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Latin Hypercube Sampling for Stochastic Evaluation of Post Occupancy in Prep-Year Building

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Abstract The purpose of this paper is to provide a picture of the post-occupancy evaluations findings of the major functional elements of performance on Prep-Year Building at the campus of King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia. The paper analyses published literature to review knowledge areas pertaining to functional performance requirement elements in Prep-Year Building. Students' feedback was obtained by distributing a user satisfaction survey with the 48 identified performance elements. Latin hypercube sampling is employed to evaluate the post occupancy stochastically in order to circumvent the uncertainties associated with experts' judgments. The findings of the survey were analyzed and reported to describe the degree of satisfaction with the identified performance elements. The paper examined the extent to which various success factors in the Prep-Year Building had been realized. A post-occupancy evaluation can provide valuable feedback to planners, design professionals, housing administrators and facility managers involved in the planning, design and operation of student housing facilities. Post-occupancy evaluation can assist in continually improving the quality and performance of the student housing facilities they design, construct, operate and maintain.

Keywords Post-occupancy; prep-year building; functional performance; Latin hypercube sampling; performance elements; student

Introduction

As we know higher education around the world is very important and the governments are focusing to improve this system to help students attain intellectual competence. They always concern about academic buildings and how these buildings work, so they have to make evaluation of these building. Post-occupancy evaluations of buildings ask questions and provide answers on how buildings actually work in technical, social and management terms for the end-users. They can have a significant impact on creating change in terms of improving use of any building in two ways: Firstly, by providing lessons and feedback for the architect and the construction industry. They can lead to improved building design and improved procurement and can influence and change the roles of professionals involved in a building project so that flaws in design or construction-related mistakes are not repeated. Secondly, by empowering end-users as post-occupancy evaluation provides benchmarks and a pool of research on architecture and buildings to show how the end product (the building design and its management) meets the needs of its clients. Several previous models were developed to evaluate

post occupancy of students. Hassanain *et al*. [1] introduced a systematic approach for the purpose of evaluating technical and performance requirements of existing cafeterias and restaurant facilities. They suggested that the developed approach provides a beneficial and practical alternative that can help planners, design professionals and building services' engineers.

Adewunmi *et al*. [2] proposed an investigative approach to post occupancy evaluation based on major technical and performance requirements of postgraduate hostel. The user satisfaction was determined according to 29 performance criteria adopted from the literature review and personal interviews. Philip *et al*. [3] introduced a model for post occupancy evaluation of students' hostel facilities in Federal universities in Nigeria. It was found that non-availability of recreational spaces, over-crowding, inadequate spaces and over-crowding constitute the main challenges in hostels. Najib [4] presented a residential satisfaction framework for post occupancy evaluation in student housing facilities. It was inferred that the mean satisfaction level is 2.61 which implies that students were satisfied with the housing facility.

Oladiran *et al*. [5] studied students' hostel accommodation and their users' satisfaction to highlight the main problems in managing the hostels. In the conducted study, eleven hostels were used and it was concluded that encompassed bathrooms, kitchen and reading rooms. Moreover, there was sparse availability of laundry, pantry and meeting room. Agyekum *et al*. [6] evaluated the students' satisfaction level with regards to some facilities and services in university campus. Results demonstrated that the students were satisfied with the provided services with a mean aggregate relative satisfaction index of 68.05. Hamid and Hassanain [7] evaluated the post occupancy of adaptively reused buildings. The data was collected using walkthrough tours, discussions and interviews. They pinpointed that the developed methodological approach could aid in helping design professionals and facility managers involved in the daily operations of adaptively reused buildings.

Research Methodology

Performance requirements of student housing facilities

This paper focuses on one performance requirement category in academic building facilities. This category is the functional elements of a building that support the activities within it, and they must be responsive to the specific needs of the organization and occupants, both quantitatively and qualitatively.

Contextual Environment

Prep-Year building should be located in a careful placement within the campus context. It should have the right relationship with immediate surroundings such as student housing, and the university main student restaurant. Buildings may give form to the exterior space, they may frame an exterior space, or they may create circulation patterns for exterior space. Overall, the following concepts should be found in the site of the building [8]:

1- Sequence of Spaces: There should be a sequence in spaces which create a sense of continuity between them. Major spaces are enhanced by the sequence of moving through secondary spaces, where there is a play of expansion and contraction, of light and shade.

