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A Comprehensive Approach to Assess Occupant's Satisfaction and Performances of Residential Building

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Abstract

This paper aims to endeavor to develop a holistic Post Occupancy Evaluation (POE) framework, amalgamating the utilization of building facilities and Building Performance Attributes (BPA) for appraising the performance of Construction and Design Firms (CDFs) alongside building performance indicators such as occupant satisfaction within residential apartment complexes. The study adopts a tripartite research methodology encompassing theoretical exploration, on-site investigations, and analytical examinations. The theoretical component entails an extensive literature survey to integrate 15 identified BPAs seamlessly. Field inquiries involve rating building performance and gauging occupant contentment. The subsequent analytical phase establishes correlations between building performance metrics and occupant satisfaction levels. This systematic approach synergizes user insights with building services, promising a rigorous and systematic building analysis. The outcomes underscore a robust correlation linking building performance attributes to occupant satisfaction, thus affirming the pivotal role of POE as an indispensable tool for appraising building performance. The analysis reveals ten highly correlated parameters, indicating a substantial 67% connection between the Building Performance Rating (BPR) and the Occupant Satisfaction Score (OSS). These influential parameters guide improvements and updates through Post-Occupancy Evaluations (POE). This process is a valuable learning tool for enhancing future organizational projects and improving building performance. The findings emphasize the pertinence of the criteria employed in evaluating building performance, which is relevant for assessing occupant contentment and CDF's effectiveness. Comparing the previous research, this research posits the potential for widespread adoption of POE in augmenting CDFs' performance and lays the groundwork for expanding its utilization. The scholarly exploration introduces novel perspectives and paves the way for a comprehensive integration of POE to enhance CDFs' operational proficiency.

Keywords: Occupant Satisfaction; Post Occupancy Evaluation; Building Performance Attributes; Construction and Design Firms.

1. Introduction

The construction industry promotes local and global improvements in sustainability by delivering social orders and client satisfaction in infrastructure projects [1]. Structure caters to clients to settle with lodging, recreation, and amusement [2]. Neither of these will play out better without proper facilities. Buildings provide shelter and hold people for more hours. The facilities provided in the building should satisfy end users [3]. These days, there is a high level of anticipation from clients and occupants regarding the facilities in the building. The clients expect easy sustenance and sustainment, and the occupants expect good well-being and comfort. This highlights the role of Construction and Design Firms (CDFs) concerning the client's and occupant's outlook [4].

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CDFs transform the clients' demand into final output, and neglecting the client's precondition may risk the CDF's position negatively in the market. The factors that influence the performance of CFDs are insufficient data, changes in the plan, mistakes, exclusions, cost, time, regulation, poor organization policy, lack of communication, low coordination, and a low skillset [5–7]. One of the critical factors is the lack of gains from completed projects. CDFs disengage from past completed projects and show disinterest in upgrading themselves with past mistakes and poor performances. The Post Occupancy Evaluation (POE) is a method of evaluating structures by observing and reviewing them regularly following a usage time [8]. It is essentially a technique to examine the utilization and functions of a building. POE provides an obvious result for inappropriate planning and design; also, it acts as an enriching base stage for CDFs to learn lessons from the inhabitants. This assessment helps the CDFs improve their performance and enhance their learning through their end products.

Consequently, this research aims to create a comprehensive post-occupancy evaluation (POE) framework system that integrates building facilities and building performance attributes (BPA) to assess occupant satisfaction in residential apartment buildings. Furthermore, this framework offers guidance for CDF's to improve their performance. With this research rationale, the present study aims to provide answers to the following research questions:

RQ1: Does user satisfaction figure prominently in the existing methods of building performance assessment in residential buildings?

RQ2: Can a group of attributes be identified to assess the performance of residential buildings?

RQ3: How can user satisfaction be quantified?

2. Literature Review

Buildings are built by following government circumscriptions, norms, and details. It needs to be designed by a high level of competent designers who comprehend the minds and expectations of the people while designing a building with high utility and performance [9]. A principal function of the building is to serve end users with utility, space, infrastructure, storage, comfort, and entertainment. Successive changes in customer needs and inclinations do not balance the terms, specifications, and standards. To bargain this, building performance evaluation is indispensable. Building performance evaluation can be done by leading the appropriate investigation, criticisms, and feedback [10]. Carrying out a building performance evaluation can improve the construction and design firms planning, designing, framing strategies, and occupant satisfaction [11]. It also gives facts about the occupant's vision and their satisfaction, expectations, and needs.

The Building Quality Assessment (BQA) tool can recognize the provided facilities in a building. Still, BQA doesn't connect well with end users and shows poor quality evaluation. Serviceability tools and methods (STM) had an objective coherence with connecting end users and experts. It comprises factors for rating the buildings, services, and facilities [12]. However, STM is designed as a universal format. The performance of CDFs has developed to various levels, including project delivery, innovative design, positive reputation, good profit, maintenance, and end-user satisfaction. The CDFs [13, 14] work hard for the on-time delivery of projects, and it reduces the chance of learning from their mistakes and lack of knowledge sharing within the organization. A study [15] is explored to improve the CDFs with a learning and evaluation tool about literature and field investigation. The results show factors like lack of client commitment, organizational fear of getting negative comments, lack of coordination, and concern about learning through POE [16]. This highlights the demand for a holistic framework for upgrading the CDF's potential with a learning tool like POE.

