists of introducing a quantitative differentiation within a qualitative sameness (of attributes). Clearly, then, the sign "same" established by the logic of classification is the requisite condition of introducing the signs "plus-minus"» (Sartori 1970).

We can say that a classification,[27] or better, «a taxonomic unfolding represents a requisite condition for comparability» (Sartori 1970) and that, «regardless of whether we rely on quantitative data or on more qualitative information, in any case the problem is … to construct fact-finding categories that own sufficient discriminating power»[28] (Sartori 1970), that is «the logical requirement of a classification is that its classes should be mutually exclusive and jointly exhaustive, it follows from

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[26]But, we must also take care that not all categories are created equal in inductive reasoning, not all properties are equal: some properties are more projectable, or more easily projected, than other properties, as a matter of fact, in assessing similarity people reason differently depending on their background knowledge and what property P is actually considered (see Heit 1997).

[27]It is key to note that a dynamic interplay between similarity and classification exists. According to Tversky (1977), «It is generally assumed that classifications are determined by similarities among the objects», but it is also possible to support «the converse hypothesis that the similarity of objects is modified by the manner in which they are classified».

[28]Genter and others more recently suggest that in similarity besides the commonalities only those differences related to the commonalities (i.e., the alignable differences) should be considered. The idea that alignable differences are more salient in the comparison process has one startling, counterintuitive implication according to which people should list more differences—particularly more alignable differences—for similar pairs than for dissimilar pairs (Genter and Markman 1994).

this that the taxonomical exercise supplies an orderly series of well sharpened categories, and thereby the basis for collecting adequately precise information» (Sartori 1970). The classical rule is that the smaller is the number of classes, the greater will be the variation between classes, and vice versa.

In classification, the classic problem is that of inclusion and exclusion: what goods should include in each class/category?

10 Selection and Classification of Cases

Even though the quality of comparison mainly depends on how cases are selected and classified—according to the similarity relationship—scholars and handbooks of comparative analysis as well as of Appraisal generally pay a little attention to these two fundamental processes simply relying on pragmatic reasons and/or the appraiser's technical knowledge, competences, skills, etc. (Seawright and Gerring 2008). But neglecting the question may undermine the results of the comparative analysis, so the next step is to address the questions of how to build a set of reference cases, and to identify the properties and attributes according to which it is possible to properly classify empirical events that occur in reality.

In the comparative analysis, the selection of cases is strictly related to analysis and specifically to its goal/s and, in no event it should follow the statistical sampling rules[29] (Ragin 1987; Lor 2012). In selecting cases for comparison, they should be comparable in respect of the phenomenon mainly relevant in the analysis, this means that entities considered should have both shared and non-shared attributes (Sartori 1991; Lor 2012). As «It is intuitively obvious that there is little point in comparing entities that are so different that hardly any commonality can be found … Neither would it be useful to compare entities that are so similar that little difference of interest can be found» (Lor 2012).

The adoption of the "Most Similar Method"—based on J.S. Mill's Method of Difference[30]—might be a suitable strategy in selecting cases for comparison. According to this method, we select cases that are very similar on all the measured, controlled, independent variables, except in respect of the particular independent variable/s or factor/s whose influences (being crucial for the analysis) we want to evaluate (Lor 2012; Seawright and Gerring 2008; Bentivegna 2009).

[29]The main kind of statistical sampling are:
· convenience sampling;
· random sampling;
· probabilistic sampling;
· judgmental or purposive sampling;
· etc.

[30]The Mill's method of difference (Mill 1872) has been developed by Przeworski and Tuene (1970) as the method of "most similar systems," and by Lijphart (1971) as the "Comparative Method".

Within each category or classes «Most similar case selection proceeds by (1) defining the relevant universe of cases, (2) identifying key variables of interest that should be similar across the target cases, (3) identifying a variable or variables that should vary meaningfully across the target cases, and (4) selecting the … cases … that have the specified similarities and differences» (Nielsen 2014). So that, if our case is similar to all the other selected cases across all background conditions that might be relevant to the outcome of interest, and if the cases differ, however, on one dimension X_1 and on the outcome, Y, it may be presumed from this pattern of covariation across cases that the presence or absence of X_1 is what causes variation on Y. Unfortunately very often this procedure is not operatively applicable due to the following reasons: the continuity of variables; the impossibility to find cases with precisely the same score on all the scalar dimensions; the larger the number of matching variables employed, the lower the likelihood of finding exact matches (Seawright and Gerring 2008). As a consequence, «if a researcher is to select cases that are really similar, however that similarity is defined, the number of appropriate cases is likely to become limited» (Collier 1993). And indeed Simonotti (2006) states that, in most practical cases of Appraisal, the sample (i.e. the whole set of buildings forming the scale of prices) is: (1) multiple because it should consider the many characteristics of the buildings (related to their intrinsic and extrinsic conditions, qualitative and quantitative modalities and prices); (2) very small because the number of "similar buildings" exchanged on the market is very limited.

Simonotti (2006) proposes a so-called *allegorical*[31] classification which encompasses equal buildings at an end, and dissimilar buildings at the opposite end, while the intermediate categories include buildings having different degrees of similarity (without the possibility to define any clear line of demarcation among them):

- equal real estates have the same characteristics and the same modality for each characteristic;
- similar real estates have the same characteristics and a different modality for at least one characteristic (e.g.: different apartments in an apartment block);
- intermediate real estates, placed between the former and the following category, may have both common and different characteristics, but should have a different modality for more than one common characteristic (e.g.: apartments vs. single-family houses);
- dissimilar properties have different characteristics except a common one (e.g.: a building and a building area).

Simonotti (2006) also suggests that, according to the purposes of comparison as well as in order to mirror the reality and increase the likelihood of the estimate, the appraiser should use samplers including the greatest possible number of buildings

[31]Allegoric relationship mainly refers to "relational" commonalities as Gentner and Markman (1997) affirm: «In a fundamental sense, similarity is like analogy … The difference between them is that in analogy, only relational predicates are shared, whereas in literal similarity, both relational predicates and object attributes are shared».

similar to the one at stake. In any case, among the selected cases should be listed, in addition to the benchmark property, at least another real estate that may be:

- equal, in this case, no comparison is possible as we do not have a similarity but rather an identity relationship and, as a consequence, the appraisal becomes a tautology;
- similar, intermediate and dissimilar, in this case, the comparison is always possible since there is at least a common feature or a standard of comparison;
- dissimilar, in this case, the comparison is impossible since there is no standard of comparison.

As Simonotti (2006) himself notes, also following his rules, the selection and classification of cases still remains highly vague and indeterminate. Several solutions to the problem are available, we will present just two relevant ones. The first solution recalls the Tversky (1977) contrast model, whereas the second solution is inspired by Lin's (1998) "theorem of similarity".

As previously addressed in paragraph 8 on similarity, according to the contrast model, the similarity between two elements a and b is an increasing function of commonalities and a decreasing function of differences that may be expressed and measured by the following formula:

$$\mathrm{S(a,b)} = \theta \mathrm{f(A \cap B)} - \alpha \mathrm{f(A - B)} - \beta \mathrm{f(B - A)}$$

Lin's "Theorem of Similarity" is based on the following three basic intuitions:

- The similarity between a and b is related to their commonality. The more commonality they share, the more similar they are;
- The similarity between a and b is related to the differences between them. The more differences they have, the less similar they are;
- The maximum similarity between a and b is reached when a and b are identical, no matter how much commonality they share;

and states that: «the similarity between a and b is measured by the ratio between the amount of information needed to state the commonality of a and b and the information needed to fully describe what a and b are» and may be measured by the following function (Lin 1998):

$$\mathrm{sim(a,b)} = \frac{\mathrm{I(common(a,b))}}{\mathrm{I(description(a,b))}} = \frac{\log \mathrm{P(common(a,b))}}{\log \mathrm{P(description(a,b))}}$$

where

a and b	are two elements;
common(a, b)	is a proposition that states the commonality between a and b;
I	is the amount of information contained in a proposition;
I(common(a, b))	is the proposition that states the commonality between a and b;
I(description(a, b))	is the proposition that describes what a and b are.

In addition, we should note that, according to the information theory, the information contained in a statement is measured by the negative logarithm of the probability of the statement.

Summarizing, we can say that, in spite of many positivistic-quantitative prejudices, comparison—properly used and applied—is a method of research having the same scientific status of the experimental and statistical ones. Moreover, it is especially suitable for those disciplines that usually rely on observation, like Appraisal, when the problem at stake is not to understand and explain the phenomenon through data aggregation and producing information about frequency distributions and relationships, but rather to highlight similarities and differences to analyze the causal covariation among cases.

According to the literature, it is possible to increase the scientific content of comparison through a careful definition and measurement of the similarity concept. Many scholars have been engaged in producing similarity functions and two interesting examples are reported above. But even though both these two similarity functions provide the researcher with a satisfying solution for comparing and classifying cases, such solutions are unfortunately merely theoretical and not yet operational ones. As a matter of fact to make them operative the experts should determine: in the case of Tversky's contrast model, the θ, α, and β parameters representing the relative weights of the three components of similarity included in the function; and in the case of Lin's theorem of similarity, a suitable way to quantify the amounts of information required, that is: I(common(a, b)) and I(description(a, b)).

Both tasks are not trivial and go beyond the limits of this paper deserving a great careful attention. As a matter of fact, a further step toward an increase of the scientific quality of the comparative research in Appraisal is required. This means that—to bridge these theoretical-methodological and practical-operational issues within a common vision—a deep and thoughtful reconsideration process should be advisable. But such a task necessarily is the responsibility of appraisers' epistemic community, and it certainly cannot be delegated to the so called "unconscious thinkers" (Sartori 1970) operating both in the research as well as in the professionals field.

11 Conclusions

The paper has been focused on the comparison method firstly addressing the reason why it should be considered the rationale of Appraisal as a scientific discipline and in what it consists highlighting its two fundamental phases and their different nature. Subsequently, the paper has addressed the need for an increase of the scientific content of comparison in Appraisal questioning the thesis that it should simply be substituted by the statistical method.

As the choice of the method of inquiry actually is a matter of logic, the paper has provided a short overview of the main research strategies (experiment, statistic, and comparison) delineating the respective application fields depending on the specific characteristics of the inquiry at stake and on what conditions must be accomplished in order to ensure the reliability and validity of results.

As not always in Appraisal the assumptions of the statistical regression are met, due to the “many variables, small N” problem, the paper has been focused on the comparative method which is especially suitable whenever we have only a limited number of observed cases. The paper has also considered the concepts of similarity (focusing on how it can be measured) and categorization as they strongly influence the selection and classification of cases and, more importantly, they condition the scientific quality of the comparison process.

Subsequently, the paper has considered a recent method of case selection and categorization (allegorical classification by Simonotti) suggesting how the methodological developments of the comparative theory should help in reducing its vagueness and indetermination using two possible measures of similarity.

Finally, the paper complains that the theoretical and methodological progress in comparative analysis are not yet matched by operative-practical solutions and exhorts the appraisers’ epistemic community for starting a deep and thoughtful reflection on this question.

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Forms and Functions of the Real Estate Market of Palermo (Italy). Science and Knowledge in the Cluster Analysis Approach

Grazia Napoli, Salvatore Giuffrida and Alberto Valenti

Abstract The analysis of the housing market of a city requires suitable approaches and tools, such as data mining models, to represent its complexity which derives on many elements, e.g. the type of capital asset-house is a common good and an investment good as well, the heterogeneity of the urban areas—each of them has own historical and representative values and different urban functions—and the variability of building quality. The housing market of the most densely populated area of Palermo (Italy), corresponding to ten districts, is analyzed to verify the degree of its inner homogeneity and the relations between the quality of the characteristics and the price of the properties. Five hundred sets of housing data have been collected and elaborated by cluster analysis with the aim of describing the structure of the housing market in each district and developing operational tools for the implementation of urban policies and public-private investments.

Keywords Housing market · Data mining · Cluster analysis · *K-means* method

1 Introduction

This paper constitutes a part of a larger research on the urban real-estate market concerned with the analysis of its general structure and the monitoring of its evolution during the last few years, when the economic and property crisis, along with the change in the fiscal system, have deeply impacted on the readiness to invest, the

G. Napoli (✉)
Department of Architecture, University of Palermo, Palermo, Italy
e-mail: grazia.napoli@unipa.it

S. Giuffrida
Department of Civil Engineering and Architecture, University of Catania, Catania, Italy
e-mail: sgiuffrida@dica.unict.it

A. Valenti
Professional, Palermo, Italy
e-mail: albvlnt79@gmail.com

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competition between different types of assets, and the very idea of urban real-estate capital as well (Breuer and Nadler 2012; Gabrielli et al. 2015; Giuffrida et al. 2015). The analysis applied to the housing market in Palermo (Italy) can provide an informative base for the public investment decision processes, and the implementation of planning policy and public/private negotiations, especially in a period in which the map of the urban values is going to be reconfigured because of significant modifications of the public transport system (streetcars and subway).

Assuming the district as the minimum spatial unit, five hundreds sets of data of houses were collected in ten urban districts corresponding to a wide, densely populated, and complex area of the city. With the aim of managing and organizing the collected data, the study applies the cluster analysis approach to provide different hypotheses of articulation of the real estate market into submarkets expressing the characteristics of the properties. In such a way, the study intends to express the fluid and mutable relationship that relates the objects (the properties having their own characteristics) to the hypothetical model that is meant to represent them. The concept of homogeneity is mostly related to the topographical demarcation of the district and the peculiar characteristics of the properties that are afferent to the same submarket. This study has continued to review this concept as necessary to be employed as a unique interpretative scheme for a systematic reading of the real estate phenomenon, by the means of data-mining models or big-data management (Case et al. 2004; Fik et al. 2003).

The cluster techniques, developed in other scientific sectors, have been effectively used for the implementation of the mass appraisal in the fiscal equalization (Nesticò et al. 2014) and the fair-land planning (Giuffrida et al. 2014), where the direct or "phenomenological" approach (which is generally applied for a case-by-case valuation) must be modified to represent the structural tendencies of the market and how the real estate values react to specific or areal transformations within the city (Chan et al. 2012; Gabrielli 2013; Hepşen and Vatansever 2012).

The study also provides the occasion for a few methodological remarks on the representation of the real estate market, at the property and urban level as well. It also shows some of the major difficulties in the development of a standardized informational support that makes possible systematic analysis of the observations and the comparisons between different urban districts.

2 The Real-Estate Market Survey

This study analyzes the area of Palermo corresponding to ten districts having varied historical, representative, and functional qualities because of the time of their establishment and the most recent urban transformations. The boundaries of the area are the Mediterranean coast on the East, Regione Siciliana Street on the South and West, and Mount Pellegrino on the North. This area covers about 48 km^2 (30% of the municipal land) where 55% of the population is located (about 370,000 people). The districts are the followings: Q1 Settecannoli-Brancaccio is a working-class suburb; Q2 Oreto-Stazione, Q5 Montegrappa-S. Rosalia, Q6 Cuba-Calatafimi, Q7 Zisa-Noce, and Q10 Malaspina-Palagonia are low and medium income districts located near the city center; Q3 Tribunali-Castellamare is a part of the historic center where there is a mix of social classes; Q8 Politeama, and Q9 Libertà constitute the city "center", that was built between the end of the 19th and the beginning of the 20th century, where high-income households live; and Q11 Resuttana-S. Lorenzo is a middle-class suburb (Fig. 1).

The market survey collected 500 residential properties for sale located in the abovementioned districts in 2014 (Fig. 1). The data sample describes the houses by four types of characteristics (k_e *location,* k_i *intrinsic,* k_t *technological,* and k_a *architectural*) (Forte 1968) that are organized in 28 quantitative and qualitative attributes as shown in Table 1. The data sample also contains the asking prices, and the prices per square meters, as well as per room. Each attribute is expresses in a standard scale (from 1 to 5) so that the scores are aggregated at the characteristic level and, afterward, the overall quality k^* is achieved by calculating the weighted average score of each house.

Due to the generalized inconsistency of the coefficients of the four regressors calculated by the multiple linear regression for each district, the weights for the score aggregation have been calculated on the basis of the mean of the most significant coefficients in each district, having excluded the negative or the highest ones. Moreover, the weights λ_j of each district have been iteratively varied within the ranges shown below to obtain the maximum value of R^2. Assuming $\sum_j \lambda_j = 1; j = e, i, t, a$, the ranges are: $0,10 \leq \lambda_e \leq 0,30$; $0,10 \leq \lambda_i \leq 0,30$; $0,30 \leq \lambda_t \leq 0,50$; $0,10 \leq \lambda_a \leq 0,30$.

A sample of the database for the Q3 district is shown in Table 2.

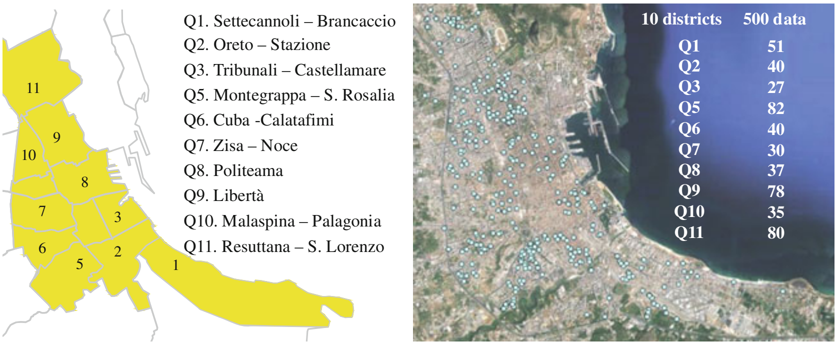

Fig. 1 Localization of the real estate data in the analyzed districts in Palermo

Table 1 Characteristics and attributes of the houses

Characteristics		Attributes
k_e Location	Urban contest	k_{e1} Centrality k_{e2} Functional complexity k_{e3} Social complexity k_{e4} Facilities k_{e5} External accessibility with public transport k_{e6} External accessibility with private transport k_{e7} Internal accessibility
	Micro-context	k_{e8} Functionality k_{e9} Symbolic value k_{e10} Compositional quality k_{e11} Social mixitè
k_i Intrinsic		k_{i1} Adjacency k_{i2} Panorama k_{i3} Brightness k_{i4} Exposure k_{i5} Security
k_t Technological		k_{t1} Age k_{t2} Building maintenance status k_{t3} Building structure k_{t4} Building finishes k_{t5} Property maintenance
k_a Architectural	Building	k_{a1} Architectural type k_{a2} Super elevations k_{a3} Unit size k_{a4} Terraces
	Property	k_{a5} Dimensions and functional layout k_{a6} Accessories k_{a7} Property finishes

Table 2 Database for the Q3 district

Id	Address	Rooms	m^2	ke	ki	kt	ka	k*	€/rooms	€/m^2
92	Piazza Aragona	5.25	150	2.0	2.4	1.8	0.5	1.7	34,286	1200
93	P.tta Ch. Cocchieri	3.75	70	2.0	3.0	0.5	0.4	1.3	23,733	1271
94	Via Parlamento	4.75	110	2.0	3.0	2.5	0.5	2.1	25,263	1093
95	Discesa dei Giudici	7.25	157	2.0	2.4	0.5	0.6	1.2	31,034	1436
96	Via Giardinaccio	2.75	54	1.9	1.6	4.3	0.7	2.6	50,909	2593
97	Via dei Cassari	4.75	110	2.0	2.8	3.1	0.5	2.3	33,684	1461
98	Via Immacolatella	4.75	89	1.9	1.6	1.2	0.4	1.2	16,421	874
99	Via N. Cervello	3.75	86	1.9	1.0	2.5	0.6	1.7	23,733	1035
100	Via Vetriera	3.75	78	1.9	3.0	3.8	0.6	2.6	48,000	2300
101	P.tta S. Sofia	2.25	60	1.9	4.4	3.4	0.7	2.7	51,111	1931
102	Via S. Sebastiano	4.75	84	2.0	3.8	2.1	0.4	2.1	31,579	1777
103	P.tta Ch. Cocchieri	5.75	102	2.0	3.0	1.9	0.4	1.8	26,087	1467

(continued)

Table 2 (continued)

Id	Address	Rooms	m^2	ke	ki	kt	ka	k*	€/rooms	€/m^2
104	Via V. Emanuele	2.25	50	2.2	2.2	4.2	0.7	2.7	73,333	3325
105	Spasimo	2.75	62	2.0	2.2	3.2	0.5	2.2	21,818	969
106	Discesa dei Giudici	7.25	235	2.0	5.0	1.8	0.7	2.2	31,034	958
107	Paternostro	1.75	46	2.0	3.0	1.4	0.7	1.7	34,286	1310
108	Guascone	5.5	146	1.9	3.6	1.2	0.5	1.7	14,545	548
109	Via T. Mosche	3	75	1.9	1.0	4.1	0.7	2.4	29,667	1183
110	Via dei Frangiai	2.75	75	1.9	5.0	3.2	0.7	2.8	30,909	1137
111	Via della Vetriera	2.25	51	1.9	3.0	4.2	0.7	2.8	53,333	2365
112	Piazza Marina	6.25	153	2.2	5.0	1.1	0.4	2.0	44,800	1827
113	Via Credenzieri	3	117	2.0	2.2	3.8	0.7	2.5	70,000	1803
114	Via Garibaldi	4.25	88	2.0	2.4	1.2	0.5	1.5	20,000	966
115	Piazza Aragona	3.25	125	2.0	3.6	1.8	0.5	1.9	46,154	1202
116	Via Napoli	6	172	2.0	3.6	3.9	0.5	2.8	39,167	1364
117	Via Bara Olivella	3.25	103	2.0	4.4	3.0	0.5	2.6	50,769	1603
118	Piazza Marina	6.5	135	2.2	3.4	1.6	0.6	1.9	68,462	3296

3 Clustering Methodology

Especially when the real estate is widely heterogeneous, data-mining procedures may be applied to achieve a consistent articulation of the real estate market in submarkets that represent the similarities between objects described by a standardized set of shared characteristics. The cluster approach can be classified into these types: hierarchical, non-hierarchical (partitions), grid-based, and model-based.

The *k-mean* algorithm, which belongs to a non-hierarchical method (Jardine and Sibson 1968), has been applied to the dataset formerly described. The output of this algorithm is the optimal partition of elements that maximizes a certain objective function, and it is based on the assumption of distributing the elements of a sample over a predetermined number of groups (King 2014; Everitt et al. 2011; Kaufman and Rousseeuw 1990). The number of possible partitions p $\left(p = 2^{(n-1)} - 1\right)$ can be reduced through the initial choice of the number of groups of the partition and, consequently, the optimal partition can be constructed among those partitions having the chosen number of groups, using a criterion depending on the algorithm applied.

The *k-means* algorithm forms k groups using certain values as initial centroids and placing the elements into groups on the basis of the maximum proximity to the centroids (proximity is measured using the Euclidean metric). Once the first partition has been computed, the new centers are recalculated; the previous routine is modified in the subsequent routine, until convergence is obtained (the condition is that each element is assigned to the same group as in the previous partition). When

Table 3 Steps of the *k-means* algorithm

Steps		Description
0	Initialization	k "temporary centroids" are chosen (the choice is random or guided by an empirical criterion)
1	Partition and determination of the new centers	Each element n is assigned to the center that minimizes its Euclidean distance from it, and k groups of elements are obtained. After each assignment of n new element to a group, the centroid of the group is calculated
2	Identification of the new partition	The process of allocating elements to groups on the basis of minimum distance from the centers is repeated
3	Verification of the partition	If the partition constructed in Step 1 is the first partition or if it is not equal to the previous partition, return to Step 1, otherwise proceed to Step 4
4	Stop the procedure	The optimal partition has been obtained

this condition has been verified, the optimal partition will have been thus obtained (Steinley 2003, 2006) (Table 3).

Some problematic aspects of the iterative *k-means* procedure mainly regard the choice of both the initial centroids and the number of groups G. The choice of the initial centroids is the starting point from which the search for the final partition begins. If there are no specific indications regarding them, an internal algorithm of the software (IBM SPSS) will elect the centroids between the elements of the sample, so that they are well spaced. Alternatively, the analysis can be performed many times, and the final partition will be the one that is more consistent in respect to the information in the dataset resulting from cognitive domains. Regarding the number of groups g, if it is not available a priori on the basis of the dataset, then the procedure can be applied several times by varying g $(g = 2, 3, \ldots)$ and choosing the value of g according to the *CH Calinski-Harabasz index* (Milligan and Cooper 1985; Yanchi et al. 2010). The *CH index* is calculated in the following way:

$$CH(g) = \frac{B(g)/(g-1)}{W(g)/(n-g)} \quad B(g) = \sum_{i=1}^{g} d(\bar{x}_i, \bar{x}); \quad W(g) = \sum_{i=1}^{g} \sum_{j:x_j \in C_i} d\left(x_j, \bar{x}_i\right) \quad (1)$$

where: B is the external deviance (between the groups); W is the internal deviance (within the group); g is the number of groups; $\bar{x}_i$ is the mean value of the observations belonging to the i-th cluster C_i; $\bar{x}$ is the is mean value of the entire sample; x_j is the j-th observation; d is the Euclidean metric; and n is the number of observations. Obviously, the more this index increases, the more the validity of the partition improves, since it represents the ratio between the external variance and the internal variance of the partition.

4 Application of Cluster Analysis

The cluster analysis (*k-mean* algorithm) is applied to the data sample by deciding in advance that the numbers of the clusters are equal to 3, 4 and 5—because of the limited variability of the overall quality in each district—and leaving the software to make the choice of the initial centroids.

Figure 2 shows the resulting values of the *CH index* and the number of clusters (best partitions) for which the *CH index* is maximized for each district:

- 3 clusters for the Q2, Q3, Q5, Q8, and Q9 districts;
- 4 clusters for the Q7 district;
- 5 clusters for the Q1, Q6, Q10, and Q11 districts.

In general terms, the resulting clusters are sufficiently representative of the local housing market: the suburbs, such as Q1 and Q11 districts, have a high degree of inner heterogeneity caused by various land uses (residential, industrial, and a shopping center) and by various states of maintenance of the buildings, and this complexity can be better expressed through numerous groups of properties—in this case, 5 clusters. —The central districts, such as Q3, Q8, and Q9, are instead quite homogeneous because they originate from the same period of the urban fabric and the analogous typologies of buildings, and they may be described through 3 clusters only.

However, by observing the relations between overall quality and prices in the scatter graphs (Fig. 2), we note that significant differences between the districts having the same number of clusters may occur. By comparing the Q1 and Q11 districts, for example, it can be noted that the price elasticity with respect to the overall quality is very low in the first district, whereas it is high in the second one. The low price elasticity may be explained through the fact that Q1 is a working class suburb where the lack of public facilities stops any price increase, even if the intrinsic and technological characteristics have good quality. Otherwise, by comparing the districts with three clusters, the data points in the Q2 and Q8 districts are quite close to the trend line, whereas, in the Q9 district, the data points are much more spread, so that the market prices differ greatly in correspondence to the same overall quality.

If the partition of the Q1 district (5 clusters) and the data set of the properties involved are examined with a greater detail (Fig. 3), it has been found that:

- the clusters 1 and 2 represent two groups of similar properties as all of them have the same value of k_e and k_a, whereas the first group has k_t higher and k_i lower than the second group's corresponding k (and vice versa);
- the clusters 3 and 5 are also comparable except for the k_i;
- the properties in the cluster 4 have the lowest prices and the worst characteristics of the district.

In the partition of the Q8 district into 3 clusters (Fig. 4; Table 4):

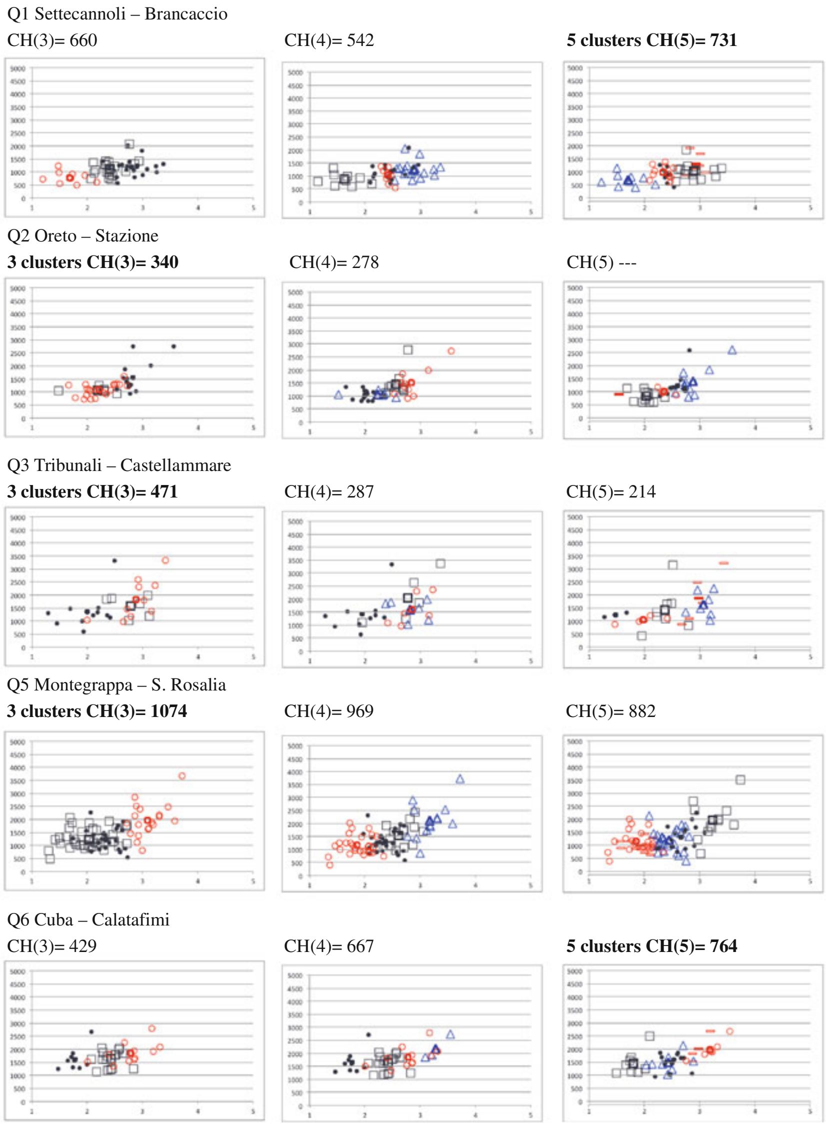

Fig. 2 Values of the *CH* index per district and relations between overall quality *k** (*x*-axis) and price €/m^2 (*y*-axis) of the houses

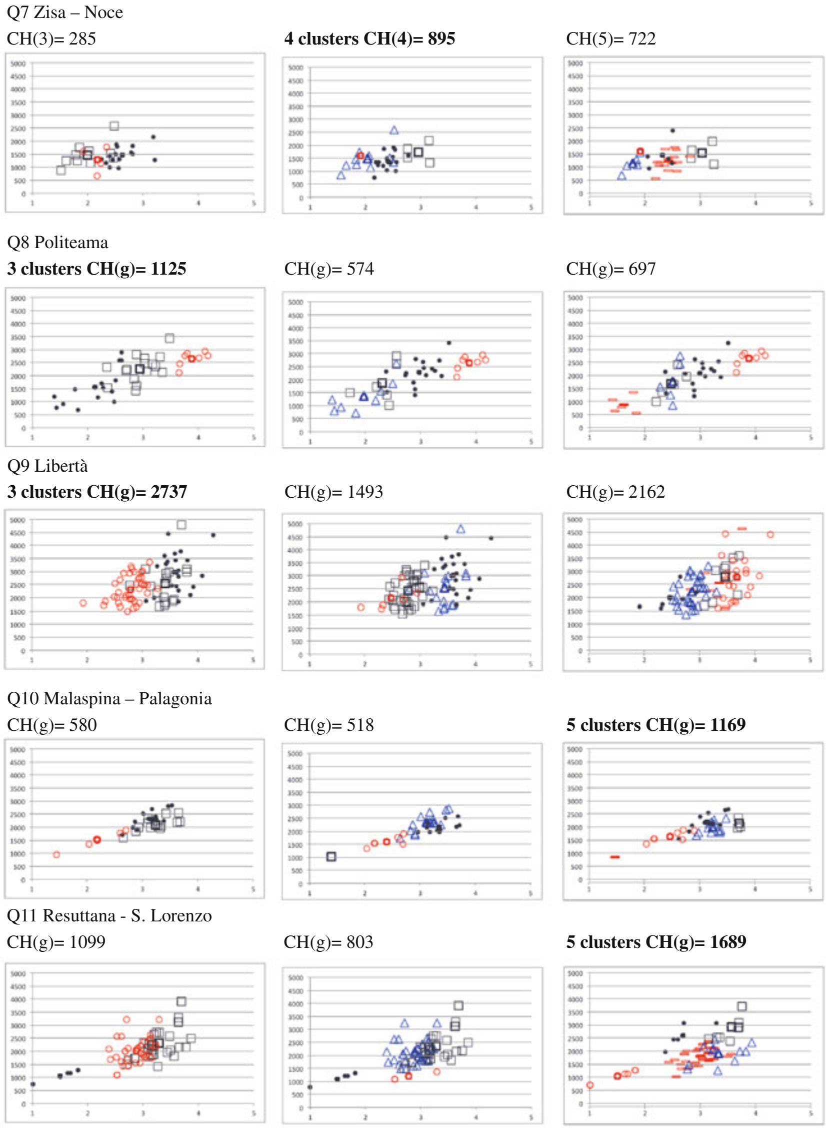

Fig. 2 (continued)

- the cluster 1 is very homogeneous, in fact the characteristics of all properties have the highest quality and the correspondent prices are higher than the mean price;
- in the cluster 2, the properties may have a low score for each k and especially k_e is very low because of their location in the blighted area of Borgo Vecchio, or they may have a high value of the location k_e and a low value of the others k,

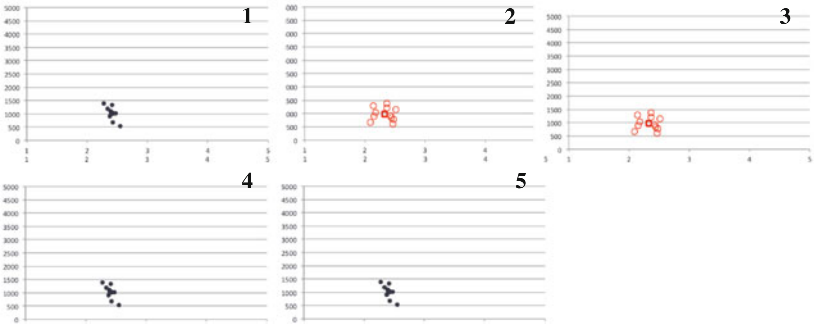

Fig. 3 The partition in the Q1 district

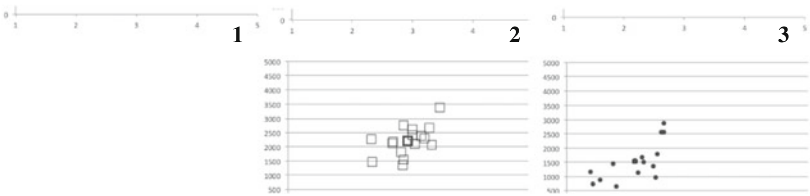

Fig. 4 The partition in the Q8 district

Table 4 Statistical results in the Q8 district

		Overall district Q8	Clusters		
			1	2	3
ke	Mean	2.95	3.87	2.69	2.78
	Deviation (from mean of sample)		0.92	−0.26	−0.17
	Deviation (%)		31	−9	−6
	Standard deviation	1.07	0.51	1.15	1.01
	Standard deviation (%)	36	13	43	37
ki	Mean	3.26	4.57	2.04	3.76
	Deviation (from mean of sample)		1.31	−1.22	0.50
	Deviation (%)		44	−37	15
	Standard deviation	1.17	0.57	0.63	0.57
	Standard deviation (%)	36	12	31	15
kt	Mean	2.81	4.06	1.96	3.02
	Deviation (from mean of sample)		1.25	−0.86	0.20
	Deviation (%)		42	−30	7
	Standard deviation	0.93	0.37	0.63	0.48
	Standard deviation (%)	33	9	32	16

(continued)

Table 4 (continued)

		Overall district Q8	Clusters		
			1	2	3
ka	Mean	2.31	2.84	2.02	2.34
	Deviation (from mean of sample)		0.53	−0.29	0.02
	Deviation (%)		18	−13	1
	Standard deviation	0.42	0.37	0.31	0.26
	Standard deviation (%)	18	13	15	11
Price per m^2	Mean	2,034	2,648	1,520	2,215
	Deviation (from mean of sample)		615	−514	181
	Deviation (%)		30	−25	9
	Standard deviation	706	285	709	521
	Standard deviation (%)	35	11	47	24

and, in this latter case, the prices rise because the market recognizes the location to produce a marginal price higher than the ones of the others features;

- the cluster 3 includes the properties with intermediate characteristics.

