

SPACE UTILISATION: INTERPRETING THE RESULT

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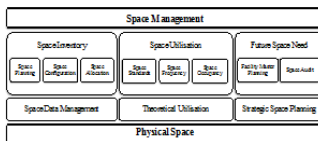
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Graphical abstract



Abstract

This paper discusses real estate management and services related with space management. The discussion is then focused on space utilisation as a tool for measuring the performance of space management in higher education institutes (HEIs). The main objective of this paper is to investigate the use of space utilisation as a tool for measuring space performance. After identifying the method to be used for this research by using Participation Action Research (PAR). Data is collected through interviews and questionnaires for planned timetabling of rooms usage rather than fields survey. The data is then analysed using descriptive statistics and qualitative analysis is carried out. Results from the analysis show that UFO rates for Faculty of Geoinformation and Real Estate (FGRE), Universiti Teknologi Malaysia (UTM) is at poor and fair score. Furthermore, this paper also suggest that in order to increase the utilisation rate, the FGRE management team should consider the occupancy rate as it is the determining factor affecting the utilisation rate. Apart from the occupancy rate, the management team should also consider the space audit and strategic space planning in order to increase the utilisation rate.

Keywords: Real estate, property management, facilities management, space management

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1.0 INTRODUCTION

The management of real estate services is needed for every organisation as to accomplish their mission statement. Throughout the years, real estate managers have shifted their roles in term of activities and services provide by them. Due to the widespread of information technology (IT) and global economies, real estate services also transform into several types of management. These are facilities management (FM); property management (PM); and asset and portfolio management (AM) as shown in Figure 1.

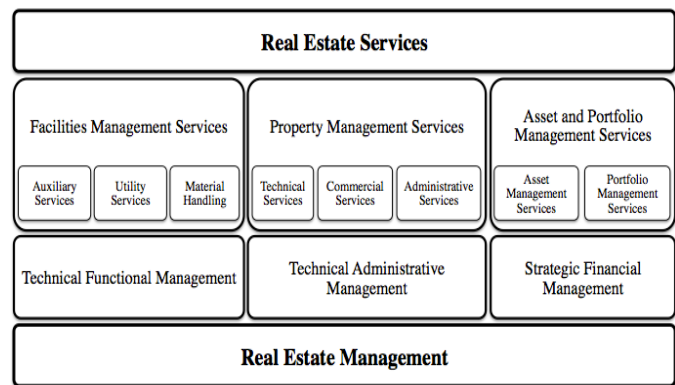


Figure 1 Real Estate Management Services

Each of real estate management components has their specific and unique agenda in real estate services. As for facilities management, the main agenda is more on non-core services provided to organisations in order to meet their mission. However, for property management, the focus is more on the technical administrative management of property. As for asset and portfolio management, their job is more on strategic financial management of real estate.

Facilities management role and function is more on day-to-day related services. As shown in Figure 1, the type of management for FM is related with the technical-functional type of management. Figure 2 show the management practices under facilities management services. As mentioned in Figure 1, facilities management services can be categories into three main services; auxiliary services, utility services, and material handlings services.

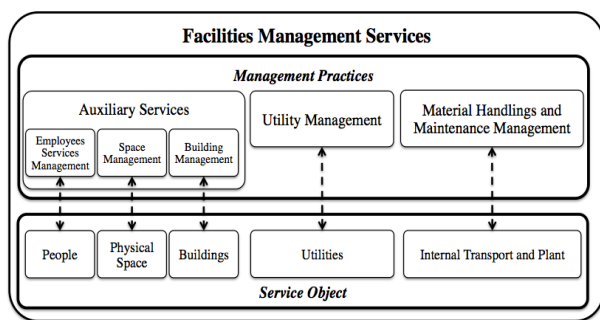


Figure 2 Facilities Management Services

The most acceptable definition of facilities management (FM) is the practice of coordinating the physical workplace with the people and work of the organisation; it integrates the principles of business administration, architecture, and the behavioral and engineering sciences [1]. Comparing with others definitions, workplace is used interchangeably with workspaces or space, and workstation [2–6].

