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POST OCCUPANCY EVALUATION OF ADAPTIVELY REUSED BUILDINGS: CASE STUDY OF AN OFFICE BUILDING IN SAUDI ARABIA

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Abstract

Adaptive reuse of buildings is the practice of converting the use of an originally designed built-environment to suit a new use. This conversion process has a direct bearing on the performance of the building, and the satisfaction of the users with the conditions of the converted built-environment. This paper presents the findings of a post occupancy evaluation (POE) of an adaptively reused student housing facility to an office building, as a case study. The POE was conducted to investigate the consequences of the conversion process on the technical and functional elements of performance of the adapted building. A review of literature was performed to identify the technical and functional elements of performance pertaining to the new use of the building, along with their recommended performance criteria in codes and standards. The study employed multiple data collection methods, including a walkthrough tour to develop insights about the performance of the building elements; interviews to confirm the validity of the identified technical and functional performance elements, and initiate discussion with the users based on the findings of the walkthrough tour; and a user satisfaction survey to obtain the users' feedback on the performance of the building. The findings of the study resulted in developing a series of recommendations to improve the performance of the case study building. The paper serves to guide design professionals involved in the planning and design of adaptive reuse projects, and facilities managers in charge of the daily operations of adaptively reused buildings.

Keywords: **Post-occupancy evaluation; Adaptive reuse; technical; Functional; Performance elements; Performance criteria.**

1. INTRODUCTION

Adaptive reuse of buildings is the process of renovating, or rehabilitating existing buildings, or structures to fulfill a use other than their current use [1]. Adaptive reuse of buildings can provide economic, social and environmental benefits to societies. The economic benefits can be achieved through reductions in the time and cost of realizing functional buildings [2]. Rehabilitated buildings can be configured quickly, in comparison to constructing new buildings, provided that their structural systems are adequate [3]. Additionally, rehabilitated buildings would cost less than new construction, since many of the building elements already exist [4]. The social benefits can be achieved by preserving historical buildings, which could be in advantageous locations [5]. The environmental benefits can be achieved through the reuse of the utilities and materials, including water, gas, and power systems, hence, reducing the demand to provide new utilities, as well as the amount of embodied energy produced through the manufacturing processes of construction materials [3].

Nevertheless, adaptively reused buildings could provide several building performance concerns for their users [6]. These concerns range from the lack of effective layout of spaces [7], compliance to regulatory requirements for health and safety [8], and the existence of utilities that could be of insufficient capacities [9]. Therefore, adaptively reused buildings need to be planned, designed, implemented and managed to satisfy the technical and functional requirements of the new use. Therefore, post occupancy evaluation (POE) of adaptively reused buildings is demanded to verify its sustainable performance and achievement of users' requirements. POE is defined as "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time" [10].

POE could provide practical feedback to design professionals, facilities managers, and owners of adaptively reuse projects [11, 12, 13], through assessing the consequences of implementing modifications or changes to buildings, and quantifying the performance levels of the main elements in the building [14, 15, 16, 17]. Through conducting a POE on an existing building, defects, systems' performance, users' satisfaction and environmental qualities can be investigated and assessed [18, 19]. This paper presents the findings of a POE of an adaptively reused student housing facility to an office building, as a case study. The POE was conducted to investigate the consequences of the conversion process on the technical and functional elements of performance of the adapted building. The findings resulted in developing recommendations to improve the performance of the case study building.

2. RESEARCH METHODS

2.1. Walkthrough Tour

A walkthrough tour throughout the case study building was conducted during the regular working hours to develop insights about the performance of the building elements. It was carried out over two hours. It served to assess the quality of the layout, and the utilization of spaces, compliance with health and safety requirements, plumbing requirements, and requirements of site configuration. The walkthrough tour was facilitated by a copy of the as-built drawings of the building. The walkthrough resulted in identifying several shortcomings in the performance of several building elements. Identification of these shortcomings aided in the formulation of several technical and functional elements of performance, that were included in the user satisfaction survey.

2.2. Literature Review

The present literature review in this study consists of previous studies, and description of the elements of performance.

