Chapter 50
Integrating BIM With BMS in Energy Performance Assessment:
Case Study of a University Building in UK

Ajiero Ikenna Reginald
Heriot-Watt University, UK

ABSTRACT

In recent times, energy performance assessment has gained a legislative imperative in that it constitutes an indispensable criterion for preparing Energy Performance Certificates (EPCs). Accordingly, production of EPC which is heralded by energy audits and simulations using BIM software programs heavily depends on data accuracy. Whereas, there have been several studies on Building Information Modelling (BIM) and Building Management System (BMS) autonomously, peer reviewed literature on both regimes in concert, remain unavailable or perhaps emerging; thus, constituting a gap in the use of BIM for energy analysis. Against this background, a university administrative building with a Gross Floor Area (GFA) of 2353.91m^2 has been the object of a comprehensive energy performance assessment. The principal aim being to use data collected from BMS readings to assess the building's energy performance, produce its EPC and highlight energy conservation strategies that will improve the building's productivity without compromising occupants' comfort. This study therefore attempts to put the teeming theoretical efforts on BIM in energy management into a practical perspective.

1. INTRODUCTION

Antecedents of global energy concerns such as the 1973 oil crisis, 1979 energy crisis and 1990 oil price hike (Fisher, 2009), and estimates of world energy use rising from 505 quad Btu in 2008 to 770 quad Btu in 2035 (US DOE, 2011) constitute strong trepidations over security and sustainability of energy supply in the future. More so, energy demand in the UK has been forecast to increase by 36% between 2011 and 2030 (BP, 2013, p.4), presenting potentials for further greenhouse gas (GHG) emissions. These

DOI: 10.4018/978-1-5225-7030-1.ch050

conditions explain the motive behind UK government's strategic plans of sourcing 15% of her energy needs from the renewables in 2020 (DECC 2011, p.5) and to cut down her gas emissions by 80% by 2050.

Similarly, the UK Cabinet Office, on 31st May, 2011 announced Government's intention to require collaborative 3D Building Information Modelling (BIM) on all her projects in 2016; this is currently considered 'the most ambitious and advanced centrally-driven programme in the world' (Cabinet Office, 2012). As contained in its education and training section, pathways to achieving this "Construction Strategy" on collaborative 3D BIM include creating greater awareness on BIM through seminars, workshops, conferences, etc., funding further researches on BIM development and subsidizing the cost of procuring BIM programs. It can be inferred that the growing importance of BIM in energy planning and management during a building's entire lifecycle further buttresses the need for the Construction Strategy.

It is worth noting that '40% of the UK's energy consumption and carbon emissions come from the way buildings are lit, heated and used (DCLG, 2014); yet in UK, the Further and Higher Education (FHE) sector alone produces a CO_2 emission of about 3.5 million tonnes per year and an annual energy cost of circa £200M, with potentials of reduction in its emissions by around 20% (Carbon Trust, 2007). This environmental challenge has been heightened by the fact that in the UK, there are currently about 200 Universities and 500 colleges of further education, with around 250 new buildings constructed each year within these universities alone (CIBSE, 1997).

Consequent on the Energy Performance of Building Directive (EPBD) which required the display of EPCs in public buildings with over 500m^2 by 2013, and a further reduction in the Gross Floor Area (GFA) to 250m^2 in 2015 (CIBSE, 2011), there has been a growing need to identify most efficient ways of monitoring and managing building systems in order to achieve optimal resource usage and best performance ranking. But the appositeness of the EPC remains a function of how precise data used for its production is. The BMS which is an automatic system is surmised a reliable way of ensuring accuracy in data populated into BIM software programs. Credence is given to the BMS in view of its ability to simultaneously monitor building systems from centrally controlled point of multiple signals, based on varying factors such as occupancy time, ambient temperature and indoor air quality (IAQ).

To this end, succinct illumination of the research subject will be achieved by critically reviewing cognate literature on BIM and BMS, while sourced primary data from 2012 – 2014 for a university building which is monitored by a BMS shall be used for the energy analyses. A CAD software (AutoCAD) and two ***level 2*** BIM software programs (Revit and IES VE) have been used to model and conduct the Simplified Building Energy Model (SBEM) and Dynamic Simulation Modelling (DSM).

This paper consists of research activities outlined in seven sections. Constituting the introduction, Section 1.0 frames the research scope, provides the rationale behind the study and highlights prevailing gaps in the BIM - BMS technologies. Section 2.0 details research and development in the BIM technologies; this section explains in details the BIM concept, its current levels of implementation in various countries and prevailing challenges. In turn, the BMS description, importance and application potentials are revealed in section 3.0. Section 4.0 presents the link between the BIM and BMS processes; it explains how the integration strategy can be achieved and benefits of this relationship. By way of assessing this BIM – BMS nexus, a complex building managed by the BMS facility is case-studied in section 5. Whereas, the design and information exchange from various BIM models of the case-studied building are captured in section 6, this section reveals how information provided by the BMS can be used in the BIM model with the aim of emphasizing the importance of precision in data provided for the BIM simulation. Lastly, section 7 reveals the study summary and recommendations.