2- Continuity: Continuity can make buildings still cohesive.

Car Parking

The availability of sufficient car parking is essential in any building. Vehicle circulation within car parking spaces should achieve many conditions. Entrances and exits must be away from the intersections of streets to avoid conflict with normal traffic in the streets. The width of the entrances or exists is at least 3.5 m. The dimensions of one car parking are about 5.5 m long and 2.5 m width.

Accessibility to the Building

Careful consideration must be given to laying out walks and drives and to the materials of the paths themselves. It can be argued that, while the grand spaces may be the most beautiful aspect of the campus plan, the connections or paths of travel are what provide the sense of campus. The connections provide the views and the experience of coming upon or into the buildings.

Circulation paths fall into several different categories, depending on use:

Vehicular Circulation

There are three levels of Vehicular Circulation:

1- Primary paths:

Characterized by full-width travel lanes and raised sidewalks. It is usually paved with asphalt, with granite or Belgium block curbs, and concrete sidewalks.

2- Secondary paths:

These are typically pathways that serve both vehicular and pedestrian traffic, characterized by an asphalt center section, with additional width to either side. They must provide an eighteen foot wide lane.

3-Tertiary paths:

These are primarily pedestrian paths that can be used occasionally by service vehicles. Minimum width for tertiary paths is four feet.

There are two levels of Pedestrian Circulation:

1- Primary paths:

Which lead from the main campus walks into buildings. These paths are constructed of durable materials such as stone, concrete pavers, or brick. They are typically five to six feet wide.

2- Secondary paths:

Secondary walks are really paths that lead to secondary entrances in buildings, or crisscross a green area. The material may be permanent in nature, such as bluestone, less permanent such as concrete or asphalt, or may be renewable, such as compacted stone dust, or wood chips. Minimum width for tertiary paths is four feet.