5 Conclusions

The results of the cluster analysis revealed that the housing market in each district has its own degree of complexity and peculiar relations between the market prices and the clusters representing the housing characteristics. The best number of clusters, chosen on the basis of *Calinski-Harabasz index*, expressed the inner variable heterogeneity of each district and represented the urban complexity.

The relationships between asking price and characteristics can significantly vary within the same cluster even when the characteristic quality is almost equivalent, and this fact is indicative of the typical information asymmetry and opacity of the real estate market and, moreover, of the current uncertainty and instability of the social and economic system, so that the owners of the real estate capitals express dissimilar expectations of the capital gains or losses (plus-minus valorization), translating them into different bid prices (Rizzo 1999).

Cluster analysis may be a useful tool to manage and analyze big data for describing, even in not exhaustive way, the structure of the real estate market, because this approach can select homogeneous groups of properties, reduce the degree of intrinsic complexity of the urban property data, and build a knowledge system to support the implementation of urban policy.

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Gaps and Overlaps of Urban Housing Sub-market: Hard Clustering and Fuzzy Clustering Approaches

Laura Gabrielli, Salvatore Giuffrida and Maria Rosa Trovato

Abstract It has long been argued that the housing market is spatially subdivided within an urban area. The argument has important implications for explaining how the housing market works and describing the distinctiveness of each housing submarkets, having determined, a priori, its segmentation. The most commonly used method for identifying housing submarkets is based on cluster analysis, although hedonic analysis has been extensively used. The hedonic analysis is used to derive dimensionality of the housing market by estimating what attributes are significant factors influencing housing price. Those attributes or variables can then be used for cluster analysis. The paper proposes an analysis of the real estate market in San Cristoforo, Catania, trying to integrate two different clustering analysis approaches to defining its possible submarkets articulation. The first one is a hard clustering approach using the K-means method and hypothesizing different numbers of clusters. The second one can be considered a verification of the previous results: a fuzzy algorithm is applied to obtain the fuzzy set membership degree of each data point to housing submarkets defined within the examined urban area. The comparison between the results coming from the two different approaches suggests some reflections about the use of these powerful techniques for integrating the knowledge of the complex and multi-layered real estate markets in the urban recovery policies.

Keywords Real estate market analysis · Market segmentation · Urban renewal · Fuzzy clustering · Cluster analysis · Knowledge discovery

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L. Gabrielli (✉)
Department of Architecture, University of Ferrara, Ferrara, Italy
e-mail: laura.gabrielli@unife.it

S. Giuffrida · M.R. Trovato
Department of Civil Engineering and Architecture,
University of Catania, Catania, Italy
e-mail: sgiuffrida@dica.unict.it

M.R. Trovato
e-mail: mrtrovato@dica.unict.it

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1 Introduction

Nowadays, many factors affect the accuracy, completeness, and reliability of the appraisals in complex urban contexts getting through transformation processes, arising generalized expectation about the increase in housing prices. Some of these factors can be considered the typical effect of the financial crisis—due to the credit crunch—and of the consequent economic crisis. The former is responsible for the reduction of loans granted to householders; the latter caused the decline of the employment opportunities, of mobility, of the demand for rental houses, of the tenants' solvency—both in residential and in the directional segments due, in particular, to the suspension of numerous professional businesses.

The general uncertainty in the real economy arises monetary hoarding; similarly, the uncertainty of the real estate investment success increases the property hoarding propensity and the related "housing market viscosity".

Thus, the fall in housing prices has not been the only relevant consequence of this crisis, whose most negative effect has been the paralysis of the transactions: owners do not sell and potential purchasers cannot buy. In such a situation: the natural or physiological transactions (such as sales for the current purchase) become very difficult and result in losses; conversely, the artificial or pathological transactions (such as purchases for the future sale) become easier and give rise to probable capital gains.

In the event of significant market increasing inactivity, prices do not reflect values: prices are reduced to mere conjuncture facts whose relevance only concerns single transactions and involves individual action and point of view. Values, instead, are structural phenomena regarding the urban policies in the perspective of the balance of the conditions of the different districts in a complex and heterogeneous city. Thus, prices reflect the positive perspective, which is "how things are" while values reflect the normative one, which is "how things should be".

The second group of issues affecting the values in complex urban contexts are: the weak relationship between characteristics of properties and prices; the difficulty of aggregating many features in just a few significant attributes; the possibility to describe systems of very different individual preferences with a single pattern; the correspondence between the internal consistence of the clustering pattern and the external correspondence with prices; the significance of the asking prices; the prospect of using the values (here meant as attributes) as an effective basis for the regulation of prices in the two cases of local and global taxation.

Finally, the convergence of the effects of the economic crisis and the urban context complexity highlights one of the major issues of the debate in the valuation discipline: the basic distinction between value and price, including on real estate market. In such a doubly uncertain situation, in fact, the conjuncture prices do not reproduce the value they represent for contractors: owners, who can delay the sale, value their assets more than the market prices; potential buyers, who can delay the purchase, wait for further declines in prices and a general improvement in the economic and urban outlook.

This situation encourages, in housing market appraisals, the segmentation techniques to apply a regulatory approach based on the analysis of the values and verified by the experience of the prices. As a result, we can assume: prices as the asking price observed in the housing market analysis; value as: a) the set of attributes associated with each property; the fair value (or monetary measure) of each property based on the attributes: in such perspective, prices become the weaker foundation than the value one in a typical valuation pattern.

Therefore, a global analysis of the urban real estate market is not possible unless the segments expressing significantly the characteristics of the properties in their specific contexts are indicated and individuated. The proposed study deals with the analysis of the real estate market in the quarter of San Cristoforo in Catania, trying to integrate different approaches defining a possible articulation in the submarkets (Bourassa et al. 2003).

The first approach takes into account the sample as a whole and tries to describe a first approximation relation between asking price and the aggregate quality index, an overall score aggregating the 28 main characteristics describing each property. This analysis represents the complexity of this housing market by a sort of clustering "by nature", namely without taking into account the scores. It provides an initial hypothesis of classification of the cases and delimitation of the segments, taking into account the ranges of prices registered in the different classes of the characteristics.

The second approach consists of an in-depth analysis basing on three different clustering hypotheses, from three to four or five clusters. In this case, according to the basic principles of the proposed technique, each element only belongs to a cluster.

A different perspective has been assumed in the third approach based on a fuzzy clustering pattern aimed at identifying the natural overlaps of the different clusters and any possible gap, in the case in which some properties cannot be included in any cluster due to its extreme inconsistency with the sample.

2 San Cristoforo Neighbourhood in Catania and the Real Estate Market Survey

San Cristoforo is part of the "Centro" Municipality (the first of the ten municipalities of the "Comune" of Catania consists of), comprising the quarters of Antico Corso, San Berillo, Civita, and Fortino. It constitutes an urban sub-system characterised by a significant functional, typological and social articulation that permeates its real estate assets.

The quarter is delimited by SS. Maria Assunta Street—Concordia Street axis on the South, Plebiscito arch on the North, the harbour area on the East and Acquicella Street on the West. The northern and southern boundary areas are the most interesting regarding urban quality and vitality. In particular, Plebiscito Street still preserves most of its original urban character, as the quarter was constructed after the 1693 earthquake, in an area outside the ancient city walls, specifically assigned for a new expansion and the reconstruction of the urban centre (Dato 1983). The quarter has a surface of ca. 0.87 km^2, with a very high building density.

The real estate sample is formed by 58 properties comprised in the residential segment. The analysis has been carried out basing on 28 characteristics, aggregated into 6 groups: as follows (Forte 1968).

The attributes are expressed in a standard scale ranging from 1 to 5 representing the lowest and the highest quality conditions. Table 1 shows the sample and the values of the aggregated characteristics.

3 Methods and Procedures

3.1 Cluster Analysis

The Cluster Analysis is a multivariate method, which aims at classifying of observations into a number of different groups based on a set of measured variables. The degree of association between two objects belonging to the same group is maximal, but if they belong to a different group, it is minimal. The cluster analysis helps to identify groups and their structures within the data and analyse those groups of similar observation rather than individual data. Moreover, cluster analysis portrays relationship not revealed otherwise within the observed data, developing taxonomies.

There is a number of different approached, which can be used in order to identify clusters in a dataset: hierarchical and partitional algorithms (Jardine and Sibson 1968). Hierarchical methods can be either agglomerative or divisive. Agglomerative hierarchical clustering starts with every observation (object, subject) being a cluster into itself. At successive steps, the two most similar clusters are merged, and this is done continuously until all data are in one cluster. The problem of this approach is to find the optimum number of clusters between all the solutions. In divisive clustering, all subjects start in one cluster and end with everyone in just one cluster. Agglomerative methods are more popular and are used more often in clustering, even if once a cluster is formed, it cannot be split but only combined with other clusters. The most frequently used methods for combining clusters at each stage, defining the distance between clusters, are single linkage, complete linkage, average linkage between groups, average linkage within groups Ward's method, among the others.

The partitional algorithms decompose the whole dataset into smaller clusters, where the analyst predetermines the number of the resulting clusters. The partitioning-based clustering methods use an iterative method and based on a distance measure it updates the cluster of each object. The most used partition-based clustering algorithms are the K-means, the K-medoids, Clara, among the others.

Table 1 Synthesis of the market survey: prices and values

id	Address		Floor	Rooms	Surface	Asking price	k_{e1}	k_{e2}	k_i	k_t	k_{a1}	k_{a2}	k*
1	plaia	169	0–1	6.6	250	€240.000	3.6	3.0	3.3	2.5	3.2	3.4	2.8
2	plaia	167	0–1	11.2	300	€250.000	3.3	3.0	2.8	2.0	2.4	2.7	2.3
3	plaia	134	0	2.6	50	€28.000	3.3	2.6	1.6	2.8	2.8	2.3	2.3
4	plaia	63	1	2.6	70	€80.000	2.8	2.6	2.7	4.0	3.8	3.7	3.2
5	ortolani	5	0–1	6.3	130	€240.000	2.8	3.0	3.1	4.0	4.0	3.3	3.4
6	del principe	177	8	3.8	80	€110.000	2.5	2.4	1.7	2.0	1.9	2.0	1.9
7	del principe	177	6	3.3	90	€90.000	2.5	2.4	1.7	2.0	1.9	2.0	1.9
8	del principe	177	5	2.8	65	€90.000	2.5	2.4	1.7	2.0	1.9	2.0	1.9
9	del principe	117	3	3.8	80	€105.000	3.0	3.0	3.3	4.0	3.8	3.3	3.4
10	del faro	5	0	2.5	50	€80.000	2.5	2.4	1.4	2.0	2.3	2.3	1.9
11	ss. assunta	70	1	3.5	70	€120.000	2.7	3.0	2.4	2.8	2.6	2.0	2.5
12	villa sgabrosa	65	1	2.7	70	€85.000	2.6	2.6	2.3	2.8	2.6	2.0	2.5
13	del principe	37	3	2.8	65	€90.000	2.5	2.4	1.7	2.3	2.5	1.7	2.1
14	domenico tempio	24	1	5.1	140	€145.000	3.7	3.0	3.9	3.0	3.5	3.0	3.1
15	grimaldi	158	0	2.9	45	€48.000	2.6	2.6	1.2	1.8	1.8	1.7	1.7
16	plebiscito	597	4	6.0	130	€190.000	3.5	3.4	3.3	3.5	3.0	3.3	3.2
17	plebiscito	597	6	7.3	105	€199.000	3.5	3.4	3.6	3.3	3.0	3.0	3.2
18	plebiscito	529	2	4.6	85	€85.000	3.5	3.4	2.7	2.8	2.5	3.1	2.7
19	plebiscito	519	5	6.1	100	€185.000	3.3	3.4	3.6	3.5	3.4	2.9	3.3
20	plebiscito	415	5	4.1	100	€185.000	3.3	3.4	3.3	3.3	2.7	3.0	3.1
21	plebiscito	397	1	4.2	90	€115.000	3.3	3.4	3.1	3.5	3.0	3.7	3.2
22	plebiscito	393	0–1	2.8	60	€50.000	3.3	3.0	2.4	2.3	2.5	2.4	2.4
23	plebiscito	345	1	4.1	90	€190.000	3.3	3.4	3.1	3.5	3.0	3.7	3.2
24	plebiscito	309	0–1	8.8	170	€160.000	3.3	3.4	3.1	2.8	2.5	3.4	2.8

(continued)

Table 1 (continued)

id	Address		Floor	Rooms	Surface	Asking price	k_{e1}	k_{e2}	k_i	k_t	k_{a1}	k_{a2}	k*
25	plebiscito	246	3	6.2	100	€130.000	3.3	3.0	3.1	3.5	3.0	3.3	3.1
26	s. m. delle salette	45	0–1	5.9	110	€90.000	2.8	3.0	2.0	2.8	2.8	3.0	2.5
27	s. m. delle salette	40	0	4.0	90	€110.000	2.9	3.0	1.4	3.8	2.7	2.9	2.7
28	s. m. delle salette	38	1–2	5.8	120	€150.000	2.9	3.0	1.9	3.0	2.7	2.6	2.5
29	s. di giacomo	44	1	2.6	65	€48.000	2.3	2.6	1.7	1.0	1.2	1.7	1.4
30	reitano	1	2	3.7	80	€150.000	2.8	3.0	2.7	3.0	3.2	3.4	2.8
31	plebiscito	148	1	2.6	40	€65.000	3.3	3.4	3.0	3.0	2.7	3.0	2.9
32	plebiscito	119	1	4.7	100	€160.000	3.3	3.4	2.8	2.3	2.9	2.4	2.5
33	grimaldi	14	6	6.2	140	€260.000	3.1	3.0	4.6	3.5	3.5	3.4	3.5
34	fornai	27	1	2.6	55	€70.000	2.6	2.4	1.8	2.8	2.4	2.7	2.3
35	g. zurria	37	1	8.4	200	€240.000	3.4	3.4	3.3	3.0	2.7	3.0	3.0
36	gentile	22	2	4.9	130	€140.000	3.0	3.0	2.3	2.3	2.4	2.4	2.3
37	scuto	32	1	1.5	35	€59.000	2.6	3.0	2.0	2.3	2.3	2.0	2.2
38	cristoforo colombo	94	2	3.7	80	€145.000	3.1	2.6	2.9	2.8	2.4	2.4	2.6
39	domenico tempio	30	1	2.9	60	€78.000	3.6	3.0	2.6	3.0	2.8	2.7	2.8
40	domenico tempio	30	1	2.6	65	€85.000	3.6	3.0	2.7	3.0	2.8	3.0	2.8
41	della concordia	68	2–3	5.5	120	€145.000	3.5	3.0	3.4	3.8	3.5	3.3	3.3
42	della concordia	70	4	4.9	110	€170.000	3.5	3.0	3.6	3.0	3.0	2.7	3.0
43	de lorenzo	200	1	2.8	45	€55.000	2.4	2.0	1.5	2.8	2.2	2.3	2.1
44	mulino a vento	210	1	3.6	80	€115.000	2.2	2.0	2.6	2.8	2.7	3.0	2.4
45	belfiore	210	0–1	4.1	80	€75.000	2.3	2.0	2.1	3.0	2.9	3.0	2.4
46	belfiore	218	0	1.5	30	€25.000	2.3	2.0	2.1	2.0	2.2	2.4	2.0
47	della concordia	126 A	1	3.6	70	€90.000	2.8	2.6	2.1	2.0	2.0	2.0	2.1
48	tripoli	47	0–1	7.8	240	€230.000	1.6	2.0	2.0	2.3	2.2	2.1	2.0

(continued)

Table 1 (continued)

id	Address		Floor	Rooms	Surface	Asking price	k_{e1}	k_{e2}	k_i	k_t	k_{a1}	k_{a2}	k*
49	velis	28	1	4.1	60	€80.000	3.6	3.0	2.6	4.0	4.0	3.3	3.3
50	piombai	11	0–1–2	4.1	80	€75.000	3.6	3.0	1.7	2.8	2.2	2.3	2.4
51	zuccarelli	15	0	1.5	40	€40.000	3.3	3.0	1.4	2.3	2.5	2.0	2.1
52	cordai	97	0	3.0	55	€40.000	2.4	2.6	1.8	2.3	2.4	2.3	2.1
53	cordai	131	1	3.5	90	€70.000	2.4	2.6	2.4	3.0	2.5	2.3	2.5
54	delle margherite	30	2	3.5	50	€55.000	2.4	2.6	2.7	3.0	3.5	3.0	2.7
55	mulino a vento	116	0	4.5	100	€67.000	2.6	2.6	1.7	1.0	1.0	1.0	1.4
56	del principe	142	2	4.7	100	€50.000	2.8	3.0	3.0	3.0	3.1	3.3	2.8
57	alogna	26	1	2.6	50	€60.000	2.5	2.6	2.1	2.8	2.6	3.0	2.4
58	ortolani	35	2	5.9	120	€150.000	2.8	3.0	3.9	3.3	3.3	2.7	3.2

A Location: $k_{e1}1$ centrality and settlement quality; $k_{e1}2$ functional mix; $k_{e1}3$ socio-economic mix; $k_{e1}4$ urban maintenance; $k_{e1}5$ equipment; $k_{e1}6$ facilities; $k_{e1}7$ accessibility by private transportation; $k_{e1}8$ accessibility by public transportation; $k_{e1}9$; internal access; *B* Location 2: $k_{e2}1$ micro-environmental functional features; $k_{e2}2$ micro-environmental symbolic features; *C* Intrinsic features; k_i1 panoramic quality; k_i2 view; k_i3 brightness; k_i4 exposure; k_i5 security; *D* Technology: k_t1 plants; k_t2 finishes; k_t3 maintenance status; *E* Building Architectural quality: $k_{a1}1$ usability; $k_{a1}2$ structural and plant quality; $k_{a1}2$ finishes and building technologies; $k_{a1}4$ stylistic coherence; $k_{a1}5$ decorum; $k_{a1}6$ internal coherence; *F* Property Architectural quality: $k_{a2}1$ size, distribution and usability; $k_{a2}2$ accessories and restrooms; $k_{a2}3$ finishes

A combination of the hierarchical and partitional algorithm can be used, and many other clustering techniques have been proposed during the years, especially with the spread of the use of statistical software packages.

In order to cluster our variables collected in the real estate market, in this paper we proceeded to determine how the clusters are to be formed and the number of clusters. We used both the hierarchical and non-hierarchical approaches in order to identify different groups in real estate market.

Regarding the agglomerative hierarchical algorithms, we used the Ward's methods, which looks at clustering as an analysis of variance, rather than using distance metrics of measures of association, like other approaches. It looks at clustering as an analysis of variance problem, instead of using distance metrics or measures of association. Ward's method is based on a classical sum-of-squared criterion, producing clusters that minimize within-group dispersion at each fusion (Murtagh and Legendre 2014). In this minimum variance method, the distance between two clusters is the ANOVA sum of squares between the clusters added up over all the variables. At each step, the two clusters that merge are those that result in minimizing the within-group sum of squares. This method is most appropriate for quantitative and not binary variables.

Among the partitional approaches, we used the K-mean method, which aims at grouping data into K clusters based on how close an observation is to the mean of the observations in each cluster. The method segments the data, minimizing the within-cluster variation. The steps in the process are different, consisting in assigning, randomly, each observation to a K cluster, reassign the observations to other clusters to minimize the within-cluster variation, which is the squared distance of each observation from the mean of each cluster, and, finally, repeating the process until no observation needs to be reassigned. As K-means method does not build a hierarchy (the cluster affiliation of data could change during the process), the approaches belong to the non-hierarchical clustering approaches.

To assign an observation to the closest centroid, a proximity measure must be chosen. In this case, the Euclidean distance was used to implement the K-mean approach. Another step in the method was the definition of the appropriate number of clusters, which are correlated to the quality of clusters. In this case—study, the sum of the squared error (SSE) was used and it is the sum of the squared errors between every observation and the centroid of the cluster it belongs (Krzanowski and Lai 1968). It can be used as a measure of variation within a cluster. It is possible then to compute the total sum of the squared errors. The cluster with the smallest SSE (the centroids of this clustering are a better presentation of the point in their clusters) is preferred.

The problem with the K-means method is the choice of the number of the clusters into which the observations will be divided. The initial choice of the number k is mainly subjective, and so the results can be biased by the opinion of the user. Successive runs of K-means can optimize the clustering of the observation for a different number of clusters. A comparison with the hierarchical methods could also be used.

A process for determining the optimal number of clusters is (Gabrielli et al. 2015):

- assumed the dataset X, a specific clustering algorithm and a range of number of clusters [M_{min}, M_{max}], are defined;
- the clustering algorithm is repeated from predefined values of M_{min} to M_{max};
- he clustering results (partitions P and centroids C) are obtained and then the index value for each of them are calculated;
- the cluster M is selected, for which the partition offers the best outcome according to some criteria (minimum, maximum or knee point).

3.2 Fuzzy Clustering

The aim of cluster analysis is to partition a set of objects into two or more clusters such that objects within a cluster are similar and objects in different clusters are dissimilar (Kaufman and Rousseeuw 1986). The fuzzy clustering methods (Hwang and Thill 2009) making use of the fuzzy set theory, allow us to associate a unit to groups with a certain degree of membership, expressed by a membership function which takes values in the interval [0,1]. The interest in these methods stems from the awareness that there is a certain degree of inaccuracy in the data, and then that such a method is able to represent more than a crisp method can do.

The fuzzy clustering methods are richer in information, as they provide the degree of consistency by one unit with each cluster, allowing to establish a group hierarchy (the hierarchy is given by the different degree of unit belonging to the groups) to which it may belong to the unit, by virtue of the fact that the groups are viewed as fuzzy sets. In addition, they have no claim to provide definite answers on how you added the data. Figure 1 shows an ideal situation in which the points are perfectly separated in two clusters and a situation closer to reality in which the points are distributed in such a way that is difficult to attach a point to a cluster or another.

The fuzzy clustering generalizes partition clustering methods (such as K-means and medoid) (Kaufman and Rousseeuw 1987) by allowing an individual to be partially classified into more than one cluster. In regular clustering, each individual

Fig. 1 Comparison between an ideal situation and a real one

is a member of only one cluster. Suppose we have K clusters and we define a set of variables $m_{i1}, m_{i2}, \ldots, m_{ik}$ that represent the probability that object i is classified into cluster k. In partition clustering algorithms, one of these values will be one and the rest will be zero. This represents the fact that these algorithms classify an individual into one and only one cluster. In fuzzy clustering, the membership is spread among all clusters. The m_{ik} can now be between zero and one, with the stipulation that the sum of their values is one. We call this a fuzzification of the cluster configuration. It has the advantage that it does not force every object into a specific cluster. It has the disadvantage that there is much more information to be interpreted.

There are different approaches in the literature to fuzzy clustering, such as hierarchical and non-hierarchical. In particular, in the case of non-hierarchical classification methods, they have the characteristic of providing directly a certain number of groups fixed a priori, through iterative procedures that seek to optimize an objective function.

In this regard, there are several algorithms, which differ in the objective function, and then adopted for the choice different iterative procedure to compute the membership degrees of the unit to the groups.

The objective function determines for each solution a measure of the error, based on the distance between the data and the representative elements of the cluster.

It seeks to minimize the following objective function, C (Kaufman and Rousseeuw 1990) defined on the basis of membership in the cluster and distances $C = \sum_{k=1}^{K} \frac{\sum_{i=1}^{N} \sum_{j=1}^{N} m_{ik}^2 m_{jk}^2 d_{ij}}{2 \sum_{j=1}^{N} m_{jk}^2}$, where m_{ik} represents the unknown membership of the object i in cluster k and d_{ij} is the dissimilarity between objects i and j. The memberships are subject to the constraints that they all must be non-negative and that the memberships for a single individual must sum to one. That is, the memberships have the same constraints that they would if they were the probabilities that an individual belongs to each group (and they may be interpreted as such).

The medoid partitioning algorithms presented to accomplish this by finding a set of representative objects called medoids. The medoid of a cluster is defined as that object for which the average dissimilarity to all other objects in the cluster is minimal. If k clusters are desired, k medoids are found. Once the medoids are found, the data are classified into the cluster of the nearest medoid.

Two algorithms are available in this procedure to perform the clustering. The first, from Spath (1985), uses random starting cluster configurations. The second, from Kaufman and Rousseeuw (1990), makes special use of silhouette statistics to help determine the appropriate number of clusters.

The fundamental value used in cluster analysis is the dissimilarity between two objects. This section discusses how the dissimilarity is computed for the various types of data. For multivariate data, a critical issue is how the distance between individual variables is combined to form the overall dissimilarity. This depends on the variable type, scaling type, and distance type that is selected.

A *brief discussion of the possible* types of variables will follow. The dissimilarity (distance) between two objects is fundamental to cluster analysis since the techniques goal is to place similar objects in the same cluster and dissimilar objects in different clusters. Unfortunately, the measurement of dissimilarity depends on the type of variable. For interval variables, the distance between objects is simply the difference in their values. However, how do you quantify the difference between males and females? Is it simply 1 − 0 = 1? How do you combine the difference between males and females with the difference in age to form an overall dissimilar? These questions will be answered in this section. This discussion follows Kaufman and Rousseeuw (1990) very closely.

Assume that you have N rows (observations), which are separated to be clustered into K groups. Each row consists of P variables. Two types of distance measures are available in the program: Euclidean and Manhattan.

The *Euclidean distance* d_{jk} between rows j and k is computed using $d_{jk} = \sqrt{\frac{\sum_{j=1}^{P} \delta_{jik}^2}{P}}$ and *Manhattan distance* d_{jk} between rows j and k is computed using $d_{jk} = \sqrt{\frac{\sum_{j=1}^{P} \left|\delta_{jik}^2\right|}{P}}$ where for interval, ordinal, and ratio variables $d_{jk} = z_{ij} - z_{ik}$ and for asymmetric-binary, symmetric-binary, and nominal variables $d_{jk} = \begin{cases} 1 & if\ x_{ij} \neq x_{ik} \\ 0 & if\ x_{ij} = x_{ik} \end{cases}$ with the exception that for asymmetric-binary, the variable is completely ignored (P is decreased by one for this row) if both x_{ij} and x_{ij} are equal to zero (the non-rare event).

The value of z_{ij} for interval, ordinal, and ratio variables is defined as $z_{ij} = \frac{x_{ij} - A}{B_i}$, where x_{ij} represents the original data value for variable i and row j and z_{ij} j represents the corresponding scale value. The scaling choice determines the values used for A_i and B_i. Type of scaling of the value A_i and B_i are: absolute value, standard deviation, range ($Min_{overj}(x_{ij})$ or $Max_{overj}(x_{ij}) - Min_{overj}(x_{ij})$).

4 Applications and Results

4.1 Hard Cluster Analysis

In our case study we fixed the number of clusters $M_{min} = 2$ and $M_{max} = \sqrt{N}$. We use the previously defined 6 variables v.

We used the data for knee point detection in order to detect the proper number of clusters. The knee point in the graphs indicates the optimal number of clusters, even if the recognition of the knee points is not that easy. The maximum value and the minimum values are the most straightforward points to identify. Some other indices are monotonous, so it is not clear what the optimum value for the number of clusters. We used some validation indexes such as: SSB/SSW (the ratio between the sum-of-squares between clusters and the sum-of-squares within cluster); WB (the ratio between the sum-of-squares within cluster and the sum-of-squares between clusters, multiply by M, the number of the cluster); RSQ (the ratio between the sum-of-squares within cluster and the sum of the latter with the sum-of-squares between clusters). It was possible then to identify a range of numbers of the optimal cluster, which means that the optimal number of clusters is not defined. The option between 3 and 5 clusters are considered in the following analysis.

The three different options (3, 4 and 5 clusters) are commented hereafter. Using the K-mean method, the solution with 3 clusters has 26, 20 e 12 observations in the cluster no. 1, 2 and 3, respectively. Cluster n. 1 is quite different from cluster n. 2 and very different from cluster n. 3, while in cluster 2 and 3 the variables are not so different. The variables that have the greatest impact on clustering are k_i and k_{a2}, while both k_e variables have a small impact on clusters. In cluster n. 1 all properties with high quality and good characteristics are grouped together. In cluster n. 3, the observations show poor quality, especially for k_i, k_{a1} and k_{a2}. If the Ward's method is used replacing the K-mean, we obtain the same results. The two approaches are very consistent in clustering the data. Only two properties, no. 37 and 52, in Ward's method move from cluster 2 to cluster 3, which is plausible as the two clusters show the smallest difference between them.