Post-Occupancy Evaluation (POE) is defined as assessing buildings based on how much they address occupant issues and goals. Evaluating structure is a pattern in the developed nations of Europe and America. Still, the sub-continents are not interested in the post-evaluation of structures [17]. The structure adequately acts as a model if no procedure is set up to acquire criticism through building performance when developed with a new framework with obscure results.

In late 1970, POE was associated with a contextual analysis of domestic building divisions in countries like England, Germany, Spain, Canada, and the United States of America [18, 19]. The analysis principally includes gathering data through polls, visits, and perceptions. In the mid-1980s, by observing the coherent advancement and assessment of POE, it was later practiced in different types of structures. Analysis of POE strategies would generally center around the commercial and domestic sectors, while there is less consideration for institutional educational building [20].

The POE study mainly covers three orderly procedures: occupant demand, structure conduct, and facility administration [21]. Client issues such as inhabitant execution, laborer fulfillment, and efficiency should be reflected while conducting a POE technique [22]. The utilization of POE can provide two vital purposes. It can help improve the quality and long-haul manageability of the constructed condition [23]. Jiboye [24] insists that parameters like design and layout be covered in the POE survey. Choi et al. [25] studied office buildings in Austria, indicating insufficient knowledge among occupants about their office environmental system and indoor climate control system. Meri et al. [26] have surveyed complex buildings, and although there are elaborate instructions about the purpose of the building, the

users are still confused and often make mistakes. Ismail et al. [27] studied the performance of the occupancies, which have an enormous impact on the lighting source, with a high preference for daylight. In Iraq, the POE study of three buildings shows a malfunctioned operation due to the introduction of new users, which also potentially causes a lack of communication between architects and users [28]. A monitoring survey was conducted in eight office buildings to assess daylight performance. Visual comfort is improved by using natural lighting through large windows [29]. However, discomforts like glare and heat may cause occupants unimproved visual comfort for those who sit near windows. Wilkinson et al. [30] conducted a web-based survey for around 181 office buildings, and the dimensions evaluated are thermal comfort, air quality, lighting, and indoor environmental quality. Krada et al. [31] have assessed secondary schools' design quality through a photographic survey to find functionality and build quality. When considering new architectural designs, such as structural elements with an oblique angle, it can cause loss of space [32] and behavior problems [33].

The literature review examined multiple cases to comprehend the current landscape concerning building performance evaluation. These case studies illustrated that the interpretation of building performance evaluation varied among researchers. However, the significant research gap was that most researchers employed a similar methodology involving identifying factors for data collection, methods, and analysis. The discrepancy lay primarily in the interpretation of the analysis outcomes. It has become apparent that building performance evaluation should encompass not only functional and technical aspects but also consider perspectives from users rather than solely relying on facility managers. Existing indices and performance measurement models lack emphasis on user satisfaction. Moreover, the current approach often fails to extend beyond addressing complaints and responding to occupants' grievances.

To fill the research gap, there is a pressing need to deliberately design survey instruments aimed at eliciting desired responses from respondents to gauge user satisfaction accurately, and it is evident that the framework structure is drawn out as an endless strategy, which various CDFs may not invite due to time limitations and constraints to change in plan and development. CDFs are recommended to create a learning culture centered on POE as a learning tool for performance improvement and to adopt the proposed framework for CDF enhancement by testing and evaluating the framework regularly to improve performance.

3. Study Area and Data Collection

Each building detail is shared in Table 1. Most buildings are chosen in different orientations, and the selected buildings serve as residential apartments. The studied building serves residential purposes with natural ventilation. The age of the selected buildings is not more than five years, so this will produce better information from the occupants concerning the modern construction facilities provided.

Table 1. Details of study buildings

Study Building (B)	B1	B2	B3	B4	B5	B6	B7	B8
No of Dwelling Units	16	32	16	32	16	32	32	16
Distance from sea (Km)	3.5	4	9	14	1.5	8	11	6
Year of construction	2015	2017	2016	2017	2015	2016	2017	2015

Building Performance Attributes (BPA) were selected from conducting (Figure 1) various literature surveys, experts' opinions, and CDF's stakeholder opinions. The chosen attributes must cover all the requirements oriented to the building's performance.

BPA1. Building design: A good building design can be characterized as receptive to the site and productive. Building form, Ojile & Buba [34], and orientation are the most considered passive design strategies. This section includes the architectural, engineering, and technical attributes of a building.

BPA2. Building appearance: The most significant part of building performance is its aspect and appearance. It relates to the inhabitant's aesthetic [35] view of the building. Factors like dampness, wind invasion, delamination, shading, and disintegration affect the external appearance of the building.

BPA3. Building accessibility: Accessibility refers to the structure's closeness to the facilities that satisfy the occupants [36]. The proximity and location of the building are the central points in the fulfillment of its inhabitants.

BPA4. Building materials: The nature of development and a compatible building material should be good with the current physical environment. The durability and quality of materials [37] can be inspected through visual inspection and by occupant responses.

BPA5. Building interior layout: An efficient building interior layout [38] ought to be proficient in terms of dwelling arrangement, staircase location, width, and accessibility of passageways.

BPA6. Building landscape: The building landscape planning [39] is developed so that the planning & development strategies are efficient & sustainable. This includes less site disruption, appropriate landscaping & features of microclimate.

BPA7. Solar & daylight access: "A building's capacity to receive direct sunlight without obstruction from other buildings or impediments, excluding trees." This includes sun-light access [40] in habitable rooms & open spaces.

