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A Standard Design Process for Sustainable Design

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Abstract

This exploratory research examined the degree of adoption and impact of the concepts of Building Information Model (BIM), Integrated Project Delivery (IPD), Integrated Design Process (IDP) and Building Energy Simulation (BES) on the design processes of advanced architectural firms when executing sustainable design. Six offices identified by the press and peers' recognition for a strong commitment to sustainable design and influence in the design of high performance buildings were selected. In semi-standardized interviews, these firms presented their perceptions of the influence of BIM, BES, and IPD/IDP. The results show that a generalization of sustainable design processes is possible. A design process for sustainability (DEPROSU) model was created by collecting best practices from data gathered from the interviews and the critical literature review. This research provides evidence of commonalities found in the design processes of the selected firms. These commonalities represented in the DEPROSU model can potentially be validated as protocols or standards for sustainable design, providing architectural design practices with concrete patterns for improvement and or validation of their design methods.

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1. Introduction

Architecture and buildings are identified as being of major importance in reducing the intensity of global warming and ameliorating the impacts on humanity^{1,2}. Existing research shows that the most important decisions occur at the earlier stages of design, having the greatest impact on the Life Cycle Cost (LCC) of the building³. Architecture firms are required to produce more energy efficient buildings⁴. The three emerging concepts of Building Information

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Modelling (BIM), Building Energy Simulation (BES) and Integrated Design Process (IDP) provide a new opportunity to address the challenges of achieving sustainable communities and ameliorating the impacts of global warming.

The American Institute of Architects (AIA) contracts still guide many design projects through a conventional and linear process through consecutive phases⁵. The hypothesis behind this research is that BIM, BES, and IDP are complementary processes that together contribute to a new process for design of sustainable dwellings. This research endeavored to determine to what extent leading firms are using a design process employing these three technologies and processes. The research collected data by interviewing designers at leading firms. The data analysis provided generalizations regarding contemporary design processes and achieves insights into new and appropriate design processes that make use of new technologies.

2. Definitions

Sustainable design: Ecodesigners tend to analyze the impact of a building using a holistic approach including LCC and Life Cycle Analysis (LCA) evaluations^{6, 7} and ecological principles⁸.

Integrated Design Process (IDP): IDP is a collaborative process with a multidisciplinary design team that focuses on the design, construction, operation and occupancy of a building over its complete life-cycle, with a clear definition of environmental and economic goals and objectives⁹.

BIM: BIM is a digital representation of physical and functional characteristics of a facility and serves as a shared source for information for it¹⁰. BIM software provides objects that represent architectonic elements, parametric 3D modeling, rendering functions, automated drafting, rich graphic and non-graphic information stores, and interoperability to analysis programs¹¹.

BES: Sustainable design processes usually rely upon BES software to establish expected energy consumption of building designs¹². BES tools are best suited for examination of risk and to test design alternatives¹³.

3. Research methods

An exploratory qualitative research approach was selected to investigate this research topic¹⁴, which implemented critical literature reviews, case study analysis and interviews. Three offices in the U.S.A., two offices in the U.K. and one in Malaysia were selected due to their commitment to sustainable design and influence in the design of high performance buildings as identified by the press. Qualitative data was collected through semi-standardized interviews from design professionals to acquire insight into the interaction of BIM, IDP, and BES on sustainable design.

The open-ended interview questions were divided into different sections and presented to a particular individual with expertise in the area. When possible, multiple participants were interviewed simultaneously to provide a fluid discussion and to improve reliability of data. The interviews took place in the informant's offices. The number of total informants is summarized in Table 1. The informants included designers from different hierarchical levels and positions, as shown on Table 2. The inclusion of such variety depended on their availability and willingness to participate which was not equal across the offices and therefore, a comparison of roles across the different offices was not possible.

In general, each interview began by asking their familiarity with any of the concepts of sustainable design, BIM, IDP and BES. Then they were asked about the overall design process for high performance buildings and their use of BIM, IDP and BES. The interviews lasted in general one hour and the participation was voluntary –no compensation was provided. All recorded interviews were later transcribed verbatim and used as raw data for analysis and coding. The data was analyzed using transcription; coding; thematic analysis and exploratory analysis. The transcription of the interviews produced 49,979 words of data. Internal validity was checked by using respondent feedback, to see if the interpretation mirrors their experience¹⁵, but only two participants confirmed.

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