Figure 2 further elaborates on management practices for facilities management services and their service object. Based on that, space management is categories under auxiliary services management and it relates with the physical space of the organisations. Based on the definition, the focus of FM is physical space [1, 7–11]. Even though physical space plays a vital role in defining facilities management, there is lack of research focusing on this topic. Heap of discussion centered on people, buildings, utilities, and internal transportation and plant rather than physical space.

Research on space management area only being studies by few of researchers [6, 12, 13]. Duffy [12] has look at the design of office space and cost cutting as well as effectiveness. McGregor and Then [14] explore the need of space planning in facilities management. In FM, Then [13] emphasis on premise audit and monitoring office space utilisation.

2.0 SPACE MANAGEMENT

Space management can be described as the capability to allocate space to a specific user and/or for a specific usage [15]. The scope of space management include facility or master planning, space planning, space configuration and reconfiguration, space allocation, utilisation and relocation, as well as space use audit and monitoring [1, 2, 13]. The primary aim of space management is to make the most efficient and effective use of space, equipment and furniture, during the present time as well as in the future.

In any institution of higher education, space within its organisation is the most expensive assets owned for it is essential to the performance of almost all of their activity [3, 4, 6]. With escalating construction cost, bad economic circumstance and increased enrolments, there is ever rising pressure on higher education institutions to manage the usage of existing space more effectively before constructing new, costly buildings. Universities not only need to be successful in teaching and in spreading participation of public, they also should be efficient in order to function in a fashion which creates the best use of their resources [16]. Rogers [15] stressed that the issues of efficiency and effectiveness of space must be conveyed to the attentiveness of top university administration.

According to Rourke and Brooks [17], the allocation of space is a matter of distributing scarce or limited resources. Space management in the institution of higher education (HEI) should translate the organisation objectives into spatial relationships of its functions, together with the needs of the people who perform the functions, within a given or proposed accommodation space. The space of a typical HEI included academic space, administrative space, commercial space, general teaching space, library space, student services space and other.

With efficient space management, HEI can plan, configure and reconfigure, allocate and reallocate, audit and monitor the use of space more effectively. However, poor space management will bring negative impacts to both the end-user of the space in HEI as well as the administrative of the HEI [6, 15].

Many HEIs are facing common space management problem such as low utilisation rate for teaching space and usage of space mismatch with its design [2, 18–20]. Space management problems exist because HEIs do not know; yet does not treasure the essential of space management. TEFMA [21], states that space management is about using standards and benchmarks and planning models to measure how well space is being used and to plan for future needs. According to Minior, Hanafin, & Bringhurst [22], the space management process relies on both qualitative and quantitative analyses to provide widespread information on all research groups.

In order to ensure cost effective and reliable delivery of services in the university environment, the adoption of the best practice of space management is very important, covering the planning, acquisition, operation, maintenance and disposal in the asset's whole life cycle. The university's objective is to maximise all useable space while providing an environment, which supports its activities and creativity.

Increasingly, the teaching and learning spaces needs to be responsive to the changing demands of a leading university, and so space should be designed to be flexible and planned on the basis of functional in order to encourage effective utilisation. The key aim of space management is to effectively manage a dynamic and limited resource in order to support academic activity, minimise cost and achieve maximum and efficient design, planning and use of the institution's space. Figure 3 elaborate on space management and it components.

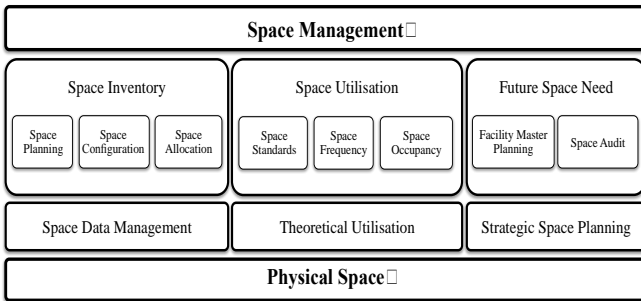


Figure 3 Components of Space Management

In managing the use of physical space, three concepts are essential. The concepts of space inventory, measuring utilisation, and future space needs must be understood first before further analysis being carried out. Space inventory dealing with knowing how much space is available. Measuring utilisation in other hand, regarding knowing how the use of space effectively by looking at frequency and occupancy rate. Space management also looking on how we can estimate how much space of what types will be needed as some point in the future.

