SPACE MANAGEMENT: MEASURING TEACHING AND LEARNING SPACE PERFORMANCE

Shahabudin Abdullah[a], Hishamuddin Mohd Ali[a], Ibrahim Sipan[b], Mark Deakin[c]

[a]Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia 81310 UTM Johor Bahru, Malaysia
[b] Centre for Real Estate Studies, Universiti Teknologi Malaysia 81310 UTM Johor Bahru, Malaysia
[c] School of Engineering & Built Environment, Edinburgh Napier University, EH10 5DT, Edinburgh, UK

Abstract

This paper discusses performance measurement in space utilisation at the university. Using planned timetabling of rooms usage, data are collected through interviews and questionnaire survey. The analysis shows that UFO rate for Universiti Teknologi Malaysia (UTM) is as good as in the United States and United Kingdom. This paper suggests that in order to increase utilisation rate, HEIs should consider occupancy rate as it is the determining factor affecting the utilisation rate. The occupancy rate is derived from the number of students occupying the designated teaching and learning space.

Key words: *facilities management, space management, space utilisation*

1.0 INTRODUCTION

The establishment of facilities management (FM) can be traced back to the evolution of office administration in the early 1990s. The move for a better management of facilities is set to continue as buildings with their infrastructure and equipment elements become ever more sophisticated (Amaratunga and Baldry, 2002). Facilities are essential in any organisations as they represent a significant portion of most organisations' assets and their operating costs. Thus, performance assessment in facilities management is becoming a common and formal part of the facilities management (FM) process (Amaratunga, 2000; Amaratunga and Baldry, 2002).One of the main elements in FM is managing the workplace, workspace, or workstations (Alexander, Atkin, Brochnerand Haugen, 2004; Barret and Baldry, 2003; Booty, 2009; Gustin, 2002; McGregor and Then, 1999; Varcoe, 1996).

The purpose of FM must not only to optimize operational costs of buildings (workstations), but also to raise efficiency of the management of space and associated resources for people and processes. These processes may be at the best combination of efficiency and cost in order for the mission and goals of an organisation to be appreciated (Amaratunga and Baldry, 1998; Amaratunga, Baldry and Sarshar, 2000).Varcoe(1996) further stated that facilities are comparable from any other aspect of an organisation in that they can be measured based on three key performance criteria, namely productivity, customer satisfaction, and flexibility.

Rogers (2002) stressed that the issue of performance measurement for academic space must be conveyed to the attention of top university administration. Many argue that university buildings are becoming under-utilized asset. Early indications are that universities, instead of raising their level of admission, might captivate the greater intake by embracing effective space

management strategies of their buildings and increasing their teaching capability in order to maintain cost and keep their teaching staff (Shabha, 2004).

The main objective of this research is to analyse the UFO for some selected sections of academic space at Universiti Teknologi Malaysia. This research also discusses the factors influencing space utilisation in HEIs.

2.0 RESEARCH BACKGROUND

FM covers a broad scope of activities involved in the effective management of built assets including property management, change management, human resource management, financial management, health and safety management. FM also encompasses essential visible services such as building maintenance, domestic services and utilities supplies (Amaratunga and Baldry, 2001; Amaratunga et al., 2000).

FM is also a mixture of management discipline where interactions between people, property and process take place in order to provide essential services to support an organisation (Amaratunga and Baldry, 2000; Then, 2005). FM is perceived to be capable ofcontributing to the performance of organisations in various modes. These modes include but not limited to service delivery, strategy, control of resources, culture, and supply chain management of organisations.

Defining performance measures enables the organisation to establish position by carefully and consistently measuring performance; communicating direction through targeting what is to be achieved by when; stimulating action through identifying who should act and what should be done; facilitating learning through explaining why this is measured; and influencing behaviour (Amaratunga and Baldry, 2000).

Based on Neely and *et al.* (1995), performance measurement is a subject that is often examined but hardly defined. Amaratunga (2000) describes a performance measure as a metric used to quantify the efficiency and/or effectiveness of an action. However, Moullin (2007) defines performance measurement as "assessing how successful organisations are managed and the value they provide for customers and other stakeholders". Defining and measuring performance enables an organisation to focus attention on feedback loops, to establish position, to communicate direction, to stimulate action, to facilitate learning, and to influence behaviour (Amaratunga and Baldry, 1998; Amaratunga, 2000).