- **Previous Studies**: Relevant published research was reviewed to provide a theoretical background about two major aspects related to the scope of this study. The first aspect (section 3.1) focused on reviewing published studies on the evaluation of performance of office buildings, since it is the function of the selected case study in this research. Three published case studies pertaining to the performance assessment of office building were presented. The second aspect (section 3.2) focused on reviewing published studies on the performance evaluation of adaptively reused facilities, since the case study building is a sample of this type of facilities. The previous studies contributed to identify the performance elements pertaining to the new use of the case study building (i.e. office building), along with their recommended performance criteria.
- **Elements of Performance**: The technical and functional elements of performance were identified. Twenty six technical elements of performance (see section 3.3.1) and twenty four functional elements of performance (see section 3.3.2) were identified and described.

2.3. Interviews with Users

Interviews were conducted with a selected sample of four permanent users of the case study building. Interviewed respondents were selected based on the number of years of using the building. Care has been exercised to select users who have been using the building for at least 12 months. The interviews included questions based on the identified performance elements through the review of literature. The interviews aimed to confirm the validity of the identified performance elements, and initiate discussion with the users based on the findings of the walkthrough tour.

2.4. User Satisfaction Survey

A user satisfaction survey was developed, pilot-tested and distributed to obtain the users' feedback on the performance of the case study building. It included the identified 50 technical and functional elements of performance. The users of the case study building were asked to indicate their level of satisfaction with the identified elements of performance, using a 4-point

Likert scale of satisfaction, employing the following evaluation terms: "strongly satisfied", "satisfied", "dissatisfied" and "strongly dissatisfied". The user satisfaction survey was pilot-tested by three professionals, acquainted with the practices of facilities performance evaluation. The pilot-testing resulted in improving the clarity and readability of the survey. The survey was distributed to all users of the case study building (65 staff). Forty responses (accounting for 61% response rate) were considered for data analysis.

2.5. Data Analysis

The data obtained through the user satisfaction survey was tabulated and analyzed to develop findings and discussions. The findings aimed at describing the level of users' satisfaction with the performance elements in the case study building. The following equation [20] was used to calculate the weighted mean response for each of the 50 elements of performance:

$$S_j = \frac{(\sum_{i=1}^{4} w_{ij}\, n_i)}{(\sum_{i=1}^{4} n_i)} \tag{1}$$

Where:

S_j is the weighted mean response.

n_i is number of respondents who evaluated element j of performance in the survey.

w_i is the assigned weight to the satisfaction rate (i = 1, 2, 3 or 4).

Table 1 presents the calibration followed to quantify the rate of satisfaction for each performance element, and develop a subjective interpretation of the quantitative findings. This calibration was used in different previous research [20, 25].

Table 1.
The assigned ranges, calibration and weight of each satisfaction rate

Satisfaction rate	Corresponding weight	Calibration
Strongly Satisfied	4	3.50–4
Satisfied	3	2.50–3.49
Dissatisfied	2	1.50–2.49
Strongly Dissatisfied	1	0–1.49

2.6. Focus Group Discussions

Focus group discussions were conducted with a selected sample of four regular users of the building, upon the completion of the data analysis, to confirm the outcomes of the POE, comment on the findings, and suggest recommendations to improve the performance of the case study building.

2.7. Recommendations

Recommendations were proposed to enhance the overall performance of the case study building. They were formulated based on the findings of the conducted walkthrough tour, initial interviews, user satisfaction survey and focus group discussions.

3. LITERATURE REVIEW

This section presents a coverage of the previous POE studies on office buildings and adaptively reused buildings. Further, it presents a coverage of the elements of performance employed in this study.

3.1. Previous Studies on the Performance Evaluation of Office Buildings

Khalil and Husin [21] conducted a POE in an office building, in Malaysia to develop recommendations for improving the "indoor environmental quality (IEQ)". The POE employed a questionnaire survey to assess five performance elements, namely "thermal comfort", "air movement", "visual comfort", "noise pollution" and "cleanliness".

Emuze *et al.* [22] performed a POE on a group of office buildings, in South Africa, to investigate occupants' satisfaction level for the IEQ, and its impact on employees' morale and productivity. The study adopted a questionnaire survey to assess the "indoor air quality (IAQ)", "lighting", "thermal comfort", "workspace availability and noise" and "office productivity and work environment".

Choi *et al.* [23] completed a POE study on 20 office buildings over seven years, in the United States, to assess the satisfaction of occupants with the IEQ. The POE utilized field measurements and occupants' satisfaction surveys. The findings were used to formulate recommendations to improve the current guidelines and standards of IEQ, thus enhancing the environmental design of office buildings in the future.

