Sustainability assessment method for healthcare buildings – criteria for materials selection in the Portuguese context

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Abstract

The health sector has a strong influence on the economy of nations and their policies and is based in a group of buildings where the quality of the indoor and outdoor environment is quite important. The impacts of these buildings are relevant compared to other buildings because they are directly related to human health. The healthcare providers are not serving patients but serving people. It is their role to design and deliver services to meet the needs of people at the most difficult times in their lives.
Regarding materials and reversible building design, it is fundamental to consider the technical, economic, financial and environmental issues in the criteria of a Building Sustainability Assessment (BSA) method. The sustainability categories and indicators should address, among others, durability, eco-efficient materials, furniture layout and flexibility and occupant's comfort. When speaking about healthcare buildings, it is also necessary to consider safety and adaptability.
In this context, the aim of this paper is to discuss the context of sustainability assessment methods in the field of healthcare buildings and to present a proposal for the incorporation of Materials criteria in a new Healthcare Buildings Sustainability Assessment (HBSA) method. The used research method is innovative since in the development of the list of sustainability criteria it considers the opinion of main healthcare buildings' stakeholders, the existing healthcare assessment methods and the ISO and CEN standardisation works in the field of sustainability assessment of construction works. As result, the proposed method is composed of twenty-two sustainability categories that cover the different dimensions of the sustainability concept and it is aimed to support decision making during the design of a new or retrofitted healthcare building in urban areas.

Keywords: Assessment methods; Healthcare buildings; Indicators; Materials criteria; Sustainability.

Healthcare building sustainable assessment tool – Portugal (HBSAtool-PT)

Healthcare Building Sustainable Assessment tool - Portugal (HBSAtool-PT) is a method to assess healthcare buildings that is adapted to the Portuguese environmental, societal and economic contexts. This method has the following characteristics:

- It is based on a comprehensive approach that takes into consideration the key aspects related to Sustainable Development goals: environmental, societal, economic, local, technical and functional;
- It considers the existing HBSA methods, the ongoing standardisation and the context where it is going to be applied;
- It has developed in way to be easily understood by both building promoters and users and by the designers that work with it;

- It can be applied in different building life cycle stages (design, construction and use phases) by various healthcare buildings stakeholders.

The proposed structure of the HBSAtool-PT can highlight different aspects during the earlier design stage, allowing supporting decision-making of design teams and mitigating adverse future impacts. This method also allows the comparison of the performance at the level of each sustainability category, making possible the adjustment of each design scenario.

Materials criteria in a new healthcare buildings sustainability assessment (HBSA) method

The proposed HBSAtool-PT is aimed at allowing a comparison of the overall performance of healthcare buildings projects. The list of indicators, categories and areas this method was previously validated by a group of researchers and experts in the field of healthcare buildings. The used adaptive learning process for developing and applying sustainability indicators used, has often been shown to be more precise and sometimes easier to apply (Reed, Fraser, & Dougill, 2006).
Table 1 presents the general structure of the HBSAtool-PT. Using the AHP method, established in 1980 by Thomas L. Saaty (Saaty, 2008), Figure 1 presents the weight of each category inside the respective area. The weights were set taking into consideration the opinion of groups of main stakeholders (including healthcare building managers and sustainable construction and healthcare building experts) (Castro, Mateus, & Bragança, 2017). The collection of data was made by interviews, to validate the proposed list of indicators and the HBSA method structure. In the list of the HBSAtool-PT criteria, there are two categories that can be directly linked with the materials selection (C4 - Materials and Solid Waste and C17 - Durability) and therefore they will be the focus on this paper. These categories are intended to promote the use of high performance materials.
Analysing Figure 1, it is possible to conclude that Category 4 is one of the most important in the Environmental Area and Category 17 has an average weight considering the other categories of the Technical Area.

Table 1. Structure of HBSAtool-PT.