The second hypothesis has 4 clusters with 16, 11, 20 and 11 cases respectively. In this scenario, the variable, which has the greater impact on clustering, is k_{a2}, while the k_{e1} and k_{e2} show a small value, and so impact, as measured by the value of the F-ratio.

The groups n. 1 and n. 4 have all properties with a high value of the variables (almost all mean >3): while the group n. 1 has a high value of variables k_{e1}, k_{e2} and k_i, group n. 4 shows the high value of the remaining variables, namely k_t, k_{a1} and k_{a2}. The group n. 2 have a very low value of almost all variable (around 1), meaning the poor quality of the characteristics of the properties included in the group. The group n. 3 has medium level characteristics and it is collocated between the groups 1–4 (high quality) and group 2 (poor quality). Again, using the Ward's method, the results is quite robust. In this case, the group n. 3, even though it retains the same characteristics of group 4 obtained with the K-mean method, it has a lower number of observations and therefore few cases are included (5 cases rather than 11).

In the third scenario, with 5 clusters (of 20, 12, 11, 3 and 12 cases each) shows less difference. The group n. 2 of the previous scenario divided into group 4 and 5 in this scenario, all the other changing only a bit (even if the cluster 1 here was the cluster 4 in the previous scenario, and so the cluster 2 here was cluster 1 in the previous situation). In this last test, the better discriminators between observations are k_i and k_{a2}, which seems to be the most significant variables to cluster in all the hypothesis analysed. The market and its demand seem to appreciate particularly the characteristics intrinsic and the ones linked to the property asset unit. The splitting of cluster n. 2 of the previous scenario, which was the one with the poorest characteristics, generates the cluster 4 and 5. The cluster n. 4 has only three observations, and they are very poor quality properties (as maintenance, location, view, etc.) and so less attractiveness for the market.

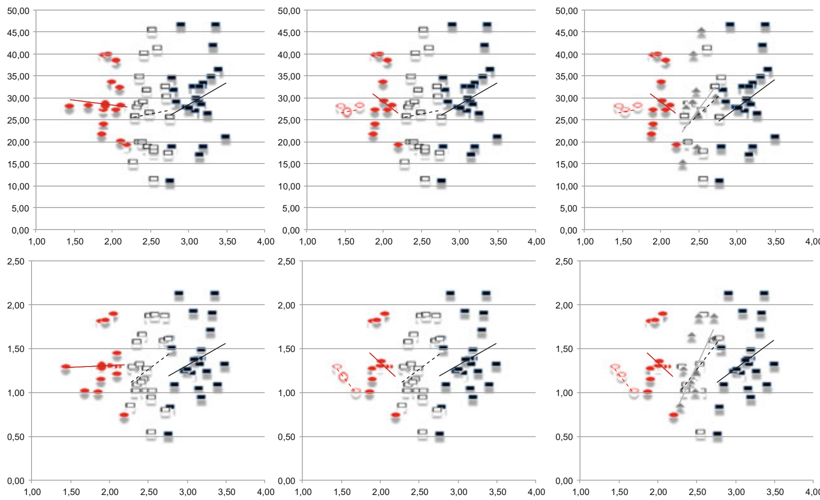

Fig. 2 Unit prices/overall value relation for each of the three hard clustering hypotheses

The mean of the ks are about 1.5, or below that number. Only k_e s are >2. Similarly, cluster 5 has buildings whose characteristics' mean is around 2. Group 1 and 2, which were group 4 and 1, respectively, show a higher value of the characteristics: in cluster 1 all the means are >3. The most similar clusters are the n. 3 and n. 5, which show little distance in their centroid and the means of the variables used for clustering. The cluster n. 5 shows smaller values of the k_i characteristic in comparison to the cases included in the 3 cluster ($k_i < 2$). The Ward's method, in this last application, differs from the—means, despite the fact that group 4 and 5 are identical. In Ward's method, the group n. 1 is a very small cluster represented by very top properties, with $k_t = 4$.

The graphs in Fig. 2 also show that in all three hypotheses of clustering segmentation for aggregated value (k*) is respected: assuming the four-cluster hypothesis, the third cluster is divided consistently into two groups, resulting in a fourth cluster comprising the three elements of limited value. Assuming the five-cluster hypothesis, the second cluster is still divided into two groups, giving rise to a fifth cluster of an intermediate value between the second and fourth groups.

4.2 *Fuzzy-Cluster Analysis*

As far as consistent, further subdivisions into four and five clusters do not add crucial information for the segmentation of the sample. This is confirmed by the fuzzy clustering analysis that strengthens the results obtained so far by changing the composition of the clusters previously delimited.

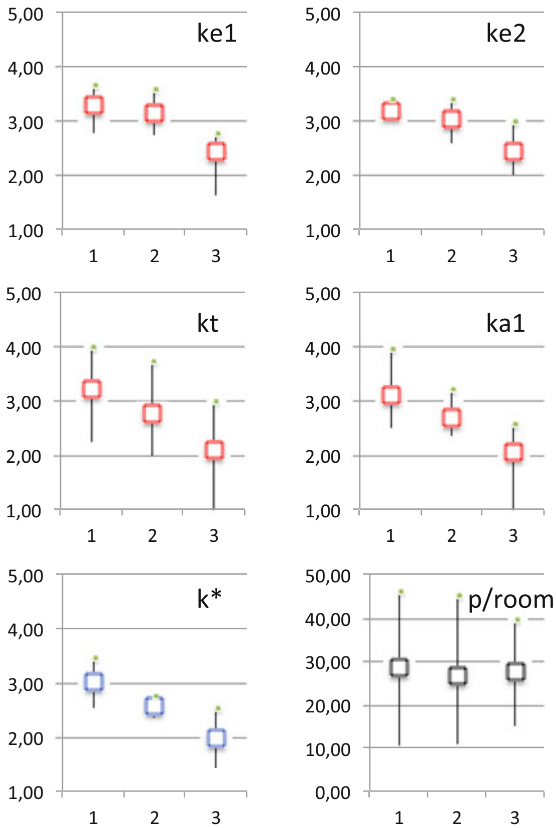

Fig. 3 Comparison of the three fuzzy clusters by minimum, average and maximum values and unit prices

The algorithm associates each element the degree of membership to each cluster. As a result, in a scenario of *strong clustering*, each element belongs to the cluster for which the degree of membership is higher, and no element can be ruled out.

Fuzzy logic "weakens" this hypothesis by selecting the elements that most reasonably can be excluded from the sample (gap) and those that may belong to two clusters (overlap). This selection can be made by requiring that any element whose three cluster membership degree is below the threshold-gap, should be excluded not belonging significantly to any cluster. Moreover, the elements that have a degree of membership to two clusters above the threshold-overlap will be included in both the clusters regardless of which is the greater degree of membership. The first test (gap-test) is a condition of admission to the second (overlap-test), as it is possible that the gap and overlap conditions occur simultaneously. Therefore, having established that at least one of three degrees of membership exceeds threshold-gap, it is checked if the element exceeds the threshold-overlap on two degrees of membership.

By imposing a threshold-gap equal to 0.38 and a threshold-overlap of 0.41, it is possible to get a segmentation in which the first cluster contains 25 elements, the second 15 and third 17. 8 elements are excluded (gap) while 7 elements belong to two clusters at the same time. The results are shown in the graphs of Fig. 3 in which we see how the clusters are well defined with respect to the value of all the characteristics taken separately and with to their aggregate value k^*, while this distinction is less marked than the unit prices. The same can be done by comparing, in Fig. 3, fluctuations in values—individual and aggregate—and unit prices: fluctuations in values distinguish very clearly some clusters; the price movements do not provide significant elements to discriminate the clusters, despite the number of elements contained therein is significantly different.

5 Discussions and Conclusions

The final verification concerns the consistency of the proposed clustering and the urban shape regarding the location of the elements belonging to the different clusters.

1. The hard-clustering pattern provides the following distribution: a group dislocated along the main axes and the other two internal (more characterized by technologic and architectural homogeneity) is outlined in the 3-cluster segmentation. The detachment of the fourth cluster does not add any significant information to the subdivision while the passage to five clusters reveals a subdivision of the second cluster basing on the architectural characteristic and independent from the urban location.
2. The fuzzy clustering analysis pattern, applied in just a 3-clusters hypothesis, provides a more strong and consistent distribution of the whole sample as displayed in Fig. 4.

The first cluster, comprising the best properties, is mostly located along the main roads and the elements are well characterized from every point of view. The second cluster has a good location but lower technological and architectural features. The third one comprises the properties locate in the internal areas with the worst characteristics from all the points of views. Figure 4 also shows the position of the gap/overlap-properties.

Despite the results of the two processes converge towards a definition of segments altogether consistent, the extension of the method to a more flexible approach allowed, through iterative displacement of *thresholds gap and overlap*, to get the best and most fitting configuration of the segments. This is due to the flexibility of a process that allows overcoming the constraint of separation and admits the possibility of multiple memberships.

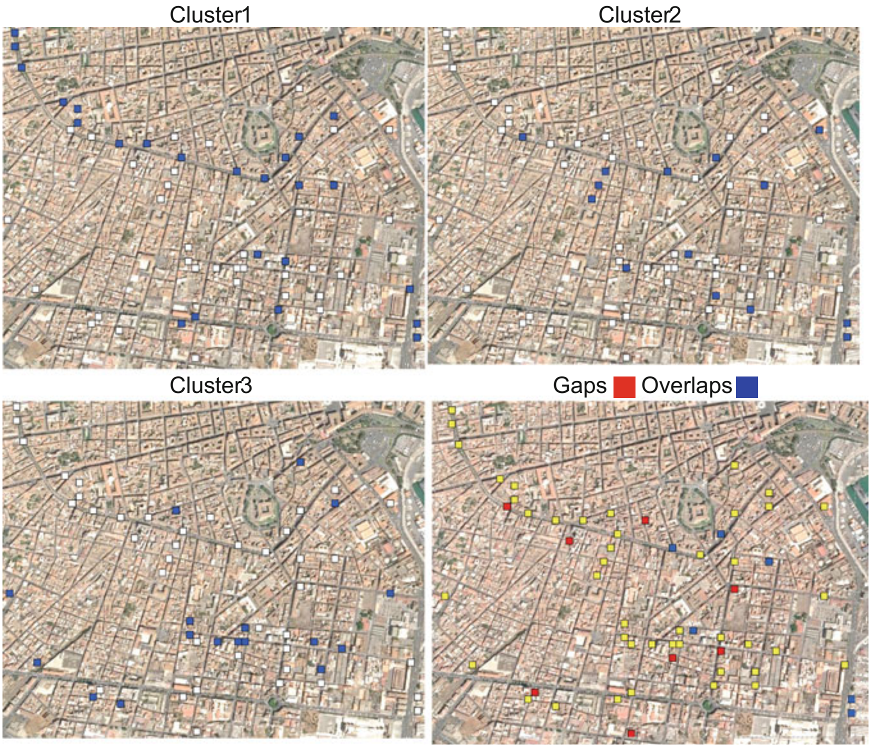

Fig. 4 Spatial distribution of the elements of the three fuzzy clusters and location of the gaps and overlaps

The fact that the strong consistency of the characteristics of the segments does not match the same consistency in prices indicates that the complexity of the context is not represented by expectations about prices, especially during a rarefaction of the transactions.

In this sense, the check of relations of similarity can be very helpful in the negotiated urban transformation processes, in which the value, rather than the price, assumes in the internalization of positive and negative externalities.

In such a perspective, the case has highlighted the complementary nature of value, specific, concrete, and that of the price, general and abstract. The price has the function of making homogeneous combinations of heterogeneous values although substitutable, by defining more easily observable preferences systems in active and transparent markets. Instead, in very articulated, complex, opaque and episodic markets, value and price are made independent from each other and, at worst, indifferent, giving rise to "semantic gaps and overlaps". As a result, from a physiological condition for which very different values are substitutable as they correspond to only one price, the pathological condition prevails whereby the same value can have very different prices. In the latter case, the value consistently measured and represented in its syntactic structure at the level of semantic chains formed by urban areas, becomes again the real foundation for the realignment of the system of administered prices in the context of local taxation (Equalization processes) and global (Land Register).

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Buildings Energy Performance and Real Estate Market Value: An Application of the Spatial Auto Regressive (SAR) Model

Marta Bottero, Marina Bravi, Giulio Mondini and Antonio Talarico

Abstract This work explores the role of the buildings energy performance in defining the real estate market value, taking in consideration the presence of spatial autocorrelation. At this regard, it is necessary to put in evidence that a great heterogeneity exists on the Italian territory with reference to buildings energy performance; for this reason, being able to identify a class of most performing estimation models, suitable to separate the spatial effects from the influence of the building components —including the energy rating—on the value, seems to be an interesting goal. In particular, this work illustrates an experiment based on the Spatial Auto Regressive (SAR) model implemented on a sample of residential units located in the city of Turin and represents a first step of a more wide research program.

Keywords Energy requalification · Hedonic pricing model · Residential buildings · Estimation · Post-carbon city

1 Introduction

In recent years the European debate regarding targets and methodologies related to energy policies and building energy performance has greatly intensified. As a matter of fact, in Europe the building sector is responsible for more than 40% of the

M. Bottero (✉) · M. Bravi · G. Mondini
Department of Regional and Urban Studies and Planning,
Politecnico di Torino, Turin, Italy
e-mail: marta.bottero@polito.it

M. Bravi
e-mail: marina.bravi@polito.it

G. Mondini
e-mail: giulio.mondini@polito.it

A. Talarico
Compagnia di San Paolo—Sistema Torino, Turin, Italy
e-mail: antonio.talarico@polito.it

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total energy consumption and for 36% of the CO_2 emissions (Blest et al. 2010; Klessman et al. 2011). To avoid a further increase of these values, the European Union decided to issue several Directivesin order to encourage the reduction of energy consumption and to promote the use of renewable energy sources. In this sense, the European Union has committed itself reducing greenhouse gas emissions by 20% compared to 1990 levels, increasing the share of renewable sources in the energy mix to 20%, and achieving the 20% energy efficiency target by 2020. To reach those targets, European legislation set out a cross-sectional framework of ambitious targets for achieving high energy performances in buildings. Key part of this European regulatory framework is the Energy Performance of Buildings Directive 2002/91/EC—EPBD (European Commission 2002; Becchio et al. 2015).

International and national researches have produced, in recent years, a number of studies on how the buildings energy performance affects the real estate market value (Fuerst and McAllister 2011; Eichholtz et al. 2013; Morri and Soffietti 2013; Högberg 2013; Hyland et al. 2013) Some conclusions about the Italian housing market (the largest sector of the real estate) appear to be shared, in particular:

- the existence of an appreciation of the users/buyers for the higher energy efficiency classes (A and B) also considered the strong segmentation of housing markets and demand (Bottero and Bravi 2014);
- a non-proportional relationship between energy rating and the market value, as well as a lower explanatory power of the intermediate energy classes (Fregonara et al. 2014);
- a strong level of spatial heterogeneity in the incidence of the energy rating on the market value, given the characteristics of the built environment.

In this respect, the paper explores the role of the buildings energy performance in the definition of the real estate market value, considering the problem of the presence of spatial autocorrelation and focusing, in particular, on the use of the spatial econometrics.

As it is well known and following the hedonic prices theory (Malpezzi 2003), real estate properties are composite goods where different attributes are affecting the value. For example, historical buildings normally have very low energy performance but very high value due to the central location in the city; on the contrary, new social housing projects, with suburban location, can be very performing from the point of view of energy efficiency.

Effectively, another very important aspect of the real estate markets is related to their complex stratification and segmentation. In particular, they are characterized by a very rigid supply and by a demand affected by cyclical fluctuations (caused by the possibility of getting credit, the households' income or the supply of new constructions in the market). In this sense, the substitution of the buildings characterized by low energy performance with more innovative buildings is conditioned by the trends of the real estate sector, by the availability of technological solutions and by the presence of incentives to investments in this industry (Bottero and Bravi 2014). In this respect, the territorial distribution of the real estate prices is, at the same time, expression of the market dynamic and of stratification, over time, of different levels of building quality. In other words, energy rating is another way to define the quality of a property; to the same extent, it is a way to identify a sub-market and a demand segment. What about the spatial structure in all of this? Since the raising of the building energy rating is achieved, or by new constructions or by a renovation, at least in theory, we expect that this phenomenon has a coherent spatial structure (Fregonara et al. 2012). These implications are very important for local taxation and policies devoted to saving energy. Consistently, the estimation, at the local scale, of costs/benefits of the improvement of the buildings energy performance can profit from an approach of this type.

In the light of the aforementioned considerations, it is necessary to analyze and to map the relationships between buildings energy performance and territorial driving forces that determine the value in order to recognize meaningful patterns and to distinguish different areas where proper policies could operate at local scale.

The present work illustrates a methodological proposal that is based, on the one hand, on the theory of hedonic prices and, on the other, on spatial econometrics (Krause and Bitter 2012), providing an application on a sample of residential units located in the city of Turin. From the methodological point of view, the analysis seems to be innovative because it faces the problem of spatial heterogeneity and inelasticity of the market supply. In fact, the application of Hedonic Pricing Model through the analysis of the spatial dependences involves the problem of spatial autocorrelation to be taken into account (Brasington and Hite 2005). Finally, the identification of spatial patterns of homogeneity/non-homogeneity allows creating a large data base that can be useful for the definition of sectorial policies.

2 Research Methodology

With the purpose of supporting decision processes in the context of energy requalification operations, the research aims at investigating innovative evaluation approaches in attempting to measure the economic value of buildings energy performances. In particular, the study is based on the application of the Spatial Auto Regressive (SAR) model that belongs to the general family of spatial econometrics. These approaches explicitly incorporate space or geography in the analysis and they are rapidly gaining attention in different fields such as urban economics, demand analysis, environmental economics and others. The famous proposition of Tobler (1970) that refers to the first law of geography, remembers us: «*Everything is related to everything else, but closer things more so*». Following Anselin (2010) it is possible to recall that spatial econometrics was originated in the early 1970s as a new investigation field in Europe because of the need to deal with sub-country data in regional econometric models; in recent years, this approach is getting more and more important, especially in the domain of social sciences.

Although this method was developed in other disciplines than real estate appraisal (Paelinck and Klaassen 1979; Anselin 1998), in the last decade, it was successfully applied in this field (Krause and Bitter 2012; Osland 2010). Considering that the *asking prices* are often correlated with nearby property prices, and that the appraisers determine values for financing purposes based on nearby comparable sales, the spatial dependence plays actually a big role in estimation process.

In spatial econometrics, spatial effects pertain to two categories of specifications, namely *spatial autocorrelation* and *spatial heterogeneity*. Spatial heterogeneity concerns structural instability of the relationships between variables in regression models; it represents a special case of observed or unobserved heterogeneity, a familiar problem in standard econometrics. Spatial autocorrelation takes instead into consideration the relative position (distance, spatial arrangements) of the observations in the geographic space. The present study refers to the latter.

Spatial autocorrelation is something like the temporal one, but a little bit different and surely more complicated. In the case of temporal autocorrelation, it is only possible to go one way: what happens at one time can be influenced only by what has happened in the past. In the case of spatial autocorrelation, we can potentially go in any direction. For this reason, models of temporal autocorrelation cannot simply shifted in the geography field (Viton 2010).

It should be remembered that, in standard linear regression models, spatial dependence can be incorporated in two distinct ways: as an additional independent factor, in the form of a spatially lagged variable, or in the error structure. The first is referred as Spatial Auto Regressive (SAR) or *spatial lag* model and it is appropriate when the focus of interest is the estimation of the strength of spatial interactions. Formally, a SAR model can be expressed as:

$$y = +\rho Wy + X\beta + \varepsilon \quad \text{with} \;\; \varepsilon \sim N(0, \sigma^2 I)$$

where y is the dependent random variable, α is the constant term, ρ is a spatial autoregressive coefficient, Wy is the spatial weights matrix and ε is the vector of error term IID. Note that the spatial weights matrix Wy (which is usually row-standardized) is correlated with the error term because the disturbances of a neighbour point (or area) depends, in turn, from its neighbours and so progressively. Since Ordinary Least Square (OLS) models would be biased and inconsistent, due to the simultaneity bias, a proper estimation method, which can take in account for this endogeneity, must be employed. Maximum Likelihood Estimation (MLE) approach can answer this need but it is still based on the assumption of error term normality.

At this regard, a very important item of the definition of spatial autocorrelation is the spatial weights matrix that, for each location in the system, specifies which of the other locations is affecting the value. As LeSage and Pace (2009) pointed out, there is an endless number of ways to construct such a matrix. For example, we can consider linear contiguity (two regions with common borders) or a distance-based approach.

As previously mentioned, in this experiment, spatial econometrics is employed in order to investigate the contribution of the energy performance in the definition of the market value starting from a question: does the values exhibit spatial autocorrelation or not? If not, it is clearly possible to employ the standard non-spatial models. But if the spatial autocorrelation does matter, a different path has to be followed that leads to the modeling of spatial relationships. In particular, the method was implemented on the real estate market of the city of Turin and the research was organized according to subsequent steps, some of which are still in progress:

1. Collection and geo-referencing of the data.
   Data related to *asking prices* of residential units in the Turin metropolitan area were collected making use of direct sources (real estate agencies). The records included the address of the apartment, the price, the energy rating and other relevant characteristics affecting the value, such as surface, floor, etc. The single addresses were also geo-referred by means of geographic coordinates (latitude and longitude).
2. Calibration of the models at a small scale (pilot experiment).
   The analysis was implemented on sub-samples of the full data-base with the aim to define the criteria to be used in the construction of the spatial weights matrix and to test the true presence of spatial autocorrelation.
3. Implementation of the models at a large scale.
   Once verified the efficiency of the estimation model at a small scale, the study will try to test the model at a large scale, considering the overall area under investigation. The final goal is to estimate, on a data-base of almost 3,000 cases, the amount of benefits generated by an energy requalification scenario on the metropolitan area of Turin.

3 Pilot Experiment

Following the research methodology illustrated in Sect. 2, a first pilot experiment was developed. It covers the steps number 1 and 2 and concerns a sample of 500 residential units pertaining to the real estate market in the city of Turin.

3.1 Construction of the Sample

The *asking prices* were collected through the Web portal "immobiliare.it" for a period of six months and were geo-referred by means of the open source tool Batchgeo (https://batchgeo.com/). It is important to highlight that the model makes use of *asking prices* or *list prices* that cannot be considered as final prices, but rather as *most probable selling price* affected by error. This is a well-known problem in real estate literature starting from Haurin's (1988) investigation. In Italian real estate market, for example, Fregonara et al. (2014) tried to test whether the appraisers are usual to take in account the location in defining the *asking prices* that definitively represent the first values in a negotiation between supply and demand. In an experimental prospective, the *asking price* is considered a good signal of the value creation process, a clear evidence of the role that space (location) performs in this respect. So, the goals of the pilot experiment were:

- to demonstrate that the energy rating explains the market value;
- to understand if the inclusion of spatial effects provides better results in terms of reduction of model error;
- to prepare and test a methodology whose purpose goes beyond these first steps (economic valuation of the benefits can be produced from an improvement in building energy performances).

The first step consists in the creation of a geo-referred database. For each case, five variables were entered: residential unit address, surface, floor, energy rating and *asking price* plus the latitude and longitude related to every single address. Actually, the available variables were more, but, as first approach to the investigation problem, it was preferred to only test the most important of them.

3.2 Estimation Results

Two estimation models were implemented on a sample of 500 residential units: a traditional linear one, based on the Ordinary Least Square (OLS) algorithm (Table 1) and a SAR model, based on the Maximum Likelihood Estimator (MLE) (Table 2). In both cases, the SpaceStat software, ver. 3.8 (2013), a special purpose package handling both estimation and specification testing of spatial regression models, was used.

As for the most delicate aspect, namely the choice of the spatial weights matrix, it must be specified that point geography spatial weights, and not polygons weights (as neighbourhoods or census tracts), were employed. In this direction, the five points (prices) closer to the point concerned (ego) were considered, defining the weight values for these neighbors. Note that spatial weights sets do not have a weight between ego and itself. The weights calculus was based on the inverse distance rank[1].

The exam of the results of Tables 1 and 2 puts in evidence that they are consistent with similar findings in the literature. In particular, following Osland (2010), the SAR model performs better compared to the OLS model; in fact, the value of R-squared is higher in the former. Moreover, when spatial regression models are

[1]This option assigns weights to nearest neighbors equal to the inverse of their rank. So the nearest neighbor's weight is 1, the second nearest neighbor weight is 1/2, the third nearest neighbor weight is 1/3, etc. For a specified nearest neighbor count, this weight value is essentially standardized because all objects in the data-set have the same count.

Table 1 OLS (linear) estimation model—dependent variable: total asking price

Variable	Coefficient	Std error	Z value	Probability
Intercept	−50297.8	16783.2	−2.99692	0.003
Surface	2970.126	93.32386	31.82601	0.000
Energy rating	−9526.12	2364.248	−4.02924	0.000
Floor	4867.794	1725.151	2.821663	0.005
R-squared		0.795126		
Adjusted R-squared		0.793077		
Log likelihood		−3795.38		
F value		388.1046		
P value		0.0		

Table 2 MLE (autoregressive) estimation model—dependent variable: total asking price

Variable	Coefficient	Std error	Z value	Probability
Rho	0.296535	0.03611	8.21195	0.000
Intercept	−101693	15985.51	−6.36161	0.000
Surface	2748.833	87.80264	31.30694	0.000
Energy rating	−6280.49	2136.156	−2.94009	0.003
Floor	4657.691	1541.389	3.021749	0.002
R-squared		0.829185		
Adjusted R-squared		0.829185		
Square correlation		0.834817		
LogLikely		-3765.06		
AIC		7540.126		
SIC		7558.711		
Sig-Sq (ML)		3.298E 9		

estimated by MLE, inference on the spatial autoregressive coefficients may be based on a Wald or asymptotic *t*-test (from the asymptotic variance matrix) or on a likelihood ratio test (Anselin and Bera 1998). In this case and in both models, the intercept, surface, energy rate and floor pass the *t*-test and they show the validity of the first hypothesis about the role of the building energy performances in determining the asking price. It should also be noted that the energy rating, in the absence of other explanatory variables, such as the status of maintenance and the construction time, tends to incorporate these features in itself as a proxy variable. Moreover, the energy rating has negative sign because the measurement order goes from the worst (G) to the best (A) class. In MLE model, the ρ and the other coefficients are also significant at 0.00 level. The estimates are quite stable in the amounts and the signs are correct.

Table 3 Spatial dependence diagnostics

Test	MI/DF	Value	Probability
Moran's I (error)	0.57188	13.34455	0.000
Lagrange multiplier (error)	1	164.8943	0.000
Lagrange multiplier (lag)	1	182.1001	0.000

Starting from the results of the model comparison, the further analysis of the spatial dependence diagnostics allows validating the initial assumptions. The tests are based on Anselin (1988a, b) (Table 3).

The most commonly used specification test for spatial autocorrelation is derived from a statistic developed by Moran in 1948 as the two-dimensional analog of a test for univariate time series correlation. The Moran's index is normally used in geographic analysis to identify clusters of observations with similar values located in the space. General formal conditions for the asymptotic normality of Moran's *I* in a wide range of regression models are given in Pinkse (1998). The results of the Moran's *I* (Table 3) confirm the presence of spatial autocorrelation effects in the case under investigation. In particular, the value of probability equal to 0 means that we have to accept the hypothesis that a spatial dependence exists in the error terms. Moreover, the Lagrange Multiplier verifies the presence of spatial heterogeneity and dependence of the error and of the spatial lag variable.

4 Conclusions

The scant considerations reported here try to testify the first steps of a research still in progress, whose purposes go well beyond what has been shown. Theses short findings emphasize that the estimation of real estate values based on the buildings energy performance goes through a new approach, where the geography becomes an endogenous variable of the observed phenomenon.

In this respect, the feasible uses of a database of this nature appear numerous: from the revision of cadastral values to local taxation; but especially it could be employed for the identification of specific forms of economic incentives, so important for the achievement of the national energy savings.

Another research perspective is to overcome the concept of *estimation sample*, or comparable units, so familiar in the real estate appraisal field, taking into account the spatial and temporal heterogeneity, pivoting on geo-referred and dynamics data-bases (i.e. continuously implemented); these could exceed, at the same time, the problem of little samples representativeness, since the ultimate goal is the almost total coverage of a geographical space.

The big family of models developed by many generations of scholars could be experimented also for this purpose. For example, it will be possible to incorporate the temporal dimension, when observations are available across space as well as over time. Four types of models can be distinguished: *pure space-recursive*, in which the dependence pertains to neighboring locations in a different period; *time–space recursive*, in which the dependence relates to the same location as well as the neighbors locations in another period; *time–space simultaneous*, with both a time-wise and a spatially lagged dependent variable and *time–space dynamic*, with all forms of dependence are present (Anselin 2003).

A lot of work remains to be done and, in this direction, these few lines have tried to mention only the main research goals and the methodology used up to this point.

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The Value of Intellectual Capital in Shipping Companies

Vincenzo Del Giudice and Pierfrancesco De Paola

Abstract Currently, the competitiveness, wealth, and growth of an enterprise mainly depend on its intangible resources and, especially, on its intellectual assets. The relevance attributed to intangibles assets is accompanied by their indisputable operational criticality. This paper highlights the central role played by intangibles in a new company's business perspective and the inadequacy of traditional financial instruments for the measurement and representation of intangibles related to the intellectual capital of a company. Also, it reports on an application of "Intangible Asset Monitor" method to a shipping company that operates in the maritime transport sector. This method evaluates the importance and contribution of intellectual capital, divided in its three macro-components (human capital, structural capital, and relational capital), compared to the assets of the company using three families of indicators that monitor the growth, efficiency, and stability of intellectual capital.

Keywords Intangible assets · Intellectual capital · Intangible asset monitor · Shipping companies

1 The Relevance of Intellectual Capital

The growing importance of intangible assets is associated with the orientation of a knowledge-based economy, on services rather than on products. Only companies that can transform the most relevant information into knowledge attain competitive success, which is affected by a high incidence of intellectual capital.

V. Del Giudice · P. De Paola (✉)
Department of Industrial Engineering, University of Naples "Federico II", Naples, Italy
e-mail: pfdepaola@libero.it

V. Del Giudice
e-mail: vincenzo.delgiudice@unina.it

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This intangible asset can be defined as everything that is not material, such as knowledge, information, experience, skills, and all that is intellectual and can be harnessed to create wealth.

The relevance of intellectual capital is recognized in the experience and knowledge accumulated by stakeholders over the years, the trust that clients place in the company, and so on. When an entrepreneur founds or purchases a firm, it is not only vital to build or take over factories or hire or buy equipment, but also to bring with them skills and abilities already acquired over years or even gamble on people's skills or revitalize what appeared to have been lost, through the taking, buying and/or trading of intellectual capital (Bontis 1998, 2000).

The significance of intellectual capital can be easily understood through Edvinsson's metaphor (Edvinsson and Malone 1997): if you imagine a company like a tree, the organizational plans, annual, and quarterly financial statements and other relevant documents of the company are the trunks, branches, and leaves; the investors will examine these parts in order to be able to collect the ripe fruit from the tree itself. But this scrupulous observation will focus only on part of the living organism, i.e., on its "visible" part and, therefore, it will be deprived of the most important part of the shaft, i.e., the "invisible" part represented by the roots. The fruit taste and flowering will be symptomatic only of visible goodness of the tree and its external structure, but assessing the health of the roots and of its innermost parts means examining the fruits and leaves in the years to come.

From here it is evident how the "intangible" resources are the basis for the success and profitability of companies.

Three is the number of the main elements that constitute the intellectual capital; moreover, these factors interact positively each other: human capital; structural capital (or organizational); and capital (customer interaction). Three is the number, also, of the fundamental aspects that differentiate intellectual capital from "tangible assets" of a company: intellectual capital is re-evaluated over time and isn't subject to depreciation, being the constantly changing know-how of each individual, it gives birth to ever new knowledge; intellectual capital is not "consumed" and does not decrease with use, nay sits growth is desirable; differently from traditional assets that are almost entirely attributable to the enterprise, intellectual capital is mainly owned by the individuals who are involved.

Methods for estimating intellectual capital can be differentiated into four different classes (Bontis 1998, 2000; Edvinsson and Malone 1997):

- Market Capitalization Methods, with which the intangible assets are estimated as the difference between the company's market value and the book value of net assets;
- Return on Assets, which is based on calculation of profitability normally structured as follows: the average income (before taxes) is divided by the average value of the tangible assets; then this value is compared with the corresponding average value of industry sector; the difference of these terms is multiplied by the average value of material goods and it is used to calculate an estimated return of intangible assets and, therefore, their value;

- Direct Intellectual Capital Methods, including the economic valuation of various corporate components, either individually or in the aggregate;
- Score Card Methods, with which the individual elements of intangible assets are first identified and then measured with non-monetary indicators.