3.2. Previous Studies on the Performance Evaluation of Adaptably Reused Facilities

Voordt *et al.* [14] conducted a POE in an organization that has experienced changes in its structure and workplace environment, in the Netherlands. The changes included changes in the office layout, furniture, information and communication technology (ICT) and document storing systems. The POE examined the performance of the new workplace environment from the perspectives of employee and mangers. The POE employed different data collection methods, including interviews, workshops, workplace and web-based questionnaire. The findings revealed that the overall satisfaction with the new workplace environment was higher, compared to the former environment. The study concluded that the utilization of POE has the potential to support the management of change, through the enhancements of the working environment.

Mundo-hernández *et al.* [15] presented the finding of a POE of adaptively reused building, in Mexico. The POE aimed to assess the performance of the building from the users' perspective. The study utilized several data collection methods, including analysis of past records, walkthrough inspection, and questionnaire survey. The questionnaire survey focused on assessing the occupants' satisfaction of the building performance in term of "ventilation", "acoustics", "artificial lighting", "daylighting" and "environmental behavior". The study concluded that POE has served to provide insights to the operation, as well as the occupants' satisfaction of the converted building.

Al-Obaidi *et al.* [17] conducted a performance evaluation of two adaptively reused buildings, in Malaysia. The study employed several data collection methods, including interviews, walkthrough inspection, IEQ measurements and occupants' satisfaction survey. The measurements focused on assessing the "air temperature", "air velocity", "relative humidity" and "light intensity". The findings indicated that adaptive reuse of buildings has the potential to satisfy the performance requirements of the new use, provided that they have been carefully thought of during the design phase.

3.3. Elements of Performance

3.3.1. Technical Elements of Performance

The technical elements of performance include the survival elements pertaining to the health and safety aspects, and the operation of building systems [10]. Based on the review of previous studies, the authors identified six technical elements of performance for assessment, namely "thermal comfort", "visual comfort", "acoustical comfort", "indoor air quality", "fire safety" and "plumbing services".

- **Thermal Comfort**: Thermal comfort is affected by air temperature, air velocity, relative humidity, mean radiant temperature, and human clothing and activity rate [24, 25]. The "Thermal Environmental Conditions for Human Occupancy" code recommended that air temperature for comfort conditions would range between 19.4°C and 27.8°C, and that the relative humidity would not be more than 65%. However, according to the adaptive model concept, these ranges of relative humidity and air temperature might be changeable based on the meteorological or climatological conditions [26].
- **Visual Comfort**: Assessment of the lighting performance is an activity within the scope of the overall diagnostic of the indoor environmental quality in buildings [27, 28]. However, the "Lighting Handbook of the Illuminating Engineering Society" (IES) recommended that the lighting intensity at the working plane level in office spaces would range between 300 to 500 Lux [29].
- **Acoustical Comfort**: Sources of noise in the workplace could be external such as traffic, or internal such as conversations and sounds of mechanical systems [20, 22]. Acoustical comfort and noise control are among the challenges that need to be considered in adaptive reuse projects [30]. The "Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 189.1, 2014) specified that the noise level in workplaces in office buildings should not exceed 44 dBA [31].
- **Indoor Air Quality (IAQ)**: Several parameters of IAQ can be measured within the context of the POE, such as concentrations of Carbon Dioxide (CO_2) and Carbon Monoxide (CO), and volatile organic compounds (VOCs) [23, 32]. The "Ventilation for Acceptable Indoor Air Quality" standard [33], specified that the concentration of these parameters should not exceed 1000 ppm, 9 ppm and 0.005 ppm, respectively.
- **Fire Safety**: Compliance with fire safety code requirements is one of the elements that constitute a challenge in adaptive reuse projects [30]. It needs to be assessed in a systematic manner, in order to protect the life of people and value of properties [34]. In office buildings, sprinkler systems, extinguishers, alarm devices, exits and evacuation plan should be adequately provided throughout the building [35]. Further, the travel distance from any point within the floor plan to the exit should not exceed 22 meters.
- **Plumbing Services**: Designers of adaptive reuse projects need to ensure that their buildings are served with plumbing services that satisfy the requirements of the building code for the new type of occupancy [36, 37]. In office buildings, it is recommended to provide one water closet per 25

occupants for the first 50 occupants, and one water closet per 50 occupants for the others who exceeded the first 50 occupants. Further, it is recommended to provide one lavatory per 40 occupants for the first 80 occupants, and one lavatory per 80 occupants for the others who exceeded the first 80 occupants [38].