BPA8. Building Security: This is treated as a specialized technical component due to its life-saving protection on disastrous occasions. The structure safety elements [41] and fire containment are the central points in building performance.

BPA9. Building Services (Electrical & Plumbing): Building services have a significant effect on personal satisfaction & occupant fulfillment [42]. They incorporate electrical & plumbing services.

BPA10. Building energy efficiency: Energy efficiency is "The ability of an apartment to manage thermal performance [43], providing increased amenity to occupants and reducing energy costs". This includes windows, door openings, overhangs, shading devices, and smart glass.

BPA11. "The state of mind expressing contentment with the surrounding thermal environment characterizes thermal comfort." This includes the occupant's comfort [44] towards building thermal performance.

BPA12. Air quality: The air quality [45] comprises temperature, humidity & air contaminants. The above factors may cause sick-building syndrome and illness.

BPA13. Common circulation and spaces: It is mutually shared by the occupants and provides social collaboration among inhabitants [46]. It includes a community hall, passages, network rooms, and different spaces.

BPA14. Building storage facility: The storage is provided by considering the floor area and the dwelling size [47]. This includes leftover space and storage for easily accessible items.

BPA15. Acoustic Privacy: Acoustic privacy is about protection and transmission. The indoor and outdoor factors [48] are considered for the influence of privacy.

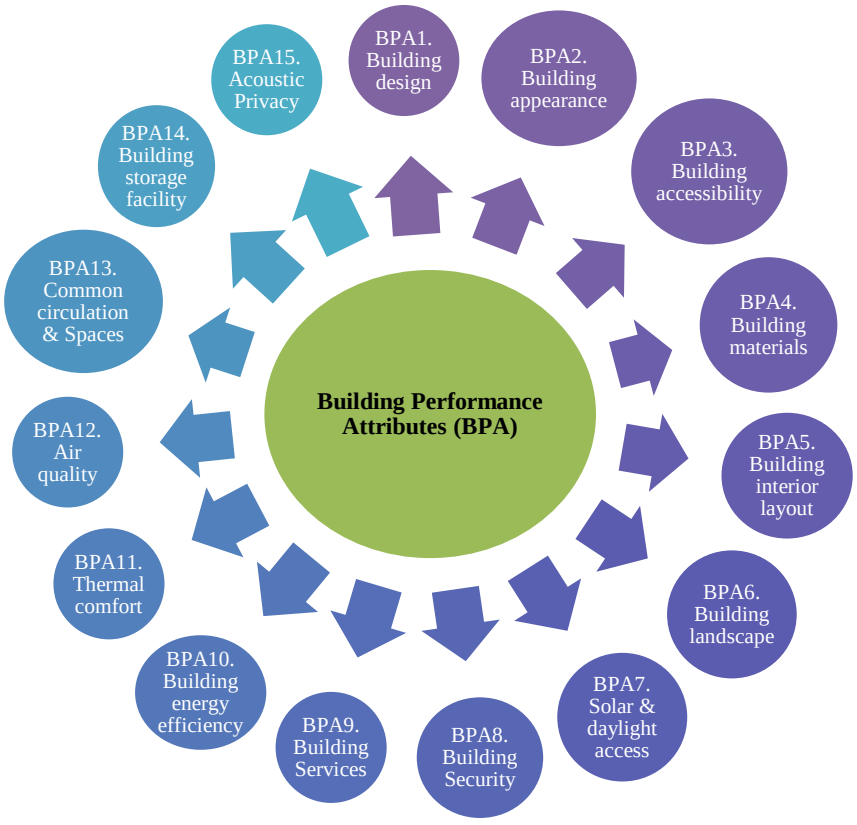

Figure 1. Building Performance Attributes (BPA)

4. Research Methodology

The methodology of this study is a basic structure underlying a system, process [49], and design. The POE-RBPIF (Residential Building Performance Framework) was initiated to coordinate by conducting a post-construction building

performance (Figure 2) as a learning tool for CDFs. This framework enhances occupant satisfaction and allows CFDs to learn from past projects [50]. Design engineers and architects in CDFs understand POE as a learning tool.

