

Correlational Study of Performance Assessment for Services and Environment Attributes in Public Buildings

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Abstract. Public buildings are constructed to expedient the public as the users and inexorably it should be able to provide a comfort environment, adequate services and satisfying the user needs. However, many newly constructed and occupied public buildings experience defective performance in terms of services environmental aspects that constitute a disturbance towards the building total performance and sustainability. In an effort to standardize the suitable allocation of services and environment needs in public buildings, the evaluative criteria derived from the occupants in public buildings needs to be measured in terms of its quality. For this research, a post-occupancy survey was used to review the overall performance of services and environmental aspects and four public buildings located in Putrajaya, Malaysia were selected as samples of the survey. A satisfaction survey was also collected from the building users and a correlation analysis was used to seek the effectiveness of empowering the users as the benchmark of the building performance. The result has showed that the variables are positively correlated with the users' satisfaction. It depicts that the level of perception from occupants is fundamental in providing the services and environment aspects in public buildings.

Keywords: Performance Assessment, Services, Environment, Users' satisfaction, Correlation analysis

1. Introduction

Any building requires a certain amount of internal infrastructure to function that includes services elements such as heating and cooling system, power system, telecommunications, water, plumbing and wastewater system. Especially in public buildings whereby particularly provided for the use of public community, these can be extremely intricate systems taking up large amounts of space and constitute a big part of the regular maintenance required. Building players aware that feedback is not a routine in the construction industry; major failures are noted by designers and builders but disappointing performance is often forgotten and mistakes are repeated. As defined by [1], performance measurement can be defined as quantifying the building efficiency and effectiveness of an action. The aim of building performance assessment is to provide a path to channel the information to all interested parties [2]. These assessments would be helpful towards revealing the quality of a building and provide the availability of information concerning the health, safety, and environmental performance of buildings.

The term of "performance" can be alienated into technical performance or functional performance. In technical performance, it involves measuring how the physical systems perform, for example lighting, energy use, ventilation and acoustics. The prominence of technical performance consists of the performance of services and environment of a building. By providing an indication of successes and failures in a building's performance, performance measurement able to improve a building's performance over its life cycle and make designers and owners more aware of and accountable for building performance. In the development of performance measurement systems, the importance of a feedback loop has long been established. User satisfaction is needed to understand the perception of the users, identify their needs, wants, requests, hopes, and to lower the gap between what the provider thought as being what the users want and

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what the users actually want [3]. According to [4], occupants' feedback and satisfaction with one or more environmental aspect does not necessarily produce satisfaction with the total environment. Building occupants balance the good features against the bad to reach their overall assessment. The opinion of as many occupiers of the building as possible would provide a greater depth of feeling for the building [5]. For this research, the aspects of performance are merely focused to the technical performance aspects particularly in provision of building services and environment. Auxiliary explanation on the term of services and environment can be referred as follows:

- Services: According to [6], services can be referred as the work performed by one that serves or contribution to the welfare of others. Simple description for this term is any system or technical provision includes for the buildings to be function. As for this research, the provision of building services to be reviewed as performance survey consists of four attributes; i) plumbing system, ii) electrical installation, iii) communication system and iv) fire protection system.
- Environment: Requirements of quality environment in buildings can be divided into outdoor aspects (building external factors) and indoor aspects (building internal factors) [7]. General environmental needs included in this survey consists of four attributes; i) thermal comfort, ii) visual comfort (natural and artificial lighting), iii) level of cleanliness and iv) noise pollution.

The main purpose of this study is to determine the correlation of two variables; the performance attributes for services and environment with the satisfaction level of the building occupants. The undertaken study comprised of approaches and evaluation methodologies that address the effectiveness of allocating performance assessment with the users' feedback and within the broader context of the problem of building procurement fragmentation.

2. Problem Statement

Malaysia as a developing country has a remarkable number of public buildings constructed for the use of public citizens. The Government of Malaysia encompasses vital responsibility in delivering the utmost services to serve the public convenient and amenities in the best endeavour. Subsequently, the government had a spate of "unfortunate incidents" at newly constructed public buildings in particular. Raising questions not only about the construction ability and quality, but also whether care is taken for the maintenance of public buildings. The repairing of cost to solve defective works in public buildings and amenities has increased year by year. [8] stated that after years of occupying the building, the accumulative problems become more apparent, forcing the management to undertake modifications and draw up maintenance strategies to ensure the building is able to sustain the demands of their operation. Though users have been recognised as one of the major concerns in public building's construction, little has been done to learn from user satisfaction that could lead to continuous improvement [8].

For instance, defect cases at the newly completed and occupied court complex in Jalan Duta, Kuala Lumpur that faces at least nine incidents in 2007 at the court complex, such as the falling of ceiling, the bursting of pipes, the cracking of walls and the accumulation of water in the filing room. The defect incidents occurred in the following events when there is collapse of a ceiling due to a leaky sprinkler system at the Entrepreneur and Co-operative Development Ministry in Putrajaya and the ceiling collapse in a secretary's room at the world's largest court complex at the Jalan Duta court complex. Before that, the Immigration Department headquarters in Putrajaya had to be closed after water flooded the 7th floor building following a failure in plumbing, turning and evacuating more than 1,000 people in the building. This is a loss and if all current information is collected from the user or occupants, the defects could be spotted early and rectified.