3.3.2. Functional Elements of Performance

The functional elements of performance include the essentials that enable users to perform their activities in the building [10]. Based on the review of previous studies, the authors identified six technical elements of performance for assessment, namely "interior and exterior finishes", "furniture", "distribution and layout of offices", "information technologies and power distribution", "car parking" and "other amenities".

- **Interior and Exterior Finishes**: Interior and exterior finishes, reflecting the image of the building, are essential components in modern office buildings [25, 39]. As adaptive reuse of buildings might require the replacement of interior and exterior finishes, defects in the installation of new materials may occur, due to the lack of quality control measures during the replacement process [17].
- **Furniture**: The quality of furniture, as a functional element, is a significant aspect that needs to be assessed in office buildings, from the perspective of users, due to its impact on the productivity of users, and flexibility of the workplace [25, 40].
- **Distribution and Layout of Offices**: The design of workplace needs to support the needs of both types of activities, paper-based and computer-based activities [23]. A well-designed office layout will provide for improved productivity levels due to user's satisfaction with the workplace environment [22].
- **Information Technologies and Power Distribution**: The workplace needs to be provided with advanced information and communication technologies (ICT), through flexible networking and high-quality building amenities [39], to support the business operations [14]. The utilization of innovative ICT in the workplace will reflect positively on the performance of the organization [40].
- **Car Parking**: The availability of sufficient car parking in office buildings is a challenging issue for designers [39]. In adaptive reuse projects, designers need to provide sufficient number of car parking to satisfy the requirements of the new type of occupancy [36, 41].
- **Other Amenities**: Other amenities in office buildings usually refer to the social spaces provided to enhance the design quality of the workplace, such as lobbies, lounges and cafeterias [39]. These spaces need to be assessed to improve the satisfaction of users with the overall quality of the workplace [40].

4. CASE STUDY

The selected case study is an adaptively reused building, that was originally built in 1986. The building is located in a university campus, located in the Eastern Province of Saudi Arabia. It was originally designed as a five story student housing building, and it was served by two elevators. The gross area of the building is 3050 square meters, with a floor area of 610 square meters. There were 16 rooms of double occupancy per floor, making a total of 80 rooms in the building. The dimensions of a typical room is 3.6 meters × 4.8 meters. The building was designed, such that each two rooms share a toilet, as well as a kitchen through a foyer. The building was converted from a student housing to an office building, right after the completion of the construction, due to the urgent need for an office building in the university campus. The conducted modifications on the original design provided workplaces for 65 users. These modifications included:

- The removal of walls between the two rooms, at the end of the floor plan, to provide wider office spaces for department managers.
- The change of the functions of some kitchens to be small individual office.
- The merge of some balconies and kitchens to provide a continuous corridor through the building.

The building envelope was mostly retained, expect for the merged balconies. The interior finishes in some locations were retained, while they were refurbished in others. Two kitchen units were retained in each floor. The layout of the air conditioning system was retained, where each room had its individual control over the operation of the system. The fixtures of the lighting systems were replaced in some locations, while they were retained in others. The original distribution of the plumbing system was retained. Figures 1 and 2 illustrate the typical floor plans of the case study building before the conversion (as a student housing) and after the conversion (as an office building), respectively.