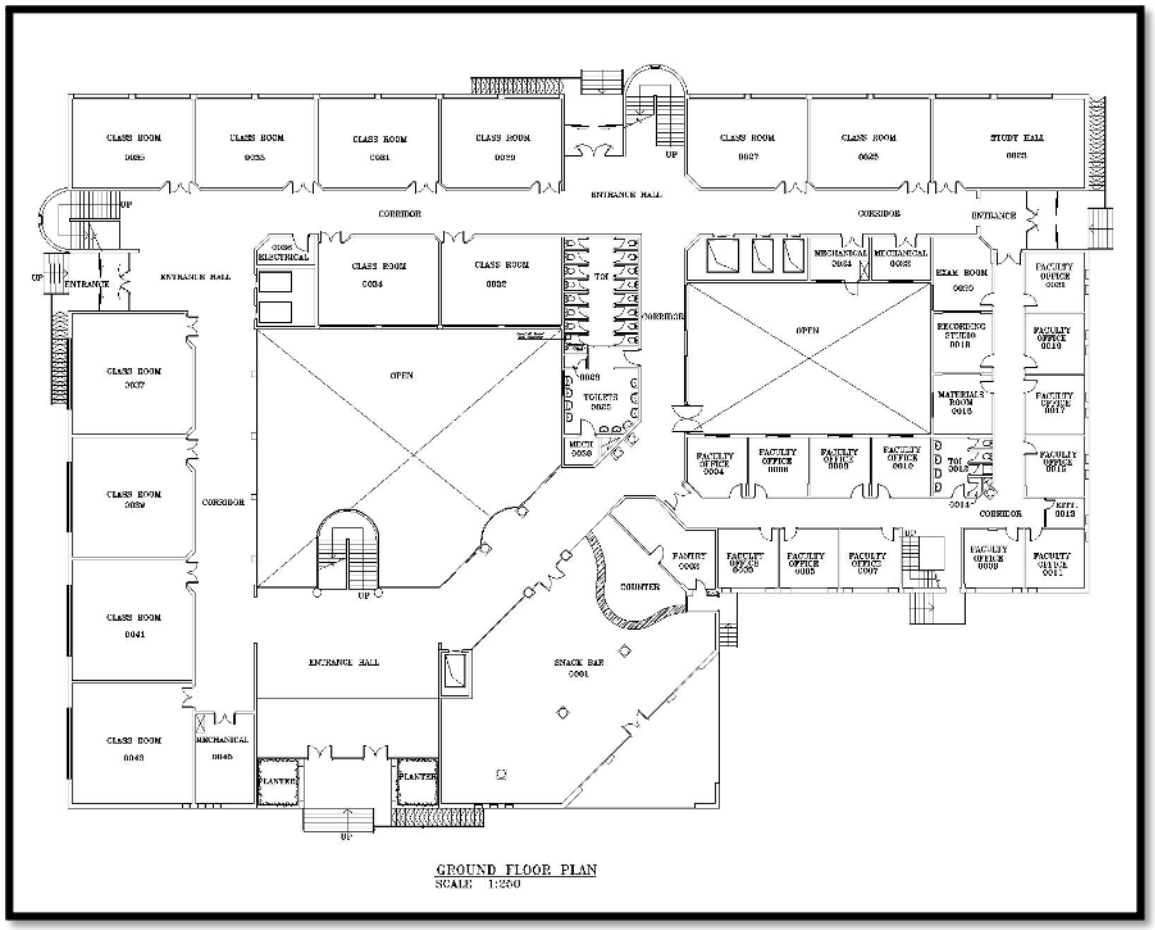

Figure 1: Ground floor plan for Prep-Year Building

Circulation

The interior layout of the building should be efficient in terms of the arrangement of rooms in each level in the building, the width of the corridors for circulation inside the building, and the location and number of stairs in

the building. The layout also should promote social interaction among the student population living in the building. Visitors should be able to easily locate rooms in the building.

Fire safety

This factor is essential because it is the main causes of life and property loss in building. There are many fundamentals of fire safety such as occupants can be evacuated quickly, so the building must remain intact throughout the fire. New building code regulation should contain all new fire issue and should provide high quality of control and restricted of use combustible structural elements, insulation and finishes.

Space Adequacy and Quality

Classroom types:

These are standard classroom types. Design details may vary to accommodate the latest best practices for teaching, with approval from Campus and Facilities Planning. There are many types of class room such as seminar room which designed for up to 22 students and size the room allowing 25 sq ft per seat, small classroom that Designed for up to 50 students and size the room allowing 25 sq ft per seat. (Where use of tablet arm chairs has been authorized by Campus and Facilities Planning, allow 18 sq ft per seat.). Large classroom are designed for 51-99 students and size the room is 20 sq ft per seat and lecture hall/auditorium which allows for 100+ students and Size the room is12 sq ft per seat [9].

All seats must be located within a 90 degree viewing angle from the center of the projection screen. That is, within 45 degree horizontal angles from the perpendicular to the center of screens. Classrooms should be narrow enough to permit all seats to be within the 90 degree viewing angle from the front wall, but no narrower. Rooms that are too narrow and deep make it hard for students and instructors to interact

Student cafeteria:

There are many fundamentals that should be consecrated when design the cafeteria such as bottlenecks in student traffic can occur if counters are not of sufficient size if there are too few cashiers or if there are not ample seats, the scramble system is most successful in universities cafeteria where people eat regularly. Smaller tables will use more space ,but will encourage more quiet conversation , a counter (35 ft) is required for every 150 to 200 seats and One to two cashiers per counter is recommended [9].

Also space layout and furniture quality should be considered, Space layout can be defined as "The process of establishing, sizing, and locating the appropriate production and support activities within a new or existing structure" [10]. This category deals with the arrangement of furniture.

Support Services:

There are many consecrations that should be taken when design the washroom. According to the International Plumbing Code [11], the code requires the provision of one toilet for every 125 males and 65 females. Furthermore, the location of the toilets should be known and it should be located near the main activates.

Teacher's Offices:

There are many fundamentals that should be consecrated when design Teacher's Offices such as there should be enough space for storage in the room, space for accommodating visitors , space formal meeting space and space of faculty lounge.

