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Roles of building performance assessment in stakeholder dialogue in AEC

Debajyoti Pati [a,*], Cheol-Soo Park [b,1], Godfried Augenbroe [c,2]

[a]Department of Architecture, College of Engineering and Technology, Biju Patnaik University of Technology, Bhubaneswar, 751003, India
[b]Department of Architectural Engineering, SungKyunKwan University, 440-746, Suwon, Kyonggi-do, South Korea
[c]College of Architecture, Georgia Institute of Technology, 247 4th Street, Atlanta, GA 30332, USA

Abstract

This paper treats rational expressions of building performance in order to better support dialogues between stakeholders in the design process. These expressions are based on the notion of objectively quantifiable performance measures, which are introduced through a set of "performance indicators". The indicators can be used to quantify expectations and fulfillments in structured dialogues between different stakeholders. Two types of indicators are introduced based on: (1) normative models in biophysics and physiology; and (2) empiricist models of Environment-Behavior studies. The treatment is positioned to support rational decision-making during different stages of building delivery and use. The focus is specifically on the fulfillment of client expectations during design evolution.

Keywords: Performance indicator; Design evolution; Stakeholder dialogue; Building evaluation

1. Stakeholder dialogue as social negotiations

Communication constitutes a vital component of a building procurement process, especially since the communication takes place among a varied set of stakeholders. Some pay for the building, some occupy them and others are associated for only a limited period of time, bringing in different levels of expertise. Paying clients expect to achieve organizational objectives in the areas of finance, business processes and customer satisfaction. Occupants are typically concerned with work/environmental support, stress, well being and comfort, among others. A large variety of external parties bring in equally varied sources of expertise to cater to the goals and expectations of the people paying for and/or intending to occupy the end product.

The key construct to note here is 'expectations'. The complexity in the term 'expectations' arises from the fact that the various stakeholders come from vastly different backgrounds. Their interests in the end product are different, and their vocabularies are as varied as their backgrounds. They focus on different issues that directly influence their operation/interests, without the required appreciation of the interactions between the different sets of issues being discussed. As a result, dialogues between stakeholders in a building procurement process frequently take the form of extremely complex processes of social negotiations. In addition, power, authority and perceived importance within or without one's organization frequently threaten to veer the negotiation process away from its the primary intention. One could assert that the shortcoming lies in the absence of a common vocabulary, barring the potential to engage the stakeholders in a constructive dialogue where the things being negotiated are commonly understood and agreed upon. The purpose of this paper is to articulate the role of 'performance indicators' in fostering structured dialogues among stakeholders.

* Corresponding author. Georgia Institute of Technology, College of Architecture, PhD Program, 247 4th Street, Atlanta, GA 30332, United States. Tel.: +1 404 894 2731; fax: +1 404 894 1629.
E-mail addresses: djpati@yahoo.com (D. Pati), cheolspark@skku.edu (C.-S. Park), godfried.augenbroe@arch.gatech.edu (G. Augenbroe).
[1] Tel.: +82 31 290 7567; fax: +82 31 290 7570.
[2] Tel.: +1 404 894 1686; fax: +1 404 894 1629.

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2. Expressions of building performance as potential enhancer of negotiation

Partly owing to the complexity of the negotiation process, the disconnect between expectation and fulfillment has traditionally been a problem in the building delivery process. Better matching of the two is considered an important target for the building industry to become more client driven, and to provide better value overall [1]. In the past decades, some researchers have utilized organizational learning techniques to capture user requirements. Placemaking [2] and Process Architecture [3] are some exemplary trends in building procurement where focus group interviews, touring interviews, role-playing and other organizational learning techniques are used in understanding end-user needs and feeding the information to the design team. Such techniques have contributed to the building procurement process, to some extent, by addressing a narrow aspect of the problem—end-user/client needs and expectations. A modality, however, is warranted in ascertaining that the needs/expectations of all stakeholders are commonly understood (agreed upon), and to match the expectations with the deliverables at different phases of the building procurement process.

Building performance has the potential to play a major role in articulating the expectations of owners and occupants, and the fulfillment of them by designers and building operators. As a result, predicted performance can be used as negotiating instruments among stakeholders at various phases of the building procurement process. Several phases during building procurement stand out as important from the viewpoint of stakeholder negotiations: (1) programming, (2) early design, (3) design development, (4) specifications and, (5) facility and portfolio management. Traditionally, the dialogues mentioned above have been cast in prescriptive terms, i.e. by addressing the aspects of the solution rather than making statements about the solution. Building codes and regulations have long contributed to this by basing their approach on prescriptive specification methods. This is no longer the case as many countries are moving parts of their regulations and standards to the performance domain [4]. Statements of building performance, thus, promise to enhance the dialogue process, while simultaneously casting a portion of the dialogue within the framework of building code requirements.

While we argue that building performance has the potential to play a major role in all phases mentioned above, this paper focuses on the design evolution phases of building procurement. In the subsequent sections, we present two ways of viewing building performance and discuss scenarios where performance indicators could prove valuable in structuring stakeholder negotiations.

3. Two frameworks of performance assessment

In this paper, two domains of knowledge are used to develop performance indicators of design settings. One set of indicators is based on existing knowledge in biophysics and physiology (referred to henceforth as ‘hard’ indicators, or indicators backed by hard objective science), and offers predictive tools to assess building performance in the areas of energy, lighting, thermal comfort and maintenance. Human behavior in built settings, however, is also influenced by cultural, social and personal factors. The second approach is based on theories and models in the field of Environment and Behavior (EB, a multi-disciplinary branch of scientific inquiry that originated from environmental psychology in the early 1960s) [5] that study interactions between the built environment and its users (referred to as ‘soft’ indicators—indicators quantified based on less objective cultural and personal factors, and subjective interpretations).

The first set of indicators, based on normative theories of biophysics and physiology, was developed as part of an ongoing research project funded by the U.S. General Services Administration (GSA). These measures quantify the performance of a building system in producing a desired condition, related to an activity or need of the tenant or any other stakeholder. The second set of indicators was developed as part of a doctoral dissertation work in the Georgia Institute of Technology. The indicators integrate variables from the physical, environmental and cultural/personal domains that take into account variations in setting types, personal attributes and cultural factors. Founded on data from buildings-in-use, the indicators enjoy a higher degree of ecological validity [6]. The two types of indicators are described in the subsequent sections.

4. Normative models based performance assessment—hard indicators

This section introduces the concept of a virtual experiment as a formal quantification method of ‘hard’ Performance Indicators (PI). Fig. 1 shows the basic notion of a performance “analysis function” (AF) as a mapping of experimental input variables, environmental and control variables and system properties (p) to a PI (p) through a specified aggregation procedure. Fig. 1 can be explained by looking at the calculation of a PI for thermal comfort. One can state that thermal comfort performance is delivered by the “comfort control system”, composed of the heating, cooling, control and enclosure systems. The calculation of the PI is based on the following experiment: a human is placed in a certain location in a given space of the building, which is subjected to the local climate. The experiment itself is normally conducted virtually by performing a dynamic computer simulation. The experiment control variables are thermostat control, ventilation actions (opening of windows) and observer properties, such as activity level and clothing. It should be observed that there is no unique way to perform the aggregation over the output data (observable states) of the