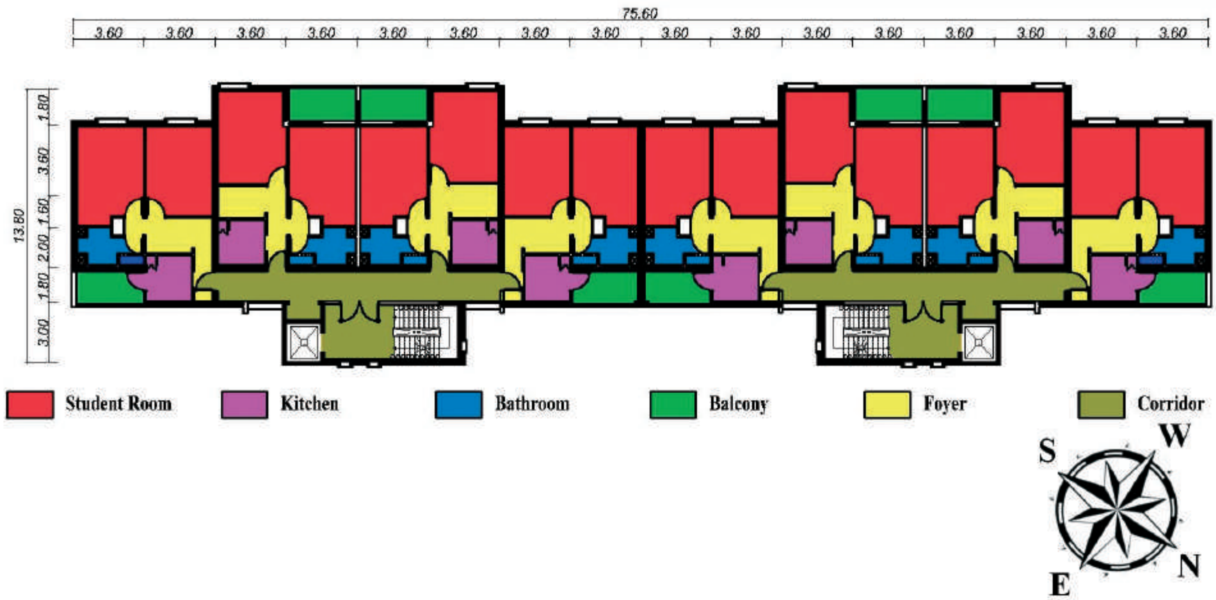

Figure 1.
Typical floor plan of the case study building (as a student housing before the conversion)

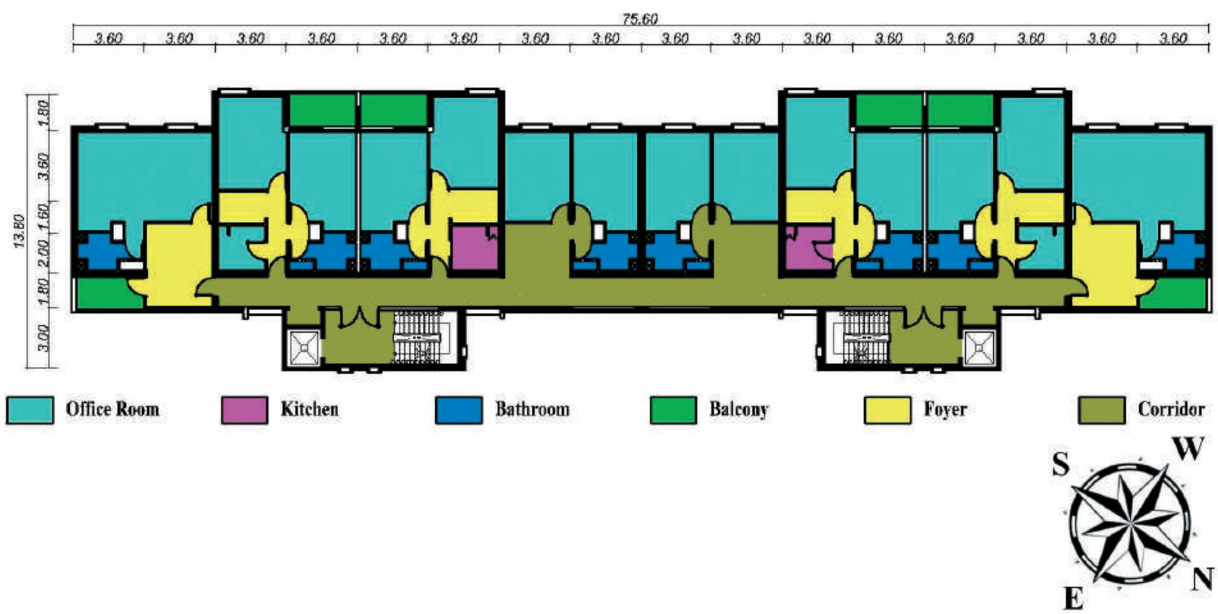

Figure 2.
Typical floor plan of the case study building (as an office building after the conversion)

5. FINDINGS AND DISCUSSION

The mean responses and the rate of users' satisfaction for the technical and functional elements of performance included in the user satisfaction survey are presented in Tables 2 and 3, and discussed as follows:

