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Sustainability qualification tool for Italian multi-family buildings

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Abstract. There is a growing interest in the real estate sector in tools for assessing the sustainability and quality of the building stock. Often such tools, regardless of their content but by their nature as an assurance tool, serve as a support and stimulus to the sustainable building market. This paper reports the steps and methodology followed in the development of a sustainability qualification system for condominium buildings. The structure of the system and its technical characteristics are described. The objective of the tool is to evaluate not only aspects related to the building's construction and technical systems quality but also to highlight the ability to optimize condominium services and management practices.

1 Introduction

To date, there are numerous protocols available internationally, which are often followed by national versions developed to refine knowledge about sustainability related to the national building stock [1, 2].

The development of national protocols is justified by the need to represent country-specific characteristics (e.g., climatic, geographical, legislative, etc.). However, the variety of evaluation methods, which are articulated on very different criteria and parameters, makes them difficult to compare in some cases, because this would require the definition of standardized reference levels, indicators, requirement criteria, calculation, and verification methods. Although there is still a lack of harmonization, the solution to which is one of the challenges researchers and government agencies are working on, at least at the European level, each of these assessment tools can be an important reference to guide the market toward sustainability.

The first building sustainability assessment protocols were introduced in the 1990s and are still being discussed and compared today [3, 4]. From the earliest rating systems to the most recent ones, there is still no single tool that covers and satisfies all the needs and areas with which the building system interacts. This is because the topic is very broad, diverse, and always evolving. In addition, several protocols have a complex structure and their implementation is time-consuming and therefore expensive [5].

The protocol proposed here responds to a specific market request from an Italian condominium management company interested in highlighting order, transparency, and clarity in the condominium market in Italy, which is often neglected in the real estate sector, to enhance the condominium community. From this cue, a simple and easy-to-use tool was developed with the aim to refer to the three levels of sustainability. The development of the protocol was based on some of the most widely used certification systems both at international and national scale, obtaining a comprehensive but at the same time lean qualification tool.

2 Method

The enhancement of sustainability in all three of its components (Environmental, Economic, and Social) and the simplicity of applying the tool are the basic criteria that guided the development of the proposed protocol. The different working phases that compose the development method of the evaluation tool are the following:

1) identification and analysis of reference protocols;
2) identification of the characteristics of the protocol;
3) definition of the technical structure of the protocol;
4) determination of the scoring mode and identification of final performance classes.

3 Definition of the protocol

3.1 Identification and analysis of reference protocols

Evaluation tools are numerous, and each has different characteristics that may be related to the objective to be achieved or to needs related to the type of object being analyzed or the context in which it is located.

Green Building Rating Systems (GBRS) follow different methodologies, requirements, and focuses that are often constantly evolving. The most recurrent macro-areas considered are the following: Site, Water, Indoor/Outdoor quality, Energy, Eco-sustainability, Project management, and Usability of services. The protocols can be classified into two macro groups based on the assessment methodology: score-based or

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threshold-based [6]. The score-based one seems to be the most popular. It was observed that all protocols analyzed involve updating over time, not only to incorporate regulatory changes but also to respond to new market needs. The analysis of environmental assessment protocols/tools shows how these instruments while having the same basis of interest in identifying assessment areas, have very different indicators [7]. Generally, most protocols focus more on environmental aspects than on economic and social ones [8, 9]. The need to distinguish between new and existing buildings is highlighted. Often the indicators of some protocols are difficult to apply to existing buildings while they can be very useful from the early stages of design in those of new construction [10].

3.2 Identification of protocol characteristics

The proposed tool aims to assess the sustainability level of condominium buildings in the Italian territory. Taking as a starting point the most widespread and well-known protocols at the international level (BREEAM [11], LEED [12]) and those at the national level (ITACA [13]), scopes and related criteria were defined. The indicators, however, were specifically designed for the territorial context of application. Within the condominium reality, it was deemed important to give equal weight to the three domains of sustainability, thinking that environmental respect, fair economic expenditure, and quality of life of the condominium community are equally important aspects.

Specifically, the protocol applies to all buildings in which there is an administrator (i.e. a building manager), which is mandatory for buildings with more than eight units, according to the Italian definition of condominium [14, 15]. The main objective of the new tool is to ensure the simplicity and ease of the assessment process while guaranteeing its completeness. This objective oriented the methodological choice toward a rating system, which does not impose the achievement of a minimum level for each category. However, it was considered appropriate to provide a set of binding prerequisites, which are indispensable for starting the rating procedure. The procedure involves a series of activities to be carried out in sequential steps involving the completion of the first step before moving on to the next one. The activities, carried out by specially trained and certified figures, can be summarized in four steps: 1. verification of the presence of mandatory documents and data acquisition; 2. determination of assessment and analysis of results; 3. improvement of assessment; 4. definition of classification.