Performance measurement has been previously portrayed as a process of assessing progress regarding attaining predetermined targets. These include material and efficiency with which resources are transformed into goods and services, the significance of those outputs and outcomes, and the effectiveness of organisational operations in terms of their specific contributions to organisational objectives (Amaratunga, Baldry and Sarshar, 2001).

A creditable performance in FM is essential due to the involvement of large amount of financial resources only second to payroll (Amaratunga, 2000). Due to that belief, there has been encouraging concentration in performance measurement throughout FM (Amaratunga and Baldry, 2002). The influence exerted by FM will be judged by an organisation's stakeholders around an extensive series of performance criteria, including the hard metrics of finance and economics (Amaratunga and Baldry, 2002).

2.1 Performance Measurement Of Space Usage

Institutions in the public and private sectors throughout the world are fighting with their performance measurement systems (Moullin, 2007). While performance measures are appreciated, they also invite considerable scepticism and thought-over as to why, how, and when they are used (Parker, 2000). This is because for every measure, they must be aligned with the organisation's policy (Parker, 2000).

Performance measures deliver a crucial feedback-loop in the process of strategic adjustment (Amaratunga and Baldry, 2000).

Researchers on performance measurement have moved from focusing on measurements themselves to how they are used in organisational settings (Elg, 2007). It is necessary that organisations can undoubtedly establish their precise performance measurement information's need in order to design fully effective systems as they serve as a link among the various units of an organisation and to facilitate higher management's dissemination of plans and goals throughout the organisation (Amaratunga and Baldry, 2000; Elg, 2007).

In FM business organisations, the key indicators can be more easily quantified and controlled because an organisation has a direct economic purpose. In other words, the inputs and outputs of an FM organisation in a commercial business and a public service higher education institution (HEI) are substantially different (Amaratunga, 2000). For a higher educational FM organisation with a social mission, the process of small incremental enhancement has to be maintained across a complex range of performance indicators.

Assessment of performance of buildings of institutions providing higher educational services has become a substance of specific concern to governments seeking to increase the effectiveness of educational provision and maximise value for money (Amaratunga and Baldry, 2000; Belcher, 1997).The university system as in any other organisation is trying to improve its efficiency in the face of rising operating costs and increasing user expectations (Amaratunga and Baldry, 1998).

While teaching spaces can contribute to a high-quality education, it is the interrelationship between organisational contexts that provides the catalyst for improved performance (Amaratunga and Baldry, 1998). A workstation is basically made up of a number of prearranged zones and workspaces. Space planning, as a discipline, forms a major part of the facilities manager's responsibilities (Steiner, 2005).
Early researchers find that researching in this area was quite difficult due to the lack of previous research in this area. The scarcity of previous literature is balanced by excessive technical reports throughout the world. Most of the references are from the technical reports for internal use, or national guidelines in other countries such as United State of America (USA), United Kingdom (UK), Australia, and Malaysia (Downie, 2005; Ahmadfauzi, 2005).

Space Management Group (SMG, 2006) reports that the origin of this survey was the University of Iowa (UOI). UOI has conducted space utilisation survey as early as 1916, yet there was no record found how they do that. In the same guideline, UK was cited as the second country applying this survey for their space management in higher education institutions (HEIs). To date, theoldest research on space utilisation, dated 1957, entitled Manual for Studies of Space Utilisation in Colleges and Universities (Russell and Doi, 1957).

Rogers (2002) in her report indicated that albeit the decade of thoughtfulness being disbursed to space management in HEIs, progress towards cultivating the efficiency of their holdings has been slow. She further added that space management practice is variables and there has remained slight advancement in fostering awareness of the space costs and the possible cost savings from improved space management. One of the criteria for measuring space performance is space utilisation.

