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Stakeholder impact analysis during post-occupancy evaluation of green buildings – A Chinese context

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ABSTRACT

The high-energy consumption of the architectural, engineering and construction (AEC) industry and associated environmental pollution have become a global challenge, and governments at different levels in China have been dedicated to improving the industry's sustainability. However, although the concept of green building (GB) has been growing rapidly, the primarily emphasis has been on energy-saving design with little attention paid to sustainable post-occupancy operations, which is hindering further development. To address this fundamental issue it is necessary to evaluate the post-occupancy performance of GB and, given China's current circumstances, one that involves the participation of all stakeholders to avoid being dominated by construction professionals. However, such participatory evaluations are currently very limited and perfunctory in the country, usually involving simply informing or placating the stakeholders. In response, this paper develops a comprehensive quantitative method to analyze stakeholder impact during GB post-occupancy evaluation (POE). This enables the various stakeholder groups to be prioritized in terms of their influence levels and hence contributes to maximizing overall stakeholder satisfaction by improving the efficiency and effectiveness of the evaluation. The findings of the paper are expected to help clients and design teams improve their building designs by integrating the views of stakeholders through the POE in order to realize the true spirit of GB development.

1. Introduction

Concomitant with a growing awareness of the importance of sustainability in the architectural, engineering and construction (AEC) industry, the concept of green building (GB) has gained increasing popularity in different countries/regions. GB-related industries in China have also boomed rapidly over the last decade [1], primarily emphasizing energy-saving design. However, little regard is being paid to the efficiency of energy use by the building occupants, which is hindering the further development of GB in China. In order to better integrate GB design and use, it is first necessary to have a reliable understanding their post-occupancy performance. A starting point for this is to develop a suitable evaluation framework.

The operation of GB involves a number of stakeholders with diverse social, environmental and economic interests [3–6,8] and, given China's current circumstances, it is important that all are able to participate in the evaluation process to avoid being dominated by construction professionals. Although such participation offers a means of better addressing and meeting stakeholder concerns and expectations, the post-occupancy evaluation (POE) of contemporary GB is becoming ever more complicated, with an increasing number of stakeholders involved to reflect their own interests.

In response, this paper provides a means of analyzing GB operations stakeholders thoroughly and comprehensively, to quantify their influence during POE. Through this, various stakeholder groups are prioritized and hence overall stakeholder satisfaction can be maximized by improving the efficiency and effectiveness of participatory GB POE. A brief review of GB concepts and participatory POE theories is presented, followed by an introduction to the research process/methods used. The results of a survey are next described to reveal the different impact levels of various stakeholder groups involved in GB POE. Subsequent validation interviews are then discussed and more in-depth opinions concerning the development of GB in China are examined. A proposed research agenda concludes the paper.

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2. The definition of green building

Sustainable development has gradually become an overarching policy goal of various countries/regions since the 1992 Earth Summit [9,10]. believe that the concept of sustainability in the construction industry is closely related to harmony with the surrounding environment, minimizing the use of resources and energy, greater adaptation of recyclable materials, less pollution, lower life cycle costs and a better living quality. Ogunbiyi et al. [11]; p. 89), on the other hand, consider sustainable construction as:

> *the set of processes by which a profitable and competitive industry delivers built assets (buildings, structures, supporting infrastructure, and their immediate surroundings), which: enhance the quality of life and offer customer satisfaction; offer flexibility and the potential to cater for user changes in the future; provide and support desirable natural and social environments, and maximize the efficient use of resources*.

[12] postulate that sustainable construction should (i) be concerned about the people who use the facilities by ensuring that they are living in a healthy and safe built environment that is in harmony with nature; (ii) safeguard the interests of future generations while at the same time meeting today's needs; (iii) lead to the maximum benefits and lowest costs to the society and environment; (iv) minimize damage to the environment and its resources; (v) improve the quality of building facilities and their services so as to promote social cohesiveness; (vi) adopt technologies and expert knowledge to seek information to improve project efficiency and effectiveness; and (vii) comply with legislation and associated responsibilities.

Many terms have been proposed that are relevant to construction sustainability, e.g. “green project” and “high performance building”. Olubunmi et al. [13]; p. 1612) define a green project as *“the practice of creating structures and using processes that are responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, and renovation”*. Projects of this type should reduce the use of resources (energy, land, water, materials, etc.) by adopting energy-efficient appliances and systems, while waste is expected to decrease by incorporating such long-lasting products as recycled steel, natural linoleum and bamboo flooring [14]. Meanwhile, high performance buildings are expected to:

i. Minimize or eliminate impacts on the environment, natural resources, and non-renewable energy sources to promote the sustainability of the built environment
ii. Enhance the health, wellbeing and productivity of occupants and whole communities
iii. Cultivate economic development and financial returns for developers and whole communities
iv. Apply life cycle approaches to community planning and development [10]; p. 49–50).