The aim of this research is to measure the performance of space management in Universiti Teknologi Malaysia (UTM), one of 20 public higher educations (HEIs) in Malaysia. The scope of this research is on space utilisation for academic space only.

3.0 RESEARCH METHODOLOGY

This paper tries to establish the performance of space management for a HEI. To do that, it is essential to study on the component of space management first. Those components are space inventory, space utilisation, and future space need. The first stage of

this research is to gather on space inventory. Second is to analyse those inventory using space utilisation and third is to establish future space need. Figure 4 briefly discuss about research methodology for this research.

Figure 4 show the interrelation between research approach and it analysis in order to measure the performance of physical space. The importance of having right data and analysis are crucial in order to review the components of space management conceptual framework as drawn in Figure 4. In stage one, data was gathered through interview and focus group. This data will show space inventory for HEI. Content and quantitative analysis were used in analysing the data for space utilisation and technical utilisation. Third stage is to ascertain the strategic space planning for the organisation.

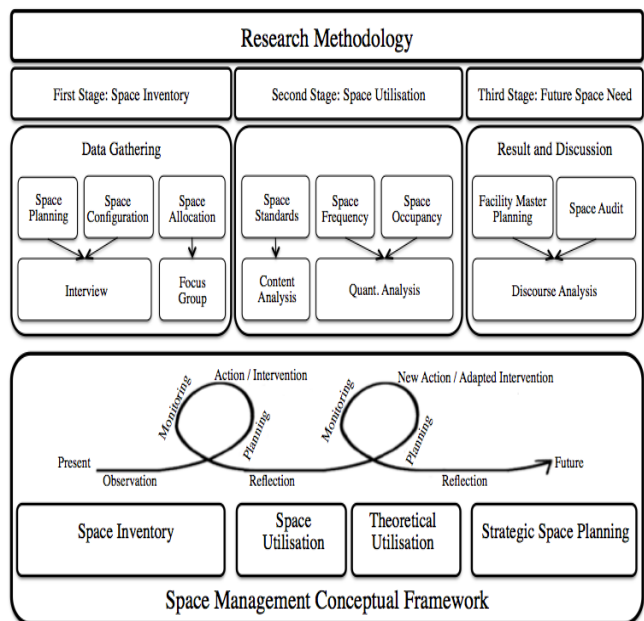


Figure 4 Research Methodology

3.1 Space Inventory

Space data management plays a vital role in ascertains accurate analysis. Thus, for HEI, it is importance for them to allocate meeting time per week along with the type and capacity of classroom space. Figure 5 show the time allocation for space usage in Universiti Teknologi Malaysia (UTM).

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

Figure 5 Time Allocation for Weekly Usage

Determining weekly time allocation for classroom is quite challenging as it affect the capacity offered by the classroom as well as affecting useable time per week [6]. In this case, time allocation of 38 hours per week is used to reflect the peak hour classroom usage.

3.2 Space Utilisation

Space utilisation is the pinnacle of this research as it measuring the performance of space management. Space utilisation can be measured by using the frequency of usage and also the space occupancy.

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

Figure 6 Formulas for Space Utilisation Rate

Figure 6 shows the approach of UFO rates calculation and Figure 7 shows the example of data and how to calculate the UFO rate.

Figure 7 states the numbers of hours used per week versus number of hours allocated per week. Figure 7 also shows the total numbers of student used the room and weekly room capacity.

