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Efficiency Evaluation Model for Higher Education Learning Space

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Abstract: Learning spaces is main physical resource for public Higher Education Institution (HEI) in Malaysia. Spaces in universities are belongs to universities and managed universities' staffs, usually by a designated department. The university is responsible for the space used by the campus community including stakeholders. However, the importance of a study on this university physical resources is not yet realized by some organizations. Learning space management is one of the most important aspect in physical resources management in public universities. Space management is important not only in terms of optimizations but also related to the cost of building maintenance.The cost implications associated with the physical resources to the universities is high. Thus, it is important to determine the level of space utilization in HEIs. The level of space utilization can be determine by two main factors which is space frequency and space occupancy. Hence, this paper provides a formulation to be used in determining the efficiency of learning spaces utilization in public universities.This model can contribute to providing a more comfortable learning space as well as to save operating costs. Besides, it also can trigger ideas for generating income to the university by leasing some extra spaces to outsiders.

Key words: Space audit, space monitoring, classroom, space frequency, space occupancy

INTRODUCTION

There are 89 public Higher Education Institution (HEIs) in Malaysia comprise of universities, polytechnics and community colleges. The total asset value of Malaysia's public HEIs is estimated to reach tens of billion and the estimated annual operating cost over RM2 billion. Among the assets, learning spaces are the main physical resource and its provision is costly. The cost related to space management in HEIs is about 20% of institutional operation cost. Therefore, learning spaces needs to be managed efficiently to assist the government in managing optimum and effective expenses. This initiative is important in order to assist the implementation and to achieve the objectives of the university in accordance with the Government Asset Management Policy (GAMP). Besides, an effective learning spaces can meet society and stakeholders demands on the function of HEIs as the centre of knowledge and a catalyst for national economic development.

Physical environment had great impacts on human lives. It affect human interaction, how students learned, how students making a decision where to register and how knowledge develop (Crawford and Duggan, 2008).

Spaces not only affect individuals but how the use of space also can portray institution's goals and priority (Hargreaves and Fink, 2004), symbolizes the values of the institution and change the institutional culture (Crawford and Duggan, 2008). Hence, this study aims to develop a model for efficiency evaluation of HEI's learning spaces. The evaluation model was developed based on the frequency index and occupancy index of the space.

MATERIALS AND METHODS

The importance of spaces audit and monitoring management: There are various issues that are frequently raised in the management of spaces in public universities because it has sorts of faculties. Space management is one of the important components in the facility management and it is important in ensuring the success of the organization in achieving its goals and objectives. The main objective of space management is to achieve efficient and effective use of spaces, furniture's and equipment either at the moment and the future. Spaces allocation refers to the allocation of scarce resources

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and also involve decision-making regarding the implementation of the programs and priorities of spaces' function.

Space should be manage to optimize the usage and to minimized maintenance operation cost (Shah *et al*., 2014). Well-managed spaces will reduce negative impact on government, especially learning spaces in public HEIs. Many institutions claim that they have a lack of learning space (Wahab, 2005). Earlier in 1992, Warmer and Leonard pointed that many HEIs failed to optimize the use of physical resources at particular times. For example, the spaces have lower consumption during the learning session, unused in the evenings, nights, holidays and semester breaks. However, some institutions became to realize that learning spaces can generate income and they have rent the spaces for example lecture hall, tutor room or any other spaces to outsiders during the breaks. This spaces can be used by outsiders for research, teaching and coaching and a medium for social interaction. Even more, sport facilities (also be recognized as one of the learning spaces) can generate income when leased to outsiders for any program such as tournament, family day, carnival and other related events. Thus, space management should be one of the strategy in asset management of an institution.

There are various issue raised related to space management such as imbalance between the use of space in between faculties. In some cases, there are faculties that had to use the classroom beyond office hours and some of them only for half-day. This situation occurs due to the increased number of students in a course that is not balanced. The increment of students will certainly increase the use of spaces. Consequently, it will contribute to unnecessary waste of space and would increase other costs such as electricity, maintenance, management, cleaning and other costs if it not well-managed. Space utilization is directly proportional to operation and maintenance cost (William and Quarterman, 1994).

There are three main factors identified by Rahman *et al*. (2015) that affect space utilization rate. The factors are people, place and process. Place can be categorized as a space factor that can be affected by condition, equipment, capacity and location. Thus, space should be managed efficiently and carefully because there are many sub-factors that may affect the utilization rate. For example, the equipment provided in each space should meet the requirement of activities. Besides, the equipment also need its own space without taking into account the vastness of space that are intended for humans. Limited space capacity, non-flexible space and limited equipment would limit the usage of space (Rahman *et al*., 2015).

Issues that identified through this research will facilitate universities to design their short and long term strategic plan in term of physical planning. Space management needs to be implemented more effectively so that the development expenses distribution can be implemented based on future needs, taking into account the actual use of the existing space. Space Inspection/ Audit should refer to:

- Building Facilities Management System Module (BFMS, mySPATA)
- Defects complain report
- Space inspection/audit report, BPA, POE, BCA and others
- Space occupancy and frequency analysis data; and
- Public Higher Education Institution Space Uses Auditing Model Development Documents

Space utilization rate can be determine based on space frequency rate and space occupancy rate (Sharp, 2009). Space usage frequency rate is the percentage of the total hours of room usage in a week compared to the actual number of hours that could be offered (Rahman *et al*., 2015). They listed several factors such as management factors, user factors and space factors that may affect the frequency rate. Meanwhile, space occupancy rate is the percentage of the capacity of actual occupant compare to maximum capacity of occupant in particular space. The occupancy rate also affected by as management factors, user factors and space factors (Rahman *et al*., 2015).