5.1. Technical Elements of Performance

- **Thermal Comfort**: The walkthrough tour indicated that the installed HAVC system was central chilled water system, with a fan coil unit type, that allow users to control the operation and temperature of these units at all occupied spaces. Further, the conducted interviews revealed that they are satisfied with the three elements of thermal comfort, due to their ability to exercise independent control over

Table 2.
Mean responses and rate of satisfaction of the technical elements of performance

Technical elements of performance		Evaluation terms				Mean response	Satisfaction rate
		SS	S	D	SD		
Thermal comfort						**3.17**	**S**
1.	Temperature inside the building	16	23	1	0	3.38	S
2.	Air movement inside the building	10	21	9	0	3.03	S
3.	Air humidity inside the building	13	19	7	1	3.10	S
Visual comfort						**3.05**	**S**
4.	Adequacy of lighting levels at the offices	19	12	9	0	3.25	S
5.	Adequacy of lighting levels at the corridors	12	21	6	1	3.10	S
6.	Adequacy of light levels at the stairs	6	18	14	2	2.70	S
7.	Control over glare at the offices	14	20	4	2	3.15	S
Acoustical comfort						**2.99**	**S**
8.	Level of noise within offices	11	20	6	3	2.98	S
9.	Sense of privacy of conversation at the offices	12	14	12	2	2.90	S
10.	Level of noise generated from office equipment	15	19	5	1	3.20	S
11.	Level of noise generated from HVAC systems	8	22	8	2	2.90	S
Indoor air quality						**2.81**	**S**
12.	Quality of air inside the offices	14	18	7	1	3.13	S
13.	Quality of air throughout the corridors	5	19	14	2	2.68	S
14.	Quality of air inside stairwells	4	17	14	5	2.50	S
15.	Overall quality of air throughout the building	7	25	7	1	2.95	S
16.	Smell of dust in the air	11	16	11	2	2.90	S
17.	Foul odors in the air	9	15	12	4	2.73	S
Fire safety						**2.65**	**S**
18.	Adequacy of fire exits	12	14	8	6	2.80	S
19.	Clarity of fire exits	8	17	8	7	2.65	S
20.	Adequacy and clarity of exit signs	4	14	15	7	2.38	D
21.	Adequacy and clarity of evacuation plans	4	8	16	12	2.10	D
22.	Adequacy and clarity of fire extinguishers	9	23	5	3	2.95	S
23.	Ease of identifying the locations of alarm bells	11	22	3	4	3.00	S
Plumbing services						**2.74**	**S**
24.	Water pressure at plumbing fixtures	8	19	6	7	2.70	S
25.	Distribution of toilets throughout the building	8	17	11	4	2.73	S
26.	Adequacy of toilets in the building	10	18	6	6	2.80	S

Note: SS = Strongly Satisfied; S = Satisfied; D = Dissatisfied; SD = Strongly Dissatisfied

the operation of the HVAC system at their workplaces. Moreover, the calculated average mean response of the three elements of performance is 3.17, which indicated that users were "satisfied" with the thermal environment in the building, as indicated in Table 2.

- **Visual Comfort**: The walkthrough tour showed that an adequate amount of natural light is admitted through the windows, to the workplace, during the work hours. However, the amount of natural and artificial lighting at the staircase tends to be inadequate. In addition, it was observed that all workplaces were provided with blinds, which enabled the users to control the amount of natural light as well as the effects of glare. Further, the conducted interviews revealed that the users are satisfied with the lighting levels at their workplaces. Moreover, the calculated average mean response of the four elements of performance is 3.05, which indicated that users were "satisfied" with visual comfort in the building, as indicated in Table 2.
- **Acoustical Comfort**: The walkthrough tour indicated that the building is located in a quiet location, away from sources of noise. In addition, the tour indicated a quiet ambient, indoor acoustical environment at the workplaces. Further, the interviews supported the findings of the walkthrough

Table 3.
Mean responses and rate of satisfaction of the functional elements of performance