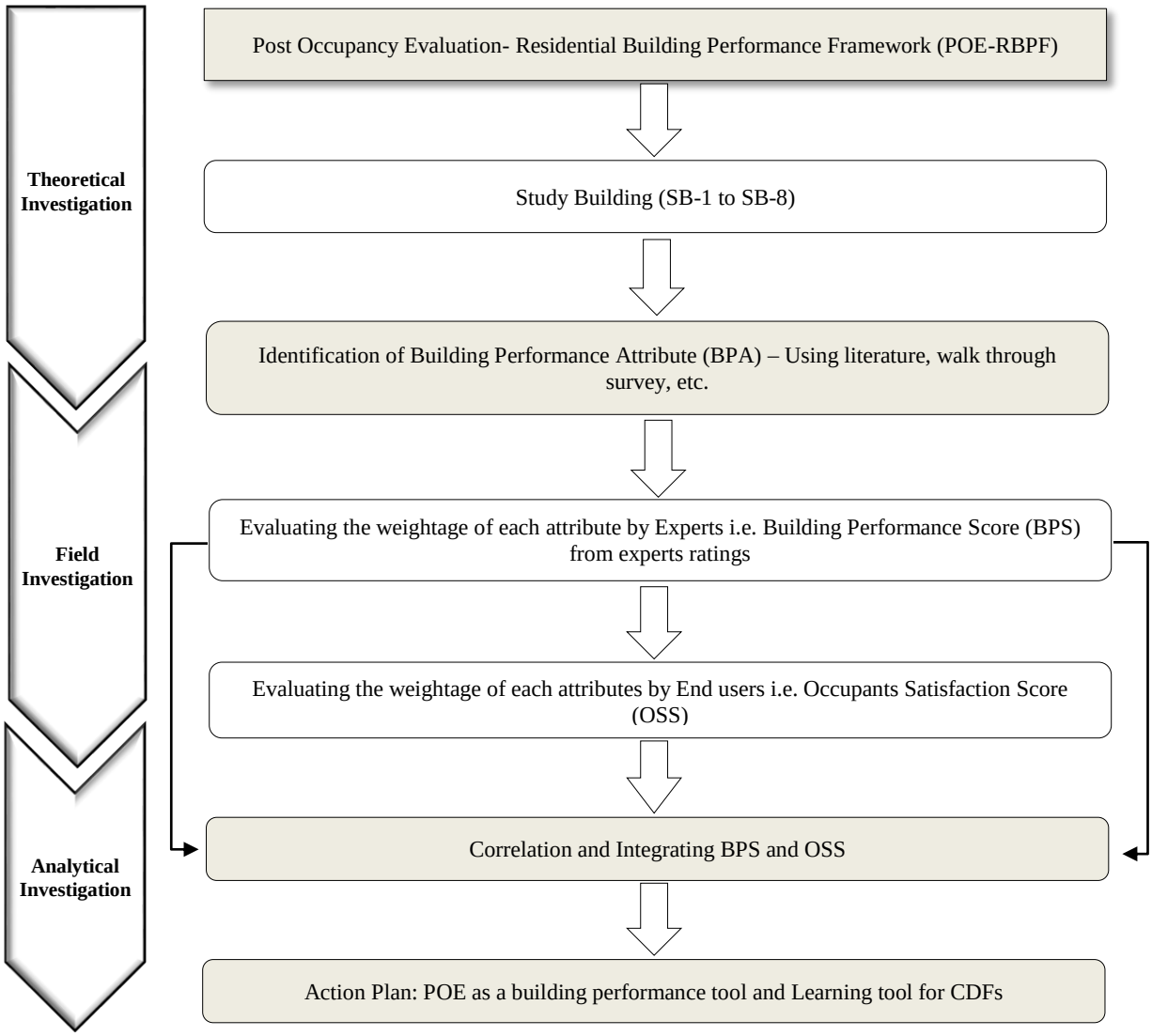

Figure 2. Methodology for POE-RBPIF (Residential Building Performance Framework) & Research Approach

The study obtained the attributes and criteria through an investigative method [51]. The questionnaire surveys are an essential and critical factor in conducting building performance studies [52]. It continuously interconnects the building users and facilities management team. The data collection and questionnaires are prepared by walk-through analysis in an investigative approach [53].

The analysis was divided into three parts. The first part involves assessing the building performance score using the Likert scale, ranging from Very Low, Low, Medium, High, to Very High. It was conducted by a group of experts who are more experienced and educated in the field to evaluate building performance. The second part was the evaluation done by occupants in the building based on the occupant score for each of the attributes from the personal satisfaction of the occupants. The mean calculated from both responses is converted into a percentage scale. The final part shows the correlation analysis [54] between building performance scores and occupant satisfaction scores based on the attributes of the selected buildings.

5. Results and Discussion

The experts conduct a building performance inspection to rate the BPR. The CDFs select the experts based on their knowledge, skill set, experience, and various factors. The performance of the building is measured using the Likert scale. Around five scales are selected: VHP- Very High Performance, HP- High Performance, MP- Moderate Performance, LP- Low Performance, and VLP- Very Low Performance. If the mean building performance score is less than 0.4, it denotes deficient performance. Similarly, if it represents a mean value of 0.6 or higher, the performance is considered high and very high, respectively. Table 2 presents the final BPR for the building parameters.

