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Improving the energy performance of the built environment: The potential of virtual collaborative life cycle tools

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ABSTRACT

Advances in information and communication technologies [ICTs] offer the opportunity to improve the way energy profiling tools and techniques are used to measure and inform the energy performance of buildings throughout their life cycle. The exploitation of this potential is one of the goals of a current EU FP7 funded project, entitled "IntUBE — Intelligent Use of Buildings' Energy Information". The overall aim of the project is to improve the energy performance of new and existing buildings via the intelligent use of buildings' energy information. The main aim the energy profiling research being conducted as part of the IntUBE project is to contribute to the development of virtual collaborative 'life cycle' building tools to support energy efficient building design, operation and retrofit. In order to illustrate how this may be achieved this paper defines the functions of energy simulations within the IntUBE system, outlines the systems architecture necessary to those functions and presents a case study illustrating some of the functionality under development.

1. Introduction

Buildings account for approximately 40% of CO2 emissions in the UK and across the EU [1]. Therefore it is unsurprising that tackling energy use through the design and development of low carbon buildings is a policy priority for the UK government and forms part of wider policies promoted by the European commitment to reduce energy consumption [2]. The search is on for technologies that might contribute to the mitigation of carbon use. Advances in information and communication technologies [ICTs] offer the opportunity to improve the way energy profiling tools and techniques are used to measure and inform the energy performance of buildings throughout their life cycle. At the heart of these advances lie BIM (Building Information Modelling) tools which allow the creation and use of coordinated, internally consistent, computable information about a building project in design and construction [3]. The use of BIM can support an assessment of both the energy performance of building designs and the energy embodied in the materials and methods used in building construction [3]. In principal the models developed by BIM could also be used to improve the energy performance of buildings during their whole life cycle by supporting comparisons between building designs and building performance during building operation and retrofit [4].

However BIMS are criticised for not explicitly incorporating feed back to the design phase of building or accounting for any changes made to the building layout or fabric during construction [5]. In the absence of accurate data obtained from actual buildings in operation, designers rely on estimate values to feed in the data about loads, air flows, or heat transfer in order to carry out energy simulations [6]. It is therefore suggested that Building Energy Management System [BEMs] can be integrated with the building energy analysis software tools traditionally used in the design phase of buildings to enable BIMs to act as a data source which can be compared against actual building energy performance [5]. This approach will enable energy profiling to be used to optimise the energy performance of the built environment rather than merely improve that performance: because rather than actual consumption being compared to some kind of benchmark of energy performance, which maybe below the optimum, it will be compared to the best possible energy performance for a particular building, organisation or neighbourhood.

The integration of BEMs with building energy analysis software tools will demand "virtual (collaborative) life cycle' building tools that simulate actual buildings and their construction coupled with intelligent systems that monitor and archive design intent and performance and feed the results back to the simulation tools, which, in turn, grow more refined through integrating better empirical data" [7]. This paper illustrates how a current a current EU FP7 funded project, entitled "IntUBE — Intelligent Use of Buildings' Energy Information", will contribute to the goal of developing such tools. To do so it outlines the functionality and rational of the energy simulation approach being developed within the IntUBE project and presents a case study demonstrating part of that functionality. As such the paper offers the reader an overview of development necessary for realising the vision of the IntUBE energy profiling research.

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