Functional elements of performance		Evaluation terms				Mean response	Satisfaction rate
		SS	S	D	SD		
Interior and exterior finishes						**2.60**	**S**
1.	Quality of the building's exterior finishes	2	25	10	3	2.65	S
2.	Quality of floor finishes of offices	6	22	8	4	2.75	S
3.	Quality of wall finishes of offices	7	16	11	6	2.60	S
4.	Quality of ceiling finishes of offices	7	20	9	4	2.75	S
5.	Quality of floor finishes of corridors	2	20	14	4	2.50	S
6.	Quality of wall finishes of corridors	3	23	11	3	2.65	S
7.	Quality of ceiling finishes of corridors	3	22	10	5	2.58	S
8.	Quality of floor finishes of stairs	3	18	15	4	2.50	S
9.	Quality of finishes in toilets	2	17	17	4	2.43	D
Furniture						**3.05**	**S**
10.	Quality of desks in offices	9	19	7	5	2.80	S
11.	Quality of chairs in offices	6	17	11	6	2.58	S
12.	Adequacy of chairs provided in offices	7	20	9	4	2.75	S
13.	Quality of storage cabinets provided in offices	7	19	11	3	2.75	S
14.	Adequacy of storage cabinets provided in offices	7	23	8	2	2.88	S
Distribution and layout of offices						**2.99**	**S**
15.	Distribution of offices throughout the building	3	18	14	5	2.48	D
16.	Layout of furniture within offices and efficiency of space utilization	4	20	11	5	2.58	S
17.	Width of corridors throughout the building	6	17	15	2	2.68	S
Information technologies and power distribution						**2.81**	**S**
18.	Quality of information and telecommunication technologies in the building	9	20	5	6	2.80	S
19.	Adequacy of socket outlets in offices	11	15	11	3	2.85	S
Car parking						**2.65**	**S**
20.	Adequacy of car parking for users	26	8	5	1	3.48	S
21.	Proximity of car parking to the building	23	8	8	1	3.33	S
Other amenities						**2.18**	**D**
22.	Quality and adequacy of lounges and seating areas	3	4	16	17	1.83	D
23.	Quality and adequacy of elevators in the building	12	18	6	4	2.95	S
24.	Quality and adequacy of cafeterias and tea/coffee rooms	3	6	10	21	1.78	D

Note: SS = Strongly Satisfied; S = Satisfied; D = Dissatisfied; SD = Strongly Dissatisfied

tour. Moreover, the calculated average mean response of the four elements of performance is 2.99, which indicated that users were almost "satisfied" with the acoustical environment in the building, as indicated in Table 2.

- **Indoor Air Quality**: The walkthrough tour indicated that the indoor air quality was acceptable inside the workplaces due to the absence of foul orders and dust. Nevertheless, air freshness at the circulation areas (i.e. corridors and stairwells) was inadequate, due to lack of ventilation. Further, the interviews with the selected sample of users confirmed these observations. Yet, the calculated average mean response of the six elements of performance is 2.81, which indicated that users were almost "satisfied" with the indoor air quality in the building, as indicated in Table 2.
- **Fire Safety**: The walkthrough tour indicated that the building was not provided with exit signs and evacuation plans. In addition, the requirement of installing fire sprinkler systems, a code requirement, was not fulfilled throughout the building. On the other hand, the building was adequately provided with fire extinguishers, smoke detectors, and fire alarm systems. The interviews revealed that the building is not fully complying with fire code requirements. Moreover, the calculated average mean response of the six elements of performance is 2.65, which indicated that users were barely "satisfied" with the provision of fire safety

elements in the building, as indicated in Table 2, despite their dissatisfaction with the adequacy and clarity of exit signs, as well as the evacuation plans.

- **Plumbing Services**: The walkthrough tour indicated that due to the original layout of rooms for the previous function of the building (i.e. student housing), each two typical offices were provided with a shared toilet. Hence, there were not public toilets for the use of visitors, except those at the offices. Further, the conducted interviews revealed that users have pointed out to the surplus number of toilets in the building. Moreover, the calculated average mean response of the three elements of performance is 2.74, which indicated that users were almost "satisfied" with the provision of plumbing services in the building, as indicated in Table 2.