Table 2. Comparison of output in the BPRS and OSS of the study buildings

Parameters	Building Performance Rating Score (BPRS)								Occupant's Satisfaction Score (OSS)							
	B1	B2	B3	B4	B5	B6	B7	B8	B 1	B 2	B 3	B 4	B 5	B 6	B 7	B 8
Building Design	0.6	0.5	0.4	0.7	0.4	0.6	0.4	0.6	0.63	0.52	0.77	0.81	0.59	0.57	0.51	0.67
Building Appearance	0.8	0.6	0.8	0.7	0.7	0.6	0.4	0.5	0.81	0.78	0.74	0.62	0.69	0.63	0.71	0.68
Building Accessibility	0.7	0.6	0.6	0.7	0.6	0.6	0.7	0.6	0.69	0.54	0.62	0.61	0.55	0.51	0.62	0.59
Building Materials	0.7	0.6	0.5	0.9	0.8	0.7	0.8	0.5	0.61	0.54	0.62	0.51	0.49	0.51	0.63	0.59
Building Interior Layout	0.6	0.8	0.7	0.5	0.7	0.8	0.7	0.8	0.55	0.51	0.71	0.63	0.68	0.69	0.54	0.57
Building Landscape	0.8	0.7	0.9	0.7	0.8	0.6	0.5	0.7	0.81	0.72	0.63	0.59	0.67	0.71	0.63	0.55
Solar and daylight access	0.7	0.6	0.6	0.6	0.5	0.6	0.5	0.7	0.49	0.71	0.63	0.67	0.59	0.54	0.61	0.62
Building Security	0.7	0.8	0.6	0.6	0.7	0.8	0.6	0.6	0.68	0.71	0.65	0.73	0.75	0.77	0.69	0.81
Building Services	0.9	0.8	0.7	0.9	0.8	0.9	0.8	0.7	0.63	0.71	0.73	0.83	0.76	0.69	0.54	0.62
Building Energy Efficiency	0.5	0.7	0.5	0.7	0.5	0.7	0.4	0.5	0.51	0.58	0.49	0.61	0.58	0.51	0.45	0.65
Thermal Comfort	0.5	0.5	0.4	0.5	0.5	0.4	0.3	0.5	0.61	0.55	0.51	0.71	0.63	0.68	0.69	0.73
Air Quality	0.5	0.5	0.6	0.6	0.6	0.5	0.6	0.7	0.65	0.63	0.71	0.73	0.83	0.85	0.69	0.62
Common circulation and space	0.6	0.6	0.5	0.7	0.6	0.6	0.5	0.9	0.55	0.51	0.52	0.62	0.66	0.68	0.71	0.53
Building Storage facility	0.6	0.7	0.5	0.5	0.4	0.4	0.4	0.6	0.64	0.59	0.71	0.79	0.81	0.77	0.65	0.63
Acoustic Privacy	0.7	0.7	0.6	0.7	0.5	0.8	0.8	0.9	0.71	0.79	0.81	0.77	0.52	0.81	0.74	0.68

The ratings are cumulated and analyzed using SPSS software (Figure 3). The expert's ratings are as follows:

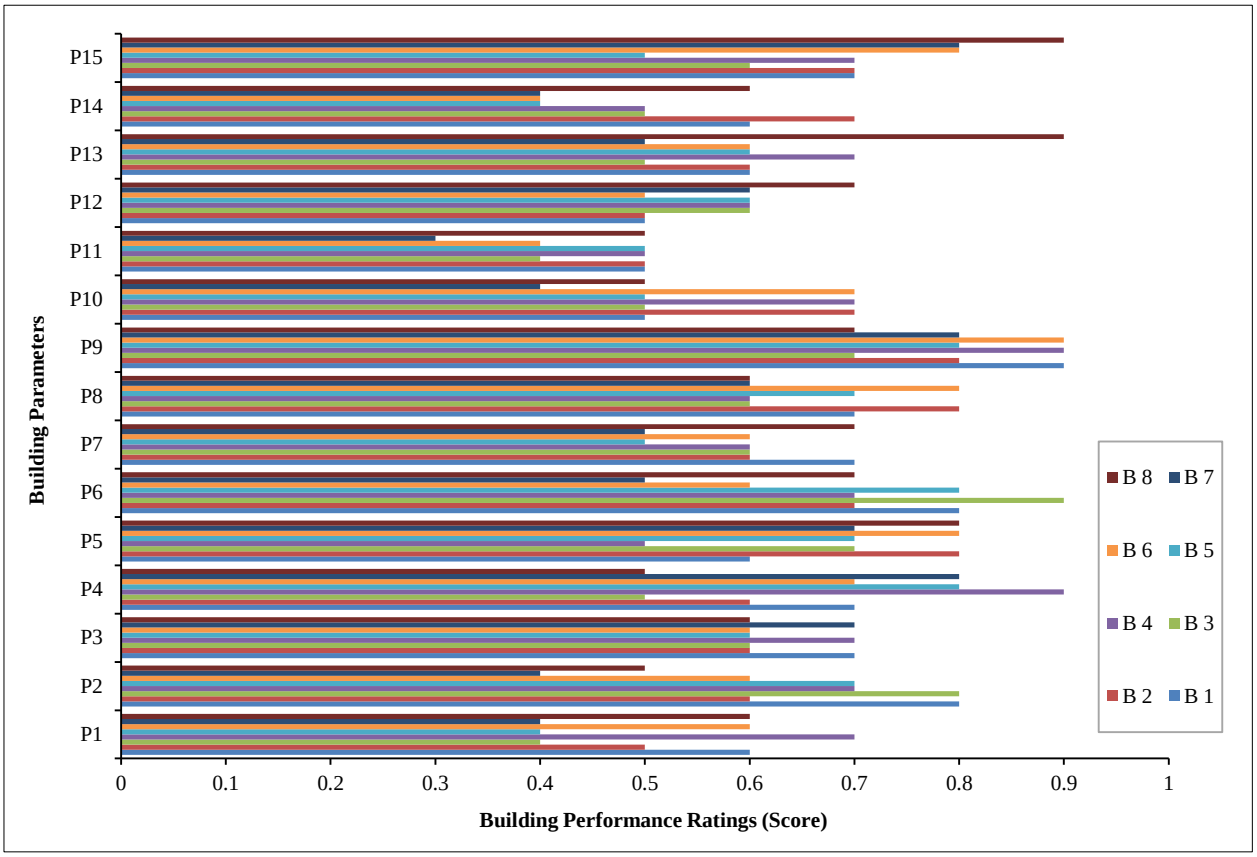

Figure 3. Building Performance Rating Score

BPRS1. Building design: Four buildings (B1, B4, B6, B8) show the building design, form & orientations achieved a high-performance rating by the experts. Due to some external factors, buildings B3, B5, and B7 are rated with a low-level rating.