Hours Used		Hours Allocated		Total Students		Capacity Per Week				
23		38		1070		2280				
Time / Day	1	2	3	4	5	6	7	8	9	10
	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
Monday		55	55	35	35				58	58
Tuesday			40	40	42	42		55	55	
Wednesday			38	38	38					
Thursday			58	58	58	58				
Friday		35	35	42	42					

Figure 7 Information on Classroom A Room Usage

Figure 7 shows the information of frequency and occupancy of room usage. As mention, the allocated hours for a week is 38 hours (greyed areas), and the frequency of used only 23 hours (numbered areas). For occupancy, the capacity of 2280 is calculated based on room capacity per hour of 60 person times 38 hours of allocated hours per week. The total students' number is calculated based on the student per class as numbered in Figure 7.

3.3 Research Analysis

The analysis for room usage is then carried out. The example of calculating the UFO is as discuss below. In order to get frequency rate (F%), hours allocated is being divided with hours used and then convert it to percentage, $23/38 \times 100 = 60.53\%$. Thus, 60.53% is

frequency rate for classroom A. To get the occupancy rate (O%), total students used classroom A is divided with capacity per week. It then will be converted into percentage. Thus, for classroom A, the occupancy rate is at 46.93% ($1070 / 2280 \times 100 = 46.93\%$). The utilisation rate for this classroom is 28.39%, ($60.53 \times 46.93 / 100 = 28.39\%$).

Table 1 shows how to interpret the result. Based on the calculation for room A, it can be concluded that the room was fairly utilised. Even though the frequency of 60.53% is considered good, but due to occupancy rate of 46.93%, which indicated poor score for occupancy rate, giving overall utilisation rate of 28.39%.

Table 1 Interpreting the Score

Score	U Rate (%)	F Rate (%)	O Rate (%)	Interpretation
	< 25%	<50%	<50%	Poor
	25% - 35%	50%-60%	50%-60%	Fair
	>35%	>60%	>60%	Good

4.0 RESULTS AND DISCUSSION

This paper seeks to find the performance of space management for Faculty of Geoinformation and Real Estate (FGRE), Universiti Teknologi Malaysia (UTM). The data gathered for four years starting semester 1 academic year of 2007/2008 until semester 2 academic year of 2011/2012. The classroom for this faculty is categorised under three different usages: lecture room, lecture hall, and computer laboratory.

4.1 UFO Rates for Faculty of Geoinformation and Real Estate (FGRE)

Tables 2 to 9 show the UFO rates for each of the room for eight semesters. Table 2 shows the UFO rates for semester 1, academic year 2007/2008. Based on Table 2, the utilisation rate for lecture rooms and lecture halls are at fair score, 32.12% and 31.18% respectively. While for computer labs, the score is poor, at only 7.38%.

Table 2 UFO Results for FGRE (Semester 1, Academic Year 2007/2008)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0708/1	Lecture Room	12	312	15522	456	33060	32.12%	68.42%	46.95%
	Lecture Hall	2	49	3308	76	6840	31.18%	64.47%	48.36%
	Computer Labs.	8	96	3420	304	14630	7.38%	31.58%	23.38%

Table 3 shows the UFO rates for semester 2, academic year 2007/2008. Based on Table 3, the utilisation rate for lecture rooms and lecture halls are

at fair score, 27.72% and 29.39% respectively. While for computer labs, the score is poor, at only 3.40%.

Table 3 UFO Results for FGRE (Semester 2, Academic Year 2007/2008)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0708/2	Lecture Room	12	284	15054	456	33820	27.72%	62.28%	44.51%
	Lecture Hall	2	50	3056	76	6840	29.39%	65.79%	44.68%
	Computer Labs.	10	65	2793	380	14060	3.40%	17.11%	19.86%

Table 4 shows the UFO rates for semester 1, academic year 2008/2009. Based on Table 4, the utilisation rate for lecture rooms is at good score of 37.00%. However the score for lecture hall is at 32.14%, scored at fair level. While for computer labs, the score is poor, at only 7.38%.