Space utilisation is a measure of whether and how space is being used. The utilisation rate is a function of a frequency rate and occupancy rate. The frequency rate measures the proportion of time that space is used as compared to its availability, and the occupancy rate measures how full the space is compared to its capacity (Space Management Group, 2006).

UK has applied this survey since 1960 and at the year of 1996, National Audit Office (NAO) succeeded in producing an early guideline to perform space utilisation survey for their public HEIs (SMG, 2006). Although there are guidelines for conducting the survey, institutions have been given the autonomy to conduct the survey as they could. Subsequently, throughout the years, difference approaches have been employed by HEIs. Some HEIs use timetabling method for their survey and others through inspections. Although there are differences, they try to achieve the same goal, namely to improve their space management process. The target is crystal clear, namely to utilise space and sustain the resources.

In Malaysia, early research recorded was by Ahmad fauzi (2005) who conducted space usage survey on 154 laboratories in six Malaysia's HEIs. However, the survey focused on frequency rate only. Later, Office of Assets and Development, Universiti Teknologi Malaysia (OAD, UTM Johor Bahru), conducted a similar survey (Mohd Shahril, 2007). This survey focused on the teaching and learning (T and L) rooms for the entire Universiti Teknologi Malaysia's Johor Bahru campus.

2.2 Space Utilisation Survey Method

Based on the literature, space utilisation survey can be conducted through survey form, planned classroom timetabling, direct surveys, and data acquisition from the registrar's office (Downie, 2005; SCHEV, 2004; SMG, 2006). The literature also suggested that HEIs staff, cleaning staff, consultants, researchers and students, can conduct the survey.

To analyse the data, a standard model, which has been applied in the USA, the UK, and Australia,is also applicable in Malaysia. The model can be abbreviated as UFO.

2.3 Ufo Space Utilisation Survey

It is learned that several methods can be applied to achieve utilisation rate. However, the basis of that rate is UFO (Table 1). Udenotesutilisation rate, which results from frequency rate (F) multiplied by occupancy rate (O). In USA, State Council Higher Education of Virginia (SCHEV, 2004) requires that HEIs must present their utilisation rate or frequency rate as indicator and evidence to apply for new space in capital budget planning. If they failed to show their space being fully utilised or over-crowded, no budget is approved for new space. In the UK, the low rate of space utilisation in HEIs will cause them to pay some penalties (National Audit Office (NAO), 1996).

Table 1: Space Utilisation Rate Formula

$\text{Space Utilisation Rate } (U) = \frac{\text{Frequency Rate } (\%) \times \text{Occupancy Rate } (\%)}{100}$
$\text{Frequency Rate } (F) = \left(\frac{\text{Number of hours used during week}}{\text{Hours allocated during week}}\right) \times 100$
$\text{Occupancy Rate } (O) = \left(\frac{\text{Total student numbers during week}}{\text{Room capacity during week}}\right) \times 100$

In this study, the allocation of number of hours per week was determined from a series of three workshops on space planning conducted at UTM Johor Bahru involving all 12 faculties and their respective departments. Before the allocated number of hours was decided, the result of space utilisation rate was presented in three different allocation-hour options, namely 39 allocated hours per week, 44 allocated hours per week, and 63 allocated hours per week. All participants have agreed on the use of 39 allocated hours per week as frequency rate factor.

This calculation is based on the space usage from Monday to Friday starting at 8.00 a.m. and finishing at 6.00 p.m. However, for Wednesday, the total hours per day is reduced from 9 hours to only 5 hours to accommodate co-curriculum activities while for Friday, the total hours is reduced to 7 hours to allow for Friday prayer. The 39 allocation hours of usage per week is shown in Table 2.

Table 2: Allocation Number of Hours Available During Week

Allocation Number of Hours Available During Week											
Time / Day	1	2	3	4	5	6	7	8	9	10	11
	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
Monday		1	2	3	4	5		6	7	8	9
Tuesday		10	11	12	13	14		15	16	17	18
Wednesday		19	20	21	22	23					
Thursday		24	25	26	27	28		29	30	31	32
Friday		33	34	35	36				37	38	39

3.0 RESEARCH METHODOLOGY

Although research is central in both business and educational undertakings, there is no understanding in the literature on how it should be expressed (Amaratunga, Baldry, Sarshar, and Newton, 2002). Silverman (2000) had defined methodology as a general approach to study a research topic. The methodology used in this study reflects the need for more qualitative studies and in-depth understanding of the relationship between organisation and decision-making. Apart from that, this research will also be using quantitative approaches in addressing research issues.