BPRS2. Building appearance: The appearance quality result indicates that the building's performance is above moderate. The exerts rating revealed that the B7 building has dampness in an exterior wall, so it is rated as 'Low' performance.

BPRS3. Building accessibility: This indicator's results achieve a higher performance level than moderate. Therefore, the building accessibility of the building is marked as 'high' performance.

BPRS4. Building materials: According to the expert's rating, the overall quality of the materials achieved mean values of more than moderate. Building B5, & B7 got a very high performance rating from the experts.

BPRS5. Building interior layout: The interior layout of the buildings got an overall rating of moderate and higher than moderate. The experts applaud building B2, B6 & B8 (Figure 3) for its proficient dwelling arrangements.

BPRS6. Building landscape: Most of the attributes considered in landscaping are moderate, and in buildings like B1, the experts' rating shows a high level of performance due to the adoption of microclimate.

BPRS7. Solar & daylight access: Based on the results obtained from the experts' rating, the building performance of B3, B5, and B7 are below moderate due to external factors like the height of the adjacent building, shading of trees, and the rest of the building show high performance.

BPRS8. Building Security: The indicator maintained a more than moderate performance in all the study buildings. According to expert ratings, the building 'B2' is applauded for its innovative and special techniques, which serve the building with high performance.

BPRS9. Building Services: According to the results, all the buildings show high-quality provision of services. The experts suggested a 'very high' performance for study buildings B1, B4, and B6, having a mean value of 0.9.

BPRS10. Building energy efficiency: This parameter recorded a low performance for buildings B3, B5, and B7 due to many external factors like window size, ventilation, etc. The overall expert rating denotes a below-moderate performance.

BPRS11. Thermal comfort: The expert's rating indicates the thermal comfort of the buildings and records a mean value of 0.5 in many cases. The indication is that the performance of the attributes is below moderate. Conversely, building B7 exhibits a 'very low' performance.

BPRS12. Air quality: According to the expert's rating, the air quality indicates a mean value of more than 0.5, which was more than a moderate level of performance. Therefore, the air quality of the building was marked as 'high performance.'

BPRS13. Common circulation & Spaces: Based on the results obtained from the experts' rating, the circulation space achieved a 'high performance.'

BPRS14. Building storage facility: The indicator shows a moderate and higher performance in all the study buildings. However, buildings B3 and B7 show a valve below moderate performance due to the dwelling site.

BPRS15. Acoustic Privacy: This parameter shows a high performance from the expert's rating for all buildings. However, building B8 has a high performance with a mean rate of 0.9.

The second part of the findings gathered user responses regarding the satisfaction level with the building's performance. The second questionnaire survey encompassed similar parameters outlined in the building performance rating (BPR). A five-point scale was utilized to rate occupant satisfaction scores, ranging from '1' VD- Very much Dissatisfied, '2' D- Dissatisfied, '3' M- Moderately satisfied, '4' S- Satisfied, to '5' HS- Highly Satisfied. Among the circulated questionnaires, a high volume of samples, approximately 86.75%, were filled out and returned appropriately. However, around 13.25% of the samples were not adequately replenished, so they were not considered for the study's purpose.

OSS1. Building design: The occupant's responses highlight a high score in building B4 (Figure 4) with a mean value of 0.81. The overall quality of the building design achieves an above-moderate degree of occupant satisfaction.

OSS2. Building appearance: Building B2 receives a high occupant satisfaction score due to its good aesthetic appearance. The average mean value of all the buildings was around 0.59, which denotes that users were delighted.

OSS3. Building accessibility: The results obtained from the occupant reveal that the location, proximity, and facilities near the building are highly accessible. All the attributes related to these factors were recorded with a mean value of 0.63, demonstrating that the users were highly satisfied.

OSS4. Building materials: Most attributes considered for the building materials record good satisfaction. The materials indicate a mean value of 0.63, which denotes a level of satisfaction more than the moderate.

OSS5. Building interior layout: The attributes & indicators in the building interior layout record a mean value of 0.55, demonstrating moderate user satisfaction. Building B7 shows dissatisfaction from the occupants with its poor layout.