3. Overview of Building Performance

There are various performance assessment scheme developed by precedent researchers that integrates feedback from users or occupants in determining the performance of buildings in general. [9] stated that the performance concept in the building process views buildings as dynamic entities and indicates a comprehensive attitude towards the management of buildings. In a simple term, performance can be measured by comparing the attributes or criteria in the building. Results derived from the assessment are

used as lesson learned or feed back to improve the evaluated building performance not only in the planning aspects, but also in programming, design and construction of future buildings. As cited by [9], building performance has been defined in British Standards (BS) 5240 as behaviour of a product in use. Performance assessment tool like Post Occupancy Evaluation (POE) has been used extensively in UK, USA, New Zealand, Australia and Canada to evaluate any performance attributes in building either for short term benefits, medium or long term benefits. [10] defined POE as the process of evaluating buildings in a systematic and rigorous manner after they have been occupied for some time. POE generally encompasses to a comprehensive review of the building details. Over the last 20 years, a range of POE methods have been developed and their systematic application has demonstrated a huge potential not only to reduce the financial and environmental costs, but also to improve the quality of life, comfort and productivity of building [11]. In UK, the performance assessment tool used to evaluate the environmental conditions in higher institution is introduced as Building Research Establishment Environmental Assessment Method (BREEAM). According to [1], BREEAM has over a decade's track record, and is now widely used in the UK private sector. It works by creating a specification for a building with a number of individual criteria (grouped into Management, Energy, Health and Well-being, Pollution, Transport, Land use, Ecology and Materials).

By learning the significant of integrating the users' feedback in performance assessment, this survey is therefore has selected four (4) buildings located in Putrajaya, Malaysia as samples of survey; as Putrajaya is marked as the Malaysia's centre of government administration. The assessment and review of the building performance is executed based on one-time observation to the buildings and the weightage of score for each attributes are described in Table 1.

Table 1: Description and Rating of Performance for Services and Environment Attributes

Source : Adapted and modified from CSP1 Matrix [13]

WEIGHTAGE SCORE	DESCRIPTION FOR SERVICES AND ENVIRONMENT ATTRIBUTES	PERFORMANCE RATING
1.0	Well function and shows no sign of defect	Excellent
0.9	Functional and shows cosmetic defects only	Good
0.8	Functional and shows very minor defects, with scheduled inspection	
0.7	Functional with minor defects but may become serious if left unattended	
0.60	Functional occasionally with minor defects but may become serious if left unattended and needs regular inspection	
0.50	Moderate defects and functional occasionally but may become serious if left unattended	Medium
0.40	Functional occasionally with major defects and become serious if left unattended, needs reactive inspection	Poor
0.30	Not well functional with very major defects and become serious if left unattended, needs reactive inspection	
0.20	Doesn't function at an acceptable standard with serious defect, needs reactive inspection	
0.10	Doesn't function at all	

After the result of performance for services and environment attributes are documented, a satisfaction survey from the perspective of the buildings users was also carried out for this research. The users need to rate their satisfaction based on the similar attributes taken for performance review. 80 respondents included for questionnaire-survey and the rate of satisfaction level are based on five likert-scale; i) Very Satisfied (score=1), ii) Satisfied (score=2), iii) Medium (score=3), iv) Dissatisfied (score=4) and v) Very Dissatisfied (score=5).

4. Correlation Analysis of Performance and Users' Satisfaction

The final result in this research involves the correlation analysis of the users' satisfaction in relation to the building performance. The analysis is shown in Table 2 and it was undertaken using the statistical software program SPSS (Statistical Packages for the Social Sciences, version 16.00). The hypotheses were statistically tested with a two-tailed alpha level of 0.05 and it was carried out to measure the strength of the relationship between two variables; performance assessment and users' satisfaction, for each attributes of building services and environment.

Table 2: Correlation of Building Performance and Users' Satisfaction Level.

Performance Category	Performance Attributes	Correlation Coefficient	Sig. (2-tailed) <i>p</i> value
Services	Plumbing System	0.998	0.002
	Electrical Services	0.956	0.044
	Communication system	0.992	0.008
	Fire System	0.396	0.604
Environment	Thermal Comfort	0.998	0.002
	Visual Comfort	0.671	0.329
	Level of cleanliness	0.432	0.568
	Noise Pollution	0.992	0.008

The result from the above table shows the coefficient score perceived for 8 performance attributes under the performance category; services and environment. The number of observation (*n*) is 4 as there are four public building selected for this analysis. The result shows that performance score of 5 attributes (i.e. electrical services, plumbing, communication, thermal comfort and noise pollution) are positively and significantly correlated with occupants' satisfaction with $p < 0.05$. It may be concluded from the high coefficient score perceived, it is the effect of evaluations that may not slightly provide important relationship with those variables. There are 3 attributes perceive a positive low correlation (i.e. fire system, visual comfort and level of cleanliness) with coefficient score range from 0.396 to 0.671 and *p* value is larger than 0.05. Despite having low correlation and not significant, none of the attributes constitute a negative correlation. The possible explanation for these low correlations is the difference perception raised by the occupants.

5. Conclusion

Analysis from the study has shown that the variables have relationship with each other and indicates a positive correlation. The level of perception from occupants is therefore fundamental in planning the best provision of services and environment in public buildings. The analysis of performance assessment outline a strategic approach to achieve the best quality in building services, whereby the assessment integrates the occupants' behaviour, perception and opinion as the building user. Hence, it is substantial to delineate the importance consideration in the aspect of building services and environment as to achieve performance's sustainability for Malaysia's public buildings.

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