Performance assessment of sustainable Prep-Year Building facilities

Building description

The building selected for carrying out the performance assessment is referred to as "Prep-Year Building 858". The building is located in the northern west part of campus KFUPM, Dhahran, Saudi Arabia. It is about 2745 sq.m. The building consists of four floors with four stairs, three for students and one for teachers and six elevators. It has four students' entrance and one teacher's entrance. Each floor has 16 toilets for students and 3 for teachers. The ground floor consists of 15 faculty offices, 12 class rooms, Sitting hall, 3 mechanical rooms, snack bar, and electrical room. The first floor consists of management department which contains: director

room, meeting room, research room, waiting and security, 19 faculty offices, 19 faculty offices, service room, personal office and Big sitting hall. The second floor consists of 13 class rooms, 19 faculty offices, big lecture hall, clerk office, data process office, assistant dean, 2 meeting rooms, security and tea room. The third floor consists of 7 class rooms, 19 faculty offices, 6 labs, library, dean office, meeting room and tutorial. Figure 1 illustrates the typical floor plan of building 805.

Data Collection Methods

The two complementary data collection methods for the assessment included:

1. Walk-through evaluation: to identify the major problematic areas that require attention. This method is subjective, and is based on personal experience with this particular type of facility. The walk-through was conducted in the first, third and fourth floors due to ease of access to all areas in these floors. The walk-through tour was conducted for the purpose of evaluating and documenting deficiencies in performance.
2. User satisfaction survey: to subjectively assess the users' perception of functional elements of performance. These functional elements included in eight area that are Contextual Environment, car Parking, accessibility to the building, circulation, fire safety, support services, space adequacy and quality for teacher's offices.

The developed questionnaire was administered to the student population residing in Prep-year building 858. 50 responses to the questionnaire survey were obtained. The respondents to the questionnaire survey were asked to mark in their degree of satisfaction (how do they feel) with the listed elements of performance, through selecting one of four evaluation terms provided. The questionnaire survey included an identified 40 elements of performance. These elements were classified under ten performance categories, including thermal comfort, acoustical comfort, visual comfort, indoor air quality, fire safety, interior and exterior finish systems, room layout and furniture quality, support services, efficiency of circulation and proximity to other facilities on campus. The evaluation terms used, along with their corresponding weight, were "Strongly Satisfied" with 4 points, "Satisfied" with 3 points, "Dissatisfied" with 2 points, and "Strongly Dissatisfied" with 1 point. The mean response for each element of performance was calculated as follows:

Step 1*:* The number of responses for each evaluation term will be multiplied by the corresponding weight of that evaluation term.

Step 2*:* The sum of the products of multiplication from Step 1 will be divided by the number of persons responding to the questionnaire survey.

To be able to quantify the degree of satisfaction for each element of performance, the authors have adopted the following calibration:

- If the mean response is below 1.49, then the respondents are "Strongly Dissatisfied".
- If the mean response is between 1.50 and 2.49, then the respondents are "Dissatisfied".
- If the mean response is between 2.50 and 3.49, then the respondents are "Satisfied".
- If the satisfaction index is above 3.50, the respondents are "Strongly Satisfied".

The residents' rates of satisfaction with each of the identified 40 elements of functional performance requirements are included in Tables from 1 to 4. A summary of the mean responses for the functional performance requirements and the associated rates of satisfaction are documented in Table 5 which describes the residents' rates of satisfaction for each of functional performance categories are discussed as follows.

Assessment of the Performance Requirements

The residents' rates of satisfaction for the eight performance requirements are discussed here in as follows:

Contextual Environment

This performance category included four performance elements, proximity of the Prep-year building to student housing, proximity to other academic and sports facilities on campus, Proximity to the main student restaurant and Proximity to the mosque. The mean response from the 10 teachers and 40 students who completed the user satisfaction survey indicated that they were either "Satisfied" or "Dissatisfied" with the listed performance elements as indicated in Table 1, with an average satisfaction rate of 2.56 for this category as illustrated in Table 5.