2 Intangible Assets Monitor

The Intangible Assets Monitor is a measurement method to support management processes and internal control of business performance which, by creating a report, describes the company as a whole and enables it to understand and monitor its quality and value. Then the purpose of this method is to assist the existing financial methods with a set of indicators for a correct valuation of intangibles in their entirety (Sveiby 1997a, b).

In this context, the Intangible Assets Monitor can be considered within the set of "information management systems".

The Intangible Assets Monitor classifies the intangible capital into three basic categories: internal structure (internal capital intended as structural capital); external structure (external capital understood as relational capital); individual skills of employees (human capital).

Human capital is the agglomeration of all the skills and competencies that belong to every individual who works within an organization. Since these resources are present in the company only temporarily and then there is the risk of losing them, it is important to share these skills for the conversion process of human capital into structural capital.

Structural capital consists of the tangible and intangible elements that assist individuals in completing their performance. A good level of structural capital ensures effective and efficient management of labor and a greater degree of motivation of employees. It is important, therefore, to emphasize the exclusive competencies, which are hard to copy, through which the firm garners economic returns and the development of knowledge, brand, and other activities.

Relational capital includes all relationships between the company and all stakeholders such as customers, suppliers, lenders, partners, etc. that ensure sustained profitability over time.

For each of these categories, three families of indicators for monitoring the growth/renewal, efficiency and stability of intellectual capital are associated. The indicators of growth/renewal refer to initiatives whose goal is to ensure company growth and renewal from any point of view; any of the performance indicators refers to the company's ability to properly use their resources in order to create value, while stability indicators refer to the company's ability to sustain its competitive advantage in the future, on the basis of undertaken initiatives. The choice of indicators must be made by each company according to its own situation and its own strategy in order to identify the elements that improve knowledge management. The main advantage of this method resides in the customization of the indexes, even if there are limits to the comparability between companies; so an analysis of enterprise management is feasibly assessed only from the perspective of a trend of several years.

3 Case Study

The shipping company treated in this study operates predominantly in the field of international maritime transport of dry bulk and liquid cargo, on behalf of third parties, with the use of its own or a hired ship. In particular, rental ships contracts are timed ("Time Charter Party") or are calculated per trip ("Voyage Charter Party"). The ships used are bulk-carriers or tanker-product carriers.

Initially, we start with a report on the company's intellectual capital that gives a picture of the future potential for company organization and its ability to compete in the market and highlights the strengths to maintain or the weaknesses to be corrected to avoid critical situations. This report enables us to grasp in advance the possible evolution of an organization and its ability to grow in subsequent years. Then, the work is to monitor the development of intangibles assets on the basis of one of the most popular innovative management models: the Intangible Asset Monitor method.

Based on the use of this methodology, we want to evaluate (from the quantitative, but non-monetary, point of view quantitative) (Del Giudice et al. 2015; Del Giudice and De Paola 2014b), the importance and contribution of intellectual capital in its three macro-components—human capital, structural Capital, and relational capital—using three families of indicators for monitoring the growth, the efficiency, and the stability of the company.

The intellectual capital report is presented in independent form, but coordinated with financial statements, which is meant to satisfy simultaneously communication purposes both internal and external to the company. Indices deemed essential for an overall evaluation of the previous three years and comments on the most important data have been inserted, highlighting, where possible, the percentage annual changes. It analyzed the priority tasks of the international maritime transport taking into account only employees with indefinite duration contract, given that the rest of the workers, mainly maritime, work temporarily or seasonally (for 6-month periods), and these aspects are not functional for the analysis.

The company's human capital is the set of individuals who compose it, as well as their knowledge and skills; it's the most important asset that the company has. Synoptic Table 1 shows the indicators identified in order to assess the value and flexibility of the company's assets.

Concerning the stability indicators, it should be said that the measure of corporate culture was calculated by a questionnaire that compared the management point of view and that of the company staff, expressing the gap between the two profiles. Four particularly significant areas of analysis have been identified for this

Table 1 Scheme for estimating a firm's human capital

	Year 01	Year 02	Year 03	Δ% 01/02	Δ% 02/03
Growth					
No. of employees	24	26	26	8.33%	Constant
Master's degree	4%	4%	4%	0%	Constant
University degree	12%	19%	19%	58.33%	Constant
High school diploma	67%	62%	62%	−7.46%	Constant
Professional courses	–	–	–	–	–
Medium secondary school	17%	15%	15%	−11.76%	Constant
Primary school	–	–	–	–	–
Average age	45	45	45	Constant	Constant
Average seniority of staff	10	10	10	Constant	Constant
Average seniority of management	15	15	15	Constant	Constant
Skills management	–	–	0.97	–	–
Efficiency					
Skills shortage	–	–	1.14	–	–
Stability					
Turnover of employees	16.67%	0%	0%	−100%	Constant
Degree of negative satisfaction of staff	–	–	0.44	–	–
Degree of positive satisfaction of staff	–	–	2.73	–	–

purpose: the strategic knowledge, organizational, business structure of the company; mode and styles of management; the management system, control, and verification; and the organizational vitality and the orientation to change. From the results of administered questionnaires emerges the complementarity of the corporate culture with business strategies expressed through the relationship between the staff profile and that of the top management (desirable for the company), taking account of critical business factors and possible improvement levers.

The employee responses showed that all the institution's employees are aware of strategy and business organization. In addition, a leadership style emerges characterized by a strong positive impact on the emotional dimension of workers, permitting employees to express their creativity and ingenuity and to choose the best way to achieve business goals.

As for the management skills, total scores of actual and ideal job profiles for every organizational role have been calculated taking into account of the number of employees: for each competence is associated a weight equal to the product between the number of employees that have particular expertise to the corresponding judgment level; then, the weights calculated for each competency and its role are added up, producing the score for ideal skills profile for each organizational role (ideal profiles). The next step is to reach an assessment of the skills actually owned by the people who have those roles (average current profiles). The final indicator is given by the ratio between the average current profiles and the ideal profiles. The results can highlight the existence of a gap between the skills required and those possessed, thus setting into motion the necessary corrective mechanisms.

This indicator reflects, therefore, the quality of management and enables us to verify the effectiveness of personnel management policies in the creation of knowledge. To measure this scope, a specific questionnaire was administered to employees of individual business departments.

The skills management index (0.97) certifies a particular business stability in terms of skills that remain solidly within the institution itself and are able to reinforce the business success, even in times of crisis.

The skills shortage index (1.14) indicates the difference between the skills of employees and the skills needed to operate efficiently in accordance with the corporate objectives and is measured using a gap defined as the ratio between total level judgment of the skills and overall level of judgment required skills (percentage of coverage). The smaller is the gap, the more objective is the evaluation, as well as the higher the gap is, the greater is the necessity to change personnel management. So a specific questionnaire was administered to employees of individual business departments that, based on this verbal feedback, revealed that the institution has possessed highly specialized skills over time.

The employee satisfaction indexes are closely related to staff turnover, because their variation is converted into an increase/decrease in turnover unless this variation does not depend on variables external to the company. From their analysis, conducted through a questionnaire addressed to employees belonging to the three corporate departments (administration and finance, technical, and commercial), the quality of the business climate (positive and negative) can be diagnosed and so can be identified, if necessary, areas for improvement.

The structural capital indicates the ability of the organization to create positive economic results with an efficient work system that enables workers to make better use of their knowledge and professional skills. The synoptic Table 2 shows the indicators identified in order to assess the value and flexibility of this corporate capital. The analysis of the data shows that the company operates efficiently and effectively, with a good system of control and verification of the ability that causes a positive effect on the management system.

For a company, relational capital is the external component of intellectual capital and includes all the relationships between the organization itself and its customers. Table 3 shows the indicators identified in order to assess the value and flexibility of this corporate capital.

Explicating to this point the consistency of corporate intangibles assets, the company's market value has been calculated (Del Giudice and De Paola 2014a; Morano et al. 2015a; b) using the asset-income mixed method (formula of perpetuity, in view of the fact that the company is an institution destined to last over time) using as reference the following inputs (see Table 4): R is equal to the ordinary, annual, and current income for the reference year (derived by corporate financial statements); i'' quantifies the average industry performance and the risk premium for similar businesses (derived from the prospectus for the public offering of the shipping company bonds); i' represents the pure financial compensation regardless

Table 2 Structural capital

	Year 01	Year 02	Year 03	Δ% 01/02	Δ% 02/03
Growth					
% company revenue:					
Time charter party	80%	75%	90%	−6.25%	20%
Voyage charter party	20%	25%	10%	25%	−60%
% spending certifications:					
Emas	1%	1%	1%	Constant	Constant
ISO 14001	0.5%	0.5%	0.5%	Constant	Constant
ISO 9001	0.5%	0.5%	0.5%	Constant	Constant
Investments in owned ships	26.385 Mil	23.938 Mil	8.600 Mil	−9.27%	−64.07%
Cost of rental contracts	150 Mil	131 Mil	120 Mil	−12.67%	−8.39%
Efficiency					
Employment cost/total cost	0.90%	1.43%	2.18%	58.88%	52.44%
Stability					
Strategic knowledge, organizational, business structure	–	–	0.93	–	–
Methods and styles of management	–	–	0.92	–	–
Management and control	–	–	0.85	–	–
Organizational vitality and openness to change	–	–	0.84	–	–

of the degree of risk risk-free rate derived from Bloomberg data); K is adjusted net equity of the company (derived by corporate financial statements).

4 Results and Concluding Remarks

The market value of the shipping company can be expressed as the sum of two terms, the tangible assets value and the intangible assets value, with the latter comprising, in addition to the intellectual capital, also the assets related to marketing and technology.

Table 3 Relational capital

	Year 01	Year 02	Year 03	Δ% 01/02	Δ% 02/03
Growth					
% revenue from active customers: charterers	60%	70%	75%	16.67%	7.14%
% revenue from new customers: charterers	40%	30%	25%	−25%	−16.67%
No. of new customers	21	20	16	−4.76%	−20%
Web research analysis (No. citations)	–	–	4770	–	–
Web research analysis (No. pages)	–	–	147	–	–
Efficiency					
Damages cost	31.000	70.000	61.000	125%	−12.85%
Stability					
No. of customers	50	55	60	10%	9%

Table 4 Company's valuation

Company's valuation	Year 02	Year 03	Δ% 02/03
K	67,588,701	72,490,948	7%
R	1,351,709	2,018,930	49%
i″	2.45%	2.61%	6,5%
i′	1.54%	1.91%	24%
W = [K + (R − i″ K)/i′]	47,834,534	79,135,778	65%

The increase of 65% of corporate value from the year 02 to year 03 (see Table 4), considering as practically constant the value of tangible assets in the reference years, can be attributed only to intellectual capital and not to the brand or other intangible assets (noting that, for a ship-owning company,, the size of the fleet is essential).

Specifically, analyzing the three specific aspects of intellectual capital, human capital gives no contribution to business value: in fact, the number of employees has remained constant over the years as the specialist skills, and staff turnover is decidedly absent. The structural capital instead gives an important contribution because the investments in owned ships dropped by 64%—in the active leases, there is an increase of 20%, the cost of charter contracts are down by 9%, and staff efficiency increases significantly due to the introduction of a bonus-incentive system. The relational capital also gives an important contribution: in fact, the turnover rate from active customers increases 7% (customer loyalty capacity) and the number of customers grew by 9%; finally, cost of damages fell by 13%.

In conclusion, the analysis of intellectual capital highlights strengths and weaknesses of the company, in order to take into account possible future corporate developments:

- Strengths: incentives of economic performance through monetary bonuses; satisfactory interpersonal skills with customers; long relationship with customers; sharing corporate objectives by internal customers who have the pleasure of being part of a team and to grow professionally; the institution's ongoing commitment to pursuing the international freight service with a reduction of the charter contracts.
- Weaknesses: low level of staff training, to be countered by a continuous and dynamic acquisition of knowledge and skills.

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Appraisal Analysis of Social Costs of Road Accidents

Francesca Salvo, Manuela De Ruggiero and Valentina Farace

Abstract The road accident is certainly one of the most dramatic events in the existence of an individual, with important consequences to the personal and subjective perspectives, which are difficult to be quantified and surely not negligible, but also to the collective perspective, in terms of financial commitments that in different ways weigh on the whole society, for an event which only involved a restricted number of citizens. The quantification of the economic loss presents complex characteristics linked to the number of subjects and objects potentially involved in the accident, to be translated into the definition of a multiple function of the loss that connects the dependent variable (the loss) with the set of independent variables ascribable to different cost voices linked to road accidents—loss of the productive ability, human costs, sanitary costs, administrative costs, legal costs, and material damage to third parties' properties. The valuation of the aforementioned costs supposes practical and methodological questions; the practical problem concerns data availability, the methodological question concerns the tools. The problem can be solved within an evaluative perspective, after having defined the valuation's standards and the valuation's procedures, identifying them among the ones recognized by the *International Valuation Standards* (IVS). This work proposes to address the problem of the social costs of road accidents in evaluative terms, defining first standards and procedures of valuation, with particular reference to social costs from road accident related to human costs, both patrimonial and non-patrimonial ones.

Keywords Road accident · Social costs · Productive ability · Non-patrimonial damage · Human costs

F. Salvo (✉) · M. De Ruggiero · V. Farace
Environmental and Chemical Engineering Department, University of Calabria,
Ponte Pietro Bucci, Cubo 46b, 87036 Arcavacata di Rende, CS, Italy
e-mail: francesca.salvo@unical.it

M. De Ruggiero
e-mail: manueladeruggiero@gmail.com

V. Farace
e-mail: valentinafarace@libero.it

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1 Social Costs Derived from Road Accidents

The quantification of the social cost of road accidents presents complexity characteristics linked to the number of subjects and objects potentially involved in the event.

The procedure of valuation of the economic loss is based on the principle of indemnifiability and on the function of the loss that links the economic loss (dependent on a variable) with the concrete variables set.

According to the principle of indemnifiability, the appraisal of damage has to refer, jointly or separately, to the material damage represented by the expenses necessary for restoration and for taking action on the stricken good, and to the financial damage represented by the actual lost income, as well as by moral and physical harm suffered by the victims of the accident. The economic damage can be expressed through a multiple function, which in general terms considers the categories of cost listed below:

- human cost, both loss of productive ability and non-patrimonial damage;
- sanitary costs;
- administrative costs;
- material injuries.

By the expression human costs we mean to quantify: the loss of productive ability, that is the missed present and future production of the victims of the accident, as a consequence of temporary or permanent estrangement from the place of work; the part of non-patrimonial loss that represents the loss of the psychological and physical integrity of the person and of her or his relatives (moral injuries in case of death and biological in case of injuring).

Sanitary costs are all the medical costs in some way related to the accident: ambulances, airplanes, emergency room (ER) treatment, recoveries, rehabilitation, and all the other types of costs necessary for the recovery of the psychological and physical functioning of the victims.

In the valuation of the economic loss should be included all the administrative costs related to the management of insurance enterprises, the costs of the intervention of the public authorities (security forces and fire fighters), the legal costs (supported by the legal administration of resolving disagreement over civil responsibility), and the material loss to third parties (costs for repairing the vehicles, the road, and all of its parts, etc.).

Any valuation analysis aimed at quantifying these cost should necessarily start from the ordinary parameter, one of the five cornerstones of the evaluative methodology, that assumes the objectivity of the valuation judgment in terms of the general efficiency of the assumptions and results of the valuation.

The loss of productive ability, meaning the loss of production for temporary or permanent estrangement from the place of work for the subjects involved in a direct or indirect way in the accident, can be evaluated recalling the parameter of valuation of lost value. The valuation procedure can be linked to the compounding of lost income, defining a horizon of time correspondent to the time of inability and predictable earnings related to the age of the subject involved in the accident.

Sanitary costs, instead, can be evaluated using the cost value and the cost approach methodologies, summing all the sanitary costs necessary to the intervention of assistance vehicles, to ER therapies, recovery and rehabilitation, based on national rates, generally linked to the severity of the injuries.

For administrative and legal costs, the same parameters can be used, while for the material injuries to third parties, more precisely, the economical parameter is linked to the reactivation cost of the injured goods, summing the costs of the reactivation when possible (costs to repair the vehicles, the road, and its parts).

2 Criteria and Method for Calculating Human Costs

If the parameter of objectivity finds acceptance in the definition of parameters and tools intended for the determination of these cost categories, on the contrary, the valuation of human costs sets methodological and deontological problems that can only with difficulty be solved in an objective way.

In general terms, the injury to the person considers the totality of all injuries, patrimonial and non-patrimonial, that a subject experiences after an inemnifiable accident.

The patrimonial injury refers to the ability of a person to supply economically relevant services, this being a source of earnings: it constitutes the injury caused to patrimony in terms of loss of earnings caused by temporary or permanent injuries caused by the accident.

The patrimonial injury itself is not enough to ensure an appropriate compensation after an accident, because the two-fold limitation of not being able to identify compensation for someone without an income, and the impossibility of justifying the compensation if the injury doesn't affect earnings.

Since the injury to a person has to exclude work capability, it is necessary to quantify appropriate compensations for the biological injury, which means that every injury to psychological and physical integrity that could reflect other activities, situations and relationships in which the person experiences during life (not only the productive life, but also the spiritual, cultural, affective, social, sportive one, and all the circumstances in which the person can express her/his personality) and for the moral injury, meaning the anxiety and the suffering.

In some cases, the concept of the existential injury is recalled when, beyond the physical injury objectively ascertainable from a medical and legal point of view, and beyond the pain and the concern caused by the accident, in the internal world of the injured, there are also permanent injuries, objectively ascertainable, that affect concrete changes, in a negative sense, in the quality of life, such as the upsetting of daily habits, of the balance and the harmony of a family, and of affective, and relational expectations.

For the principle of the equality of the value of all, it's necessary to observe that the biological injury, the moral and eventually the existential one, has to correspond equally to the subjects that suffered the same injury. On the contrary, the patrimonial injury, being linked to specific conditions of the earnings of the subject, has to correspond proportionally to these parameters, being different from one subject to another.

And for this last type of injury, the identification of the price of compensation is obvious, the parameter of evaluation being easy to identify, i.e., the lost value. The application of the valuation procedure is simple, referable to the capitalization of fluxes of lost income; it's just the actualization in a sum of money of a series of future earnings ordinarily predictable for a subject, for a period of time that corresponds to the time of lost earning.

More complex is the valuation of non-patrimonial injuries, because they are linked to intangible resources and so are difficult to quantify in monetary terms.

If the matter relating to the identification of the appraisal criterion appears solved, unanimously identified in the complementary value, research into the definition of the appraisal procedure is still underway. In Italy, the routine of insurance compensations involves using preset parameters, identified by Italian courts, based on the use of tabs whose variables are essentially linked to the age of the injured and to the degree of disability verified by a medical examination, without any reference to the income or to the patrimonial situation.

If this method, on one hand, theoretically ensures homogeneity of judgment, on the other hand, it poses the difficult task of translating into monetary terms immaterial and extra-economical characteristics with stiff and predetermined outlines, and, for this reason, it is not really compliant with the nature of the injuries that it supposes to evaluate.

The valuation of the extra-economical injury is not easy to solve, but it is possible to be carried out; for this reason, we have to observe that one of the cornerstones of the valuation discipline, the price postulate, affirms that the valuation judgment has to be expressed in monetary terms.

For quantifying the extra-economical categories, the literature aims to aspire to the "Wellness Economy", a new research orientation meant to solve problems related, in particular, to the transfer of the valuation of the quantity to the valuation of the quality, from the perspective of the subjects not already defined but also potentially so in the future.

More specifically, the valuation of the non-patrimonial injury, coming from injuries and consequent suffering and repercussions in private and relational life, could be represented using the availability to the necessary sacrifice to get back full psychological and physical integrity, using the analysis of the monetary cost supported by a subject, as a private citizen, but also as a member of the collectivity, to preserve her/his own condition in the status quo ante.

Among the methodologies most frequently cited in the literature for the economical valuation of death and injury risk caused by road accidents, one must mention the procedure called Statistical Life Value (Putignano and Pennini 1999).

This methodology considers the use of two different approaches, the procedure of the human capital and the one of the willingness to pay.

The first procedure has the aim of evaluating the value of statistical life (VOSL) using the capitalization of future missed earnings. In works about road security quoted in the European Community literature, for example, the use of a conventional value for man's life is common, namely, the one-million euro rule (Despotin et al. 1998), a value based on average loss of gross production, giving an economical loss to the collectivity which is the same as the value of the output that should have been produced by the subject if he didn't get hurt in a way that prevent her/him from working.

As we can see, it's a resizing approach which ignores the deep impact that a dramatic event like an accident has from a subjective perspective, ignoring the importance of intangible values and violating the principles of the wellness economy.

The second approach, known as the method of the willingness to pay (WTP), or of the willingness to accept (WTA) is based on the detection of individual preferences evaluating how much the subjects are ready to spend to prevent the risk linked to a certain event.

In practical terms, the willingness to pay or to accept can be empirically evaluated using two different procedures, the one of the revealed preferences and the one of the declared preferences (Carthy et al. 1999; Jones-Lee and Loomes 1995).

The method of the revealed preferences is based on the use of the contingent valuation that, in a fairly direct way, wants to get information about the willingness to pay for a hypothetic improvement of security conditions and reduction of the risk, typically rather restrained, from a representative sample of the population at risk.

The main characteristic of the Contingent Valuation is that the interviewed subjects are asked to express directly their willingness to pay, normally through specific questionnaires.

An alternative approach is the method of the revealed preferences, based on the observation of the behavior of the subjects in some relevant markets for that specific type of goods or in situations in some way related to the analyzed one (for example, the purchase of more secure vehicles, or the use of the safety belt, etc.).

The two different approaches have limits and advantages (Lanoie et al. 1995) that, in practical terms, can be identified in the large range of values evaluated using the two different approaches.

The method of the declared preferences risks being strongly influenced by the geographical and cultural scenarios, from the income and from the educational level (Alberini et al. 2004; Bowland and Beghin 2001), but also from the appointed scenario and from the initial level of correspondent risk (de Blaeij et al. 2003); the method of the revealed preferences, on the other hand, is usually hampered by the absence of the information necessary for the comprehension of the perception of the risk by subjects potentially involved in the supposed scenarios.

Even if an approach based on revealed preferences might seem potentially better, studies of the value of statistical life using this approach proved a variable trend of the results, depending on the particular situations in which the data are analyzed.

The approach of the contingent valuation, on the contrary, enables control of the situation and the critical valuation of the answers, with a high probability of coherence and relevance.

During the last 20 years, the valuation of the value of statistical life using the WTP has been performed through the method of declared preferences (Viscusi and Aldy 2002; Rizzi et al. 2003; Hojman et al. 2005; de Blaeij et al. 2002), considering this method more reliable compared to the one of revealed preferences.

In this work, we want to use the method of the contingent valuation for the valuation of VOSL, aiming to give useful information, on a background, the national one, which, in the principal bibliography of valuation of social costs of road accidents has used conventional values to quantify human costs.

3 Appraisal of the Economic Damage Related to the Loss of Productive Ability

The injury linked to the valuation of the loss of productive ability is quantifiable after having identified the practical reason for the valuation. The parameter of the missed value, meant as the difference between the market value given to a good in an hypothetical market and the market price of the same good in a real market (Simonotti 2006), is defined by the valuation method, univocally identified in literature in the financial method (*Income Approach*) and in the shape of the *Yield Capitalization* (IVSC 2011).

The method considers the capitalization of future missed earnings, actualizing a series of future earnings commonly predictable for a subject in an actual money capital, for a period of time corresponding to the period of missed earnings.

Starting from the premise that the estimation analysis has to formulate judgments ordinarily valid and not economic judgments (referring to the specificity of the subject), the variables that have to be considered in the valuation of this type of injury are represented by the productive capacity related to the age of the involved subjects, and by the length of time of missed ability, without referring to specific productive capacities.

The actual value of future losses for missed productivity is calculated as:

$$A = \sum \left(R_j \frac{1 - (1 + i)^{-n}}{i} \right) \tag{1}$$

where

- A is the actual value of future losses for missed productivity (i.e., the injury),
- Rj is the earning ordinarily predictable for a certain range of age j,

- n is the time of unproductiveness,
- i is an actualization rate.

For what it may concern, the ordinary productivity *Rj*, usually the reference, is represented by the distribution of Domestic Gross Product (GDP), e.g., for the region, quantifying the productive quote ascribable to the subject and multiplying this value with a coefficient that conveys the productive parabola of people during their productive stage.

The actualization rate i can be obtained from the time series of price-index numbers, available in the databases of the statistical institutes or derived using statistical methodologies (Salvo et al. 2014, 2015).

The productive parabola can be represented using the Laffer curve, designed by the American economist Arthur Laffer in 1980 in a financial context, but it can be used for the human capital (Sabetta 2004); the human being, as every other productive factor, has a certain range of output that can be sketched using a bell curve in a graphic that reports (on the abscissa) the age and (on the ordinate) the productive percentage (Fig. 1).

Laffer's curve can be built for points, assuming a perfectly symmetrical parabola that has two intercepts with the abscissa's axis, the first corresponding to the beginning of working age, the second corresponding to life expectation (Odifreddi 2004).

The productive parabola has to be differentiated for males and females, with a life expectancy of 79.4 years for men and 84.5 years for women (ISTAT 2012).

The outcome curve can be expressed in this way (Figs. 2 and 3).

In the valuation of the lost production, the future missed earnings are actualized using a specific rate calculated on the basis of the prices index numbers derived from Gross Domestic Product (GDP) in the period 2002–2012. The horizon of time is represented by the number of inability days if slightly hurt; it means, in cases of permanent injuries or death, the number of years equal to the difference between the age at which the accident occurred and life expectancy related to age.

Based on these considerations, the loss of productivity linked to a single accidental event can be evaluated clearly for every involved subject, distinguishing male and female as:

Fig. 1 Productive parabola

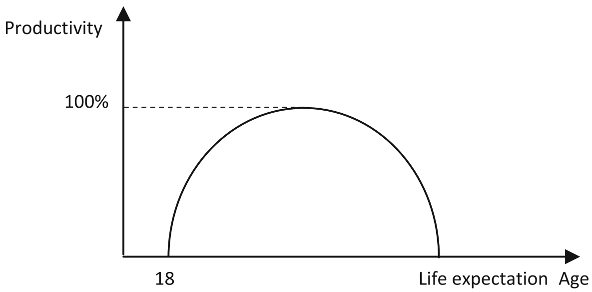


Fig. 2 Production parabola for males

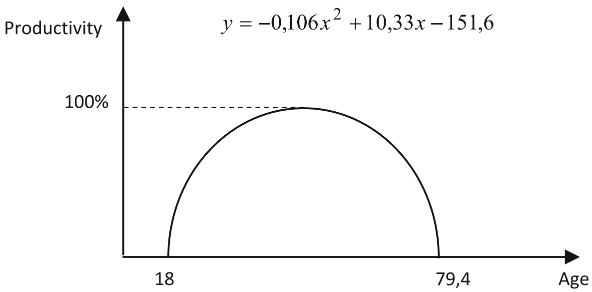
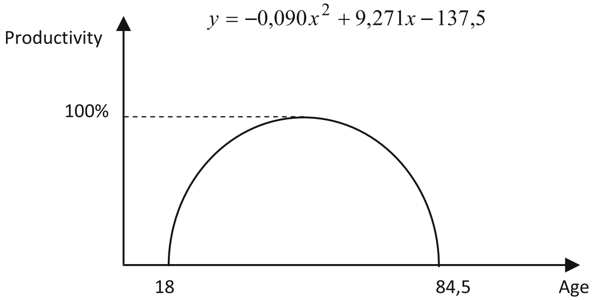


Fig. 3 Production parabola for females



$$A = GDP_{pro\_capita}(-0.106\ age^2 + 10.33\ age - 151.6)\frac{1-(1+i)^{-n}}{i} \quad (\mathrm{M}) \quad (2)$$

$$A = GDP_{pro\_capita}(-0.090\ age^2 + 9.271\ age - 137.5)\frac{1-(1+i)^{-n}}{i} \quad (\mathrm{F}) \quad (3)$$

where

$$i = 100\left(\frac{GDP_{2012}}{GDP_{2002}}\right)^{\frac{1}{10}} - 100 \quad (4)$$

and GDP_{pro_capita} represents the gross domestic product (at purchasing power parity) per capita, i.e., the purchasing power parity value of all final goods and services produced within a country in a given year, divided by the average (or mid-year) population for the same year. The valuation of the total loss of productivity linked to each accident requires, respecting the methodological rigors, precise knowledge of the sex and the age of each victim, and also of the length of disability in case of injury; we also have to specify that the loss of productive capability concerns all the subjects indirectly involved in the accident. Normally, the road accident detection tabs of the Italian National Institute of Statistics (ISTAT) don't consider the collection of information about the disturbances of traffic, and it's not possible to identify data of the importance of the injuries to the victims to calculate the times of missed productivity.

This level of information does not allow a precise valuation of the missed production and, in practical terms, it requires simplification on the number of subjects involved and assumptions on the time period, assumptions which are made more complex by the lack of distinction between slight and severe injuries. ISTAT survey does not give any information about the level of importance of injuries, thus creating major simplifications.

Even if, in theory, the methodology offers the possibility to evaluate analytically the loss of productive capacity, the nature of data makes it practically difficult to apply the methodology itself.

The other option is to use procedures for the valuation of human capital, such as a summary of patrimonial injuries (for missed productivity) and non-patrimonial (regarding the interior perspective of subjects) through the quantification of human costs linked separately to death or to injuries.

4 Non-patrimonial Damage Appraisal

The valuation of the value of a person has always been an ethical problem, negatively impacting on the dignity of a person to be assigned an economical or monetary valuation.

The recognition of human rights, with the aim of protecting human beings' prerogatives and compensating for the losses caused by others responsibilities, on the life conditions of some subjects, necessitated research into a quantitative approach that, without the aim of being an absolute reference or establishing a financial correspondence, could give generally accurate direction for the economic impact generally normally ascribed by society to the risks to life or health.

Costs ascribable to the risk of death or decline of the quality of life are not easy to define, because they are not only direct losses (loss of production), but also indirect costs and affective costs (Pierantoni 1986), in terms of the degree of suffering and difficulty of adjustment for the relatives after a premature death (moral injury) or discomfort or suffering for injuries apart by the loss of earning capacity (biological injury).

The implicit complexity in the valuation of the value of a person is evidenced by the wide range of values reported in a many empirical studies that can be found in the international literature, going from 200,000 € to almost 30 million euro, when encompassing various countries and backgrounds of analysis (Cohen 1980; Persson and Cedervall 1991). A 1999 work proposes contingent valuation as the evaluative methodology. The method's based on the idea that, in order to evaluate goods that are not in markets—man is surely the most significant example—it's possible to ask the subject directly what value they'd give, or better, which monetary value they'd be willing to pay or to accept for the good itself.

The valuation of non-patrimonial injuries can be solved through the construction of a set of demand curves with the information collected regarding the willingness to pay, information verified concretely through costs in order to assess the causes of damage to the single citizen, and also through the outcomes of all the collectivity to maintain a certain level of psychological and physical functionality of each subject.

The approach used is linked to the willingness to pay WTP, through analysis and elaboration of data collected by a questionnaire completed by a variety of subjects, over 18 years of age, in the area of Cosenza, producing a sample of more than 1350 direct interviews collected from June to September 2012 (Festa et al. 2012).

To collect the data, we have considered to use the technique of the iterative game, extracting randomly a price from a series of growing preset amounts and modifying the offer in the framework of a conveniently defined range. The survey has been administered by five different interviewers, working in different roles in university activities, aware of the purposes of the survey, and adequately instructed.

The procedural the approach to the subjects of the sample anticipated a very short interview, lasting 20 min, directed to university students and academics, as well as customers of shopping centers and service sector operators.

The results of the analysis are reported in Table 1.

As we can see, the willingness to pay is certainly larger for the decreased risk of death, and gradually lowers for severe and slight injuries.

The observation of the results and the comparison with values obtained in other European countries (Le et al. 2011) suggest the conclusion that the price obtained for the decrease of risk of death, meaning the sum of the patrimonial injury and of the non-patrimonial one, seems acceptable while the prices obtained for the scenarios with severe and slight injuries seem less reliable.

The reason for this discordance has to be searched in the nature of the utilized procedure, that leads to assessing very high prices for the decrease of risk of injury (Le et al. 2011), because of the direct and personal involvement of the respondents.

Studies done in a European setting propose the valuation of the human cost in the case of injuries as a percentage of the price obtained in the case of death. In particular, the reference is reflected by the advice from the Conference of Ministers of Transport (ECMT), that evaluate as 13 and 1% the fractions of human cost caused by slight and severe injuries, prices shared by the principal studies in the transport sector (UNITE 2003; HEATCO 2005; IMPACT 2008).