The assessment method, therefore, aims to describe the actual state of the building at the time of its evaluation. Accordingly, the assessment must be repeated when significant changes are made to the building (e.g., changing components, adding new elements/features, adopting new management strategies, etc.). The protocol is structured for buildings that have been in operation for at least 3 years, so that consolidated consumption and expenditures are available. However, in order not to neglect newly constructed buildings, the proposed protocol can also be applied to new buildings, with the requirement to renew the certification at the end of the 3rd year of operation. In this case, some data are only estimated and therefore provisional. The protocol provides for a periodic update of the adopted baseline data, every 3 years.

3.3 Definition of the technical structure of the protocol

The structure of the proposed rating protocol includes three levels, represented in Figure 1:

- AREA (A,...) identifies the three categories of sustainability: Environmental, Economic, and Social;
- CATEGORY (A.1,...) represents macro-themes considered significant for quality assessment within each Area;
- CRITERION (A.1.1,...) delves into specific aspects of a category; each category may contain several evaluation criteria and each criterion is evaluated through one or more indicators.

The indicator can be quantitative (numerical score that can be determined by comparing the detected performance with specific thresholds) or qualitative (presence or absence of a specific characteristic). The indicator may depend on the design or management activity of the building or on third factors such as the case of context or structures dependent on territorial regulation.

The environmental area is defined in 3 categories that bring out energy and resource consumption on the one hand and exogenous environmental effects impacting the building (air, noise, and electromagnetic pollution) on the other. For this area, 13 criteria with 25 indicators have been identified. The economic area is defined with 5 categories that aim to highlight the operational costs of the building (water and energy supplies), administration, and maintenance. A total of 11 criteria with 14 indicators have been identified. The social area is represented by 4 categories that aim to highlight the building's performance in terms of service delivery, building quality and safety. For the social area, 16 criteria were identified with a total of 21 indicators.

A. ENVIRONMENTAL AREA		
A.1 ENVIRONMENTAL QUALITY OF THE BUILDING-CONTEXT SYSTEM	A.2 RESOURCES CONSUMPTION	A.3 ENERGY CONSUMPTION AND QUALITY OF BUILDING ENVELOPE AND HVAC SYSTEM
A.1.1 Permeability of surfaces	A.2.1 Land consumption	A.3.1 Building energy performance
A.1.2 Noise pollution	A.2.2 Water consumption	A.3.2 Auxiliary services energy performance
A.1.3 Air pollution	A.2.3 Raw materials consumption	A.3.3 Energy production from renewable sources or cogeneration and connection to district heating
A.1.4 Electromagnetic pollution		A.3.4 Building envelope energy quality (opaque, transparent envelope and solar control systems)
		A.3.5 HVAC energy quality (heating systems, cooling systems, mechanical ventilation)
		A.3.6 Building automation and control systems quality (BACS)

B. ECONOMIC AREA				
B.1 ENERGY METERING	B.2 ENERGY SUPPLY	B.3 WATER SUPPLY	B.4 MAINTENANCE	B.5 ADMINISTRATION
B.1.1 Water metering (cold and hot domestic water)	B.2.1 Electricity supply cost	B.3.1 Drinking water supply cost	B.4.1 Ordinary and extraordinary maintenance cost	B.5.1 Ordinary condominium fees
B.1.2 Metering for space climatization	B.2.2 Fuel supply cost			B.5.2 Financial statement
				B.5.3 Building insurance
				B.5.4 Accessibility of documentation
				B.5.5 Certification of building manager requirements

C. SOCIAL AREA			
C.1 SITE CONTEXT	C.2 BUILDING QUALITY	C.3 CONDOMINIUM SERVICES	C.4 CONDOMINIUM AMENITIES
C.1.1 Presence of infrastructure	C.2.1 Materials certification	C.3.1 Presence of common spaces	C.4.1 Waste Management
C.1.2 Presence of public transport cycle lanes	C.2.2 State of building preservation	C.3.2 Protection against theft and burglary	C.4.2 Presence of sports and wellness facilities
C.1.3 Presence of public green space	C.2.3 Redevelopment works	C.3.3 Availability of other condominium services	C.4.3 Presence of health and safety equipment
C.1.4 Presence of neighbourhood services			C.4.4 Presence of other equipment
C.1.5 Building accessibility			
C.1.6 Presence of legal actions and disputes			

Fig. 1. Representation of the protocol structure: the tool is based on the three areas of sustainability (Environmental, Economic, and Social); each area is represented by categories within which macro criteria are identified and described with specific and individual indicators.