Car Parking

There were five performance elements in this category. These are proximity of the building to car parking spaces, sufficiency of car parking spaces and sufficiency of car parking spaces. The mean response indicated that the sample user were "Dissatisfied" with two out of the three performance elements listed as shown in Table 1, with an average dissatisfaction rate of 2.42 for this category as illustrated in Table 5.

Accessibility to the Building

Six performance measures were included in this category. These measures are Adequacy of paths linking the building to student housing, Adequacy of paths linking the building to the main student restaurant, Width of corridors for circulation inside the building, Ease by which visitors can locate rooms in the building, Distribution and capacity of staircases to facilitate vertical circulation, Distribution and capacity of elevators to facilitate vertical circulation and Proximity of classrooms to laboratories. The mean response indicated that the surveyed teachers and students were "Dissatisfied" with the four measures listed in this category as presented in Table 1, with an average satisfaction rate of 2.45 for this performance categories as illustrated in Table 5.

Circulation

There were five performance elements in this category. These are Adequacy of the main foyer to accommodate social activities, Adequacy of the corridors to accommodate social interactions, width of corridors for circulation inside the building, ease by which visitors can locate rooms in the building, distribution and capacity of staircases to facilitate vertical circulation, distribution and capacity of elevators to facilitate vertical circulation and Proximity of classrooms to laboratories. The mean response indicated that the surveyed teachers and students were "Dissatisfied" with the five measures listed in this category as presented in Table 2, with an average satisfaction rate of 2.50 for this performance categories as illustrated in Table 5.

Table 1: Performance requirements along with their mean responses and rate of satisfaction for Prep-Year Building

Elements of Performance	**Evaluation Terms**				**Mean**	**Rate of Satisfaction**
1. Contextual Environment	**SS**	**S**	**D**	**SD**		
01. Proximity of the Prep-year building to student housing.	5	28	10	7	2.62	S
02. Proximity to other academic and sports facilities on campus.	5	15	23	7	2.36	D
03. Proximity to the main student restaurant.	4	19	19	8	2.38	D
04. Proximity to the mosque.	15	17	15	3	2.88	S
2. Car Parking						
05. Proximity of the building to car parking spaces.	7	21	15	7	2.56	S
06. Sufficiency of car parking spaces.	3	23	19	5	2.48	D
07. Vehicle circulation within car parking spaces.	3	16	21	10	2.24	D
3. Accessibility to the Building						
08. Adequacy of paths linking the building to student housing.	2	23	22	4	2.5	S
09. Adequacy of paths linking the building to the main student restaurant.	4	14	29	2	2.36	D
10. Adequacy of paths linking the building to the mosque.	4	16	26	4	2.4	D
11. Adequacy of paths linking the building to the car parking spaces.	3	21	20	6	2.48	D
12. Ease of identifying and reaching the building's main entrance.	6	20	22	2	2.6	S
13. Distribution and adequacy of other entrances to the building.	6	17	22	4	2.46	D

Table 2: Performance requirements along with their mean responses and rate of satisfaction for Prep-Year Building (Continued)

	Elements of Performance	Evaluation Terms				Mean	Rate of Satisfaction
1.	**Circulation**	**SS**	**S**	**D**	**SD**		
14.	Adequacy of the main foyer to accommodate social activities.	4	20	20	6	2.44	D
15.	Adequacy of the corridors to accommodate social interactions.	3	24	15	8	2.44	D
16.	Width of corridors for circulation inside the building.	5	26	17	2	2.68	S
17.	Ease by which visitors can locate rooms in the building.	8	21	16	4	2.62	S
18.	Distribution and capacity of staircases to facilitate vertical circulation.	3	22	19	6	2.44	D
19.	Distribution and capacity of elevators to facilitate vertical circulation.	5	16	22	7	2.38	D
20.	Proximity of classrooms to laboratories.	4	22	14	10	2.4	D
2.	**Safety**						
21.	Ease to identify emergency exits to occupants and visitors.	8	16	14	12	2.4	D
22.	Ease of existing the building in case of fire emergencies.	4	19	18	10	2.38	D
23.	Ease to identify and reach fire alarm system.	4	18	21	7	2.38	D
24.	Adequacy of fire safety systems in the building (fire extinguishers, smoke detectors, etc).	7	15	18	10	2.38	D