Table 1 Value of human capital with a maximum frequency

	Value of the human capital (maximum frequency f = 150)
Death-risk reduction	V = €202,644,000
Permanent serious-injuries risk reduction	V = €156,429,400
Permanent light-injuries risk reduction	V = €94,265,900

Considering the human cost of death corresponding to maximum frequency equal at:

$$C_{death} = €202{,}644{,}000 \tag{5}$$

the human costs for severe and slight injury can be directly evaluated as:

$$C_{seriousinjured} = €202{,}644{,}000 \cdot 0,13 = €26{,}343{,}720 \tag{6}$$

$$C_{lightinjured} = €202{,}644{,}000 \cdot 0,01 = €2{,}026{,}440 \tag{7}$$

In Italy, the distinction between severe and slight injured is unknown, because the archives of accident data held by ISTAT only reports the total number of injured, without making any distinction concerning the degree of the injuries.

Keeping in mind the definition of seriously injured proposed in the glossary of the European road accident database CARE/CADAS, for which an injured can be defined seriously injured when, after an accident, she/he had to recover in a hospital for at least 24 h, it's possible to entrust to the valuation of the division between seriously and slightly injured, based on the historical data of recoveries after accidents supplied per region.

Referring to a work done by the administration of Piedmont (Italy), it's possible to verify that the percentage of seriously injured is around the 14% of the total injured, reducing to 86% for the slightly injured (Ministero delle Infrastrutture e dei Transporti 2012).

Based on this distinction, it's possible to calculate a medial total cost for the injured as:

$$C_{injured} = C_{seriousinjured} \cdot 0.14 + C_{lightinjured} \cdot 0.86 = €5{,}430{,}859 \tag{8}$$

which is the total cost of the patrimonial injury and of the non-patrimonial injury subsequent to the accident.

5 Conclusions

The human cost appraisal has always seemed to be an ethical issue, resulting in an economic or monetary assessment that might appear to denigrate human dignity.

The recognition of human rights, however, imposes a research for a quantitative approach that, without the pretension of becoming an absolute reference, nor to establish a financial compensation, could provide information about the economic impact generally referable to the risk of life or health.

The research described in this work aims to identify a scientific procedure oriented to the formalization of the valuation equation of the human costs related to the phenomenon of road accidents, underlining for each cost factor the important variables, the parameters of valuation and the analytic procedures for their quantification, respecting the principles of the valuation itself.

The described method is based on the main reference literature and employs a repertoire of incidental data available in Calabria, Italy, but it can be used in other situations where a database of incidental data is available.

The method is not intended to quantify the value of life, certainly immeasurable, but to provide a useful tool to management and economic policies of control and analysis of the incidental phenomena.

Even if the European trend shows a progressive decrease in the number of accidents per year, the phenomenon of road accidents continues to have important dimensions, which reflects in economic terms on indirect responsibilities that weighs on each member of the collectivity.

It's this invisible impact that affects the pockets of everyone and that should bring us to reflect on how to intervene in order to reduce the accident numbers, and to evaluate the dramatic consequences linked to the loss of human lives.

The phenomenon of road accidents assumes even more important dimensions when it produces extra-patrimonial damages that, even if quantifiable with suitable valuation tools under a methodological and ethical perspective, even if perfectible, only in part correspond with the great suffering that is imposed on the victims of such dramatic events. A human beings, in effect, carries inside a unique, singular and irreplaceable heritage, and its price cannot really be quantified by an evaluation procedure.

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The Definition of Fair Divisional Projects in Bankruptcy and Inheritance Disputes

Francesco Tajani and Pierluigi Morano

Abstract In this research a model to support the definition of efficient and fair divisional projects in considerably complex bankruptcy procedures and inheritance disputes has been developed. The model is based on the principle that is generally pursued in defining shares to be assigned for inheritance divisions, according to which the assignment of the deceased's assets must minimize the monetary compensations that result from the difference between the heirs' legal right shares and the portions to be assigned to them. The application of the proposed model demonstrates its validity, implemented by user-friendly software. The work must be attributed in equal part to the two authors.

Keywords Property valuation · Liquidation · Bankruptcy · Inheritance

1 Introduction

Among the most important effects generated by the current economic crisis, the increase of legal disputes requires a specific in-depth analysis. According to Credit Reform's bankruptcy statistics (Cerved 2014), in 2008 more than 150,000 European companies were obliged to initiate the liquidation procedure. Between 2007 and 2008, the number of insolvent companies increased by 139% in Spain, 121% in Ireland, 21% in Italy, and 15% in France and the United Kingdom. After 2008, the continuing loss of jobs, the reduction of consumption, the credit crunch, and the psychological effects produced by bankruptcy declarations (Ferris et al. 1997; Iqbal 2002; Lang and Stulz 1992) have further worsened the economic situation. The stagnation of the European real-estate market, affected by the global

F. Tajani (✉) · P. Morano
Department of Science of Civil Engineering and Architecture,
Polytechnic of Bari, Bari, Italy
e-mail: francescotajani@yahoo.it

P. Morano
e-mail: pierluigi.morano@poliba.it

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recession, has prolonged the duration of bankruptcy procedures. The difficulty in executing the auctions of property assets of bankrupt companies—and their subsequent conversion into cash—has affected the efficiency of the economic system and the creditors' opportunity to quickly recover their capital.

Numerous legal disputes also concern inheritance divisions, especially in countries where legal right shares are provided for the heirs (*legitima portio*) and the assets of the deceased are characterized by a considerable economic range. In these cases, it is necessary to define the fairest divisional project for the parties involved (Hamnett 1991).

In this context, the direct transfer of property assets of the debtor to creditors, provided in many countries by specific bankruptcy laws, could offer several advantages. On the one hand, it could reduce the duration and the costs of judicial procedures by transferring to creditors the burden of the assets' sale (Branch 2002); on the other hand, it would make possible satisfaction—fully or partially, if monetary compensations were necessary—the creditors, which could: (a) try to sell the assets assigned without the constraint of the judicial procedure, which mainly attracts investors interested in making an underpriced deal, whereas it keeps away ordinary buyers (Pulvino 1999), (b) obtain revenues from the properties, postponing the sale until more favorable market conditions exist. However, the lack of adequate evaluation skills and the risk of generating unfair assignments generally influence the insolvency practitioners who avoid the elaboration of a divisional project of the assets and prefer their auctioning.

2 Aim of the Work

Considering the aforementioned framework, the aim of this research is to develop and test a model to support the definition of efficient and fair divisional projects in considerably complex cases. This model can be used in: (a) bankruptcy procedures, in particular, in the phase of arrangement with creditors, providing the direct transfer of the assets owned by the debtor to the creditors; (b) inheritance divisions, if the deceased's assets are numerous and there are several heirs with similar or different legal right shares. The model is based on the principle that is generally pursued in the inheritance divisions for defining shares to be assigned, according to which the assignment of the deceased's assets must minimize the monetary compensations that result from the difference between the heirs' legal right shares and the portions to be assigned to them. This criterion aims to satisfy, as much as possible, the parties involved through the attribution of assets, reducing any possible charges related to the acquisition of sums of money for the heirs.

The appraisal of the value of the assets and the analysis of the conditions of concrete divisibility of each asset are fundamental prerequisites for the implementation of the model. Once the number of assets to be assigned and the corresponding market values have been specified, the model enables obtaining, through the development of a logical path characterized by the steps of *data entry*, *calculation* and *outputs*, the optimal composition of the shares to be attributed to the parties involved.

Furthermore, considering the data-entry phase, the model has been developed in order to take into account: (a) preemption rights related to the different ranks of creditors in bankruptcy procedures or to any legatees in hereditary successions; (b) possible "preferential" restrictions related to particular conditions which may lead to prefer—in order to prevent further disputes and speed up the procedures—the assignment of certain assets to specific subjects (e.g., in an inheritance division, a deceased's asset is the house of an heir).

The work involves three sections. In the first one, the major international legal principles concerning bankruptcy procedures and inheritance divisions are illustrated. In the second section, the concept of "comfortable" divisibility is clarified, as a support for the estimation phase, which is preparatory to the implementation of the model. In the third section, the three steps of the model are explained, and an application is developed, in order to test its validity and user-friendly configuration. Finally, conclusions are discussed. The algorithm of the model, codified in Visual Basic 5.0, can be requested and obtained from the authors.

3 Bankruptcy: The Legal Admissibility of the Transfer of the Assets to the Creditors

In most European countries (e.g., Italy, France, Belgium, Latvia, and Austria), bankruptcy laws provide a first phase of judicial settlement, called the *arrangement with creditors*, focused on rescuing the company, keeping the activity and the employment and the liquidation of debts in any form, including the direct transfer of the assets. In this phase, it is essential to develop a restructuring plan taking into account the debtor's assets, their market values as estimated by experts, and the different ranks of the creditors, giving priority to the ones privileged by, for example, guarantees such as pawn or mortgage (*secured*), and then to the ordinary creditors (*unsecured*). In any case, the main purpose of the phase of arrangement with creditors is to try to avoid the bankruptcy of the company, with any procedure that allows minimization of time and costs, supporting creditors' interests (Armour and Cumming 2008; Niemi-Kiesilainen 1997; Sak and Schiffman 1994).

In the Netherlands, the bankruptcy law (Act of 09/30/1893, as amended) does not prescribe any procedure to rescue the insolvent company. However, in cases of bankruptcy, by request of interested parties, the judge can set a period of reflection, valid for any third party for the recovery of the debtor's assets. In Finland (Law No. 120/2004), a preventive measure of rehabilitation—not legally regulated—through which the debtor may reach agreements with creditors on debt payments, or other arrangements outside official insolvency procedures, is provided. Even in Sweden (Laws Nos. 672/1987 and 764/1996), the insolvent subjects, called *konkurs*, may enter into voluntary arrangements with their creditors, seeking to reduce debts without any specific regulation. In Spain, Law No. 38/2011 has radically reformed the Law No. 22/2003, introducing a series of major changes according to the current global economic situation. In particular, this law aims to prevent the prolongation of a debtor's insolvency, avoiding a serious injury to the creditors. Moreover, it provides a simplified procedure to enable the debtor in reaching an arrangement with creditors. In the US, several forms of judicial settlements may be activated by either the debtor companies or creditors. In these cases, an "exclusivity period" is granted to the company that is experiencing the crisis (Chapter "Market Prices and Property Taxation in Italian Real Estate: A Turin Case Study", US Bankruptcy Code), during which the judge ensures the survival of the business activities (Francois and Morellec 2004). In Italy, recent changes to bankruptcy laws have been introduced by Law No. 132/2015. On the one hand, it aims to bring the parties involved in bankruptcy procedures to preferring an arrangement with creditors, reversing the trend of the ordinary practice that more and more frequently ends with the suspension of the procedure, due to its excessive length and the large discrepancy between the estimated values of the debtor's assets and their settlement prices (art. 108 of the Italian Bankruptcy Law). On the other hand, the new legal provisions try to guarantee the elaboration of a fair divisional project, ensuring to the unsecured creditors—who have always been the most penalized figures in bankruptcy procedure—minimum satisfaction, representing at least one-fifth of the respective debt.

4 Inheritance Divisions

After the death of a subject, i.e., the owner of property and non-property assets, social and ethical reasons prevent the conclusion of all the relationships gradually established during his life with several persons, first of all with his relatives (Hirsch 2004). There is hereditary succession when the deceased, having rights and obligations concerning assets, is succeeded by one or more persons, called "heirs".

In general, the attribution of the right to succeed can occur: for *legitimate* succession, when there are no testamentary dispositions; for *testamentary* succession, if the deceased has expressed his will in favor of his heirs; for *necessary* succession, when the testament and/or donations made in life have affected legal right shares.

The principle of *legitima portio* exists in many countries, and it aims to protect the interest of certain categories of heirs, in favor of which a share of the deceased's assets is always reserved, even against her/his will (Langbein and Waggoner 1987; Litman 2005). The remaining part of the deceased's assets represents the "available" share, of which the owner, during his life, may freely dispose. National laws establish the legal right shares in favor of specific heirs. Once the heirs' shares established by laws or by the deceased's will have been unveiled, it is essential to evaluate the assets and to define the portions to be attributed to the heirs. The portions of the heirs are defined: (i) considering the number of subjects involved;

(ii) in proportion to their legal right shares; and (iii) considering market values estimation of the deceased's assets that remain after the payment of debts incurred during her/his life. It is necessary to identify well-defined portions, ensuring that: (a) each heir is the exclusive ownership of the assets assigned; (b) the value of each portion is equal to the legal right share; and (c) legal dispositions and deceased's provisions are satisfied.

If there is inequality between the legal right shares and the determined portions, it is necessary to consider monetary compensations, as credit or debt. The need to proceed through monetary compensations is generated by indivisible assets included in the deceased's estate, or assets declared indivisible for national interest by law (e.g., libraries, galleries and collections characterized by historic, scientific, archaeological, or artistic relevance). If the deceased's estate is composed of a single indivisible property, the criterion of "preference for the majority" legal right share should be applied, i.e., the property should preferably be included in the portion of the heir characterized by the highest legal right share, with the burden of monetary compensations. If there are only equal legal right shares, unless otherwise agreed, the assignment is performed through drawings lots.

5 The Concept of "Comfortable" Divisibility

In the definition of a divisional project, the appraisal of the debtor/deceased's assets for the portions arrangement should be carried out with reference to the moment in which the division is made. In the event of a long period between the appraisal of the assets and the time of the division, a new valuation will be necessary. In fact, it is possible that phenomena such as inflation, currency devaluation, or, on the contrary, a violent deflation of property values, associated with an economic downturn, could lead into too different—in economic terms—outcomes, compared to those expected in the divisional project. The evaluation of properties must be carried out considering the criterion of the *market value*, using the approaches specified by international best practices, according to the characteristic, the intended uses and the potentialities of the properties (Appraisal Institute 1993; Tajani et al. 2015; TEGOVA 2003).

In the estimation phase, it is essential to verify the "comfortable" divisibility of the properties, i.e., the possibility to hypothesize the fractionation and then the identification of independent units for the definition of the portions. In particular, the concept of "comfortable" divisibility does not only refer to the possibility of a material subdivision of the property, but also to its potential for a real division, which can generate other properties that, losing as little as possible of the original value as parts of an unique entity, are not characterized by specific functional limitations or restrictions (Italian Supreme Court, Nos. 2305/1985, 4233/1987, 8805/1993, 9203/2004, 407/2014). In short, that the original value of the property may be impaired in some way must be avoided. The aim is to ensure that the sum of the values of the parts obtained is equal to the original value of the property as a whole. The "comfortable" divisibility, therefore, excludes the possibility to incur substantial costs, in relation to the value of the entire property, for making the parts obtained independent. The subdivision of the property must be implementable by the determination of specific autonomous and freely usable parts, that can be formed without expensive technical interventions. Finally, the subdivision should not affect the original intended use of the property, as well as it must not lead to a depreciation of the value of individual parts compared to the value of the entire property, taking into account its usual function.

Therefore, although the fractionation of a property is permissible from the strictly physical and functional standpoint, the high complementarity of its parts may affect the possibility of considering functionally and economically independent lots, since the subdivision may cause an excessive reduction of the market value of the original property, disregarding the requirements specified by the definition of "comfortable" divisibility.

6 The Model

After the estimation of assets to be divided and the verification of their "comfortable" divisibility or, conversely, the existence of phenomena of complementarity, the following model enables determination of the effective and optimal composition of the shares to be assigned.

The logic of the model translates, into a mathematical algorithm, the procedure of distribution of the assets established by the Italian normative and ordinarily used in hereditary successions (Italian Supreme Court, No. 8922/1991), known as *method of preference for entity of share*: assigned the *j*th asset with the highest value to the *i*th subject characterize by the largest legal right share, the *j*+1th asset with the highest value will be assigned to the "new" subject with the largest legal right share, identified after computing the value of the *j*th asset already assigned from the legal right share of the *i*th subject, and so on, until all the assets are assigned, providing the correction of disproportions through monetary compensations. The algorithm of the model, codified in Visual Basic 5.0, operates in order to minimize, for each subject involved in the process division, the monetary compensation—as credit or debt—required to satisfy the portion to be attributed.

The logical process of the model can be formalized in the following three steps:
Step 1: Data Entry

- (a) list of the m indivisible assets of the debtor/deceased's estate and detection of the n subjects involved in the divisional project;
- (b) attribution of the market value (V_k)—previously estimated—to each asset G_k (k = 1, …, m);
- (c) determination of the total value of assets (V_{TOT}). Denoting with apex "1" the initial phase, which precedes the activation of the cycles that characterize the subsequent step of *calculation*, it can be written:

$$\sum_{k=1}^{m} V_k^1 = V_{TOT}; \tag{1}$$

- (d′) in the case of inheritance division: knowing the legal right share p_i of each subject S_i (i = 1,…, n), this is translated into monetary terms (Q_i^1) using the formula:

$$Q_i^1 = p_i \cdot V_{TOT}; \tag{2}$$

- (d″) in the case of bankruptcy procedure: knowing the value of the credit of each subject S_i, it can already identify the respective Q_i^1.

In both situations (d′) and (d″), this initial condition must be verified:

$$\sum_{i=1}^{n} Q_i^1 = V_{TOT}. \tag{3}$$

If the total credit of the parties involved is less than the total value of the debtor's assets, the remaining share competes to a *virtual* subject S_i, to be considered for the implementation of the model;

- (e) assignment of assets for which there are "preference" constraints to the respective subjects.

Step 2: Calculation

- (f) identification of the asset characterized by the highest value (V_{max}^1) and of the subject with the highest legal right share (S_{max}^1). If there are more assets with the same highest value or more subjects characterized by the same highest legal right share, the model proceeds randomly in the choice among them;
- (g) assignment of the asset with the highest value (G_{max}^1) to the subject characterized by the largest legal right share (S_{max}^1);
- (h) determination of the residual value (Q_i^2) due to the subject S_{max}^1, that must be used in the next cycle. This value is obtained by reducing the original share Q_i^1 considering the assignment of the asset G_{max}^1. The other shares to be satisfied are not modified, except for the apex that identifies the new cycle to be activated. The shares Q_i^2 are calculated using the following formulas:

$$\text{for } S_i = S_{max}^1: \quad Q_i^2 = Q_i^1 - V_{max}^1 \tag{4}$$

$$\text{for } S_i \neq \mathrm{S}_{max}^1: \quad Q_i^2 = Q_i^1$$

Since the asset $G_{\max}^1$ has been assigned, the list of assets to be attributed is consequently updated, in a number equal to $m-1$, and their values are equally updated in the apex which identifies the cycle to be iterated. Therefore, in the second cycle the Eqs. (1) and (3) are modified as follows:

$$\sum_{k=1}^{m-1} V_k^2 = V_{TOT} - V_{max}^1 \quad \text{and} \quad \sum_{i=1}^{n} Q_i^2 = V_{TOT} - V_{max}^1. \tag{5}$$

The cycle described by the phases (f), (g), and (h) is repeated *m* times, until all the assets are assigned. In general terms, for the *j*th cycle (j = 1, …, m) the following formulas are applied:

$$\sum_{k=1}^{m-(j-1)} V_k^j = V_{TOT} - \sum_{l=1}^{j-1} V_{max}^l \quad \text{and} \quad \sum_{i=1}^{n} Q_i^j = V_{TOT} - \sum_{l=1}^{j-1} V_{max}^l, \tag{6}$$

whereas the Q_i^j are determined through the following equations:

$$\text{for } S_i = S_{max}^{j-1}: \qquad Q_i^j = Q_i^{j-1} - V_{max}^{j-1} \tag{7}$$

$$\text{for } S_i \neq S_{max}^{j-1}: \qquad Q_i^j = Q_i^{j-1}$$

Step 3: Outputs

Once all the assets have been assigned, the model formulates the list of subjects with the respective portions, consisting of the assets assigned by the process and the monetary compensations in order to satisfy the respective legal right shares. In particular, the monetary compensations (C_i) for each subject S_i are equal to the residual shares that result from the iteration and the conclusion of the *m*th cycle (Q_i^{m+1}), to be received, if they are positive, or to be paid, if they are negative:

$$C_i = Q_i^{m+1}. \tag{8}$$

7 Application of the Model

The algorithm described has been applied to a case study, concerning a legitimate succession for which the sizes of the deceased's assets, the number of the subjects involved in the succession, and the diversity of the shares to be assigned require the development of a valid divisional project.

The hypothesis is that, in the phase of appraisal of the assets and verification of the "comfortable" divisibility, the valuer has identified fifty properties (G_k, with k = 1, …, 50), characterized by the intended uses and the market values summarized in Table 1. The total value of the deceased's estate is equal to 35,090,000 €.

The subjects (S_i, with: i = A,…, R) involved in the division are eighteen, whose respective legal right shares (Q_i^1) are the following: Q_A^1 = 25%; Q_B^1 = 10.71%;

Table 1 Input data for the application of the model

Asset (G_i)	Intended use	Market value (€)	Asset (G_i)	Intended use	Market value (€)
1	Villa	830,000	26	Flat	230,000
2	Villa	1,300,000	27	Flat	290,000
3	Villa	630,000	28	Flat	225,000
4	Shed	3,500,000	29	Flat	325,000
5	Shed	4,320,000	30	Flat	250,000
6	Structured offices	4,560,000	31	Shop	150,000
7	Structured offices	3,240,000	32	Shop	120,000
8	Shopping center	2,300,000	33	Shop	430,000
9	Flat	320,000	34	Shop	620,000
10	Flat	245,000	35	Shop	360,000
11	Flat	285,000	36	Shop	270,000
12	Flat	310,000	37	Shop	380,000
13	Flat	220,000	38	Shop	160,000
14	Flat	330,000	39	Shop	175,000
15	Flat	345,000	40	Office	230,000
16	Flat	250,000	41	Office	320,000
17	Flat	215,000	42	Office	340,000
18	Flat	190,000	43	Building land	1,200,000
19	Flat	370,000	44	Building land	850,000
20	Flat	340,000	45	Building land	780,000
21	Flat	180,000	46	Farmland	430,000
22	Flat	260,000	47	Farmland	525,000
23	Flat	205,000	48	Farmland	180,000
24	Flat	310,000	49	Farmland	465,000
25	Flat	335,000	50	Farmland	395,000

$Q_C^1 = 10{,}71\%$; $Q_D^1 = 10.71\%$; $Q_E^1 = 5.37\%$; $Q_F^1 = 5.37\%$; $Q_G^1 = 3.57\%$; $Q_H^1 = 3.57\%$; $Q_I^1 = 3.57\%$; $Q_J^1 = 2.14\%$; $Q_K^1 = 2.14\%$; $Q_L^1 = 2.14\%$; $Q_M^1 = 2.14\%$; $Q_N^1 = 2.14\%$; $Q_O^1 = 2.68\%$; $Q_P^1 = 2.68\%$; $Q_Q^1 = 2.68\%$; $Q_R^1 = 2.68\%$.

Regarding any “preference” constraints, it is assumed that assets “1” and “2” represent the main dwelling respectively for the subjects S_G and S_E: therefore, these contingencies have been appropriately considered in the assignment phase. In Table 2, the outputs of the model have been summarized.

The number of assets assigned by the model to each subject involved ranges from a minimum of two to a maximum of four. The assets with the highest market values, identified by the sequential numbers “5” and “6”, have been assigned to the

Table 2 Outputs of the application of the model

Subject	Value to be assigned (Q_i^1) (€)	Assets assigned	Value of the assets assigned (V) (€)	Monetary compensation ($C_i = Q_i^1 - V$) (€)	C_i/Q_i^1 (%)
S_A	8,772,500	5–6	8,880,000	−107,500	−1.23
S_B	3,758,139	4–28	3,725,000	33,139	0.88
S_C	3,758,139	7–14–17	3,785,000	−26,861	−0.71
S_D	3,758,139	8–40–42–44	3,720,000	38,139	1.01
S_E	1,884,333	2–13–25	1,855,000	29,333	1.56
S_F	1,884,333	15–16–43	1,795,000	89,333	4.74
S_G	1,252,713	1–12–48	1,320,000	−67,287	−5.37
S_H	1,252,713	21–41–45	1,280,000	−27,287	−2.18
S_I	1,252,713	3–20–26	1,200,000	52,713	4.21
S_J	750,926	30–46	680,000	70,926	9.44
S_K	750,926	22–32–50	775,000	−24,074	−3.21
S_L	750,926	36–37–38	810,000	−59,074	−7.87
S_M	750,926	11–19	655,000	95,926	12.77
S_N	750,926	27–31–35	800,000	−49,074	−6.53
S_O	940,412	24–39–47	1,010,000	−69,588	−7.40
S_P	940,412	9–18–49	975,000	−34,588	−3.68
S_Q	940,412	23–29–33	960,000	−19,588	−2.08
S_R	940,412	10–34	865,000	75,412	8.02

subject S_A, characterized by the highest legal right share. With regard to the monetary compensations, ten subjects must pay a compensation, whereas eight subjects must be paid. The highest monetary compensation, equal to −107,500 €, concerns the subject S_A, whereas the lowest one, equal to −19,588 €, is attributed to the subject S_Q. The sixth column shows the "weight" (in percent) of the monetary compensation relating to each subject on the respective legal right share. In absolute terms, these percentages vary from a minimum of 0.71% to a maximum of 12.77%, with an average value equal to 4.60%. Despite the "preference" constraint imposed for the assignment of the assets "1" and "2", the algorithm of the model is able to strongly reduce the monetary compensations corresponding to each subject. Furthermore, the average value of the positive percentages (monetary compensations to be received) is equal to +5.33%, whereas the average value of the negative percentages (monetary compensations to be paid) is equal to −4.02%. The highest values of the positive percentages are equal to +12.77% (subject S_M), +9.44% (subject S_J) and +8.02% (subject S_R). This distribution of the monetary compensations would enable avoidance of possible disputes among the parties involved: in fact, each negative monetary compensation is paid by a single subject, but each positive monetary compensation is obtained through the sum of several negative monetary compensations.

8 Conclusions

In this research, a model that aims to ensure the fair distribution of assets among parties involved have been developed and successfully tested. The model may be used in the disputes that could arise in hereditary successions and in bankruptcy procedures. In inheritance disputes, the model could support the definition of the best solution in considerably complex situations, characterized by a large number of assets to be assigned and/or the existence of "preferential" constraints for the assignment of the assets. In bankruptcy procedures, given the current crisis in the property market, the direct transfer of assets to creditors would enable significant reduction in the duration of the procedures and avoidance of the classical shortcomings about the auctioning phases, which ordinarily generate a considerable discrepancy between the market value of the debtor's assets and the final sale prices (Pedowitz 1985).

The algorithm formulated is composed by a series of logical-operational steps which were codified in an easy-to-use software. The application of the model to an actual case has highlighted the excellent potentialities of the presented method.

Finally, it is important to remark that the defined protocol needs a preparatory phase for the implementation of the software, concerning the appraisal of the assets to be assigned and the analysis of their "comfortable" divisibility. In this phase, the professional competences of the valuer are essential, which must operate in compliance with the criteria and the approaches indicated by International Valuation Standards, in order to provide market values that are consistent with the reference market and to consequently avoid further disputes.

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Compensation for Land/Property Owners Hosting a Wind Farm. The Italian Case

Benedetto Manganelli

Abstract This paper deals with the problem of estimating the compensation for the expropriation or easement of land to be used as a wind farm and the infrastructure essential for its activity. Bear in mind that the construction of a wind farm requires the acquisition (through expropriation, or amicable agreement of the surface rights) of at least the land that must be transformed for the realization of the windmill support, while other land could be encumbered with easements. Areas identified by the ground projection of the blades are, in fact, affected by overflight easements, and all transport infrastructures linked to the wind farm generate easements (underground conduits or power lines). The issue involves many aspects and takes place in a changing regulatory framework. The case law, in relation to the frequency of cases (expropriation is certainly much more frequent than easements), has developed a well-established approach that makes specific reference to the expropriation of the entire property and not merely of the right of fruition. If one pays attention to urban planning, there is a profound difference between the two cases. In the case of easement, unlike expropriation, the procedure does not require a change in the urban destination of land. A land intended for agricultural use remains as such even if it houses a plant for the production of alternative energy. This, without a thorough analysis of the principles that underlie the decisions of the judges, could also lead to profound inequality in terms of compensation payments. The issue is therefore considered by trying to transfer those principles already established with regard to the expropriation of property, even in the case of easements, where in both cases the beneficiary is a private individual, who by virtue of the possession of land, reaps a profit.

Keywords Compensation · Expropriation · Easement · Wind farm · Urban planning

B. Manganelli (✉)
School of Engineering, University of Basilicata,
Via dell'Ateneo Lucano 10, 85100 Potenza, Italy
e-mail: benedetto.manganelli@unibas.it

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1 Introduction

In recent decades, renewable energy has achieved a significant share of power generation. Among the various sources of renewable energy, wind-power generation has experienced considerable growth. From 1998 to 2008, worldwide, the global installed capacity of wind power has increased from approximately 10 to 120 GW (EWEA 2009; Blanco 2009).

At the end of 2011, Europe accounted for 41% of the globally-installed wind-power capacity, and the top ten countries by installed capacity accounted for 86% of the total. On the same date, Italy had achieved seventh place in the world rankings with the percentage of 2.8% of the total installed wind-power capacity (IRENA 2012).

In 2015, installed wind turbines in Europe have a total capacity of 120 GW, and produce 284 TW of electricity per year (D'Amico et al. 2015). Even then, the installed capacity in Europe grows with a mean of 3% per year (Suomalainen et al. 2014).

This is why the state governments have played a key role by promoting, via various means, investment in this area. In the United States, as elsewhere, state and federal governments have considered or implemented a range of policies to create more sustainable energy-generation systems. These policies include both regulatory instruments and market incentives (Horner et al. 2013). In Europe, the Directive 2009/28/EC established a common policy framework for the promotion of renewable energy committing the member states to achieve scheduling targets in 2020.

The growth of investment in this sector is obviously influenced by the expected return. On the one hand, the profits depend on energy prices (gross of state incentives); on the other hand, they are related to the total installed cost and operating and maintenance costs of the wind farms. The following section provides a description of the factors characterizing the investment in a wind farm.

This paper focuses on a component of the investment cost: the land rent. In 2006, the land rent comprised 3.9% of total investment costs (cost structure of a typical 2 MW wind turbine installed in Europe in EWEA 2009). This study examines specifically the Italian case. This issue involves a discussion on a legal framework that regulates the compensation for the acquisition of land rights and on the jurisprudence that has formed over the matter (Sect. 3). Based on that discussion a solution is proposed to make consistent with the framework outlined the current compensation mode and the amounts paid to landowners, which exceed the value of agricultural land (Sect. 4).

2 Investments in Wind Farms

The wind farm and its related infrastructure was duly authorized by the competent body that simultaneously provided for the application of the pre-established confiscation constraint on property rights and other actual rights required for the construction of the plant, in accordance with art. 10 par. 1 of Presidential Decree 327/2001 (Manganelli 2015).

The wind farm, however, is not a public work, nor is its management exclusively granted to a public authority. It is built and operated by a private party, the so-called 'beneficiary'. The wind farm and works related thereto bring a profit to the private business that deals with the construction and management thereof.

It is true that electricity produced from renewable sources cannot yet compete with conventional sources in a free market. For this reason, the various states of the European community, including Italy, in order to promote renewable energy, and taking into account their obligations under the Kyoto Protocol, have identified various forms of incentives: investment subsidies, fixed price mechanisms, fixed premium mechanisms, and quota systems based on auctions or tradable green certificates (Ragwitz et al. 2007; EWEA 2005).

A study conducted in January 2010 by Unindustria Bologna shows that, in the context of investments in renewable energy and the gross of government incentives, wind power has very good yields, lower than biomass but higher than mini-hydro and photovoltaic (Manganelli 2014). Prior to 2010, yields reached 30% of the internal rate of return, where the percentage of self-consumed energy was equal to zero and the percentage of external capital was very high (around 90%).

There is no doubt that incentives were crucial for the achievement of these performances and now, as a result of increased competition and a perimeter of incentives for new initiatives confined to a certain amount of resources, profitability levels are no longer as high.

Figure 1 shows the reduction of the discounts on the offers of the tenders with which some companies won the most recent bids for allocation of incentives in Campania.

The increase of the discount is partly due to the increased competition in the field, but partly justified even in a progressive improvement of the production technology that enables savings in installation costs and greater technical efficiency.