Table 4 UFO Results for FGRE (Semester 1, Academic Year 2008/2009)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0809/1	Lecture Room	13	335	17621	494	32300	37.00%	67.81%	54.55%
	Lecture Hall	2	51	3276	76	6840	32.14%	67.11%	47.89%
	Computer Labs.	9	86	3588	342	18050	5.00%	25.15%	19.88%

Table 5 shows the UFO rates for semester 2, academic year 2008/2009. Based on Table 5, the utilisation rate for lecture rooms and lecture halls are at fair score, 24.85% and 25.10% respectively. While for computer labs, the score is poor, at only 5.29%.

Table 5 UFO Results for FGRE (Semester 2, Academic Year 2008/2009)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0809/2	Lecture Room	13	331	12967	494	34960	24.85%	67.00%	37.09%
	Lecture Hall	2	53	2462	76	6840	25.10%	69.74%	35.99%
	Computer Labs.	9	90	2713	342	13490	5.29%	26.32%	20.11%

Table 6 shows the UFO rates for semester 1, academic year 2009/2010. Based on Table 6, the utilisation rate for lecture rooms and lecture halls are at fair score, 26.02% and 25.70% respectively. While for computer labs, the score is poor, at only 10.34%.

Table 6 UFO Results for FGRE (Semester 1, Academic Year 2009/2010)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0910/1	Lecture Room	13	321	16890	494	42180	26.02%	64.98%	40.04%
	Lecture Hall	2	39	3426	76	6840	25.70%	51.32%	50.09%
	Computer Labs.	9	110	4947	342	15390	10.34%	32.16%	32.14%

Table 7 shows the UFO rates for semester 2, academic year 2009/2010. Based on Table 7, the utilisation rate for lecture rooms and lecture halls are at fair score, 20.44% and 13.16% respectively. While for computer labs, the score is poor, at only 2.62%.

Table 7 UFO Results for FGRE (Semester 2, Academic Year 2009/2010)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
0910/2	Lecture Room	13	287	14843	494	42180	20.44%	58.10%	35.19%
	Lecture Hall	2	36	1900	76	6840	13.16%	47.37%	27.78%
	Computer Labs.	9	58	2374	342	15390	2.62%	16.96%	15.43%

Table 8 shows the UFO rates for semester 1, academic year 2010/2011. Based on Table 8, the utilisation rate for lecture rooms and lecture halls are at fair score, 24.62% and 23.94% respectively. While for computer labs, the score is poor, at only 5.26%.

Table 8 UFO Results for FGRE (Semester 1, Academic Year 2010/2011)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
1011/1	Lecture Room	13	303	16934	494	42180	24.62%	61.34%	40.15%
	Lecture Hall	2	47	2648	76	6840	23.94%	61.84%	38.71%
	Computer Labs.	9	76	3642	342	15390	5.26%	22.22%	23.66%

Table 9 shows the UFO rates for semester 2, academic year 2010/2011. Based on Table 9, the utilisation rate for lecture rooms and lecture halls are at fair score, 25.3% and 13.81% respectively. While for computer labs, the score is poor, at only 8.97%.

Table 9 UFO Results for FGRE (Semester 2, Academic Year 2010/2011)

Semester	Room Type	No. of Room	Frequency	Occupancy	Meeting Time	Capacity	Utilisation Rate	Frequency Rate	Occupancy Rate
1011/2	Lecture Room	13	320	16513	494	42180	25.36%	64.78%	39.15%
	Lecture Hall	2	52	1381	76	6840	13.81%	68.42%	20.19%
	Computer Labs.	9	119	3967	342	15390	8.97%	34.80%	25.78%

Table 10 shows the summary of UFO rate for Faculty of Geoinformation and Real Estate for 8 semesters. Based on Table 10, the utilisation rate for semester 2 for academic year of 2007/2008, 2008/2009, and 2009/2010 is lower for semester 1 respectively. This is because for semester 2 every academic year, the student will undergo the industrial training for six months (1 semester).