In order to review the problem arise in this research, a research design is identified. Having had the research issues and objectives, it is important to look at the sources of data. Objective one will be on the performance measurement of space management for HEIs.

3.1 Data Acquisition and Analysis

To achieve the first objective, the data on room's timetable and total student number per subject were collected. The data were gathered from faculties/department in UTM for the whole four semesters beginning with Semester 1, 2007/2008 until Semester 2, 2008/2009. Usage of lecture halls, lecture rooms, tutorial rooms, labs, and studios, and workshops was timetabled. To determine the trend of space usage (UFO), MS Excel was used for data entry while specialist software was used to analyse the data.

Table 3 shows an example of calculating UFO for a room with the capacity of 60 persons per hour. From the table, out of the possible 39 hours of meetings per week, the room can be only beused for 15 hours per week. Given that information, we can derive the frequency rate by using the formula as in Table 1 (F = 15/39 x 100 = 38.46%). Based on Table 1, we can also derive the occupancy rate and utilisation as well. From this example the occupancy rate is 14.957% (O = 350 / (60 x 39) x 100). The utilisation rate is 5.75%(38.46% x 14.975 / 100). The calculation of UFO is then calculated for all 959 rooms for four (4) semesters. The discussion of mean scores for UFO is then presented by semester.

Table 3: An Example of UFO Calculation

Calculation of UFO for Room A											
									Room Capacity: 60		
Time / Day	1	2	3	4	5	6	7	8	9	10	11
	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
Monday		26	26		25	25					
Tuesday			20	20		21		20			
Wednesday			26	26	26	26					
Thursday				21	21	21					
Friday											

After UFO rates have been determined, the three workshops have been conducted with cooperation from OAD, UTM. All 12 faculties were involved in this survey and have attended this workshop.

4.0 RESEARCH FINDINGS AND DISCUSSIONS

4.1 Determination of Space Utilisation Rate in UTM.

Space utilisation rate (UFO) from 2007 until 2009 in is shown in Figure 1 and Table 5. Clearly, space utilisation rate has increased in the first three semesters but dropped in the final semester. The lower side of utilisation rate (U) was 20.73% while the upper side was 40.38%.

If we only consider the frequency rate (F), UTM has actually reached a good level of usage whereby the usage was constantly above 60% for each semester. However if the result for occupancy rate (O) being analysed, UTM has performed poorly. The lowest occupancy stood at 31.99% for semester one 2007/2008 and the highest stood at 58.85% for semester one 2008/2009.

Based on Table 4, UFO rate for UTM Johor Bahru can be considered 'fair to good' as per NAO (1996). However, the interpretation based on NAO (1996) is for actual surveyed UFO rather than planned UFO (39-hour space usage per week as in the case of UTM). Notwithstanding this, other HEIs in Malaysia use the range from 40 hours to 45 hours of space usage per week.

In the United State of America, some states' space utilisation guideline suggest that HEIs should at least allocate around 24 hours to 32 hours out of possible 40 hours of space usage. This means that the targeted frequency rate for USA is about 60% - 80%. As for occupancy rate, it is targeted to be around 60% - 75% of room capacity. Based on this range, it can be estimated that targeted utilisation rate for HEIs in USA, which is based on 40 hours usage, should be around 36% to 60% depending on the type of T and L room usage.