Note that in recent decades, the cost of a kilowatt per hour of wind energy has dropped sharply. The reduction of investment costs was very strong between 1980 and 2000, both in the US (Wiser and Bolinger 2011) and in Europe (EWEA 2009). It resulted from technological innovations and increased production volumes leading to economies of scale. The development of larger turbines at the same time has led to a decrease in costs related to works and infrastructures—for example, roads and underground cables—that were interrupted between 2004 and 2010 (Tegen et al. 2010). The trend reversal was driven by increases in turbine costs until they reached a plateau in 2009–2010 (Lantz et al. 2012). Turbine costs, in turn, have been affected by various factors elaborated in detail by Wiser and

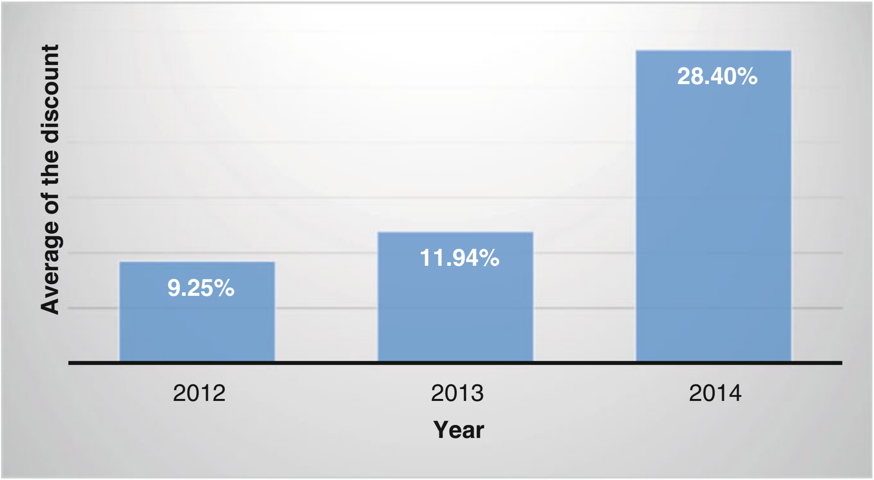

Fig. 1 Average of the discounts on the offers of the tenders with which some companies won the most recent bids for allocation of incentives in Campania (authors' compilation)

Bolinger (2011). Once the downward pressure has run out, due to the growth of the power of the turbines, one of the critical factors that caused the increase in turbine costs was the dramatic increase in demand. However, other significant factors may be those associated with the need to use less suitable sites, leading to additional costs for infrastructures, but also the awareness of the proprietors who have increased their compensation claims over a period of time. Some analyses identify scenarios where the cost in the future will again decrease (Lantz et al. 2012). Since 2008, wind-turbine prices have declined substantially. Because approximately 75% of the total cost of energy for a wind farm is related to upfront costs such as the cost of the turbine, foundation, electrical equipment, grid-connection, and so on, a reversal of the previously mentioned underlying trends is likely to occur. The future of wind power will depend on the ability of the industry to continue to achieve cost reductions.

Of the renewable sources, the energy sector is the one that has a technology, that, when applied to large-scale plants, is very mature and closer to economic competitiveness.

Although incentives are still necessary for the increase of renewable generation and for achieving the objectives set by the EU, the reduction of investment costs in the near future could enable the achievement of grid parity. This refers to the 'parity' between the cost of producing energy from renewable sources and the cost of buying energy from the network, which, instead, relies almost entirely on electricity production from fossil fuels. Grid parity is achieved when investing in a wind farm becomes profitable, in terms of return on investment, even without incentives.

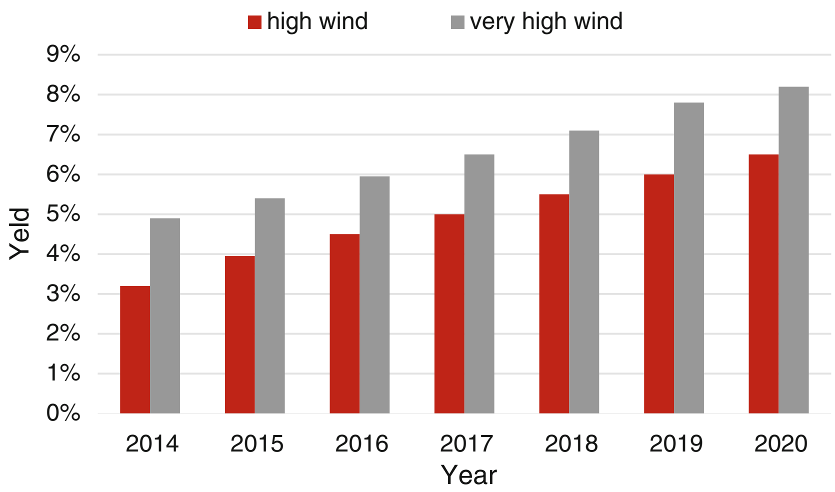

Fig. 2 Likely future dynamics of yields (Newsletter, Gestore Mercati Energetici GME, n°. 63 13/08/2013)

This appears to be reachable in view of the scenario envisaged by the Energy Markets Operator (Fig. 2) that describes a probable increase in real returns obtained from investments in this field in the near future. However, grid parity will not be able to be achieved in a short time. The European condition is not different from that of the US (or other countries) where some studies show that, without dramatic cost declines and improvements in efficiency and utilization, it is unlikely to reach grid parity without state incentives within the next 10–15 years (Motyka and Given 2015; Yao et al. 2015).

However, the presence of government incentives, although fundamental for the assessment of the actual return on investment, does not entail any impact on the ensuing discussion about the legal and economic aspects involved in the process of acquiring land for the installation of a wind farm and works connected to it.

3 The Legal and Urban-Planning Aspects

The Consolidated Law on expropriation (Presidential Decree 327/2001 and subsequent amendments) and, in particular, art. 44 paragraph 1, requires that compensation, payable to the owner of the land encumbered with easements, is commensurate with the permanent decrease in value due to the loss or reduced ability to exercise the rights of property.

Article 44 of Presidential Decree 327/2001 substantially repeats the provision of art. 46 of the Law n° 2359/1865: whereby, compensation for servitude is due whenever a lawful government activity, consisting of the implementation of public works, directly involves the obligation of an easement or the production of permanent damage to the private property.

The Supreme Court (Sec. I, January 12, 2006 n° 464) established that compensation for easements should be determined as a percentage compensation for expropriation, in relation to the content of the easements imposed and for any damage incurred, having to determine the compensation for expropriation according to the criteria in force. Hence, the current criteria for estimating compensation for expropriation, with regards to building plots or not, all refer to the market value in relation to the use allowed by law.

As a matter of fact, art. 36 of Presidential Decree 327/2001 has already identified a distinct criterion for the estimation of compensation in case of expropriation of building soils aimed at the implementation of private works of public utility. When Presidential Decree (June 2003) was issued, a compensation equal to the market value of the property was recognized, thus excluding the application of penalizing criteria valid until 2007 for building areas and up to 2011 for non-building areas.

With regard to non-building land and following the ruling of the Constitutional Court (n° 181/2011), the market value should be assessed with reference to objective characteristics, taking into account their possible economic usability, different to an intended agricultural use, midway between the latter and a buildable one, permitted by law and conformable to urban planning instruments.

Given that easement is a form of partial expropriation of full ownership rights, given the unique legislation that regulates the procedure (Presidential Decree 327 of 2001), and taking into account the concurrence of the criteria to be used for the estimation of compensation (see art. 33 par. 1 governing compensation for partial expropriation, and art. 44 par. 1 concerning the criteria for the estimate of compensation for the imposition of easements), the rulings issued by the Supreme Court and the consolidated case law on this subject can reasonably be transferred to the case of the easement.

Hence, an urban constraint becomes part of the property if the transformation of the land, as permitted by the same constraint, generates an income; this element contributes exclusively to the acknowledgement of the building rights (Supreme Court including n. 11129/2009). Basically, the application of a pre-established confiscation constraint, provided for by the planning instrument or following a variation, also takes effect in the qualification of the land in order to estimate compensation for expropriation. The constraint therefore becomes ‘confirmative’ of the property, if what is to be built on the land is privately owned and the private individual can derive an economic benefit from it.

In this case, the constraints imposed have changed the conformation of the land, or its intended use. It is not reasonable to assume that the land retains a value corresponding to its agricultural use, although its use was agricultural, at least up to the establishment of the bond.

Therefore, if the value attributable to this land is not that of an agricultural area, what is its market value?

The case law has retained that the market value should be commensurate with the actual and/or potential exploitation of land, to be defined with reference to its income capacity but not resulting in the building exploitation (Supreme Court Sec. 1 n° 8873/2014). The issue of compensation for expropriation, though still conditioned by a fundamental dilemma, suitability for building or not, where there is no space for recognition of income of land development, admits the reference to a wide range of human activities that can develop in the territory, with the aim of rewarding freedom of private initiative.

The Supreme Court also specified (Sec. 1 n° 12548/2014) that private initiative, is essential in determining compensation: "Private initiative is the measure which, in a market economy, identifies the demand for land as a factor of production in the business logic… Where expropriation is necessary, compensation should take into account the potential profitability of the land. It therefore constitutes a transversal parameter, which helps to determine the market value for each type of land".

This principle is actually stated by the legislature in art. 36 of Presidential Decree 327/2001.

4 The Solution

With regard to the easement or expropriation that is discussed here, although the bonds from which they stem are not to be included by the planning instrument or entail its variation, the estimate of the compensation cannot ignore the fact that by acquiring those rights some private entities generate profits.

If, then, the court has stated that, in case of the expropriation of land intended for an entrepreneurial venture, pending of course public utility, expropriated persons must, somehow, benefit from the income brought on by that specific activity. This principle cannot be rejected if the expropriation relates only to the right of fruition or when the expropriation does not change the urban land use. The land is a productive factor of a business, and a remuneration should be acknowledged (i.e., to those who possessed the right) by those exploiting it and who are obtaining a profit therefrom.

This remuneration should therefore be determined in proportion to the actual potential economic exploitation according to the legitimate use for which the property is intended (Supreme Court Sec. 1 n° 8873/2014). Although the urban destination of these soils has not changed, they were legitimately intended to accommodate a wind farm and related infrastructure. This type of constraint comes from land-use decisions legitimately defined by the region or by the territorial government, which has jurisdiction over the exercise of administrative functions inherent the authorization procedures.

Land use decisions, which have no reflection or proof on the certificates or evidence of urban destination, must have an effect on estimates of compensation. In practice, the urban use of land has not changed but its economic utility does.

Because the value of the land must reflect this utility, the benchmark for estimating the compensation may not be the agricultural value.

In order to give legitimacy to the view sustained, an attempt has been made to identify similar current cases, through the case law already resolved with solutions anchored to the principles laid out. Research has highlighted the case of quarries. These are non-building land with earning capacities that are not however connected to agricultural use, but to the availability of the natural resources on the site. The extraction capacity of a site can somehow be compared to the capacity to generate wind power or transferring it. Note that, in economics, production (the creation of utility) is synonymous with transformation, which in turn may be material, spatial, or temporal. The transfer of an asset or a resource in space from a site where it is available in abundance to another place where the availability is rather limited generates utility. The operation of a power line may be regarded as a productive activity.

Case law has always treated the compensation offered for land assigned to mining differently with respect to the criteria of clear distinction between building areas and does not consider the quarry "as a tool for the production of income related to the extraction of the material for the period of its planned usability", identifying this income as "the rational reference to keep in mind in order to calculate compensation for the expropriation of this source of income" (Supreme Court n° 12354/99).

The Supreme Court Section I (n° 13911/2012) states that the negation of a third category, that is, another different case with regards to building or non-building areas, is not applicable to land that contains a quarry or a mine from which it is possible to extract specific products susceptible to particular industrial or commercial uses (in the present case, it is produced by the wind energy that is characteristic of this land). These areas are opposed to the first two (building or non-building land), because of the concurrent presence of a negative aspect (building ban) and a positive one relating to the possibility of a different economic use, more so than one or the other category (building or agricultural use).

Lastly, the United Section of the Supreme Court has dealt with the issue (judgments n° 6309/2010, n° 19433/2011), stating that "quarries, being entities open to the appropriation of non-reversible or renewable materials, are goods with their own legal and economic status". They are not comparable to land intended for agricultural use, with the result that the criteria provided for non-building areas cannot be applied (art. 40, paragraph 1 of Presidential Decree 327/2001). They should refer to the net income obtainable for the entire duration of the planned quarrying, or, in the case of a lease to a third party, to the relevant income, subject to the calculations of discounting.

Although wind energy is a renewable energy source, unlike mining activity, it is not immediately recognizable as physically belonging to the land, and the possibility of its exploitation in terms of income capacity derives from the availability of the resource, precisely the wind, its speed, and continuity. These elements, although non-exhaustible, are characteristics of the site, as is the availability of material in the subsoil.

5 Conclusions

The land used for wind farms and related infrastructure in line with what was stated previously can be considered as assets with their own legal and economic status, and not comparable to the land intended for agricultural use.

With regard to their assessment, market research has also confirmed that these lands have actually changed their agricultural nature.

In recent years, several wind farms have been created in the territory under study. The construction of these numerous wind farms comprising windmills or wind turbines and related infrastructures (cable ducts and power lines, cabins, power stations, etc.), has imposed on those companies who have the rights for the creation and management of the such farms, the need to obtain from the landowners of the interested properties, the accessibility for the use and transformation of the land, through the conclusion of lease agreements, the assignment of surface rights, and/or of easement.

The amounts agreed upon between the parties were stipulated as one-off payments for a limited duration (normally 20 years renewable) or defined as annual rents for a similar duration. The prices paid have reached levels that cannot in any way be justified in relation to the agricultural use of the land.

Another interesting aspect that confirms the above statements is that the payments, from voluntary transfers of rights over land, reflect the typical dynamics of differential rent. On the territories under investigation, it was observed that the first companies who invested in the sector, occupying the best positions and thus guaranteeing the best energy-output performance, had paid the proprietors very high sums of money.

The data processing of the contracts for the sale of annual surface rights, related to wind farms comprising wind turbines with power 2.0 or 2.5 MW, define unit values of about 300 €/m^2 (2010–2011). The construction of index numbers showed that these amounts have been reduced over time (Salvo et al. 2014).

If it is true that currently the most appealing land is being depleted and also state funding is being reduced (the latter somehow offset by the reduction of plant costs), then a reasonable estimate of the land today could be performed looking for the value investment through the development of the investment financial plan and the application of one of the models that use the Discounted Cash Flow Analysis (Afanasyeva et al. 2016; Petković et al. 2016; Venetsanos et al. 2002). This approach would lead to determine levels of landowner compensation depending on many factors, including wind speed, turbine size, price of energy, nature of the soil, and distance from grids.

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Infrastructure Development and Territorial Vulnerability. The Role of Composite Indicators for Addressing Siting Decisions

Alessandra Oppio, Stefano Corsi, Francesca Torrieri and Sergio Mattia

Abstract Composite indicators have been analyzed by several scholars, especially with the aim of defining standardization and aggregation rules consistent to the multidimensional theoretical framework underlying these kind of measures and adequate to the difficulty of comparing data of different nature. Starting from a broadly shared methodology, set up by OECD in 2008, the paper proposes a Composite Indicator of Territorial Vulnerability based on environmental, social and economic criteria. A special attention has been paid to the methodological approach more than to the results, with a focus on uncertainty and sensitivity analysis. The latter one has been developed by the use of the SimLab (http://ipsc.jrc.ec.europa.eu), which has allowed to estimate the probability distribution function of the composite indicator and to point out the field of variation of its variables. Lombardy Region has been selected as a pilot case study since it is one of the Italian regions with the highest infrastructural development. The results show that the Composite Indicator of Territorial Vulnerability applied to municipalities in the Lombardy Region has a limited variation range, and thus low uncertainty. Furthermore, the synthetic measure of territorial vulnerability seems to be a promising decision aid tool in the field of regional infrastructural development policies.

Keywords Territorial vulnerability · Composite indicator · Uncertainty and sensistivity analysis

A. Oppio (✉) · S. Mattia
Deparment of Architecture and Urban Studies, Politecnico di Milano, via Bonardi 3, 20133 Milan, Italy
e-mail: alessandra.oppio@polimi.it

S. Corsi
Department of Agricultural and Environmental Science, University of Milano, via Celoria, 2, 20133 Milan, Italy

F. Torrieri
Deparment of Industrial Engeneering, University of Naples Federico II, piazzale Tecchio 2, Naples, Italy

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1 The Multidimensional Notion of Territorial Vulnerability

Vulnerability refers to the degree to which communities and individuals are susceptible to the effects of hazardous processes, encompassing the physical, social and organizational components of social systems (Golobič and Breskvar Žaucery 2010; Tavares et al. 2015). At the same time vulnerability refers to the ability to prepare for, respond to, and recover from external events (Cutter et al. 2009; Toro et al. 2011) that have the potential to become worse (Bradley and Smith 2004).

Vulnerability is an "integral part of the causal chain of risk" which can be defined as the product of the level of damage in the conditions of use and the frequency of adverse events (Cutter et al. 2000).

The definition conforms to the following formula:

$$R = D \times F$$

where R represents the risk, D for damage and F for the frequency of harmful events.

Territorial vulnerability could affect both the frequency and the level of harm Thus, the risk (R) should be commensurate to the degree of territorial vulnerability (V):

$$R \sim V$$

According to UNISDR (2012) understanding vulnerability is one of the foundations that support the achievement of the 10 essentials of safe and resilient cities, and is crucial to the development of local plans and policies.

Although the many definitions (Tran et al. 2010) of the notion of vulnerability highlight the different faces of the same concept, they all focus on the following concepts:

(i) vulnerability is an intrinsic feature of a system that can be described by the use of a specific set of criteria;
(ii) the notion of vulnerability is multidimensional as it includes health, education, social assistance, the economy, spatial planning and transportation and their mutual relationships (Millenium Ecosystem Assessment 2005; Cutter et al. 2003; Menoni et al. 2012; Tavares et al. 2015).

The development of infrastructure in a vulnerable context strengthens the risk, as it increases the frequency and the significance of the harmful events. The vulnerability of the territory with respect to the realization of infrastructures can also be associated with land consumption and the impact on the agricultural system as well as on environment (Mazzocchi et al. 2013; Torre et al. 2014; Oppio et al. 2016).

Finally reducing vulnerability is a cost-effective strategy of risk management (Kasperson et al. 2001) and a key element in any risk governance process.

Moreover understanding vulnerability is crucial to the development of disaster mitigation plans and policies.

Many scholars attempting to evaluate the sustainability of development policies and programs have underlined the necessity to adopt a multidimensional approach in order to assess their impacts in a comprehensive way. In these kind of decision making processes, environmental, social and economic vulnerability assessment plays a crucial role. Providing an aggregate vulnerability measure, able to tackle all these issues together, is important in policy making and regional planning both from a conceptual and an operational perspective (Granger and Hayne 2001; Munda 2010).

2 Using Composite Indicators for Assessing Territorial Vulnerability

Composite indicators play very important role in policymaking and benchmarking (Freudenberg 2008; Saltelli 2006) as a tool to measure the complexity of environmental and societal phenomena. Despite composite indicators are increasingly used because of their capacity to process a large amount of data and to communicate the outputs of the analysis in a simple way, they could be misleading and poorly reliable if not supported by a robust and clearly stated methodology. Actually, it involves both theoretical and methodological assumption, which need to be assessed carefully to avoid producing results of dubious analytic rigor (Saisana et al. 2005). To overcome this problematic issue, Nardo et al. (2005) propose a Handbook of Composite Indicators (Ci) offering guidelines for composite indicator development. The latter guidelines were then recall in the OECD Guidelines (2008) that summarized pros and cons of using Ci and proposed a comprehensive and robust methodology. According to the OECD Guidelines, "A composite indicator is formed when individual indicators are compiled into a single index on the basis of an underlying model. The composite indicator should ideally measure multidimensional concepts which cannot be captured by a single indicator…". Many different Ci has been developed in various fields, such as the economy, environment, society and globalization; a complete list is reported in the EU site (http://composite-indicators.jrc.ec.europa.eu/) developed by the Composite Indicator Research Group where a 10-step guide is reported for the formulation of a robust Ci, already tested in several different cases. The guide proposed tries to answer the main issues related to the development of a Ci (Saltelli et al. 2008) such as, (i) the definition of a set of indicators in the index; (ii) the mechanism for including and excluding indicators in the index; (iii) the model choice for estimating the measurement error in the data; (iv) the indicator preliminary treatment; (v) the choice of weights attached to the indicators; (vi) the choice of the aggregation method; (vii) the type of normalization scheme applied to the indicators to

Table 1 Check list for the definition of composite indicators (*Source* OECD 2008)

Step	Methodology
Theoretical framework	Literature review and expert interview
Data selection	Variable selection. The use of proxy variables should be considered when data are scarce
Input of missing data	Estimating missing values, mean/median/mode substitution, regression imputation, hot-and cold-deck imputation, expectation-maximisation imputation, or multiple imputation
Multivariate analysis	Principal components analysis (PCA), factor analysis (FA), cluster analysis (CA).
Normalization	Standardization or z-scores; min-max normalization; distance to reference
Weighting and aggregation	Principal component analysis, linear aggregation method, geometric aggregation method
Uncertainty and sensitivity analysis	Probability distribution function, Montecarlo analysis
Links to other indicators	Spider diagram, critical consideration
Visualization of the results	Chart and diagram

remove scale effects. The Checklist for building a composite indicator (EU checklist) and the methodology proposed is reported in Table 1.

In general an index is a function of the underline indicators. Weights are assigned to each indicator to express the relevance of indicators in the context of the phenomena to be measured. As showed in Fig. 1 the first phase of the analysis regards the definition of a theoretical framework, the data selection and the input of missing data. These phases regard the selection of the indicators on the base of the literature and the expert opinions and the quantification of the selected variables.

The third phase is about a multivariate analysis helpful in assessing the suitability of the data set and provides an understanding of the implications of the methodological choices, as weighting and aggregation.

There are many analytical approaches to perform multivariate analysis, among the others Principal Components Analysis (PCA), Factor Analysis (FA), Cluster Analysis (CA). In this work we did perform multivariate analysis using the PCA method, with the double aim of finding the most relevant criteria (variables) and of attaching weights to the criteria before running the aggregation phase. The application of PCA is well described later on.

The normalization phase regards the standardization of the different unites measurement of the indicators in a unique one. Three methodologies will be applied. The first method is the standardization or z-scores. This method converts indicators to a common scale with a mean of zero and standard deviation of one. In this way the values close to the two extremes acquire higher importance than the ones close to the average 0.

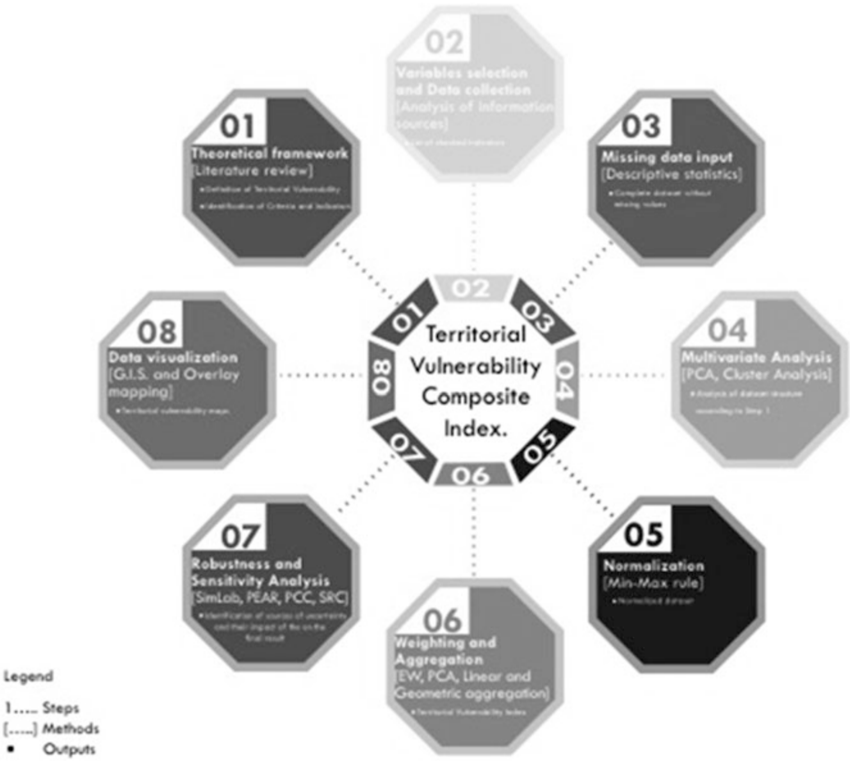

Fig. 1 Steps of the evaluation framework (adapted from OECD 2008)

For each individual indicator x^t_{qc}, the average across municipalities $x^t_{qc=c}$ and the standard deviation across countries $\sigma^t_{qc=c}$ are calculated. The normalization formula is

$$I^t_{qc} = x^t_{qc} - x^t_{qc=c}/\sigma^t_{qc=c} \tag{1}$$

so that all I^t_{qc} have similar dispersion across municipality.

The second method is the Min-Max normalization. This method brings the values into an interval between 0 and 1.

Each indicator x^t_{qc} for a generic municipality c and time t is transformed in

$$I^t_{qc} = x^t_{qc} - min_c(x^t_q)/max_c(x^t_q) - min_c(x^t_q) \tag{2}$$

where $min_c\left(x^t_q\right)$ and $max_c\left(x^t_q\right)$ are the minimum and the maximum values of x^t_{qc} across all municipality c at time t.

The last method is called “distance to a reference”. This method of normalization makes use of a benchmark in order to evaluate performances of the countries.

This method takes the ratios of the indicator x_{qc}^{t} for a generic country c and time t with respect to the individual indicator $x_{qc=c}^{t0}$ for the reference country at the initial time t^{0}.

$$I_{qc}^{t} = x_{qc}^{t} / x_{qc=c}^{t0} \tag{3}$$

Once the data have been normalized there are still two fundamental steps for the construction of the composite indicator, weighting and aggregating. The first step aims to give different importance to the criteria and several methods are available to make the choice. Some of these methods accept some grade of individual judgment by experts in the specific field when attaching weights to the criteria. Some other methods are instead based on statistical properties, giving more weights to the criteria that are statistically more relevant. For this research, we decided to implement the PCA method to find weights, which are valid by a statistical point of view, to be comparing the outcome then with a linear additive aggregation with no weights applied. In practical terms, we compared a statistical based weighting system to an “equal weights” system, and then two aggregation methods, the linear and the geometrical one. The results are then described.

The more interesting phase is the uncertainty and sensitivity analysis, because when constructing a composite indicator there is always some grade of uncertainty. A combination of uncertainty and sensitivity analysis is used to assess robustness of composite indicators (Del Giudice et al. 2014).

“Uncertainty analysis focuses on how uncertainty in the input factors propagates through the structure of the composite indicator and affects the composite indicator values. Sensitivity analysis assesses the contribution of the individual source of uncertainty to the output variance. While uncertainty analysis is used more often than sensitivity analysis and is almost always treated separately, the iterative use of uncertainty and sensitivity analysis during the development of a composite indicator could improve its structure” (Saisana et al. 2005; Tarantola et al. 2000; Gall 2007).

The results of the robustness analysis are generally reported as country rankings (in our case municipality ranking) with their related uncertainty bounds, which are due to the uncertainties at play. This makes it possible to communicate to the user the plausible range of the composite indicator values for each country. The sensitivity analysis results are generally shown in terms of the sensitivity measure for each input source of uncertainty. These sensitivity measures represent how much the uncertainty in the composite indicator for a given municipality would be reduced if that particular input source of uncertainty were removed. The aim of uncertainty analysis is thus to create a statistically reliable sample to which one can compare the output variance generated by using the real values.

One way of doing this simulation is through Monte Carlo analysis, in which we look at the distribution functions of the input parameters, as derived from the estimation. For example we may have the following scheme:

We start from a factor $\alpha \sim N(\overline{\alpha}, \sigma_\alpha)$, which reads: after estimation α is known to be normally distributed with mean $\overline{\alpha}$ and standard deviation σ_α.

Likewise for factors β, γ, and so on. For each of these factors, we draw a sample from the respective distributions, thus we produce a set of row vectors $\left(\alpha^j, \beta^j, \ldots\right)$, with $j = 1, 2, \ldots, N$ in such a way that $(\alpha^1, \alpha^2, \ldots, \alpha^N)$ is a sample from $N\ (\overline{\alpha}, \sigma_\alpha)$ and likewise for the distribution function of the other factors.

$$\begin{bmatrix} \alpha^1 & \beta^1 & \gamma^1 & \ldots \\ \alpha^2 & \beta^2 & \gamma^2 & \ldots \\ \ldots & \ldots & \ldots & \ldots \\ \alpha^N & \beta^N & \gamma^N & \ldots \end{bmatrix}$$

We can then compute the model for all vectors $\left(\alpha^j, \beta^j, \ldots\right)$ thereby producing a set of N values of a model output Y_j.

$$\begin{bmatrix} y^1 \\ y^2 \\ \ldots \\ y^n \end{bmatrix}$$

These steps constitute our uncertainty analysis. Having performed this uncertainty analysis we can then move on to a sensitivity analysis, in order to determine which of the input parameters are more important in influencing the uncertainty in the model output.

There are several methods of sensitivity analysis based on linear regression or correlation. The most important of them are: the PEAR analysis based on simple correlation between the criteria composing the indicator and the output; the PCC analysis based on correlation and partial correlation; the SRC method based on regression analysis.

Once the composite indicator is built a number of analysis can be done to better understand the performance of its components. The “back to the detail” step suggests that the intrinsic nature of the composite indicator can give a great amount of information other than the final outcome alone.

In this view one can investigate which municipalities are the leaders and which are the laggards, make spider diagrams to show the performance of one municipality in respect to the criteria, and many other types of analysis. The methodology proposed will be then applied to the case study of Lombardy Region. The main results are reported in Sect. 4.

3 Case Study

3.1 The Evaluation Framework

According to the methodological approach described in the previous section, an evaluation framework, divided into 8 steps (Fig. 1), has been defined and applied to a pilot case study.

The analysis has focused on Lombardy Region, as it is one of the Italian regions with the highest infrastructural development (Corsi 2009).

Starting from literature review, a theoretical framework has been developed with the aim of modelling the multidimensional concept of territorial vulnerability and of defining a composite indicator. The variables have been selected from previous studies on the analysis and evaluation of territorial vulnerability (Oppio et al. 2015; Oppio and Corsi 2017), with respect to their relevance, analytical soundness and accessibility. Three main vulnerability dimensions, each divided into criteria, have been considered: the environmental, the social and the economic one. The criteria have been measured at municipality scale. Table 2 reports criteria and indicators used and the way they have been calculated.

Differently from the first efforts for measuring territorial vulnerability, this paper focus more on the methodological process than on the outputs, in order to improve the robustness and effectiveness of the Composite Territorial Vulnerability Index (CTVI). Thus, a multivariate analysis based on PCA has been perfomed for studying the overall structure of the dataset, assessing its suitability and guiding the subsequent methodological choices. Furthermore, weights have been assigned still by the use of PCA and alternative aggregation methods—linear and geometric—have been tested with reference to the theoretical framework. Finally, robustness and sensitivity analysis of the results have been developed.

In order to support decision makers in the field of infrastructures development, the CTVI has been mapped by the use of G.I.S.

3.2 Results

In order to perform robustness, uncertainty and sensitivity analysis the Monte Carlo method has been developed by generating new samples with high number of observations and simulating probability density functions similar to the ones of the existing criteria. Thus, a statistical base, that is comparable with the case under study, has been obtained. To these new samples the Equal Weights and the Weighted Sum aggregation models have been applied in order to check if we get similar results out of the simulation.

More in deep, uncertainty analysis consists in verifying the probability density functions for the two CTVI according to the largeness of the interval its values.

Table 2 Vulnerability assessment framework

Vulnerability dimension	Criteria	Acronym	C/B	Indicators	Unit of measurement	Sources	Year
Environmental components	Protected areas	PA	C	Areas under protection on municipality land	kmq	Geoportale Regione Lombardia - SIC; ZPS; APB	2008
	Air quality	AQ	C	Air quality index	N°	ARPA Lombardia; Regional Agency for Environmental Protection	2011
	Water quality	WQ	C	Sewage treatment channeled into the drainage system	N°	ARPA Lombardia:Regional Agency for Environmental Protection	2011
	Weak areas	WA		Areas under hydro-geological risk on municipality land	%	Geoportale Regione Lombardia - aree a vincolo idrogeologico	2013
Social components	Cultural heritage	CH	C	Number of listed buildings	N°	Geoportale Regione Lombardia - beni vincolati	2011
	Schools	Sc	B	Number of schools	%	Geoportale Regione Lombardia - Scuole; ISTAT	2014
	Average age	AA	C	Total population; Population age	Years	ISTAT_Population survey	2013
	Immigration	Imm	C	Foreign population on total population	%	ISTAT_Population survey	2014
Economic components	Per capita income	PcInc	B	Average income per capita	%	ISTAT (Population survey)	2011
	Business	Bs	B	Number of operating business on total population	%	ISTAT (Labor force survey)	2013
	Workers	Ws	B	Number of people working on total population	%	ISTAT (Labor force survey)	2013
	Public workers	PWs	B	Number of public workers on total population	%	ISTAT (Labor force survey)	2013

A first consideration is that the probability density function curves of the dependent variables as calculated on the simulated criteria are very much similar to the ones calculated on the real values. This is true both in terms of probability density function shape, as they all have a normal distribution, and in terms of interval values. A second consideration is that some grade of uncertainty exists, as the probability density function interval is quite large (Figs. 2 and 3). For understanding which criteria determine more than others the distribution of values in the probability density function, the sensitivity analysis has been carried out.

