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Environmentally friendly construction products selection based on building model data

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Abstract

This paper presents the general scheme of the decision making support system which would allow to optimize building's environmental performance by supporting the environmentally friendly construction products selection process. Moreover, it identifies the elements of the proposed system that could be realized with currently available technologies and resources, and reveals the areas in which there is still a need for development.

Keywords: BIM; construction products; decision support; specification; sustainability;

1. Introduction

Construction, as most of the industry branches, is constantly facing new challenges as consumers expectations and legal obligations are becoming more and more demanding. Nowadays, buildings are expected to be consistent with the sustainable development rules, which means that they have to excel in the three essential areas: social performance, economic performance and environmental performance. The first two issues have existed in the construction industry for a long time. Construction experts are familiar with them and they have at least basic knowledge how to assess potential solutions in their context, whether using calculations or intuition, and how to act to achieve the desired results. Environmental performance however is definitely less understood. There is no global formula that would allow to conclude that one solution is better than the other in the context of environmental impact [1, 2, 3]. Furthermore, it is unclear what range of environmental characteristics of buildings and their

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constituent elements should be taken into consideration, but it is undeniable that many of them. Thanks to the worldwide efforts, numerous tools facilitating sustainable construction have been developed up to this day, e.g.:

- various building sustainability assessment systems, such as commercial systems, of which two are considered to be most common [4, 5]: BREEAM (Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design), or Open House methodology, developed under the cooperation of research bodies and industry representatives within the EU's Seventh Framework Programme for Research (FP7) [6];
- guidelines for the qualitative assessment of buildings environmental performance, such as LCA methodology and the European standards set (EN 15643-2 "Sustainability of construction works – Assessment of buildings - Part 2: Framework for the assessment of environmental performance" , EN 15798 "Sustainability of construction works – Assessment of environmental performance of buildings - Calculation method", EN 15804 "Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products"), which specify the system boundaries and calculation rules [7];
- simulation tools that allow to assess some environmental characteristics of building design, and therefore give the possibility to compare different building design variants [8, 9, 10].

Due to the complexity of the issue, one of the crucial goals that have to be achieved in order to meet sustainability expectations towards buildings is addressing the potential of the innovative data management technologies, improving accessibility of the environmentally relevant data, intensifying its sharing and reuse during all the building lifecycle stages, as well as supporting its processing [11]. At the same time the construction industry experiences rapid development and increasingly wide adoption of BIM (Building information Modeling) concept [12]. One of its most significant advantages is the automation of building data transfer and reuse, which can facilitate the process of performing detailed design analysis before the beginning of the on-site construction works. A digital model of building can also be utilized as the input data for decision support systems. One of the essential parts of the construction process which greatly affects the buildings environmental performance [13, 14], is the selection of the construction products to be used. Due to the specificity of the construction industry and the issue considered, many multi-criteria decisions that require considering a huge number of possible solutions which are characterized with many parameters have been involved [15, 16, 17]. Because of that, it is particularly important to provide building design process participants with software tools which would allow to efficiently perform environmentally friendly construction products selection based on a wide range of precise data. What is more, this data should accurately reflect the current situation on the construction products market so that the recommended decisions would be indeed the most useful and actually possible to apply in practice [14]. This paper presents the conceptual framework for the environmentally friendly construction products selection decision support system. Moreover, it identifies the elements of the proposed system that could be realized with currently available technologies, methodologies, standards etc., and reveals the areas in which there is still a need for development.

2. Environmentally friendly products and materials selection as a decision problem

Every construction process aims to meet the needs of the investor related to the functionality and sustainability in the most effective manner. This also applies to all individual stages of the process, including the two phases of construction products and materials selection [14]:

- on the general design level, when the major assumptions are made (e.g. if the building will be wooden or concrete) and building elements dimensions and functional requirements towards them are defined;
- when specific construction products and materials available on the market are selected.

In the former phase the designer makes his decisions taking into consideration many parameters, such as functionality, visual features, environmental performance, etc. These decisions can be based on his professional knowledge and experience or external guidelines. They can also be supported by decision support systems [18, 19]. In this phase only statistical data about materials and products is available, which causes certain problems. Using