Table 4: Score and Interpretation of Utilisation Rate

	Rate (%)	Interpretation
Score	< 25%	Poor
	25% – 35%	Fair
	> 35%	Good

Source: National Audit Office, UK (1996)

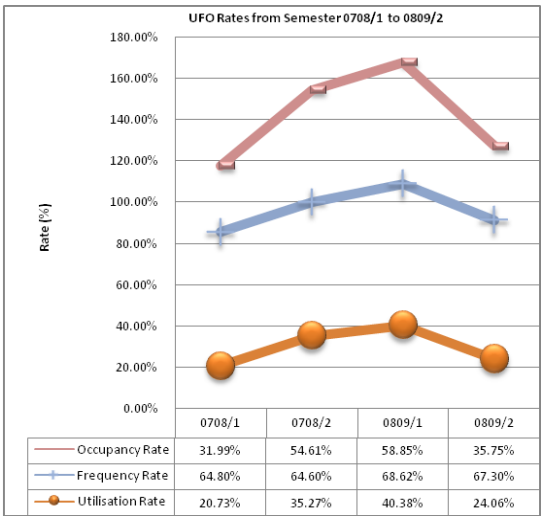

Figure 1: UFO Rate (%) in UTM Johor Bahru from 2007 until 2009

As for Australian universities, based on space planning guidelines by TEFMA (2009), the space usage is 67.5 hours per week. The targeted utilisation is from 34% to 60% depending on space type. This calculation is based on frequency rate ranging from 45% to 80% and targeted room occupancy of 75%. As for teaching spaces, lecture theatres and computer laboratories, targeted utilisation rate is 56% based on frequency and occupancy of 75%.

Table 5: Utilisation Rate for UTM based on 39 Hours Room Usage

UTM Utilisation Rate for 39 Hours Time Allocation				
Session	Academic Calendar Year			
	0708/1	0708/2	0809/1	0809/2
No. of Rooms	227	244	240	248
Utilisation Rate	20.73%	35.27%	40.38%	24.06%
Frequency Rate	64.80%	64.60%	68.62%	67.30%
Occupancy Rate	31.99%	54.61%	58.85%	35.75%

4.2 Factors Influencing Space Utilisation Rate (UFO's Rate)

As discussed above, factors influencing utilisation rate are frequency and occupancy rates of space usage. To achieve the second objective, two different approaches have been applied. First approach iscomparing utilisation, frequency, and occupancy rates between semesters. Second approach, is the use of correlation analysis in order to determine the major factor contributing to UFO's rate.

The trend of UFO's rate in Figure 1 and Table 5 shows an obvious drop in occupancy rate from semester 1 to semester 3 2008/2009 sessions and this has contributed to the drop in the utilisation rate and occupancy rate for that semester. At the same time, the frequency rate was consistent at 64% and 68% each semester. So, occupancy rate here has played a major role to influence utilisation rate as a whole.

The correlation analysis mainly only looks at the relationship between variables and it does not analyse why and how that relationship happens. In this study, correlation analysis was applied to test if the frequency and occupancy have any meaningful relationship with utilisation rate.

Based on Table 6, occupancy rate has a strong relationship with the utilisation rate. From the table, it has a strong positive relationship with the utilisation rate with the value reach 0.940while the frequency rate only reaches 0.800. Although frequency rate has a strong positive relationship with the UFO's rate, occupancy is more dominant in this case as can be seen in table 6.

Table 6: Correlation Analysis for UFO's Rate

Correlations

		Utilisation Rate	Frequency Rate	Occupancy Rate
Utilisation Rate	Pearson Correlation	1.000	.800	.940
	Sig. (2-tailed)		.000	.000
	N	959	959	959
Frequency Rate	Pearson Correlation	.800	1.000	.665
	Sig. (2-tailed)	.000		.000
	N	959	959.000	959
Occupancy Rate	Pearson Correlation	.940	.665	1.000
	Sig. (2-tailed)	.000	.000	
	N	959	959	959

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7 shows the regression coefficient for UFO's rate. Standardised Coefficient for occupancy rate was higher as compared to frequency rate for all four semesters. This shows that occupancy rate has influenced the utilisation rate more strongly than frequency rate. For UTM to increase its space utilisation rate, a consideration on occupancy rate, or room capacity should be addressed more than the frequency of room usage.