As the CTVI has been defined by supposing that a linear relation exists between the independent variable and the criteria, therefore using linear aggregation models, the sensitivity analysis has been based on the Pearson Product Moment Correlation Coefficient (PEAR) and the Standardized Regression Coefficients (SRC). The sensitivity analysis methods have been applied to the CTVI Equal Weights (CTVI_EW) and CTVI Principal Component Analysis (CTVI_PCA). According to the results shown in Figs. 4 and 5, the criteria that give a lower contribution to the territorial vulnerability evaluation are the economic ones, whilst the environmental criteria are the ones explaining most of the variance of the dependent variable.

The results of these analysis show that among the two composite indicators tested, CTVI_ EW and the CI _PCA, generate very similar outcomes, thus suggesting almost the same insights in terms of territorial vulnerability. Although the

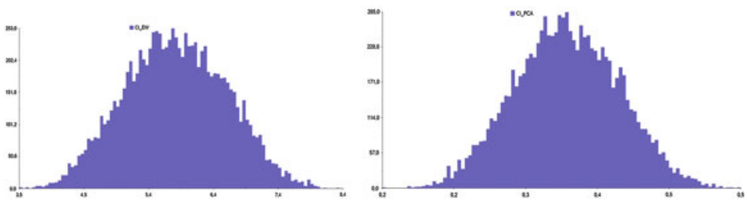

Fig. 2 Probability density functions of CI EW and CI PCA generated sample (SimLab)

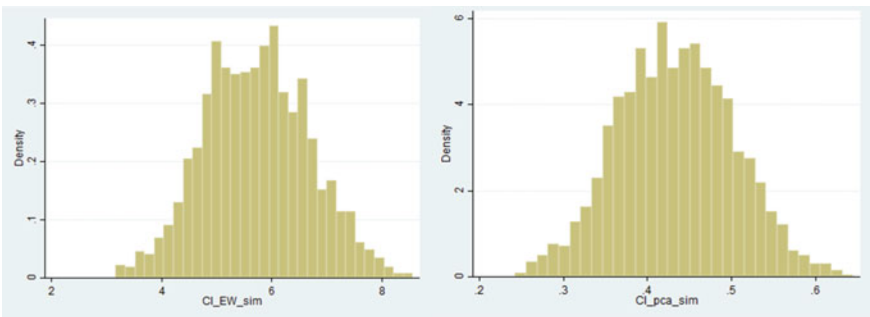

Fig. 3 Probability density functions of CI EW and CI PCA generated with real values from our dataset (Stata 13)

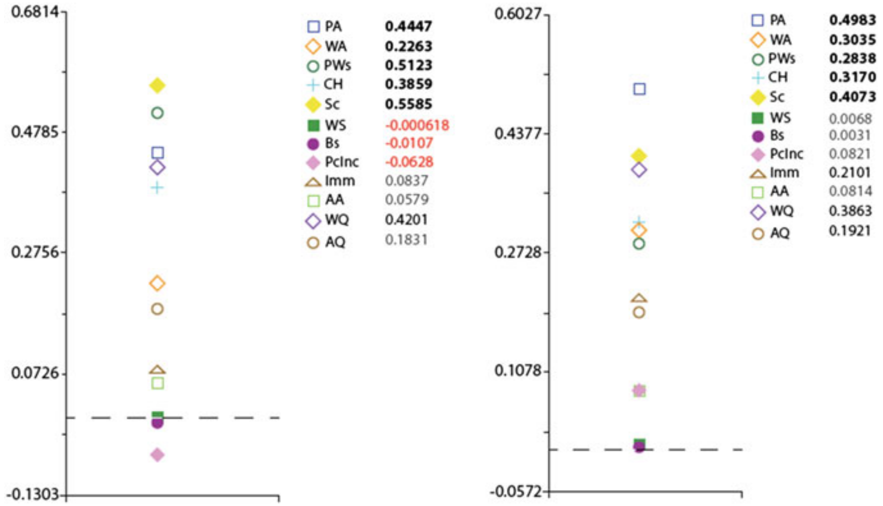

Fig. 4 Sensitivity analysis on CTVI_PCA by PEAR on the left and SCR on the right

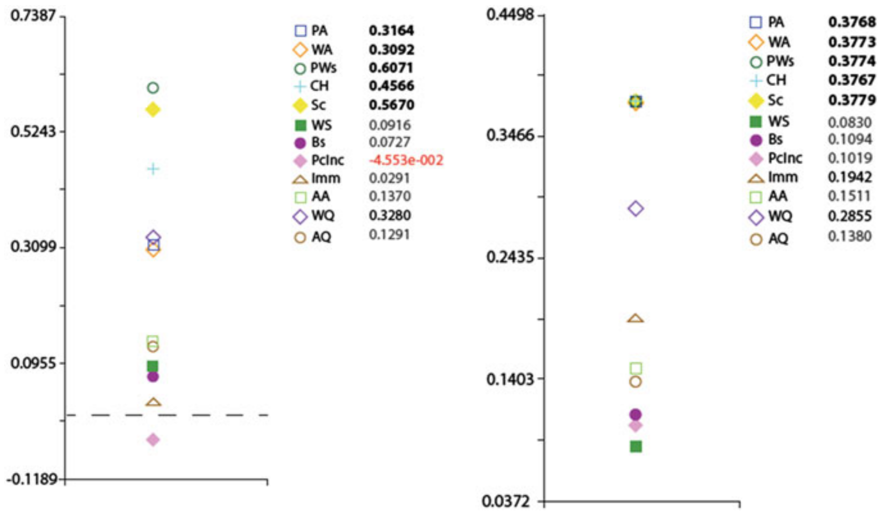

Fig. 5 Sensitivity analysis on CTVI_EW by PEAR on the left and SCR on the right

CI_PCA includes a weighting system, this does not influence the final results compared to the ones obtained by the CI_EW.

Given these premises, the linear additive model, combined to the PCA weighting system, seems to be a promising measurement of the territorial vulnerability of Lombardy region and for investigating the potential use of territorial vulnerability maps in the field of infrastructure development (Fig. 6).

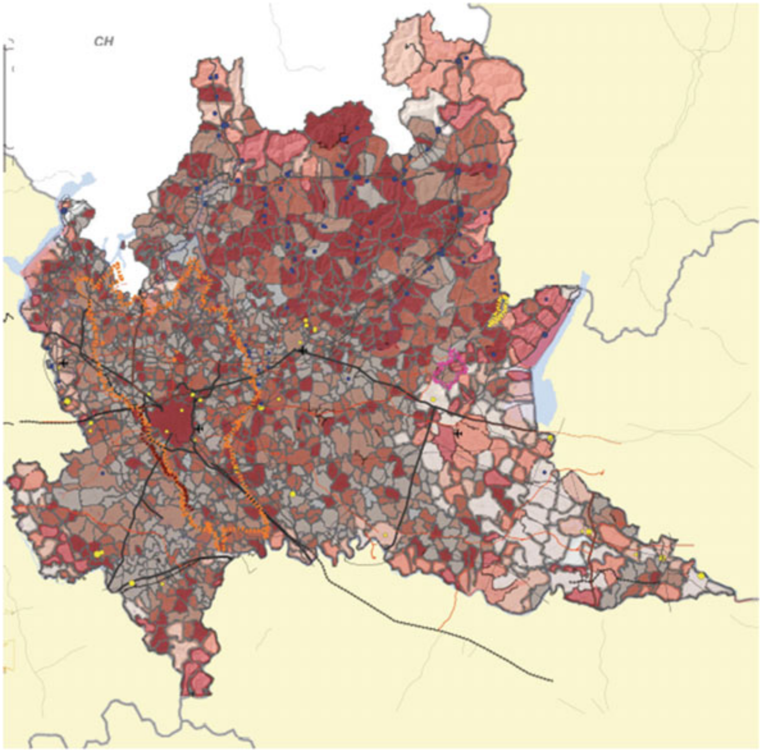

Fig. 6 Spatial overlay of CI_{PCA} to the Infrastructural development program of Lombardy Region

4 Conclusions

The development of a composite indicator for assessing territorial vulnerability can be integrated into the regional planning system, in particular for supporting the definition of strategic socioeconomic objectives of the regional government.

The uncertainty analysis carried out allows to evaluate the range of variability of each indicator and so to estimate differences among municipalities in terms of territorial vulnerability. Moreover sensitivity analysis highlights those criteria that are significant in the definition of the composite indicator. These analyses contribute on one hand to verify the robustness of the results obtained and on the other hand to explain more in deep the topic under investigation.

The overlay of Territorial Vulnerability Composite Indicator with infrastructures plan supports effectively the feasibility studies of infrastructural development by highlighting territorial weaknesses and strengths. Furthermore, the identification of alarming situations is helpful for programming mitigation interventions.

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Valuing the Impact of Social Housing Renovation Programs: An Application of the Social Return on Investment (SROI)

Marta Bottero, Gustavo Ambrosini and Guido Callegari

Abstract Urban regeneration operations refer to complex processes where it is necessary to provide the Decision Makers with integrated evaluation tools, able to consider the multiplicity of objectives and values and to include the opinions and the needs of the different stakeholders involved. In this context, the paper aims at investigating the methodology of Social Return On Investment (SROI), that is a very recent and innovative framework for measuring and accounting for the complex value related to an investment, including social, environmental and economic costs and benefits. Starting from a real—world problem, the paper describes the application of the SROI method for supporting the process related to the requalification of a social housing district located in Rovereto (Italy).

Keywords Social benefits · Urban regeneration · Stakeholders participation · Cost benefit analysis

1 Introduction

Urban transformation processes must face important changes that are emerging in cities. In particular, it is possible to highlight that in 2010, 50% of the world's population lived in urban areas and this figure is forecast to rise to 75% by 2050. Due to this increase in urban population, governments are required to figure out

M. Bottero (✉)
Department of Regional and Urban Studies and Planning,
Politecnico di Torino, Torino, Italy
e-mail: marta.bottero@polito.it

G. Ambrosini · G. Callegari
Department of Architecture and Design, Politecnico di Torino,
Torino, Italy
e-mail: gustavo.ambrosini@polito.it

G. Callegari
e-mail: guido.callegari@polito.it

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how to address the new demand of urban spaces, paying also attention to the reduction of soil consumption (Roberts 2000).

According to this approach, a crucial role is played by urban regeneration operations, meaning not only buildings restoration operations, but also programmes aiming at eliminating social decline, increasing the quality of life of the inhabitants, supporting the valorization of cultural resources, protecting the environmental system, bringing economic development and so on. Taking into consideration this complexity, it is of particular importance to provide the Decision Makers with integrated evaluation tools, able to consider the multiplicity of objectives and values when dealing with urban regeneration processes and to include the opinions and the needs of the different stakeholders involved (Bottero 2015).

The objective of the paper is related to an investigation of the methodology of Social Return On Investment (SROI) for supporting decision process in the context of urban regeneration operations. SROI is a framework for measuring and accounting for the complex value related to an investment, including social, environmental and economic costs and benefits (Nicholls et al. 2012). SROI was developed from social accounting and Cost Benefit Analysis but this method puts more emphasis on stakeholders involvement, transparency of the evaluation and verification of the results. Mention has to be made to the fact that the applications of the SROI are limited to the context of social economy and non-profit organizations while the research in the field of urban and territorial transformations is very poor.

Starting from a real-world problem, the paper describes the application of the SROI method for supporting the process related to the requalification of a social housing district located in Rovereto (Italy).[1]

2 Methodological Background

The methodology of SROI aims at measuring the changes that a certain project or policy is likely to produce. These changes are evaluated by social, environmental and economic outcomes that are estimated using monetary values. The method enables a ratio of benefits to costs to be calculated.

The SROI technique is a very recent implementation of existing evaluation approaches in the context of project, plans and programmes and it is based on social accounting and Cost Benefit Analysis (European Commission 2014). With respect to the aforementioned method, the SROI technique puts more emphasis on the involvement of the stakeholders groups in the development of the evaluation process.

[1]The material used for the illustration of the case study application is based on the thesis work developed by Christian Ferro and Cristina Lodato at the Master Program in Architecture Construction City of Politecnico di Torino under the scientific supervision of the authors of the present paper.

From a methodological point of view, the SROI method is structured according to 6 subsequent stages (Nicholls et al. 2012).

2.1 Establishing the Scope and Identifying Stakeholders

In this stage it is necessary to explicit the boundary of the analysis, clarifying important parameters such as the purpose of the analysis, the audience, the available resources, the period of the study and if the analysis is a forecast or an ex-post evaluation.

This stage also concerns the identification of the stakeholders, that are defined as people or organizations that experience changes or affect the activity of the project under investigation. For each stakeholder, the analysis must clarify the reason of inclusion in the study, the method of involvement, the number of people to be involved and the period.

2.2 Mapping Outcomes

A very important phase of the SROI process consists in identifying the inputs of the project (for example, the financial value of the investment or the volunteer time and contribution of foods and services).

Once having estimated the inputs, it is necessary to describe the outcomes, which are a measure of the changes produced by the project for the different stakeholders groups previously identified.

2.3 Demonstrating Outcomes and Giving Them a Value

For each outcome, it is necessary to clarify one or more indicators that are able to tell whether the outcome has occurred in the operation under investigation and by how much.

Another part of this stage involves data collection of the selected indicators. The data may be available from existing sources or it can be necessary to collect them making use of interviews, focus groups, surveys etc.

In this stage it is also important to determine the temporal duration of each outcome.

The last step consists in identifying appropriate monetary values for the outcomes. In particular, the SROI methodology uses financial proxies to estimate the social value of non-traded goods to different stakeholders. Examples of these proxies are cost savings due to a certain project or increase in taxes. For other more intangible impacts, such as increase in environmental quality or in indoor comfort, specific methods are available which are based on the paradigm of Total Economic Value and that are normally employed for the evaluation of public goods and services (Pearce and Turner 1990). Examples of evaluation methods include Contingent Valuation Method, Travel Cost Method or Hedonic Pricing models (Louviere et al. 2000; Rosen 1974).

2.4 Establishing Impact

In this stage it is necessary to define the deadweight, that is a measure of the amount of outcome that would have happened even is the activity of the project had not taken place. To calculate the deadweight, which is normally expressed as a percentage of the outcome, reference is made to comparison groups or benchmarks. Another important element is related to the attribution effect, that is an assessment of how much of the outcome was caused by the contribution of the project under examination. Attribution is calculated as a percentage (proportion of the outcome attributable to the project). Moreover, it is necessary to assess the drop-off effect; this variable allows to consider that the intensity of an impact may reduce over time. Drop-off is usually calculated by deducting a fixed percentage from the remaining level of output at the end of each year of the analysis.

Finally, it is possible to value the impact of each outcome as follows:

- Multiply the financial proxy by the quantity of the outcome in order to obtain a total value for each outcome;
- Deduce deadweight or attribution effects from the total value of each outcome;
- Repeat the calculation for each outcome;
- Add up the total to arrive at the overall impact of the outcomes.

2.5 Calculating the SROI

The first phase in calculating the SROI is to project the value of all the outcomes achieved in the future. Normally the temporal period are represented in years.

The second step consists in the calculation of the Present Value (PV) that allows costs and benefits related to different temporal periods to be added up. For the calculation of the PV the Eq. (1) is used (Manganelli 2015):

$$\mathrm{PV} = \frac{\mathrm{V_t}}{(1+\mathrm{r})^{\mathrm{t}}}. \tag{1}$$

where V_t is the value of the impact at the t year and r is the discount rate.

For the calculation of the SROI, it is necessary to divide the present value of the benefits by the total investment, as represented in Eq. (2):

$$\mathrm{SROI} = \frac{\mathrm{Present\_value}}{\mathrm{Value\_of\_inputs}} \quad (2)$$

Mention has to be made to the fact that the value of the SROI represents a feasibility indicator for the project: in particular, the SROI value indicates the amount of social benefits that the project is able to deliver for 1 € of investment.

Finally, it can be useful to perform a sensitivity analysis on the results on the model. In particular, it is interesting to modify some figures (for example, drop-off, deadweight, attribution, financial proxies, quantity of outcomes, value on inputs etc.) and to see how these changes affect the final value of SROI.

2.6 Reporting, Using and Embedding

The final stage of the process consists in communicating the results to the stakeholders groups and in using the findings of the study in the preparation of the project.

3 Application

3.1 Description of the Case Study

The case used for the experimentation of the proposed method is related to a real-world operation. In particular, the application considers the requalification of the Brione social housing district located in Rovereto (Italy). The district is made by 16 buildings that are owned by the Regional Public Housing Authority (ITEA). The district is actually composed by 120 apartments that are rent-controlled. In order to face the demand of the ITEA for an increase in the number of apartments and for an overall requalification of the district, a new project has been proposed and it has been evaluated by means of the SROI methodology.

The project considers the construction of one new storey on the top of the existing buildings in order to expand the current supply and to create 60 new apartments. The project also considers energy retrofitting operations for the existing buildings by means of innovative technologies. The ground floor of the buildings will be renovated and new common spaces for social aggregation will be created. Moreover, the project takes into account the requalification of the external areas of the buildings and the creation of a new square, additional parking, pedestrian and cycle paths (Fig. 1).

Fig. 1 The project for the requalification of the Brione social housing district (*Source* Lodato and Ferro 2014)

3.2 Analysis of the Stakeholders

One of the first steps of the method consists in the identification of the main stakeholders involved in the project.

Table 1 details the relevant stakeholders for the case under investigation. As it is possible to see, the inhabitants of the district are crucial actors as they constitute the final users of the intervention. In the analysis, the inhabitants have been subdivided in different categories, namely aged people, young people and families with children as they express different objectives and values. Other important stakeholders are related to the different associations that are active in the area and the Regional Public Housing Authority that is the owner of the buildings and represents the "client" of the analysis.

Following the SROI methodology, all the stakeholders groups have been involved since the preliminary phases of the process by means of interviews, questionnaires and focus groups in order to understand their specific objectives and needs.

3.3 Evaluation of the Social Impacts of the Project

According to the SROI methodology described in Sect. 2, once having indentified the relevant stakeholders, it is necessary to map the outcomes generated by the project. Table 2 details the evaluation process for the project. As it is possible to see, the outcomes have been divided according to different categories, namely

Table 1 Stakeholders groups involved in the SROI evaluation

Stakeholders	Reason of inclusion	Mean of inclusion	Dimension
Families	Beneficiaries of the activities considered in the project	Questionnaire and focus group	Sample of 50 inhabitants
Aged people	Beneficiaries of the activities considered in the project	Questionnaire and focus group	Sample of 50 inhabitants
Young/students	Beneficiaries of the activities considered in the project	Questionnaire and focus group	Sample of 50 inhabitants
Citizens of Rovereto	Beneficiaries of cycle—paths and new aggregation poles	Questionnaire	Sample of 50 inhabitants
ITEA (regional public housing authority)	Owner of 50% of the apartments in the district	Interview	4–5 representatives
Associations for urban agriculture	Managers of the future activities (urban gardens)	Interview	1 representative
Local laboratories	Managers of the future activities (laboratories)	Interview	1 representative
District Authority	Managers of part of the future common spaces of the project	Interview	2 representatives

economy, education, social inclusion, mobility and health. For each outcome, a specific indicator, the source of information, the typology of beneficiaries, the quantity, the proxy for the evaluation and the estimated value are reported. It is important to put in evidence that for some outcomes the traditional estimation approaches based on market values have been applied. This is the case, for example, of the evaluation of the increase in the asset value due to the requalification project; in this case, the unit market price related to the zone under investigation has been applied for the calculation of the market value of the new apartments. In other cases, techniques based on the Total Economic Value (TEV) approach have been applied. This is the case of the estimation of the social benefits generated by the new square considered in the project; in this case, a simplified version of the Contingent Valuation Method (Carson 2000) has been applied for the evaluation of the Willingness To Pay of the inhabitants for the new space.

3.4 Calculation of the SROI

After having estimated the economic value for the full range of outcomes generated by the project, it is necessary to project them over the years and to calculate the SROI ratio. Moreover, it is necessary to estimate the inputs, that in this case are represented by the construction costs of the project. It is possible to highlight that these costs have been appraised following the comparative-unit method. In this case, the construction cost was estimated as 1,400 €/m^2 for the new apartments and 250 €/m^2 for the energy refurbishment of the facade of the buildings.

Table 2 Impacts map for the project under investigation

Category	Outcome indicators	Source of information	Typology	Quantity	Duration (years)	Financial proxy	Value [€]
Economy	Increase in income for the new inhabitants	Direct sources	New families	60	5	Reduction in rents (free rent – controlled rent)	2,018.25
	Increase in income for the old inhabitants	Direct sources	Old families	120	5	Reduction in energy bills (energy cost pre – energy cost post intervention)	817.80
	Market value of the apartment due to the new surface (balconies and lodges)	Indirect sources	Refurbished apartments	120	1	Market value [€/m^2] * additional surface [m^2] * estimation coefficient	15,534.00
	Market value of the apartment due to the requalification	Indirect sources	Refurbished apartments	120	1	Increase in market value [€/m^2]*surface of the apartments [m^2]	56,820.00
	New parking	Direct sources	Garages	153	5	Garage rent – parking rent	7,500.00
Education	Increase in income due to the new in educational activities	Questionnaire	People with an increase in salary	24	3	Part-time minimum salary	6,707.64
Social inclusion	Participation to the new activities proposed by the project	Questionnaire	New subscribers	66	1	Registration fee for project activities	360.00
		Questionnaire	People who will abandon their activities	/	1	Actual registration fee – registration fee for project activities	480.00
	Increase in quality of life of the inhabitants	Questionnaire	Potential users	66	5	Willingness To Pay (WTP) for the new square	35.00
Mobility	Availability of new pedestrian paths	Questionnaire	Potential users	36	5	WTP for the new connection with the park and the forest	5.00

(continued)

Table 2 (continued)

Category	Outcome indicators	Source of information	Typology	Quantity	Duration (years)	Financial proxy	Value [€]
	Availability of new cycle paths		Potential users	36	1	Registration fee for the bike-sharing	15.00
Health	Reduction of the impacts of the construction works	Questionnaire	People that would be willing to pay	96	1	WTP for reducing the impacts of the construction works	70.00
	Increase in sport activities	Questionnaire	People that will benefit from the sport facilities	/	1	Gym membership fee	500.00

Table 3 represents the economic table useful for the calculation. Considering a discount rate of 3%, the application of the formula (2) provides the final SROI ratio that is equal to 1.51. This value means that for each euro invested in the construction of the project, there will be 1.51 € of social benefits that the project is likely to generate for the stakeholders involved in the operation.

Table 3 Economic table for the calculation of the SROI

	Year 1	Year 2	Year 3	Year 4	Year 5
Benefits					
Increase in income for the new inhabitants	54,492.75	54,492.75	54,492.75	54,492.75	54,492.75
Increase in income for the old inhabitants	98,136.00	98,136.00	98,136.00	98,136.00	98,136.00
Market value of the apartment due to new surfaces	1,864,080.00				
Market value of the apartment due to the requalification	6,477,480.00				
New parking	1,124,550.00	1,124,550.00	1,124,550.00	1,124,550.00	1,124,550.00
Increase in income due to the new in educational activities	157,763.70	149,875.50	142,381.70		
Participation to the new activities proposed by the project	22,572.00				
Increase in quality of life of the inhabitants	1,848.00	1,848.00	1,848.00	1,848.00	1,848.00
Availability of new pedestrian paths	171.00	171.00	171.00	171.00	171.00
Availability of new cycle paths	513.00				
Reduction of the impacts of the construction works	6,720.00				
Total benefits	9,808,326.45	1,429,073.25	1,421,579.45	1,279,197.75	1,279,197.75
Total Inputs	9,564,328.00				
SROI	1.51				

4 Discussion and Conclusions

The paper illustrated the experimentation of the SROI methodology for the evaluation of a requalification project for the Brione social housing district located in Rovereto (Italy). The present research, that was developed in a strict collaboration with the ITEA, the Regional Public Housing Authority in charge for the district under investigation, represents one of the first applications of the methodology in the domain of urban and territorial transformation operations.

From the results of the application it is possible to state that the SROI method is able to represent the complexity of urban regeneration processes. The proposed model proved to be effective in informing in a transparent way the Decision Makers about the social performance of the operation and the achievement of the initial goals. This is particularly useful in the context of urban regeneration and energy retrofit operations, where a clear evaluation has to be done in order to examine the impacts on social welfare of this kind of interventions (Tyler et al. 2013). However, it can be noticed that the SROI approach is subject to some limitations due to the problems arising in the economic measurement of intangible costs and benefits. In fact, only in some cases the output of urban regeneration activities can be evaluated using market-based data. In other cases, as for example in the valuation of the environmental quality, it is necessary to apply specific evaluation methods, such as the Contingent Valuation Method (Carson 2000), that can result time-consuming, complex to apply and require a great cognitive effort from the analysis (Tyler et al. 2013).

From the point of view of the future perspectives of the study, it would be interesting to implement the model with an evaluation of the deadweight, attribution and drop-off effects in order to have a more complete picture of the impacts of the project.

Moreover, it could be of scientific interest to include in the model the analysis and the estimation of other outcomes, such as the impacts of the projects on public health or soil consumption and the benefits that the operation is able to generate in terms of increase in the quality of urban landscape (Capolongo et al. 2015).

Finally, further research could explore the application of sensitivity analysis on the results of the evaluation with the aim of verifying the stability of the model.

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Designing Adaptive Reuse Strategies for Cultural Heritage with Choice Experiments

Alessandra Oppio, Marta Bottero and Valentina Ferretti

Abstract The introduction of the sustainable development concept in the field of cultural heritage preservation has led relevant changes to traditional interventions on historical buildings and areas. Although the idea of reusing cultural heritage is not new, the emerging concept of adaptive reuse stresses even more the importance of a holistic approach for addressing successful interventions. Selecting among the potential uses the one that could ensure the preservation of physical characters as well as intangible values, fueling economic development, is a challenging policy and design issue. In this context, this paper proposes the use of Choice Experiments to support the design of adaptive reuse strategies for three mostly unused castles in Northern Italy characterized by different states of conservation, accessibility and surrounding territorial context.

Keywords Cultural heritage conservation · Total Economic Value · Stated preferences · Valle d'Aosta castles · Questionnaires

A. Oppio
Department of Architecture and Urban Studies,
Politecnico di Milano, Milan, Italy
e-mail: alessandra.oppio@polimi.it

M. Bottero (✉)
Department of Regional and Urban Studies and Planning,
Politecnico di Torino, Turin, Italy
e-mail: marta.bottero@polito.it

V. Ferretti
Department of Management, London School of Economics
and Political Science, London, UK
e-mail: v.ferretti@lse.ac.uk

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1 Introduction

The European Commission's (2014) Communication "Towards an integrated approach to cultural heritage for Europe" underlines the importance of enhancing the intrinsic, economic and societal value of cultural heritage, defining a strong relationship among preservation and sustainable development principles.

The conceptual concurrence among sustainable development paradigm and preservation (Throsby 2001) has led relevant changes in the field of interventions on historical buildings and areas. As a consequence, the idea of adaptive reuse of cultural heritage into accessible and usable places, by respecting its tangible and intangible aspects, seems to be an increasingly promising strategy for achieving a balance among improvements in material and resource efficiency (Environmental sustainability), cost reductions (Economic sustainability) and intrinsic values retention (Social sustainability).

Although different approaches exist to adaptive reuse (see for example the review by Plevoets and Van Cleempoel 2011), it is broadly acknowledged that adaptive reuse is one that respects the building's heritage significance and adds a contemporary layer that provides value for the future (Latham 2000; DEH 2004; Bullen and Love 2011). Adaptive reuse becomes successful when heritage values, physical characteristics, building's and area's potentials have been analysed holistically (Misirlisoy and Günce 2016).

Considering an intervention on historical buildings, the guiding principles of an adaptive reuse intervention can be summarized as follows (Elsorady 2014): adaptation should preserve the intactness of existing buildings involving minimal changes consistent to new uses' requirements); adaptation should retain the symbolic values of historical buildings; adaptive reuse design should follow the sustainability principles; the community engagement is encouraged and, finally, the selection of potential adaptive uses should consider the instance of fuelling larger territorial development processes.

This paper is divided into 4 main sections: the first introduces the role of economic evaluation for supporting cultural policies; the second focuses on the Choice Experiments methodology; the third describes the application of Choice Experiments to three castles located in the Valle d'Aosta Region (Italy); the last one discusses the results and proposes future research lines.

2 Supporting the Design of Alternatives Uses of Cultural Heritage

Cultural heritage enhancement and conservation is generally characterised by high levels of complexity and uncertainty, due to the wide, and sometimes divergent, range of interests and values (i.e. economic, aesthetic, cultural, educational, political) to be considered. Despite the social function assigned to cultural heritage by the Government, that makes it to be considered as a public good, under the economic perspective the not-rivalry and not-excludable conditions should be verified case by case, as well as the economic feasibility of the preservation interventions (Stellin 1994; Bottero 2011). Being operationally impossible and economically a paradox to preserve the entire cultural heritage (Vecco 2010), the decisions about what and how to conserve for representing us and our past to future generations should be supported by robust evaluation methodologies. The achievement of a balance among goal and instrumental values is still a challenging decision problem. Over the past two decades, several theoretical advancements and methodological proposals have been developed to support cultural heritage evaluation. The money value of cultural heritage is a crucial instance for cultural policy as (1) markets concerning heritage are not able to reflect the value users and society attach to the cultural goods (Mazzanti 2002) and (2) the allocation of public resources requires legitimation, transparency and efficiency.

Although the differences among the operational contexts and the evaluation techniques, there are some common issues: the acknowledgement of different categories of value within the notion of Total Economic Value (Pearce and Turner 1990); the use of stated preference questionnaire-based techniques for estimating the extent of collective willingness to pay for a specific benefit rather than the revealed ones, that are not able to capture use and non-use values; the relevance of including different categories of stakeholders into the evaluation processes.

3 Methodological Background

The term Choice Experiments (CE) refers to a statistical methodology which aims to study individual choices using preferences expressed about various profiles, i.e. several versions of a product or service (Lancaster 1966).

The development of a CE model includes the following steps:

- Definition of a set of attributes or features describing the good, service, project or policy, each taking a number of pre-specified levels.
- Combination of these levels and attributes to build up descriptions of hypothetical bundles, using experimental design techniques.
- Questionnaire for asking individuals to state their preferences over these alternatives, using a number of different protocols. In particular, respondents are asked to choose between different bundles of goods, which are described in terms of their attributes, or characteristics, and the levels that these can take. One of the attribute is usually the price.
- Analysis of the individual responses and prioritization among the different combinations of features. It is assumed that the total worthiness of a particular product choice is determined by the different part utilities (partworths) of each feature level (Sayadi et al. 2005). Responses are then analyzed using statistical models.

As stated by Louviere et al. (2010), CE are based on a well-tested theory of choice behavior called Random Utility Theory (RUT; McFadden 1986) that is able to offer an explanation of the choice behavior of human beings. Among the main strengths of the CE we can recall the possibility of providing a comprehensive conceptualization of the entire system under investigation, the capacity of representing real-world decision making processes, avoiding unfeasible or unrealistic options, and the faculty of considering in a flexible way different protocols of eliciting preferences. For the aforementioned reasons, CE are able to provide a deep understanding of how people make their choices and different applications of the method exist, not only in marketing, but also in other fields of applied economics.

In particular, CE have been mostly used to estimate the value of environmental goods (e.g. Alvarez-Farizo and Hanley 2002; Adamovicz et al. 1998). Few applications exist dealing with the assessment of the value of landscape and cultural heritage. As far as landscape valuation is considered, different applications of CE focus on the economic analysis of rural landscapes (Rambonilaza and Dachary-Bernard 2007; Hanley et al. 1998a, b; Sayadi et al. 2005, 2009; Tagliafierro et al. 2013; Bottero et al. 2015). Other studies consider the implementation of the method for assessing natural and archaeological sites (Kinghorn; Bullock and Collier 2011).