Table 3: Performance requirements along with their mean responses and rate of satisfaction for Prep-Year Building (Continued)

	Elements of Performance	Evaluation Terms				Mean	Rate of Satisfaction
1.	**Space Adequacy and Quality**	**SS**	**S**	**D**	**SD**		
25.	Adequacy of classrooms to accommodate various learning and teaching methods (lectures, group discussion and team work).	11	21	12	6	2.74	S
26.	Capacity of study halls.	2	16	24	8	2.24	D
27.	Distribution of study halls throughout the building.	2	14	23	10	2.12	D
28.	Adequacy and capacity of computer laboratories.	2	11	22	15	2	D
29.	Adequacy of student cafeteria to accommodate large number of students.	1	7	19	21	1.68	D
30.	Suitability of interior outdoor courtyards for informal gatherings.	4	19	19	8	2.38	D
2.	**Support Services**						
31.	Distribution of washroom facilities throughout the building.	11	27	8	4	2..9	S
32.	Adequacy of washroom facilities for users.	6	22	19	3	2.62	S
33.	Cleanliness and house-keeping level throughout the building.	4	17	23	6	2.38	D
34.	Distribution of water fountains throughout the building.	2	26	16	5	2.46	D
35.	Quality of drinking water.	2	14	20	14	2.08	D

Table 4: Performance requirements along with their mean responses and rate of satisfaction for Teacher's Offices

Elements of Performance	Evaluation Terms				Mean	Rate of Satisfaction
1. Space adequacy and quality for teacher's offices	**SS**	**S**	**D**	**SD**		
1. Adequacy and capacity of the office.	0	2	5	3	1.9	D
2. Adequacy of storage space in the room.	0	2	5	3	1.9	D
3. Adequacy of office for accommodating visitors.	0	1	6	3	1.8	D
4. Adequacy of formal meeting space.	0	1	7	2	1.9	D
5. Adequacy of faculty lounge space.	0	0	5	5	1.5	D

Safety

This performance category included four performance elements, ease to identify emergency exits to occupants and visitors, ease of existing the building in case of fire emergencies, ease to identify and reach fire alarm system and adequacy of fire safety systems in the building (fire extinguishers, smoke detectors, etc). The mean response from the student residents and teachers who completed the user satisfaction survey indicated that they were dissatisfied with the listed performance elements as indicated in Table 2 with an average satisfaction rate of 2.38 for this category as illustrated in Table 5.

Space Adequacy and Quality

There were six performance elements in this category. These are adequacy of classrooms to accommodate various learning and teaching methods (lectures, group discussion and team work), capacity of study halls, distribution of study halls throughout the building, adequacy and capacity of computer laboratories, adequacy of student cafeteria to accommodate large number of students and suitability of interior outdoor courtyards for informal gatherings. The mean response from the student residents and teachers who completed the survey indicated that they were "Dissatisfied" with five out of the six performance elements listed as shown in Table 3, with an average satisfaction rate of 2.19 for this category as illustrated in Table 5.

Support Services

Five performance elements were identified and assessed in this category. These are distribution of washroom facilities throughout the building, adequacy of washroom facilities for users, cleanliness and house-keeping level throughout the building, distribution of water fountains throughout the building and quality of drinking water. The mean response indicated that the sample student residents were "Dissatisfied" with three out of the five performance elements listed as shown in Table 3, with an average satisfaction rate of 2.32 for this category as illustrated in Table 5.

Space Adequacy and Quality for Teacher's Offices

Five performance measures were included in this category. These measures are the adequacy and capacity of the office, adequacy of storage space in the room, adequacy of office for accommodating visitors, adequacy of formal meeting space and the adequacy of faculty lounge space. The mean response from the 10 teachers who completed the user satisfaction survey indicated that they were "Dissatisfied" with the listed performance elements as indicated in Table 4, with an average satisfaction rate of 1.8 for this category as illustrated in Table 5.