Although these terms are used almost synonymously, “green building” (GB) is more recognized in China [1,15]. In this paper, we refer to projects with minimal usage of various resources (e.g. energy, land, water, materials, etc.) throughout the project lifecycle, to imply an emphasis on environmental protection and pollution reduction as well as the provision of healthy, adaptive and efficient living space that is harmonious with the surroundings.

3. Stakeholder participation in the post-occupancy evaluation of green buildings

In recent years, issues relating to energy consumption and environmental pollution in the architectural, engineering and construction (AEC) industry have attracted the attention of the Chinese government at various levels, attracting increasing attention from the mass media as well as the public towards the concept of sustainable construction [4,6]. Despite the boom in the GB-related industry in China, barriers still exist which hinder its further development.

The greatest hindrance lies with the quantitative imbalance between the GB design and operation phases [16]. While more than 80% of energy consumption occurs during the actual occupancy operation stage rather than during the construction stage [4–6], which indicates that the post-occupancy performance of GB largely determines the overall sustainability level, GB labelling relies instead on the information available at the preconstruction stage. In China, this has created an anomaly of alarming proportions as, of the 1446 projects - equivalent to an overall area of 162,900,000 m^2 - passing assessments by January 2014 since the April 2008 introduction of its GB evaluation labeling policy, an estimated 92% have not achieved the designed performance during their operation stage [17]. It seems that many proposals exaggerated their expected energy performance when seeking their green labels, as they have later been found to have an actual energy consumption far exceeding their designed levels, sometimes with indoor air quality even worse than unlabeled buildings [1,15]. attribute this shortcoming to the lack of a participatory evaluation framework to assess the life-cycle sustainability of GB.

According to [18]; a good participatory mechanism should involve individuals and groups positively or negatively affected by a proposed intervention (e.g., a project, program, plan or policy) throughout the decision/evaluation process. Through this, stakeholders can influence and share control over development initiatives as well as the decisions/evaluations that most affecting them [19–22] [23]. highlight 16 techniques for facilitating participatory decisions/evaluations, comprising interviews, field offices, hotlines, displays or exhibits, newspaper inserts, information bulletins, surveys, participatory television, brochures, contests, mediation and charrettes, Delphi, simulation games, providing technical assistance to stakeholders and training programs for stakeholders. No consensus has yet been reached in formulating a universal and effective way of engaging stakeholders after comparing the advantages and disadvantaged of each technique. However, it is accepted by researchers and practitioners that the advantages of participatory decision/evaluations generally overshadow the disadvantages [24–26]. [27]; for example, identifies the value of a participatory approach to decisions/evaluations as: (i) the public have a say in the actions that could affect their lives; (ii) there is a good chance that the public's contribution will influence the decisions/evaluations; (iii) sustainable decisions/evaluations are promoted by recognizing and communicating the needs and interests of all participants; (iv) it seeks and facilitates the involvement of those potentially affected or interested; (v) it promotes input from participants in designing how they should participate; (vi) participants are provided with the information they need to participate in a meaningful way; and (vii) it communicates to participants how their input affects the decision/evaluations.

While GB is expected to achieve environmental, social and economic sustainability, a participatory approach to assess GB post-occupancy performance should play a vital role during the process [1,15]. Stakeholder participation is beneficial in enhancing the transparency of the evaluation process as well as improving the credibility of the evaluation outcome. As a result, less controversy is expected throughout the project lifecycle (especially during the operation stage) so as to help realize China's governing philosophy of maintaining societal harmony. However, the current participatory evaluations of GB post-occupancy performance are rather limited and perfunctory in China, and usually take form of informing or placating stakeholders. This can be partly attributed to the diversity of the stakeholder groups involved and difficulty in reaching, not to mention about satisfying, all those concerned participants during the evaluation.

Stakeholder theory offers some insights into a solution. The theory began in the 1960s, with researchers at the Stanford Research Institute first proposing the definition of stakeholders as groups without whose support an organization would cease to exist [28]. Freeman [29]; p. 46) later further interpreted this as *“any group or individual who can affect, or*