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Exploring energy modelling in architecture logics of investment and risk

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Abstract

This paper examines the ways architects negotiate new early stage design energy modelling tools in their design practice. Energy modelling tools have traditionally mostly been used by building services engineers with their engagement often occurring at late stages in design to largely verify and validate already established ideas. Recently, however, with a growing international energy agenda and development of new modelling technologies there has been a greater need for broadening use particularly with architects early in design. Yet despite the broadening of use, and increased importance placed on building performance, few studies account for the ways new groups of users such as architects negotiate use of new energy modelling tools in their design practice. Research on the topic of energy modelling has tended to focus on addressing improvements within a particular professional domain or in enhancing features within tools and providing better analysis parameters. The data draws on semi structured interviews and focus group sessions with 26 participants across 4 large international architecture firms in the UK. Preliminary findings indicate differing organizational principles as well as team identities and project assumptions on the ways energy modelling contributes or detracts from fulfilling overall project needs. The implications of the findings are twofold. First, the analysis provides an initial overview of how early stage design energy modelling is considered in design in architecture practice in the UK. Second, the paper provides an understanding of how architects negotiate meaning on energy in design. There are also implications for energy policy development in the context of the built environment particularly concerning building performance.

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1. Introduction

Building services engineers have traditionally fulfilled the role of energy analysis in building design with emphasis often placed on verifying established simulation models at late stages of design. Recently, however, leading architecture firms in the UK are adopting energy modelling technology within their design practice. Application of energy modelling at early stages of design has been promoted and advocated by government construction policy [1]; international professional institutions [2,3] and academic literature [4]. Broadening use of energy modelling to new user groups at early stages of design and architects in particular is viewed as a key way to enable improved analysis and prediction of building performance [5]. Although studies have accounted for other building professionals such as building surveyors [6], widening the use of energy modelling technology in architects' design practice are largely unexamined and poorly understood.

Research in energy modelling in buildings has been focusing on analyzing and improving the technical accuracy of modelling tools [7]. In addition, there are few examples of qualitative analysis that accounts for the cultural and social context technology adoption and implementation is situated within. There is a critical need to better understand the ways architects engage with energy modelling and the approaches they draw on to negotiate and justify particular views. The purpose of the paper is to examine how architects approach use of energy modelling in their design practice. The analysis draws on an institutional logics theoretical framework in order to reflect upon the principles, identities and assumptions within particular approaches to new technology adoption. Institutional logics is a helpful analytical lens as its premise is in understanding how actors negotiate meanings in complex organizational contexts with overlapping industry, organizational and social demands [8].

The following section discusses and reviews research on energy modelling in building design followed by the theoretical framework and empirical setting. The methods discuss the approach to data collection and analysis, whilst the findings provide an overview of key insights. Finally, the paper concludes with a discussion of key contributions and areas for further research.

2. Literature review

Energy modelling discussions are generally situated within a broader literature that examines building performance specifically related to prediction, assessment and management of energy in buildings. In particular growing attention has been developing for some time on the issue of the 'performance gap' and the need for simplifying and widening the use of tools amongst diverse building professionals at early stages of design. Early work by Tucker [9] proposes a simplified method whereby considerations of energy and environment can be integrated into each project from the very start of the design process. Balcomb [10] suggests building simulation tools need to be user friendly and also produce effective results quickly in order to be useful in building design. More recently Bleil de Souza and Tucker [11] suggest that the development of tools need to be informed by users. Their custom based framework is argued to allow software developers flexibility in approach often hindered by statistical analysis.

De Wilde [7] reviews approaches to explaining reasons for the performance gap between predicted and measured energy performance. He identifies three types of gap, and suggests a reduction in the performance gap could be achieved through a number of measures. These measures include enabling a combinative approach that incorporates validation and verification, improved data collection for predictions, better forecasting and change of industry practice [7]. Crawley et al. [12] review a report, which compares and contrasts 20 energy simulation programs in terms of their features and capabilities, and identify the benefits and challenges of these programs. Zhao and Magoules [13] similarly review the applicability of recent developments in simulation models, and suggest further improvement is required to better predict energy consumption in buildings. Most studies emphasize the need for developing a template, standard or protocol as a way of standardizing current approaches.

For other scholars, issues lie in the growing diversity and number of modelling tools. A number of recent literature reviews point to a need for cohesion between the multiple approaches whether related to prediction, assessment or management of building energy performance [14,15]. Fumo [15] for instance, highlights the need for an up-to-date review that takes account of the "basics of building energy estimation". His review collates various