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Sustainability assessment through green BIM for environmental, social and economic efficiency

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Abstract

BIM is representing a shift in the traditional process of building delivery. Its adoption in US reached 71% in 2012 rising from 17% in 2007; moreover, Europe is going to adopt BIM for public contracting as promoted by the European Union Public Procurement Directive. Meanwhile, BIM is widely diffused in UK and Northern Europe, as it includes a more accurate documentation, less rework and shorter project timelines. The use of BIM to provide data for energy performance evaluation and sustainability assessment is defined Green BIM and pioneering design organizations are adopting this approach to enable integrated design, construction and maintenance towards Net Zero Energy buildings. Green BIM includes Building Energy Modelling dealing with project energy performance to identify options optimising building energy efficiency during the life cycle. By allowing revisions during the design phase, project teams can ensure that customers' green ambitions beyond regulation compliance can be realized, together with technical and economic requirements. Thus, BIM can provide information to support the calculation of a number of credit points to define goal levels of sustainability related to rating systems. The aim of the paper is to investigate the opportunity to include the "green dimension" in BIM considering the more diffused rating systems.

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Keywords: BIM; Green BIM; sustainability; rating; BEM

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1. Introduction

LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Methodology) rating systems are widely adopted and internationally considered as robust rating systems. CESBA (Common European Sustainable Built Environment Assessment) tries to implement the harmonization of the indicators included in the various rating systems to promote a uniform rating and quality of the sustainable assets which now are adopting different criteria/weights in each country. Despite the diffusion of the main reported rating systems (LEED and BREEAM), they are getting more and more complicated and this is mainly due to the increased demand of clients and users, that pushed also for different versions, devoted to different aspects of the building (e.g. new construction, existing buildings, operation, site, core & shell) and of the neighborhood. This complexity and the need of reliable results (since early stages) claim for the integration with existing tools and methods, like Building Information Modeling (BIM). BIM can be considered the most innovative process-oriented methodology in the Architecture, Engineering and Construction (AEC) sector 0. Even if BIM has already been used for many years in the construction sector 0, it has been widely adopted only since few years ago from Governments, local authorities and private companies both for new construction and for existing buildings. BIM, in general, allows for a better and more reliable data storage and elaboration, avoiding data ambiguity, duplicates and misleading information. The plurality of rating systems, actors in the building process, technological solutions for building and services, users' and clients' requirements arise the need for exchanging huge amount of data and, thus, for having a common data exchange protocol. The answer to this need could be given by the Industry Foundation Classes (IFC) protocol, which is currently the most advanced non-proprietary data exchange format for the building sector. IFC provides not only an instrument to exchange information, but also a robust framework and a classification able to manage with the building complexity. LEED, BREEAM, CESBA, as well as other rating systems, are no more just a certification to be achieved at the end of the construction, but complex systems to be applied starting from the early design stages to building operation. Their strong connection with design tools boosts for a solid integration with BIM 0. Using IFC, in combination with defined procedures and tools, will allow for a better data extraction and elaboration, providing more reliable results with less effort. The aim of the paper is to investigate the opportunity to include the "green dimension" in BIM considering the more diffused rating systems. This inclusion could give designers a reliable and quick forecast of the sustainability rating throughout all the design stage, allowing architects and engineers to compare alternative design options having the rating score automatically computed. Moreover, storing sustainability rating system data in the Asset Information Model allow for faster update of the rating in case of major maintenance operations or replacements. This paper, with the help of some examples, provides the framework for a practical implementation of the connection among BIM models and rating systems through IFC.

2. Research methodology

2.1. Theoretical framework

The framework of the work and the main steps to be performed are described, accordingly to define the context of the research together with potential and limitations of the proposed approach which wants to include and connect the field of sustainability assessment through the BIM process and promote a data-driven procedure to enable design for a sustainable built environment. The idea supporting this research is to provide stakeholders with tools and procedures allowing them to extract rating protocols data from a BIM model in order to forecast the sustainability rating in every step of the design phase and of the operational life of the building. Data should not only be readily available to fulfill rating protocol paperwork in order to achieve the final ranking nevertheless they have also to be readable by a web server to publish a forecast of the sustainability rating 0 when two or more design options are under investigation and evaluation to enable informed choices. The need of effortlessly available data and of more precise and reliable procedures to effectively work with BIM has been highlighted 0. Satisfying this need is not that easy because complexity and variety of both rating systems and BIM software are growing as it is the amount of data to be handled. Data exchange between BIM software and rating systems must, consequently, be based on a standard exchange protocols like IFC or COBie, which essentially is a Model View Definition (MDV) of IFC. Using IFC as a means of information interchange leads to a more interoperable and open access to data 0, which could be