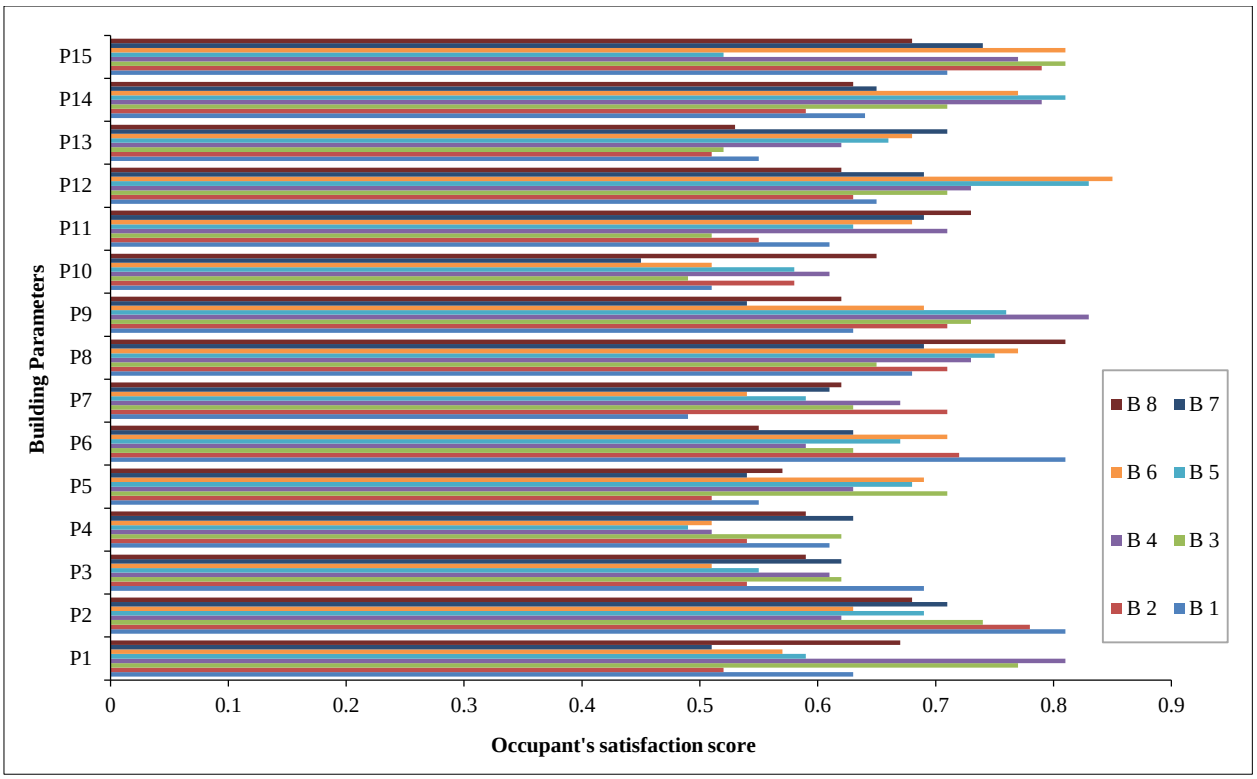

Figure 4. Occupants Satisfaction Score

OSS6. Building landscape: The landscape achieves a mean rating of 0.70, demonstrating a high occupant satisfaction core. This is mainly achieved due to green balconies and microclimate features in all the buildings.

OSS7. Solar & daylight access: Most of the indicators in this attribute show moderate and below moderate satisfaction with a mean of 0.45; some buildings are receiving more solar incident rays, and on the contrary, building B7 receives a minimal amount of daylight.

OSS8. Building Security: According to the occupant's score, this attribute indicates a mean of 0.61, demonstrating high satisfaction. In contrast, buildings B7 & B5 achieve a level of dissatisfaction oriented with occupant's external factors.

OSS9. Building Services: All items & attributes related to this factor denote a mean value of 0.75, showing a high level of occupant satisfaction.

OSS10. Building energy efficiency: The results obtained from users show the overall energy efficiency of the building shows dissatisfaction among the occupants. The occupant denotes that using natural ventilation is minimal due to external factors.

OSS11. Thermal comfort: The attributes denote a moderate level of satisfaction with thermal comfort. The occupants believe the building is inferior in climatic response & fails to provide a comfortable environment during summer days.

OSS12. Air quality: The items & attributes indicate a mean value of 0.70, demonstrating that users are highly satisfied. The occupants encompass the air quality in the lobby, stairs & balcony towards their above moderate satisfaction.

OSS13. Common circulation & Spaces: The occupants feel the circulation space is more restrictive and not easily accommodating for more users. The users show divergent responses in this attribute with a dissatisfaction note.

OSS14. Building storage facility: The occupant score related to the attributes and indicator of this parameter with a deficient mean score denotes dissatisfaction due to the lack of an easily accessible storage facility.

OSS15. Acoustic Privacy: The findings of the attribute show a mean score about a below moderate level of satisfaction. The building near busy traffic zones has no buffer zone, implying slight dissatisfaction.

5.1. Correlation Analysis

The analysis is performed by conducting a correlation between BPS and OSS. The correlation analysis was undertaken by Kendall's tau correlation using a statistical software program (SPSS- Statistical Package for the Social Sciences) using a two-tailed hypothesis, which was statistically tested with a level of 0.05. Based on the 15 BPA and

the framed questionnaires, the correlation analysis identifies the performance, efficiency, and relevancy levels between the BPS and OSS. The correlation values are represented in Figure 5, and the explanation follows.

