Analysis of an energy efficient building design through data mining approach

Hyunjoo Kim [a,*], Annette Stumpf [b,1], Wooyoung Kim [c,2]

[a] Department of Civil and Environmental Engineering, California State University, United States
[b] U.S. Army Corps of Engineers, Engineering Research and Development Center, United States
[c] Construction & Economy Research Institute of Korea, South Korea

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ABSTRACT

Incorporating energy efficiency and sustainable green design features into new/existing buildings has become a top priority in recent years for building owners, designers, contractors, and facility managers. This paper intends to address why delivery of an energy efficient building is not just the result of applying one or more isolated technologies. Rather, it can best be obtained using an integrated whole building process throughout the entire project development process, which leads building designers to generate a large amount of data during energy simulations. The authors observed that even a simple energy modeling run generated pages of data with many different variables. The volumes of energy modeling data clearly overwhelm traditional data analysis methods such as spreadsheets and ad-hoc queries with so many factors to be considered. An integrated or whole building design process involves studies of the energy-related impacts and interactions of all building components, including the building location, envelope (walls, windows, doors, and roof), heating, ventilation and air conditioning (HVAC) system, lighting, controls, and equipment, which shows why it is so difficult to find the correlation between different systems. The objective of this research is to develop an energy efficient building design process using data mining technology which can help project teams discover important patterns to improve the building design. This paper utilizes the data mining technology to extract interrelationships and patterns of interest from a large dataset. Case study revealed that data mining based energy modeling help project teams discover useful patterns to improve the energy efficiency of building design during the design phase. The method developed during this research could be used to guide designers and engineers through the process of completing an early design energy analysis based on energy simulation models.

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1. Introduction

Building energy simulation programs are in use throughout the building energy community. Energy modeling programs provide users with key building performance indicators such as thermal loads, energy use and demand, temperature, humidity, and costs. The A/E/C industry is embracing energy simulation programs, so building designers are currently dealing with a large amount of data generated during energy simulations. From our experience, even a simple energy modeling run generated pages of data with many different variables. Examples of those variables include but are not limited to the estimated energy costs or savings in terms of building orientation, HVAC system, lighting efficiency and control, construction of roof and walls, glazing type, water usage, day-lighting, etc. Such volumes of data clearly overwhelm traditional data analysis methods such as spreadsheets and ad-hoc queries with so many factors to be considered. It is difficult to find the best correlation/combination of different energy systems during the building design process.

The objective of this research is to develop a process which can help project teams discover useful patterns to improve energy efficient building design. This paper utilized data mining technology, which is a data analysis process that combines different techniques from machine learning, pattern recognition, statistics, and visualization, to automatically extract concepts, interrelationships and patterns of interest from a large dataset. By applying data mining technology to the analysis of energy efficient building designs one can identify valid, useful, and previously unknown patterns out of energy simulation modeling.

This paper presents the necessary steps to develop the data mining approach such as 1) requirement identification, 2) energy simulation, 3) data mining, and 4) refinement. In order to establish a process, a case study was conducted with an on-going design project. Then detailed steps showing how energy analysis tools were used early in the design process are presented.

* Corresponding author. Tel.: +1 657 278 3867; fax: +1 657 278 3916.
E-mail addresses: hykim@fullerton.edu (H. Kim), Annette.L.Stumpf@usace.army.mil (A. Stumpf), beladomo@cerik.re.kr (W. Kim).
[1] Tel.: +1 217 373 4492; fax: +1 217 373 6724.
[2] Tel.: +82 2 3441 0716; fax: +82 2 34410890.