Areas	*Categories*
A1 - Environmental	C1 - Environmental life cycle impact assessment
	C2 - Energy
	C3 - Soil use and biodiversity
	C4 - Materials and Solid Waste
	C5 - Water

Table 1. Structure of HBSAtool-PT (cont.)

Areas	*Categories*
A2 - Sociocultural and functional	C6 – User's health and comfort
	C7 - Controllability by the user
	C8 - Landscaping
	C9 - Passive design
	C10 - Mobility plan
A3 - Economy	C12 - Life cycle costs
	C13 - Local economy
A4 - Technical	C14 - Environmental management systems

A5 - Site	C15 – Technical systems C16 - Security C17 - Durability C18 - Awareness and education for sustainability C19 - Skills in sustainability C20 - Local community C21 - Cultural value C22 -Facilities

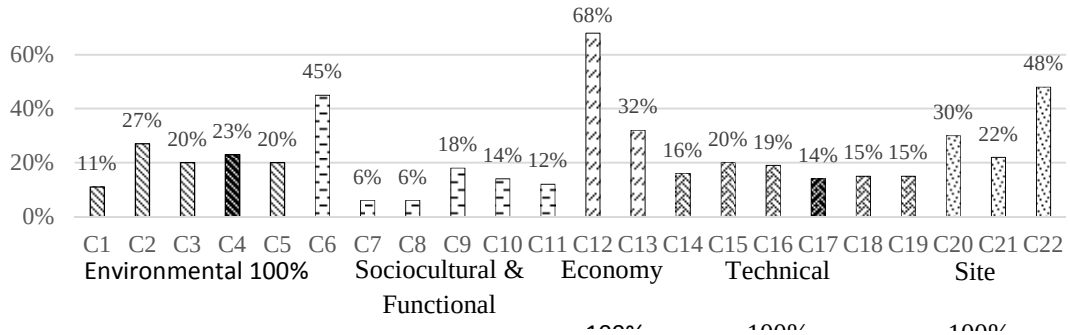

Figure 1. Weighting system of HBSAtool-PT.

Indicators related with the life cycle of materials

Each the two mentioned Categories has a different number of indicators (Table 2). Respondents argued that all the proposed indicators in these two Categories (4 and 17) are relevant and representative of the category to which they belong. Considering each indicator, the respondents were asked to set the relative weight in the assessment of the performance at the level of each category. Results are presented in Figure 1.

Table 2. Indicator of Categories 4 and 17.

Categories	*Indicators*
C4 - Materials and Solid Waste	I11 - Construction waste
	I12 - Reused products and recycled materials
	I13 - Waste separation and storage
C17 - Durability	I42 – Materials of high strength and durability
	I43 - Proper selection of furniture

Indicator 12 - Reused products and recycled materials

As an example, in this section the assessment method of Indicator 12 is presented. The reuse of materials or building elements, which result from the end of the life cycle of other product, do not require major treatment or processing interventions to be incorporated into a new life cycle. If materials cannot be reused, the choice of materials with recycled content should be considered, resulting in a more efficient use of resources and in a reduction on the need to exploit virgin raw materials. Reducing waste production and its recycling, should be a priority in any building project, since the construction sector is responsible, at European level, for 22% of global waste production (European Environment Agency, 2001)
Thus, at the level of this indicator, evaluation is done by the Percentage of the cost of Reused and Recycled Materials (P_{RRM}), which results from the quotient between the sum of the total

Cost of Reused Materials (C_{REU}) and the total Cost of Recycled Materials (C_{REC}) and Total Cost (TC) of the building materials used (Equation 1).

$$P_{RRM} = \frac{C_{REU} + C_{REC}}{CT} \quad (1)$$

Conclusion

Comparing the HBSAtool-PT method with other existing approaches, it is possible to conclude that it allows for the integration of more comprehensive social and economic concerns, rather than focusing on reducing potential environmental impacts. If the decisions are made in an early design stage, it is possible to integrate Materials criteria with a greater probability of success, reducing costs, increasing the durability of the building, and promoting a better experience for all occupants.

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