Table 10 UFO Results for FGRE

FGRE Utilisation Rate for 38 Hours Time Allocation								
Academic Year Semester	2007/2008		2008/2009		2009/2010		2010/2011	
	July	December	July	December	July	December	July	December
Number of Room	22	24	24	24	24	24	24	24
Utilisation Rate	22.31%	16.71%	22.16%	17.05%	20.21%	15.99%	16.84%	18.27%
Frequency Rate	54.67%	43.75%	51.75%	51.97%	51.54%	47.48%	46.71%	53.84%
Occupancy Rate	40.80%	38.20%	42.81%	32.81%	39.22%	33.67%	36.06%	33.94%

4.2 Discussion

Table 2 until 9 show the UFO rate for 8 semesters starting semester 1, academic year 2007/2008 until semester 2, academic year 2010/2011. Based on the result, the performance of room usage for FGRE is considered as poor. This is due to lower frequency and occupancy rates for the whole 8 semesters. Table 10 shows that the frequencies rate ranging from 43.75% - 54.67% are scored poor to fair usage. Based on that, 3 semesters scored poor (semester 2, academic year 2007/2008, 2009/2010, and semester 1 2010/2011), while others semesters only scored fair. For the occupancy rate, all 8 semesters scored poorly in term of their usage. Based on Table 10, the occupancies rate ranging from 32.81% - 42.81%. The frequency rate is calculated based on the number of student used the classroom. For FGRE, the total numbers of student for semester 2, academic year 2010/2011 stand at 1150. However, due to changes in UTM enrolment policy, for 2011/2012, the total numbers of student drop to 1024.

The reduction of student numbers will continue until the enrolment by year 2015/2016 is at 800 students. The decline of student intake is not reflected into space management, as the classroom capacity has not been reduced accordingly. This has led to under utilise of classroom usage.

In this research, participatory action research (PAR) was used as research method. Researchers have reflected the PAR findings with FGRE management team. For first PAR cycle, the management has agreed to increase meeting time allocation per week from 35 hours to 38 hours. Even though this action has decrease the overall utilisation rate, however, this action is needed in order to benchmark the utilisation rate with other faculties. For second cycle, the research reflects the need of decreasing the room capacity as the student number also decreased. Apart from that, the room capacity for FGRE is not tally with the number of student per class. For FGRE classroom, the classroom capacity ranging from 80 to 120 while the student number per class was reduced to only 40 to 60 persons. This led to the decrease of occupancy rate as shown in above results.

Researchers and FGRE management team discussed the need of changing the classroom from lecture-centered orientation to student-centered orientation. FGRE management team suggests that

several classrooms being assign to student class. For a start, all 4 class of final year student being assign their designated room. The utilisation rate for PAR second cycle also at poor score. This is due to the fact that for calculating the utilisation rate, the planned timetabling of frequency and occupancy is used rather than the actual on field survey.

For the third PAR cycle, it is suggested that the computer labs. Being taken out from the calculation as the usage for it is not planned in the timetable. Based on the course information, the planned computer usage is only at 1 hour per semester, this led to 16 hours of usage as oppose to 128 total hours for student to graduate.

The computer laboratories will be allocated as a centralised usage, whereby every student can use it at their free time rather than as per planned timetabling as before. The FGRE management team has not taken any action regarding this. However, they agree to the suggestion that computer laboratories should be used as per student requirement rather than per planned timetable.

Table 11 shows room capacity for 8 semesters. Based on data from Table 11, researchers can calculate theoretical utilisation rate based on the formula in Figure 8.

Table 11 Room Capacity for 8 Semesters

Semester	2007 - 2008 - 1	2007 - 2008 - 2	2008 - 2009 - 1	2008 - 2009 - 2	2009 - 2010 - 1 2010 - 2011 - 2
Lecture Room	870	890	850	920	1110
Lecture Hall	180	180	180	180	180
Computer Labs.	385	370	475	355	405
Total	1435	1440	1505	1455	1695

Based on Table 11, for the first 4 semesters (2007/2008 – 1 until 2008/2009 – 2), the data for room capacity is not consistent. This is due to the inconsistencies of numbers of room and capacity per room. That inconsistencies being brought forward to the FGRE management team and their action is to offer the capacity of 1695 for 24 rooms (13 lecture rooms, 9 computer labs, and 2 lecture halls). Figure 8 shows the formula for theoretical utilisation rate calculation. The calculation for theoretical utilisation is starting from semester 1 academic year 2009/2010. This is carried out on second PAR cycle.