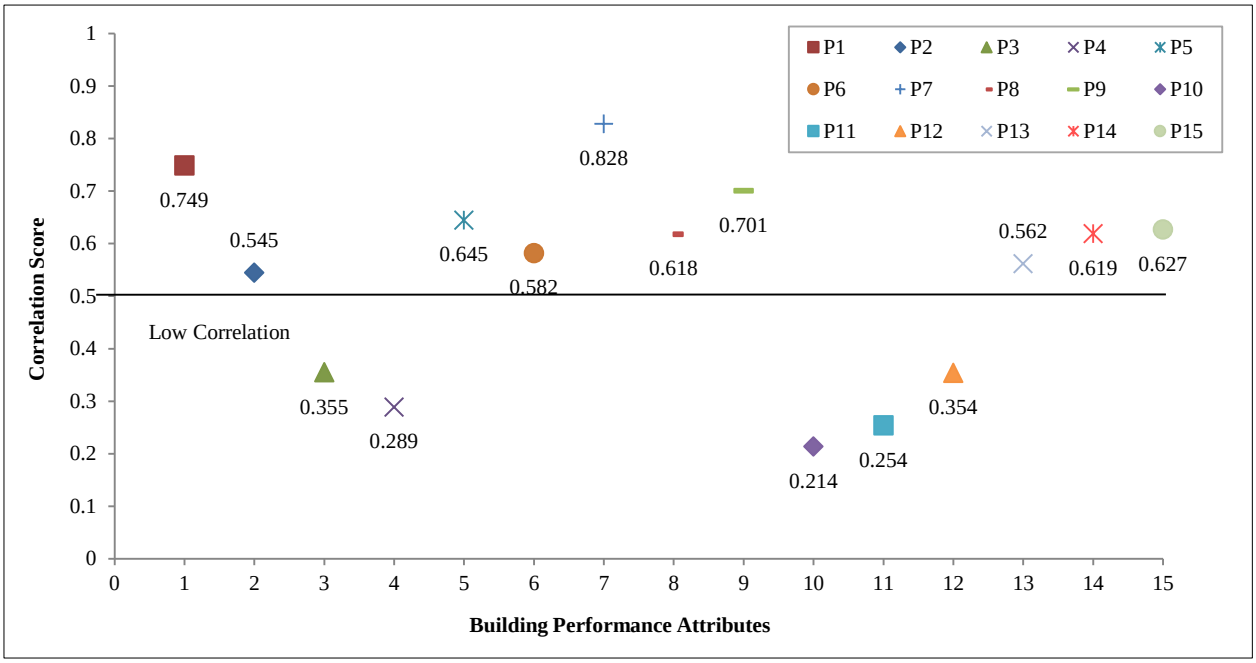

Figure 5. Correlation of BPS and OSS

The correlation is high for building performance attributes like building design, appearance, interior layout, landscape, solar and daylight access, security, services, storage facilities, and acoustic privacy. The output shows ten parameters are picked under high correlation, which denotes that around 67% of attributes are highly related between BPR and OSS. The high correlation values represent the strong relationship between building performance and Occupant satisfaction. These parameters are improved, and facilities are updated by conducting post-occupancy evaluations. Therefore, POE can be applied by CDFs as a learning tool to improve future projects within the organization, and it is effective in finding building performance.

The correlation is low for building performance attributes like accessibility, building materials, building energy efficiency, thermal comfort, and air quality. The five attributes show a 33% low correlation, but the indexed values are not below 0.100; in any case, it shows the attributes don't establish a negative index regardless of having a low correlation index. The low correlation output arises due to the disparity in perception between occupants and experts. This finding indicates that there's no necessity for further examination of the surveyed attributes to ensure their alignment with occupant satisfaction. The validation of this model occurred by comparing the OSS and BPR. The results confirm that the proposed framework applies to various regions of the country within Construction and Design Firms.

In contrast to previous studies, this research asserts the considerable potential for the extensive adoption of POE (Post-Occupancy Evaluation) in enhancing the performance of CDFs. It aims to establish a foundation for broadening the application and utilization of POE within this context. Thus, the proposed framework is also applicable to POE in residential buildings.

6. Conclusion

In the concern of building facilities and their performance, this paper collects the data of 211 occupants and ten experts' scores for determining the building performance and Construction and Design Firms' (CDFs) performances. Firstly, a framework is developed to study the building performance, and secondly, a correlation analysis shows the performance of the CDFs. The thrust of the discoveries is that the pointers and factors utilized in surveying the building's performance are noteworthy in finding the occupants' satisfaction and CDF performance. In contrast to previous research focusing only on occupant or user feedback, this paper produces an outcome on the proposed framework to study building and CDF performance. Overall, the study addresses the potential of improving the performance of CDFs by using post-occupancy evaluation as a learning tool.

The study contributes to the residential building on facilities management, particularly end-user satisfaction, building performance, and POE as a learning tool in CDFs. POE can alleviate the rise of inadequate issues as the procedure enables a vital evaluation of current building performance. The framework identifies eight study buildings and 15 building performance attributes. This study performs a correlation analysis between building performance and occupant satisfaction in eight selected residential buildings. A high correlation is indicated by the correlation analysis between

performance and end-user demands, and the index values are not less than 0.100 in any attribute, meaning that the attributes do not establish a negative index. Some building performance attributes, like thermal comfort, air quality, and Energy efficiency, have a low correlation value. The lack of correlation is mainly due to the distinction between the experts' and occupants' opinions. However, the said factors significantly influence achieving better CDF performance. These sensitive factors are to be acclaimed again with some proper evaluation techniques by the CDFs to get feedback with a constructive method of analyzing those factors. The adopted framework is more suitable and adequate for exploring the building. This approach integrates user opinion with building services in a planned strategy, which gives great potential for analyzing the buildings. The research noticed numerous thoughts and findings are created to achieve sustainability; it can open a door for more extensive utilization of POE, particularly for residential buildings.

7. Declarations

7.1. Author Contributions

Conceptualization, J.K.; methodology, J.K. and A.K.K.; software, J.K. and A.K.K.; validation, J.K. and A.K.K.; formal analysis, J.K.; writing-original draft preparation, J.K. and A.K.K.; writing-review and editing, J.K. and A.K.K.; supervision, A.K.K.; project administration, A.K.K. All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

Data sharing is not applicable to this article.

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7.5. Conflicts of Interest

The authors declare no conflict of interest.

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