5.2. Functional Elements of Performance

- **Interior and Exterior Finishes**: The case study building has gone through two renovation projects that were implemented on the second and third floors only, separately. The remaining floors have not been renovated. All the toilets have been renovated, as well. The walkthrough tour indicated that due to the implementation of these separate renovation activities, there are several inconsistencies in the interior finishes used in the building. These inconsistencies emerged from the use of different floor and wall finishes. Also, the one floor did not have a suspended ceiling. Further, the conducted interviews revealed that the building's interior finish is outdated. Moreover, the calculated average mean response of the nine elements of performance is 2.60, which indicated that users were barely "satisfied" with the elements pertaining to the internal and external finishes of the building, as indicated in Table 2, despite their dissatisfaction with the quality of finishes in the toilets.
- **Furniture**: The walkthrough tour indicated various inconsistencies in the style, quality and age of the available furniture in the building. The interviews pointed out to the average quality of the furniture in the fourth floor of the building. Moreover, the calculated average mean response of the five elements of performance is 2.75, which indicated that users were almost "satisfied" with the elements pertaining to the provided furniture in the building, as indicated in Table 2.
- **Distribution and Layout of Offices**: The walkthrough tour indicated that several offices, within the same departments, were distributed in different areas within the same floors in the building. This scattered distribution of offices did not take into consideration the workflow between the correlated departments, hence, it leads to inefficiencies and lose of productive time. The conducted interviews pointed out that some departments were even distributed over two floors in the building. Moreover, the calculated average mean response of the three elements of performance is 2.58, which indicated that users were barely "satisfied" with the elements pertaining to the distributions and layout of offices, as indicated in Table 2, despite their dissatisfaction with the distribution of offices throughout the building.
- **Information Technologies and Power Distribution**: The walkthrough tour indicated the provision of modern telecommunication technologies in most offices, except the ground and fourth floors. The interviews pointed out to the need for an upgrade for telecommunication technologies in these floors. Moreover, the calculated average mean response of the four elements of performance is 2.83, which indicated that users were almost "satisfied" with the elements pertaining to information technologies and power distribution, in the case study building, as indicated in Table 2.
- **Car Parking**: The walkthrough tour indicate the adequate provision of shaded, adjacent car parking for the building users. The conducted interviews conducted confirmed the findings of the walkthrough tour. Moreover, the calculated average mean response of the two elements of performance is 3.4, which indicated that users were "satisfied" with the elements pertaining to car parking, as indicated in Table 2.
- **Other Amenities**: The walkthrough tour, in the case study building, indicated the lack of other amenities such as cafeterias and tea/coffee rooms, lounges and seating areas. The conducted interviews pointed out to the slow operation of the elevators. Moreover, the calculated average mean response of the three elements of performance is 2.18, which indicated that users were barely "satisfied" with the elements pertaining to the other amenities, as indicated in Table 2, despite their dissatisfaction with the quality and adequacy of lounges and seating areas, and quality and adequacy of cafeterias and tea/coffee rooms.

6. CONCLUSIONS AND RECOMMENDATIONS

Adaptive reuse of buildings is the practice of converting the use of an originally designed built-environment to suit a new use, which is different from the original use. This conversion process has a direct bearing on the performance of the building, and the satisfaction of the users with the conditions of the converted built-environment. This paper presents the findings of a conducted POE on a case study building that was adaptably reused, to assess the level of user satisfaction with its elements of performance. The case study building was originally designed as a student housing facility in a university campus, and converted to an office building. The present study utilized a triangulation approach in the data collection, including walkthrough tour, interviews with users, and user satisfaction survey to obtain the feedback of users on the quality of the built-environment of the adaptively reused building.

The POE findings indicated that users were generally satisfied with the identified categories of performance elements, namely: "thermal comfort", "visual comfort", "acoustical comfort", "indoor air quality", "fire safety", "plumbing services", "internal and external finishes", "furniture", "distribution and layout of offices", "information technologies and power distribution", "car parking" and "other amenities".

In conclusion, an adaptively reused building can meet the performance requirement of its new use. Careful consideration should be exercised during the design, construction, operation and maintenance phases to maintain the performance of the converted built-environment and ensure the satisfaction of its users. The study concludes with the following recommendations to improve the quality of the built-environment in the adaptively reused building:

- Adequate number of lighting fixtures should be installed in all stairs to improve the visual comfort in the stairwells.
- The distribution of offices in some locations should be reconsidered to improve the workflow of the activities in the building.
- Fire sprinkler system, evacuation plans and exit signs should be provided, as required by fire safety codes, to provide the minimum level of safety to protect the life of users who protect the property.
- The outdated furniture, finishes and communication technologies throughout the building should be upgraded to improve the level of users' satisfaction with the building, and hence their productivity in the workplace.
- Lounges and additional seating areas should be provided to enhance the users' level of satisfaction with the building.

This paper provides a methodical approach to assess the quality and performance of the technical and functional elements of performance in adaptively reused buildings. It serves to guide design professionals involved in the planning and design of adaptive reuse projects, and facilities managers in charge of the daily operations of adaptively reused buildings.

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