Latin hypercube sampling is adopted to address the uncertainties associated with the feedback of the respondents. Latin hypercube sampling proved its efficiency in dealing with diverse problems such as modeling uncertainties encountered during bridge inspection process [12] and during data capturing, transmission and processing [13]. Latin hypercube is a stratified sampling algorithm that provides better exploration and coverage of the input variables. It is selected over Monte Carlo simulation since it is able to provide faster convergence within less number of iterations and sampling error in addition to its time efficiency [14-15]. It is used to construct the probability distribution of the stratification of respondents which converged to normal distribution

in the present case study (see Figure 2). The mean of the responses is used to reflect the feedback of the respondents and it was found to be equal to 2.38 which imply that the surveyed teachers and students were "Dissatisfied".

Table 5: Summary of the mean responses for the technical and functional performance requirements and their associated rate of satisfaction for Prep-Year Building

	Elements of Performance	Mean	Rate of Satisfaction
1.	Contextual Environment	2.56	S
2.	Car Parking	2.42	D
3.	Accessibility to the Building	2.45	D
4	Circulation	2..50	S
5	Safety	2.83	D
6	Space Adequacy and Quality	2.19	D
7.	Support Services	2.32	D
8.	Space Adequacy and Quality for Teacher's Offices	1.8	D
	Overall average	2.32	D

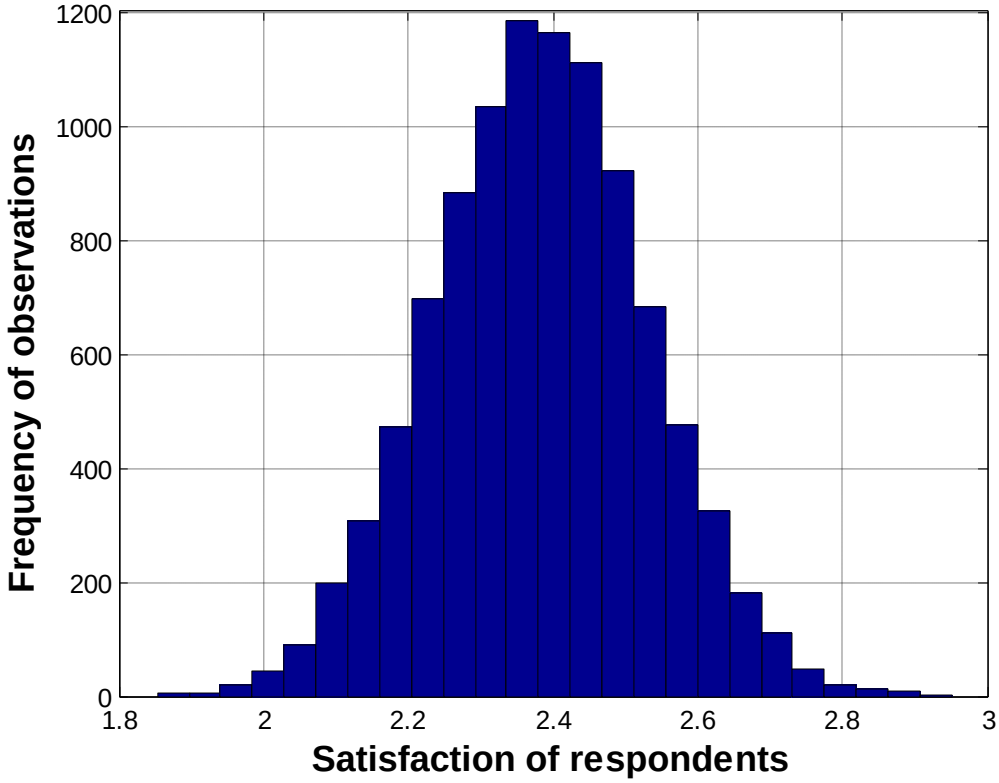

Figure 2: Normal distribution of satisfaction of respondents

Findings of the Assessment

Proximity to other academic and sports facilities on campus

The Prep-Year building is located in the far north-west of the campus faraway from all academic buildings and sports facilities. It is not possible to reach the Prep-Year building from any academic building within a few minutes of walking. Staff and student are strongly dissatisfied with Proximity of Prep-Year building to other academic and sports facilities (2.36 satisfaction mean).