4 Case Study

4.1 The Castles Under Evaluation

In this study CE have been applied to a group of three castles located in the Valle d'Aosta Region. The castles are owned and managed by the Regional government in Valle d'Aosta. Actually, the Regional Superintendence for Cultural Heritage is enhancing a "Restitution" policy, based on the idea of bringing cultural heritage back to local communities, despite the continuous reduction of the available resources for cultural policies (Oppio et al. 2014, 2015). Valle d'Aosta is well known for its rich heritage of defensive architectures: castles and towers dominate the valley, characterizing this territory, which was for a long time a crossing point. Built for defensive purposes, castles gradually lost their original function and today some of them are completely empty and unused, some others have become important attractors for tourism and related activities (e.g. the Castle of Bard in the lower part of the Valley). Among the 13 castles owned by the Region Valle d'Aosta, the study focuses on the ones that are mostly unused: the Chateau Vallaise (Arnad), the Sant-Germain castle (Montjovet) and the Ussel castle (Châtillon). The castles have been analyzed from the point of view of the historical and architectural points of view. In particular, the study took into account different types of data, including different intrinsic features (age, state of conservation, uses and activities) and extrinsic features (accessibility, quality of the landscape, connections to the mobility system, surrounding functions). These features make it challenging to define the best potential adaptive reuse for the castles.

The first castle is a medieval architecture located in the municipality of Arnad (Fig. 1a). During the centuries, the building has undergone several restorations that significantly modified its structure and appearance and today the castle looks like a XVII century building. The interiors are characterized by prestigious frescos, one of the few examples of Valle d'Aosta Baroque art. The castle is currently under restoration, although it has been made accessible to the public in two special openings in 2011. The Saint-Germain castle is located on the edge of a hill over the valley (Fig. 1b). It has been built between the X and XI centuries by the De Mongioveto family for strategic purposes. Originally constituted by a single 19 m tower, this fortress passed over from owner to owner and for a long time it was owned by the Savoy family. Today Montjovet castle is a ruin. The castle of Ussel is the oldest example of a single block castle in Valle d'Aosta (Fig. 1c). Built in the mid XIV century, it dominates the Châtillon plain. In the XVIII century, the castle began to fall into ruins and in 1983 the owner donated the structure to the Region of Valle d'Aosta. After a restoration intervention that ended in 1999, the castle has been opened during summer and hosted exposition spaces.

4.2 Experimental Design and Questionnaire

As mentioned in Sect. 3, the first step of Choice Experiments deals with the selection of the attributes and the definition of their levels of intensity according to the following methodological requirements: attributes should be clear and not redundant; for each attribute the status quo should be included among the levels; each combination of attributes and levels should define a profile.

In the case study under investigation, attributes and levels have been identified by focus groups with experts in the field of adaptive reuse of historic and architectural resources and with technicians of the Superintendence of the Valle d'Aosta. Consistently with the idea widely shared among the experts involved, that active conservation of cultural heritage represents a kind of prevention from decay and abandon only if it is able to generate economic and financial resources adequate to sustain maintenance activities over time, the following attributes have bee defined (see Table 1):

(1) Multifunctionality, defined as the capability of a building to host different functions or services with a high level of complementarity among them in order to ensure vitality, to avoid periods of disuse, as well as to encourage the transformation of hosted functions with reference to emerging changes of needs;
(2) Conservation, meant as the attention to maintain the structural and material features of the buildings as they have been changed over time. The conservative approach differs from the restorative one for its purpose to not operate

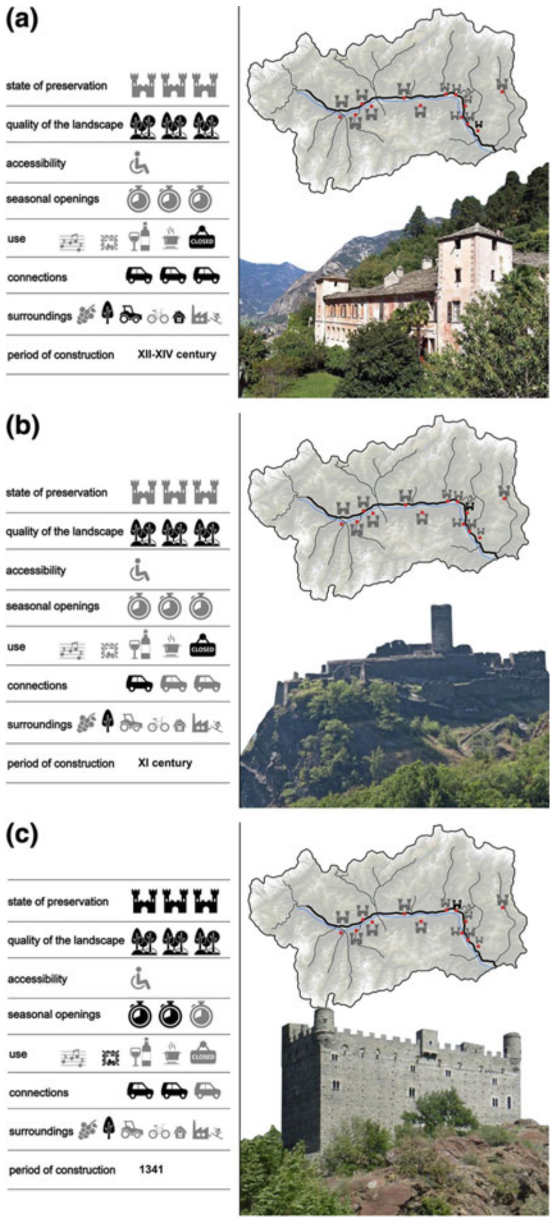

Fig. 1 The three castles under examination: **a** Chateau Vallaise (Arnad); **b** Sant-Germain castle (Montjovet); **c** Ussel. The legend displays the different elements considered in the analysis of the castle, highlighting in *dark grey* the achieved factors and in *light grey* the not achieved factors

Table 1 Attributes and levels

Attributes	Levels		
Multi-functionality	Low: the castle remains unused Medium: presence of one or two different functions High: presence of more than two different functions		
Conservation	Low: the castle remains as it is actually Medium: some portions of the castle are restored High: the castle is totally restored		
Exclusivity	Private: the access to the castle is not allowed except for those authorized Semiprivate: the castle is open according to specific limitations Public: the castle is open and can be visited without limitations		
Interaction	Low: local productions are not considered among the potential functions Medium: the potential functions are indirectly connected with local production High: local products and services are included in the potential functions		
Cost_Inhabitants	Arnad	Monjovet	Ussel
	0 €	0 €	0 €
	30 €	25 €	30 €
	60 €	50 €	60 €
Cost_Tourists	Arnad	Monjovet	Ussel
	0 €	0 €	0 €
	7 €	4.5 €	5.5 €
	14 €	9 €	11 €

irreversible changes to the structure in order to ensure a bequest to future generations;

(3) Exclusivity, referred to the use of the castles. Under an economic perspective public goods are not-excludable, as it is difficult for economic and technical reasons to exclude someone from their consumptions independently from the ownership;

(4) Interaction, that deals with the opportunity to create synergies with the local activities and productions in order to strengthen the population' sense of ownership of the castels and to revitalize the regional economy starting from the castles and their surroundings;

(5) Cost, that is the most probable amount of money for an entrance ticket that tourists would be willing to pay or the most probable annual tax that inhabitants would be willing to pay in order to support investments aimed at enhancing the castle. Consistently with the CE literature (Bullock and Collier 2011; Hanley et al. 1998a, b; Bravi and Giaccaria 2006), the levels of this attribute are defined by a questionnaire administered to a limited sample of respondents. In particular, a pre-test has been carried out with the participation of some experts from the Superintendence, in order to point out the Willingness To Pay for the sub-sample tourists and the sub-sample residents. The cost equal to 0 Euro has been included as it refers to the current situation, where no interventions are developed. Given the differences between the

actual state of conservation and use of the castles under investigation and the proposed ones, different levels of cost have been considered for each of them. The higher levels, both for inhabitants and for tourists, have been assigned to the castles of Arnad and Ussel, as they show a higher suitability to adaptive reuse.

Attributes and levels have been combined by a partial factorial design. Dawes and Corrigan (1974) have shown that on average the main effects explain from 70 to 90% of the variance of the gathered observations while the two-way interactions effects explain instead a varying percentage from 5 to 15%. Therefore, partial factorial design represents a good trade-off between complexity of the questionnaires and accuracy of the results.

The Orthoplan function of SPSS software has been used in order to define a subset of all the possible alternatives according to the orthogonal design rule. More specifically, the Orthoplan function provides a default set having the minimum number of alternatives so that we can analyse the main effects of the individual attributes. It also automatically discards the dominant or dominated alternatives when at least two attributes are numeric or ordinal. The orthogonality of the design avoids the respondents' preferences to depend on a biased construction of alternatives in the questionnaire. In other words, the probability that alternative A is preferred to alternative B must depend solely on the fact that the individual prefers A to B, without being influenced by the fact that alternative A has a higher probability of being extracted by the set of alternatives compared to B (Johnson et al. 2013).

Three of the five attributes described above have been considered as ordinal (Multifunctionality, Interaction and Conservation). Attribute Cost is numeric and attribute Exclusivity is categorical. According to these properties, a subset of eighteen alternatives has been generated, which have been coupled in order to obtain nine choice experiments. In each choice experiment, the status quo alternative has also been included, using the level of the attributes corresponding to each castle's current state (Fig. 2).

Fig. 2 Example of choice experiment

4.3 Econometric Model

A sample of around 600 respondents (divided into tourists and residents) was surveyed with face to face interviews between August and September 2014. The answers to the CE questionnaire were analysed within the random utility model framework (McFadden 1974). Responses were run through the software SPSS in order to estimate the probability of a given choice being made as a function of its characteristics. Logit regression model was estimated and the results are represented in Table 2.

From the analysis of the estimation coefficients of Table 2, it is possible to formulate some interesting observations. Firstly, the coefficient of the price has a negative sign. This is consistent with economic theory and logic because, if the cost of the option increases, the preference for the option decreases. Secondly, the exclusivity attribute has always a negative sign: this means that respondents tend to appreciate a non-excludable castle (i.e. public property of the cultural assets). Thirdly, it is possible to state that tourists tend to appreciate the state of conservation of the castles more than residents. Fourthly, one of the most important feature for the residents is the multi-functionality.

4.4 Consumer Surplus and Reuse Scenarios for the Castles

Starting from the results of the CE model, the estimated coefficients were used to generate alternative reuse projects for the three castles. In particular, both for the tourists and for the residents, the two most preferred attributes were selected as fundamental elements to be considered in the design of the reuse project for the castles. As an example, let us consider the estimation coefficients of the Arnad castle resulting from the tourist model. These coefficients are highlighted in grey in Table 2. In this case, the highest values correspond to the attribute "Multi-functionality" (regression coefficient 0.910) and "Conservation" (regression coefficient 1.413). The reuse project for the Arnad castle under the tourist scenario

Table 2 Estimation coefficients of the regression model considering the three castles under investigation and the preferences expressed by residents and tourists

	Arnad		Ussel		Montjovet	
	Residents	Tourists	Residents	Tourists	Residents	Tourists
Multi-functionality	0.729	0.910	0.703	0.054	0.601	0.741
Conservation	0.532	1.413	0.396	0.455	0.586	0.501
Exclusivity	−0.567	−0.618	−0.452	−0.53	−0.489	−0.697
Interaction	0.538	0.538	0.619	0.036	0.655	0.234
Price	−0.015	−0.038	−0.016	−0.058	−0.007	−0.061
Const	−2.51	−4.518	−2.712	−0.729	−2.962	−2.281

considers a deep restoration of the building to improve the state of conservation; this project will also focus on the creation of different functions to be developed in the castle, such as small shops, coffees and restaurants, a museum and so on. Following a very similar reasoning, two different projects have been defined for each castle (one for the tourist scenario and the other for the residents scenario), leading to a set of 6 alternative options (Table 3).

The analysis of the data collected with the CE survey can be useful also to assess how much individuals value project concepts. In other words, the coefficients resulting from the CE evaluation reveal the role of the different factors in influencing the final choice. For this purpose, the estimation coefficients of Table 2 are used to evaluate the degree to which the interviewees do trade-offs among the attributes. In particular, from the parameters of the model it is possible to calculate the Willingness To Pay (WTP) or consumer surplus for the specific reuse projects for the three castles.

Equation (1) represents the formula proposed by Harpman (2008) for the valuation of the consumer surplus:

$$WTP = \frac{\ln(1 + e^{\alpha})}{-\beta_{mon}} \tag{1}$$

where α is the sum of the βixi coefficients of the regression model for all the attributes, excluding the price and βmon is the regression coefficient related to the monetary attribute.

As an example, we can consider again alternative 2 related to the Arnad caste under the tourist scenario. In this case, the measure of the consumer surplus can be calculated using Eq. (1) as follows:

$$WTP = \frac{\ln\left(1 + \mathrm{e}^{(0.910*3 + 1.413*3 - 0.618*1 + 0.538*1 - 4.518)}\right)}{-0.038} = 64.74\,€. \tag{2}$$

In particular, the WTP for alternative 2 is calculated using the values that each attribute takes on under this scenario, namely high multi-functionality (3), high conservation (3), public exclusivity (1) and low interaction (1), and using the estimates provided in Table 2.

5 Discussion and Conclusions

This study proposed the use of Choice Experiments to define proper requalification strategies for three castles located in the Valle d'Aosta Region (Norther Italy). The three castles are owned and managed by the Regional government in the Valle d'Aosta Region which has been significantly involved in the overall planning and decision making process by co-structuring the decision problem and providing preference information.

Table 3 Alternative reuse projects that have been generated from the CE results

Alternatives	1. Arnad residents	2. Arnad tourists	3. Ussel residents	4. Ussel tourists	5. Monjovet residents	6. Monjovet tourists
Attributes	Multi-functionality interaction	Multi-functionality conservation	Multi-functionality interaction	Multi-functionality conservation	Multi-functionality interaction	Multi-functionality conservation
WTP	100.44 €	64.74 €	91.36 €	14.77 €	177.61 €	21.31 €

The study has an innovative value which stems from the context of application of the Choice Experiments approach. As highlighted in Sect. 3, Choice Experiments have been mostly used to estimate the value of environmental goods and only recent applications have explored limits and advantages of this methodological approach for dealing with the economic assessment of the landscape in its own. The study proposed in this paper explores the applicability of Choice Experiments for dealing with an emerging dimension of environmental goods, i.e. cultural heritage in the form of architectural buildings calling for both preservation and renovation, thus representing a challenging context of application.

Another element of innovation brought by this study refers to the use of a formal approach to support the design of alternative solutions for a complex decision making problem. As highlighted in the scientific literature (Colorni and Tsoukiàs 2003; Ferretti 2016), there is indeed a need to investigate more in depth the design phase of alternative solutions since alternatives are rarely given, they are rather constructed through the decision making process. This study showed how the use of Choice Experiments can support the identification of the most relevant features needed for the design and implementation of successful requalification alternatives.

Future developments of the study may explore the integration of Choice Experiments and Multicriteria Decision Aiding techniques for the elicitation of preference information and the evaluation of the designed alternatives according to a mixed methods approach.

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Decision Support Methods for Public-Private Partnerships: An Application to the Territorial Context of the Apulia Region (Italy)

Pierluigi Morano and Francesco Tajani

Abstract In this paper, a methodology to support decisions of Public Administrations in the defining of planning parameters of urban regeneration initiatives to be implemented with the involvement of private investors is applied. The decision support method proposed borrows the logic of the Break-Even Analysis. The model is applied to an urban area located in a city of the Apulia Region (Italy), which has been promoting urban redevelopment policies, as well as investing significant public funding. The results highlight the simplicity and flexibility of the model, the phases of which are easily implementable in any territorial context. The work must be attributed in equal parts to the authors.

Keywords Break-even point · Urban redevelopment · Public-private partnership · Decision support method

1 Introduction

The Apulia Region has been promoting urban regeneration, acknowledging in the regional laws (L. No. 21/2011; L. No. 14/2009; L. No. 21/2008) national and Community directives, enacting specific regulations (L. No. 13/2008), investing significant public funding (e.g.: Call for Integrated Programs for Redevelopment of the Suburbs, referred to BURP No. 81/2006; Call for Urban Redevelopment Program for sustainable housing rent, referred to BURP No. 137/2008; axis VII of the PO FESR 2007–2013).

This broad regulatory and financial initiative has produced remarkable results in the programs supported by regional and national funding, but it has been unable to significantly influence the ordinary activities of local governments. Urban renewal

P. Morano · F. Tajani (✉)
Department of Science of Civil Engineering and Architecture, Polytechnic of Bari, Bari, Italy
e-mail: francescotajani@yahoo.it

P. Morano
e-mail: pierluigi.morano@poliba.it

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has difficulty to spread through adequate programs, especially in initiatives indicated by the prevailing investment of the private entrepreneur, who seems to prefer new buildings even in the current crisis of demand (Calabrò and Della Spina 2014b; Morano and Tajani 2015).

In fact, urban renewal is a more complex process than realising new constructions and requires a strong change of mentality in entrepreneurial and administrative behavior, a focused use of public funding and development of assessment tools that allow to define valid intervention programs, along with their quick and certain approval (Calabrò and Della Spina 2014a; Tajani and Morano 2014). The use of the same evaluation tool for both the public operator and private investor acknowledges the need to adopt the same methodology and language for both the determination of the reciprocal advantages as well as the definition of the negotiating agreements.

In order to promote urban regeneration initiatives that require private involvement, Break-Even Analysis is applied. This method is characterized by its simplicity and flexibility of use, with it being easily implemented to any local context. In international literature, and specifically in the Anglo-Saxon territory, there is a broad range of scientific applications of Break-Even Analysis (Dean 1939; Ingraham 1951; Colantoni et al. 1969; Adar et al. 1977; Conine 1986; Kee 2001). In the Italian context, Break-Even Analysis has been mainly applied to the business sector as well as in several engineering fields (Guatri 1994; Pratali 1996; Luciano and Ravazzi 1997; Mella 1998).

This research is divided into three parts. The first presents a case study, concerning the urban regeneration of a private property located in a Municipality of the Apulia Region; the investment and context in which it is inserted are described, and the essential elements of the Program Agreement formalized between the Public Administration and the private investors are illustrated. In the second part, the steps for the implementation of the model with reference to the case study are developed: (i) collection of the physical-planning and market data of the investment and construction of the financial balance of the initiative; (ii) organization of the financial balance in "fixed" and "variable" items; (iii) determination of the weighted mean values of the prices and variable costs and analysis of the break-even point. In the third part, the results are discussed and some considerations on the outputs obtained are made.

2 The Case Study

The case study concerns the urban redevelopment of a private area of 23,084 m^2, located in a Municipality of the Apulia Region. The redevelopment initiative includes a variant of the urban destination currently established by the General Regulatory Plan of the Municipality—area for health and hospital facilities. In particular, the new urban destination provided for the realization of public facilities and private buildings in the area.

The area has a flat morphology. The context in which it is located is equipped with infrastructures as well as public and private services: in particular, the area is adjacent to the public hospital, a position that has influenced the choice of the new public functions. The predominant construction typology in the reference area is represented by buildings with the ground floor used as private warehouses and four floors intended for residences.

Currently occupied by a few buildings in disuse, the study area is immediately buildable. Both due to its location and extension, the entire project area represents an element of mediation between the town board and the entrance areas to the city, but because of its general state of disuse, it is still considered an abandoned area.

The urban area variant was defined with the Program Agreement approved by Regional Decree No. 540 of 06.27.2012. The variant confirms the original destination established by the General Regulatory Plan of the Municipality—area for health and hospital facilities—only for a part of the total surface, precisely for 7,600 m^2, divided into 6,100 m^2 for the realization of a public multifunctional health structure and 1,500 m^2 for the construction of a private health structure. For the remaining 15,484 m^2, a housing development is planned, divided between the private surface for the construction of five buildings with the ground floor intended for commercial activities and five floors for residences, and the surface for public facilities (according to Ministerial Decree No. 1444/1968) and public connecting roads, and social housing as additional public work.

The planning parameters of the housing development identified by the Program Agreement and the commitments of the private investors are as follows:

(i) the free transfer of 6,100 m^2 in favor of the Local Health Company (ASL), for the realization of a public multifunctional health structure;
(ii) the realization of the housing development over an area of 15,484 m^2, in compliance with the volumes and surfaces provided by the Urban Executive Plan annexed to the Program Agreement. In particular, the project involves the construction of 26,198.92 m^3 of private volumes to be sold on the free market, of which 20,360.10 m^3 are intended for residences, and 5838.82 m^3 are intended for commercial activities;
(iii) the free transfer in favor of the Municipality of the surfaces for public facilities that are located in the housing development (primary and secondary urbanizations and public connecting roads), for a total of 7,150 m^2;
(iv) the realization of the primary and secondary urbanizations, constituted by public parking and connecting roads (2,636.96 m^2), public green facilities (2,571.04 m^2) and a nursery school (1,941 m^2);
(v) the payment of the local planning fees for the properties to be sold on the free market;
(vi) the realization and subsequent free transfer in favor of the Municipality, of a building of four floors to be intended for social housing, for a total volume of 2,911 m^3.

Fig. 1 General plan of the investment with the specifications of the public and private surfaces

The planning parameters for the construction of the public and private health structures are those established by the Technical Regulations for the implementation of the General Regulatory Plan of the Municipality.

The general plan of the investment under analysis, with the specifications of the functions in the public and private surfaces, is shown in Fig. 1.

3 Implementation of the Break-Even Analysis

The three steps for the implementation of the Break-Even Analysis to the case study are developed below: (i) collection of the physical-planning and market data of the investment and construction of the financial balance of the initiative; (ii) organization of the private investor's balance in "fixed" and "variable" items; (iii) determination of the weighted mean values of the prices and variable costs and analysis of the break-even point.

3.1 Physical-Planning and Market Data of the Investment

In Table 1, the main physical-planning data of the investment under analysis are summarized.

The total area of the investment, equal to 23,084 m^2, is divided by 32.7% in the surface for private buildings to be sold on the free market (=7,551 m^2), by 3.39% in

Table 1 Physical-planning data of the investment

Total surface for housing development (excluding private and public health structures)	15,484 m^2
Total volume (free market residential, social housing, commercial)	29,109.92 m^3
Construction index	1.88 m^3/m^2
Gross floor area of social housing	970.00 m^2
Volume of social housing	2,911.00 m^3
Gross floor area of private housing	6,786.70 m^2
Volume of private housing	20,360.10 m^3
Gross floor area of commercial use	1,534.10 m^2
Volume of commercial use	5,838.82 m^3
Surface of primary and secondary urbanizations – public parking and connecting roads – public green facilities – nursery school	7,150.00 m^2 2,637.96 m^2 2,571.04 m^2 1,941.00 m^2
Surface of public facilities	7,150 m^2
Surface of private parking	4,421.00 m^2
Surface of private facilities	5,926.00 m^2
Footprint area of the nursery school	775.00 m^2
Appurtenant area of the nursery school	1,491.00 m^2
Volume of the private health structure	3,750.00 m^3
Footprint area of the private health structure	600.00 m^2
Appurtenant area of the private health structure	900.00 m^2
Gross floor area of the private health structure	850.00 m^2

the surface for social housing (=783 m^2), by 26.4% in the surface for the public health structure (=6,100 m^2), by 6.50% in the surface for the private health structure (=1,500 m^2), by 31% in the surface for public (=7,150 m^2). Both the surface for public facilities (=7,150 m^2) and the surface for private parking (=4,421 m^2) satisfy the national regulatory limits, amounting respectively to 5,239.79 m^2 for public facilities (art. 3, Ministerial Decree No. 1444/1968) and 2,619.89 m^2 for private parking (L. No. 122/1989).

Table 2 summarizes the market data that occur for the development of the private investor's balance. The data were collected by municipal technical regulations and market surveys. The quantities with the unknown "x" (local planning fees, construction costs of free market residential, construction costs of commercial, residential sale, commercial sale) will be determined by the model.

3.2 *Organization of the Private Investor's Balance in "Fixed" and "Variables" Items*

The analysis of the costs and the revenues shown in Table 2 has allowed for the organization of the private investor's balance in "fixed" and "variable" items outlined in Table 3. The amounts for the implementation of the Break-Even Analysis are highlighted in bold: the total fixed costs (Cf = 5,036,447 €), the fixed revenues from the sale of the private health structure (Rf = 1,360,000 €), the unit variable

Table 2 Market data for the development of the private investor's balance

Costs	Unit cost or percentage	Quantity
Land purchase	48.86 (€/m^2)	23,084 (m^2)
Taxes and notary fees	11 (%)	1,127,884 (€)
Sub total A		
Local planning fees		
Residential, commercial, private health structure	48.12 (€/m^2)	x (m^2)
Sub total B		
Construction costs		
Free market residential	1,100 (€/m^2)	x (m^2)
Commercial	900 (€/m^2)	x (m^2)
Private facilities	40 (€/m^2)	5,926 (m^2)
Social housing	1,000 (€/m^2)	970 (m^2)
Public green facilities	40 (€/m^2)	2,571 (m^2)
Public parking and connecting roads	80 (€/m^2)	2,638 (m^2)
Nursery school	550 (€/m^2)	775 (m^2)
Private health structure	1,100 (€/m^2)	850 (m^2)
Appurtenant facilities of the private health structure	40 (€/m^2)	900 (m^2)
Total construction costs (*Sub total C*)		
Technical and general expenses (*Sub total D*)	9 (%)	Sub total C
Total costs (before financial charges and profit) [*Sub total (A+B+C+D)*]		
Financial charges	6.50 (%)	Sub total (A + B + C + D)
Normal profit of the private investor	20 (%)	Total revenues
Total costs		
Revenues	Unit price	Quantity
Residential sale	2,200 (€/m^2)	x (m^2)
Commercial sale	2,000 (€/m^2)	x (m^2)
Sale of the private health structure	1,600 (€/m^2)	850 (m^2)
Total revenues		

Table 3 Organization of the private investor's balance in "fixed" and "variables" items

Fixed costs	
Land purchase	1,127,884 €
Taxes and notary's fees	124,067 €
Construction private facilities	237,040 €
Construction social housing	970,000 €
Construction public green facilities	102,840 €
Construction public parking and connecting roads	211,040 €
Construction nursery school	426,250 €
Construction private health structure	935,000 €
Construction appurtenant facilities of the private health structure	36,000 €
Local planning fees for the construction of the private health structure	40,902 €
Technical and general expenses	262,635 €
Financial charges	290,788 €
Normal profit of the private investor on the private health structure	272,000 €
Additional request	–
Total	**5,036,447 €**
Variable unit costs	
Free market residential	
Local planning fees	48.12 €/m^2
Normal profit of the private investor	440.00 €/m^2
Technical and general expenses	99.00 €/m^2
Financial charges	81.06 €/m^2
Construction	1,100.00 €/m^2
Total	**1,768.18 €/m^2**
Commercial	
Local planning fees	48.12 €/m^2
Normal profit of the private investor	400.00 €/m^2
Technical and general expenses	81.00 €/m^2
Financial charges	66.89 €/m^2
Construction	900.00 €/m^2
Total	**1,496.01 €/m^2**
Unit revenues	
Residential sale	**2,200.00 €/m^2**
Commercial sale	**2,000.00 €/m^2**
Fixed revenues	
Revenue from the sale of the private health structure	**1,360,000.00 €**

costs related to the residential units (Cvu_{res} = 1,768.18 €/m^2) and those related to the commercial units (Cvu_{comm} = 1,496.01 €/m^2), the unit selling prices of the residential units (pu_{res} = 2,200 €/m^2) and those of the commercial units (pu_{comm} = 2,000.00 €/m^2).

In Table 3, the item “additional request” that the Public Administration can advance to the private investor is also reported, the amount of which is determined by the evaluation model in relation to the financial conveniences of the investment.

3.3 Weighted Mean Values of Prices and Variable Costs and Analysis of the Break-Even Point

The implementation of the model requires the calculation of the weighted mean values of the quantities to be inserted into the financial analysis, in relation to the different intended uses of the investment. In the case study, the weighting of the sales prices and unit variable costs is carried out by applying the percentages established by the Program Agreement for the corresponding functions in which the total gross floor area (GFA) is divided, equal to 8,320 m^2 (Table 4).

The fixed costs and fixed revenues in Table 3, and the weighted mean values of Table 4 allow for the determination of the amounts of gross floor area (q*) that the generic private investor should realize to guarantee the financial balance of the investment. Analytically, q* may be directly calculated through the following equation, which links the break-even point to the fixed costs (Cf), the fixed revenues (Rf), the unit selling price (pu) and the unit variable cost (Cvu):

$$q^* = \frac{Cf - Rf}{pu - Cvu}. \tag{1}$$

Replacing the symbols with the corresponding amounts, it can be obtained:

$$q^* = \frac{5,036,447 - 1,360,000}{2,163.13 - 1,718.00} = 8,259.3\,\mathrm{m}^2. \tag{2}$$

The amount of GFA determines the balance of the total costs and the total revenues of the investment under analysis, and identifies the minimum threshold of the financial convenience for the private investor. Since the q* also identifies the surfaces that the private entrepreneur should produce and sell in order to ensure the commitments established in the Program Agreement, this amount of GFA represents the balance between the financial conveniences of both the public and private entities involved in the investment.

Table 4 Determination of weighted mean unit values of prices and variable costs

Intended uses	Unit price (€/m^2)	Variable unit cost (€/m^2)	% of total
Residential	2,200.00	1,768.18	82%
Commercial	2,000.00	1,496.01	18%
Weighted mean values	2,163.13	1,718.00	

Table 5 Extract data for the detection of the break-even point

GFA (m^2)	4,000	6,000	8,000	8,320	10,000	12,000
Fixed costs (€)	5,036,447	5,036,447	5,036,447	5,036,447	5,036,447	5,036,447
Variable costs (€)	6,872,012	10,308,018	13,744,024	14,293,785	17,180,030	20,616,036
Total costs (€)	11,908,459	15,344,465	18,780,471	19,330,232	22,216,477	25,652,483
Total revenues (€)	10,012,505	14,338,757	18,665,009	19,357,209	22,991,261	27,317,514
Normal profit (€)	2,002,501	2,867,751	3,733,002	3,871,442	4,598,252	5,463,503
Total profit (€)	−1,895,954	−1,005,708	−115,462	26,978	774,785	1,665,031

For the GFA equal to q*, the total profit is zero, since the break-even point determines the equality of the total revenues and the total costs of the investment, but the normal profit of the private investor is guaranteed.

Considering a variation of the GFA between 4,000 and 12,000 m^2, so as to involve the amount of total GFA provided by the Program Agreement for the case study (=8,320 m^2), in Table 5 an extract of the financial analysis is reported. Table 5 shows that the total profit is negative for a GFA between 4,000 and 8,000 m^2, whereas it is positive for higher values. The point of reversal of the total profit, i.e. the amount of GFA for which the total profit is equal to zero, occurs in correspondence to the break-even point, equal to 8,259.3 m^2.

4 Conclusions

The results obtained from the application of the evaluation model to the case study give rise to interesting conclusions.

First, it appears that, starting from the amount of GFA corresponding to the break-even point, equal to 8,259.3 m^2 (slightly lower than the projected GFA, equal to 8,320 m^2), the priority requests of the Public Administration, initially established by the Program Agreement, can be satisfied without reducing the financial feasibility of the initiative for the private investor.

From a purely financial point of view, the advantages of the investment for the Public Administration are: (i) the values of the surfaces transferred free by the private investor—area for the realization of the public multifunctional health structure, area for public facilities, area for social housing—amounting to 685,652 €, (ii) the payment of local planning fees of the functions to be sold on the free market of the contribution on the cost of co-construction of destinations free market (residential, commercial, private health structure), amounting to 441,299 €, (iii) the value of the public services realized by the private investor—green spaces, social housing, nursery school, public roads and public parking—, equal to 1,710,130 €. As a result, the total financial benefit of the initiative for the Public Administration, amounting to 2,837,081 €, represents 14.66% of the total revenues of the investment for the private entrepreneur.

Secondly, the extract of the financial analysis reported in Table 5 shows that, for the amount of the projected GFA, equal to 8,320 m^2, the initiative generates a low extra-profit, equal to 26,978 €. This amount constitutes the maximum additional request that the Public Administration can claim from the private investor, since it is compatible with the constraint of financial convenience of the initiative. Therefore, in financial terms, the project provided by the Program Agreement already represents an acceptable equilibrium solution between the private eligible volumes and the requests made by the Public Administration in terms of free transfers of areas, local planning fees, public facilities and social housing.

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