Total student enrolment for semester 1, academic year 2009/2010 is 1154 and each student should take 16 credit hours per semester. Table 11 shows the capacity per hour and the classroom is 38 hours available per week. Based on that, the TUJ for semester 1, academic year 2009/2010 is 28.67% $((1154 \times 16) / (1695 \times 38))$. The utilisation rate for semester 1, academic year 2009/2010 is 20.21% (as stated in Table 10) as opposed to 28.67% for theoretical utilisation rate. For semester 2, academic year 2009/2010, the utilisation rate decreased to 15.99%. This is due to the industrial training by half of the student enrolment for that semester.

For semester 1, academic year 2010/2011, the theoretical utilisation rate is 25.44% $((1024 \times 16) / (1695 \times 38))$ as oppose to the utilisation rate of 16.84% in Table 10. The FGRE management team has

agreed to reconfigure the classroom from lecture-centered to student-centered in order to overcome low utilisation rate score for the faculty.

As discussed earlier, the FGRE management team also agreed to taken out the computer laboratories from planned timetabling and reallocate as general used computer laboratories. This will reduce the capacity from 1695 to only 1290. The outcome as being studied for PAR stage shows that the theoretical utilisation rate will rise from 25.44% to 33.42%. This increment will still make FGRE utilisation rate score at a fair usage only. The management team has to execute space reconfiguration as to increase the utilisation rate.

Figure 9 shows the space management conceptual framework that FGRE team management should use in order to increase the utilisation rate.

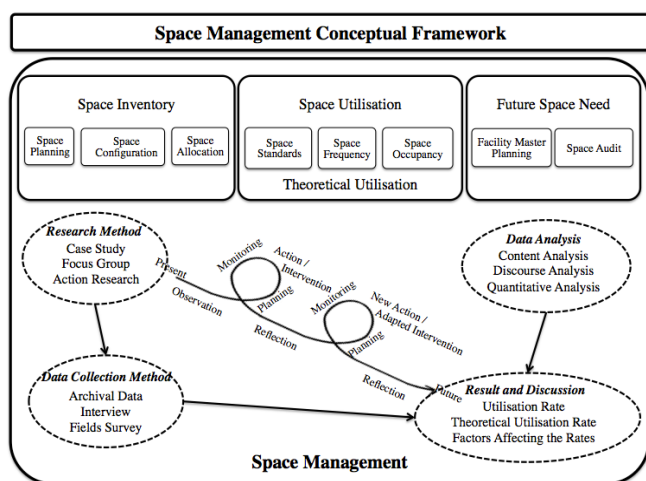


Figure 9 Space Management Conceptual Framework

Based on Figure 9, in order to manage the performance of academic space accordingly, the management must consider all components in space management. These components are space inventory, space utilisation, theoretical utilisation, and future space need. This research, using a participatory action research (PAR) method has reflected and shared its findings with the management team for their future action. As shown in Figure 9, the management must undertake space audit and also carry a facility master planning for their space.

5.0 CONCLUSION

One of the performance measures for academic space is by using space utilisation. Space utilisation is a part of space management. In order to manage the space properly, researchers must study all components related with space management. For Faculty of Geoinformation and Real Estate (FGRE), Universiti Teknologi Malaysia (UTM), the performance

of its space usage is scored as poor to fair. In order to overcome this, researchers have engaged PAR as their main research method.

This method let the researchers to interact with the real world problem situation. This problem is then being studied based on stages. The management team of FGRE has agreed for their academic space being used as a case study. Based on the study, several reflections have been exchanged between researchers and the management as to improve the performance of academic space.

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