Vehicle circulation within car parking spaces

Vehicle circulation within car parking spaces is complex and contains many problems. There is no separation between the movement of pedestrians and vehicular traffic while traveling or leaving the parking. Therefore, many of the problems occur during the end of the day when the students went outside the building. Entrances and exits of parking are unresolved. Those were some of the reasons that brought the satisfaction level with these elements down (2.24 satisfaction mean).

Adequacy of paths linking the building to the mosque

There are no sufficient paths for movement between the building and the mosque. Furthermore, the area between the building and the mosque are unprepared well. Therefore, many of problems occurred during the pray time. Users of the Prep-Year building are quite satisfied with the number and location of the workstations (2.4 satisfaction mean).

Distribution and capacity of elevators to facilitate vertical circulation

Prep-Year building has six elevators distributed all over it. Elevators are new with adequate capacity and speed. Users are quite dissatisfied with distribution of elevators to facilitate. There are no elevators opposite the main entrance some of the elevators are hidden. Those were some of the reasons that brought the satisfaction level with these elements down (2.38 satisfaction mean).

Ease to identify emergency exits to occupants and visitors

During the work through inside the building, there was no marks to show the occupants and visitors the emergency exits, so identify emergency exits to occupants and visitors was so difficult. Also, it is difficult to identify and reach fire alarm system. Those were some of the reasons that brought the satisfaction level with these elements down (2.40 satisfaction mean).

Distribution of study halls throughout the building

Students and teachers are almost dissatisfied with the distribution of study halls throughout the building (2.12 satisfaction mean). This because the building has four floors and there is only one study hall in the second floor.

Adequacy and distribution of washroom facilities throughout the building

Each floor has 16 toilets and 10 sinks for students and 3 toilets and 4 sinks for teachers. The number of toilets is acceptable according to the International Plumbing Code (International Code Council, 2003). The code requires the provision of one toilet for every 125 males and 65 females. Furthermore, adequacy and distribution of washroom facilities throughout the building is considered satisfactory by the users 2.9 and 2.62 satisfaction mean.

Adequacy of student cafeteria

Teachers and students are almost dissatisfied with the adequacy of student cafeteria, because it is too small to accommodate large number of students. Further the near courtyard is not prepared well for eating and setting. As result of that It is found that one of the worst elements when measuring the users' satisfaction was adequacy of student cafeteria (1.6 satisfaction mean).

Adequacy and capacity of teacher's offices

Teachers are almost dissatisfied with the adequacy and capacity of the office. Because this year they put two teachers in one office to accommodate large number of teachers that they need since the number of students was increased. As result of that there is no enough space for storage in the room and there is no enough space for accommodating visitors. Those were some of the reasons that brought the satisfaction level with these elements down (2.9 satisfaction mean).

Conclusions and Recommendations

An indicative assessment of the major performance requirements was carried out on the Prep-Year building of King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia. The study has determined the values of the satisfaction indices obtained for the 40 elements of performance, and identified the. Below are some recommendations that have the potential to improve the performance of the Prep-Year building.

- Prep-Year building should be located in an appropriate and closer location due to student and teachers housing and the university main restaurant.
- Vehicle circulation within car parking spaces needs to be organized. The cars entrances and exits should be separated from walking paths and pedestrians.
- There should be enough paths linking the building to student housing, the main student restaurant, the mosque and the car parking spaces.
- Entrances of the building should be visible, unique and easy-discrimination.
- New exit signs, should be installed on all floors so that visitors can locate rooms in the building.
- Elevators and staircases need to be distributed properly to facilitate vertical circulation.
- Improving the utilization of space inside the courtyard to be prepared it well for eating and setting to accommodate a large number of students that will help to reduce the presser in the cafeteria.
- Student cafeteria need to be re-designed, it should be more spaces to accommodate a large number of student.
- New exit signs, that are continuously illuminated, should be installed on all floors leading to the emergency exits.
- Safety systems need to be re-evaluated and exit doors need to be clearly identified.

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