RESULTS AND DISCUSSION

Space evaluation formulation model: The formulation model developed to measure the efficiency of teaching and learning space utilization in public universities. It is intended to assess the function of the space used in an academic institution. The formula has been developed based on the data collected in three public universities. Thus, the rate focused on the frequency of space utilization and space occupancy in teaching and learning spaces. Table 1 shows the space frequency index based on percentage rate. The frequency of space utilization measurement is based on total utilization hours. There are 2 steps to calculate the frequency:

- Determine utilization hours of each space
- Determine the maximum number of allocated hours

Space frequency based on total sapce utilization time compare to maximum allocated time:

Table 1: Space frequency percentage rate (frequency index)

Levels	Range	Interpretation	Percentage (%)	Description (frequency)
1	0-1	Very low	0-30	Space utilization at very low level
2	1-2	Low	31-59	Space utilization at low level
3	2-3	Medium	60-75	Space utilization at semi-optimum level
4	3-4	High	76-100	Space utilization at optimum level
5	4-5	Very high	101 and above	Space utilization at critical level because have been used more than allocated time

Table 2: Percentage rate of space occupancy (occupancy index)

Levels	Range	Interpretation	Percentage (%)	Description (frequency)
1	0-1	Very low	0-30	Space occupancy at very low level
2	1-2	Low	31-59	Space occupancy at low level
3	2-3	Medium	60-75	Space occupancy at semi-optimum level
4	3-4	High	76-100	Space occupancy at optimum level
5	4-5	Dense	101 and above	Space occupancy at dense level because the occupant are more than maximum capacity

$$= \frac{\text{Total utilization time}}{\text{Total allocatd time}} \times 100$$

For example:

$$\frac{100\text{ h}}{160\text{h}} \times 100 = 62.5\%$$

(level 3-medium utilization)

Table 2 shows the occupancy index based on percentage rate. Occupancy is the measurement of space occupy based on capacity. There are 2 steps to calculate space occupancy rate:

- Determine the number of occupant in each space. For common spaces such as meeting room, this information can be obtained through reservation records. For office space, information can be obtained by staff attendance records
- Determine the maximum capacity of space

Space occuoancy based on total occupant compare to maximum capacity:

$$= \frac{\text{Total occupant}}{\text{Maximum capcity}} \times 100$$

Example of space occupancy index calculation for a meeting room:

- Current occupant = 25 person
- Maximum occupant = 40 person
- Hours = 40 h/week = 160 h/month

$$= \frac{25\text{ person} \times 160\text{ h}}{25\text{ person} \times 160\text{h}} \times 100 = 62.6\%$$

(level 3-medium utilization)

Table 3: Space utilization index (utilization rate) space utilization matrix

	Occupancy				
Index (frequency)	5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Table 4: Space utilization index (utilization rate) space utilization matrix

	Occupancy				
Index (frequency)	5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Space utilization index: Space utilization index can be determine by using the matrix that based on frequency index and occupancy index. Table 3 shows space utilization index. From the matrix, space utilization score can be determine by multiplying frequency and occupancy rate to obtained score from 1-25. From the score obtained by using the matrix, space utilization index can be categorized into 5 level such as very low, low, medium, high and dense. Table 4 shows space utilization index based on matrix score. However, there are different type of spaces that available in HEIs such as office spaces, shared spaces (meeting room, pantry, foyer, etc.), residential spaces and study spaces. Thus, each spaces have different type of activities and different requirement. Therefore, the authors suggested weightage ratio for each type of spaces that shown in Table 5. Furthermore, space utilization index can be determine by:

- Determine space frequency rate
- Determine space occupancy rate

Space utilization index x based on frequency occupancy and weightage ratio:

Table 5: Suggested weightages ratio are based on type of space

Type of space	Weightage value Frequency rate	Occupancy rate	Total weightage
Office space	0.4-0.5	0.5-0.6	1.0
Shared space	0.5-0.6	0.4-0.5	1.0
Residential space	0.35-0.45	0.55-0.65	1.0
Study space	0.4-0.6	0.4-0.6	1.0

$$=\text{Total (weightage} \times \text{Frequency index)} + \text{Total (weightage} \times \text{Occupancy index)}$$

The example of space utilization index calculation:

$$= (0.5\times5)+(0.5\times5) = 3.5$$

(level 3-medium utilization)

The index obtained from this model will demonstrate the level of space utilization in HEIs. This may facilitate facility management in order to plan and upgrade current or future spaces. A good space management will create a good impact in term of occupant comfort and can minimize operational cost. Thus, it will provide a worthwhile return on investment.

CONCLUSION

Space utilization index is important to determine the effectiveness and the efficiency of institution in managing space monitoring and auditing. The formulation can facilitate building management to determine score level for space utilization in HEI. It can demonstrate and indicate the need of new space when compare to students enrolment within the stipulated time frame. Otherwise, the institutions that have low space utilization index can increase their income by leasing the spaces to outsiders.

Besides, this model not only can be used for learning spaces in HEIs. It also can be used to determine space utilization index in other types of building such as office building, factory, commercial building and others. However, a further research should be conducted to determine the actual weightage value for frequency rate and occupancy rate.

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