3.4 Determination of scoring mode and identification of final performance classes

The evaluation methodology applied is the scoring method. The score is assigned to each indicator based on the degree of performance detected against qualitative/quantitative thresholds inferred from normative limits, reference values identified through experimental cases, and/or observation of good building practices. The maximum score ranges were defined by giving more importance to factors related to building design and management and less to those related to the settlement context. Examples include proximity to sources of pollutant emissions, external noise sources, and the presence or absence of public transportation lines. According to the described logic, the maximum scores attributable to the three areas are as follows: Environmental 215, Economic 135, and Social 200 points.

Having deemed it appropriate to give equal importance to each of the three evaluation areas identified, the total score obtained in each area is assigned a weight equal to 1/3 of the total. For simplicity, the final score obtained as a weighted sum of the values achieved for each area is expressed as a percentage of the maximum score that can be attributed for the specific case under consideration. In detail, the score obtained by a given building in one of the 3 assessment areas is first expressed as a percentage of the maximum score attributable to that assessment area (e.g. , the assignment of 80 points out of a maximum of 100 corresponds to a score of 80% within the specific area). It is then multiplied by the weight factor 1/3 to equalize the weight on the three main areas. The weighted sum of the scores thus calculated for each area determines the final value assigned to the building being evaluated.

Based on the final result obtainable through the qualification methodology, 7 score classes were identified to establish the performance level of the analyzed building. Class 1 for a low score (< 20% of the obtainable score), up to Class 7 for a high score (i.e., above 81%) (Figure 2).

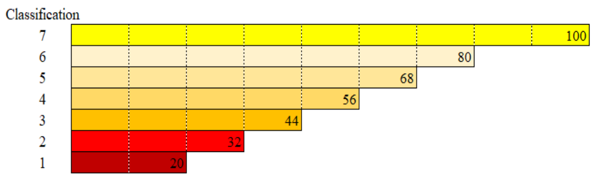

Fig. 2. Graphic representation of the classification of condominiums according to the scores obtained. The classification is made up of 7 Classes: from level 1 (the lowest score) to level 7 (the highest score).

Classes 1 and 7 are wider than the others because we wanted to take into account the weight of those factors included in the qualification methodology that are independent of the building's design and management activities. For example, a well-designed and managed building will belong to the highest class (Class 7) even if the context in which it is placed does not have all the optimal characteristics considered in the assessment. On the other hand, it is believed that even buildings with very poor design and management can achieve a minimum score related to favorable environmental/social characteristics (Class 1).

The protocol allows the easy identification of improvement actions to increase the score. Adopting certain improvement strategies can significantly increase a building's rating level and thus its overall sustainability level. The intervention choices can be different, for example, low-cost or high-cost, to be implemented over a short or longer time horizon. Some low-cost improvement actions that can be implemented in a short time are: evaluating alternative supply contracts; incorporating energy metering systems; and improving the services offered by the condominium. More costly actions could be energy retrofits; upgrading technical systems; installing renewable energy systems; and providing equipment for collective use.

4 Conclusions

With the emergence of the concept of sustainability in the construction industry, research efforts to develop building sustainability rating systems have intensified over the past three decades. The need to have a rating system to quantify and verify the environmental, economic, and social performance of condominium buildings has arisen from multiple stakeholders of the condominium reality, such as:

- *facility managers*, who can monitor and improve building performance and services, enhancing sustainability aspects;
- *designers*, who can guide the design process toward a clear level of sustainability;
- *users*, who can get feedback on the building's operation.

Within this framework, the proposed sustainability assessment protocol aims to evaluate condominium buildings with the purpose of:

- identify areas for improvement;
- be simple and pragmatic, precisely to facilitate communication between different professionals;
- enable a quick but comprehensive assessment process;
- provide greater user awareness of the features and potentials of the collective place in which they live.

Possible future research developments focus both on continuous updating of the protocol and optimization of the criteria and related indicators and on the development of a twin protocol specifically for buildings in the design phase, along with guidelines for improving the future sustainability performance of buildings.

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