Table 7: Regression Analysis for UFO's Rate

Coefficients

Semester	Model		Unstandardized Coefficients		Standardized Coefficients		
			B	Std. Error	Beta	t	Sig.
0708/1	1	(Constant)	-16.308	.978		-16.677	.000
		Frequency Rate	.216	.020	.255	10.563	.000
		Occupancy Rate	.831	.026	.767	31.754	.000
0708/2	1	(Constant)	-19.725	1.271		-15.523	.000
		Frequency Rate	.365	.023	.316	15.709	.000
		Occupancy Rate	.715	.020	.736	36.623	.000
0809/1	1	(Constant)	-26.298	1.304		-20.168	.000
		Frequency Rate	.438	.034	.405	12.700	.000
		Occupancy Rate	.711	.038	.598	18.740	.000
0809/2	1	(Constant)	-19.216	1.035		-18.558	.000
		Frequency Rate	.302	.019	.376	15.495	.000
		Occupancy Rate	.748	.027	.663	27.352	.000

a. Dependent Variable: Utilisation Rate

5.0 CONCLUSION

Space utilisation survey to examine UFO's rate for building space is important. The factors influencing UFO's rate trend are also important to be identified. In our case, occupancy rate (O) was the main factor influencing the trend of UFO's rate.

In order to increase utilisation rate in HEIs, administrators should look at the room capacity and size, as it will influence occupancy rate. Based on space standards in the USA, the UK and Australia, there isa clear indication of expected utilisation rate for different types of teaching and learning space. This paper has yet to address the utilisation rate for different types of academic space or workstations.

Further research needs to be carried out in term of benchmarking among HEIs. Another suggestion is to broaden the scope of study to examine office space. Also, it is suggested to vary the methods of survey based on the type of space usage such as labs, lecture halls, and so on. A real-time survey is one of the ways to enhance the quality of data.

The existing space resources must be utilised. Effective and efficient management of these resources not only can reduce operating cost, but also can sustain the physical and the function of the space. Therefore, all related bodies should play their roles against the needs of currents way of lifeto sustain our resources, including existing building space.

REFERENCES

Ahmad Fauzi A. Wahab (2005) Pengurusan Sumber Fizikal IPT: Pengurusan Ruang. *Journal Teknologi,* 43 (E) Dis 2005: 15-28, UTM

Amaratunga, D. (2000). Assessment of Facilities Management Performance. *Property Management*, *18*(4), 258-266.

Amaratunga, D., and Baldry, D. (1998). Appraising the Total Performance of Higher Education Buildings: A Participatory Approach towards a Knowledge-Base System.*COBRA '98*. London: RICS Research.

Amaratunga, D., and Baldry, D. (2000). Assessment of Facilities Management Performance in Higher Education Properties. *Facilities*, *18*(7/8), 293-301.

Amaratunga, D., and Baldry, D. (2001). Case Study Methodology as a Means of Theory Building: Performance Measurement in Facilities Management Organisations. *Work Study, 50*(3), 95-104.

Amaratunga, D., and Baldry, D. (2002). Moving from Performance Measurement to Performance Management. *Facilities*, *20*(5/6), 217-223.

Amaratunga, D., Baldry, D., and Sarshar, M. (2000). Assessment of Facilities Management Performance - What Next? *Facilities*, *18*(1/2), 66-75.

Elg, M. (2007). The process of constructing performance measurement. *The TQM Magazine*, *19*(3), 217-228.doi:10.1108/09544780710745649

Pursglove, J., and Simpson, M. (2007). Benchmarking the Performance of English Universities. *Benchmarking: An International Journal*, *14*(1), 102-122.

Rogers, C. (2002). *Space Management in Higher Education: Report of the Findings of the Newcastle University Space Management Project, Jointly Funded by the HEFCE Good Management Practice Programme and the University* (pp. 1-88). Newcastle: University of New castle.

Shabha, G. (2004). An assessment of the Effectiveness of e-learning on University Space Planning Design .*Facilities*, *22*(3-4), 79-86.

Then, D. S.-S.(2005). A Proactive Property Management Model that Integrates Real Estate Provision and Facilities Services Management. *International Journal of Strategic Property Management*, *9*(1), 33-42.

Varcoe, B. J. (1996). Facilities Performance Measurement . *Facilities*, *14*(10/11), 46-51. doi:10.1108/02632779610129168