# SPACE UTILIZATION MODEL FOR HIGHER EDUCATION INSTITUTIONS

Mohd Shahril Abdul Rahman, Hishamuddin Mohd Ali*, Ibrahim Sipan, Mariah Awang, Abdul Hakim Mohammed

Faculty of Geoinformation and Real Estate, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

## Graphical abstract

## Abstract

This paper presents the development of a space utilization model to accommodate the increasing demand of academic spaces in higher education institutions (HEIs) as well as to overcome the lack of awareness, knowledge and skills towards space utilization. The model developed using interviews and focus group discussions. The system development life cycle (SDLC) model is adapted by applying data flow diagram (DFD) to establish the prototype of space utilization model. The model helps in providing better understanding and promoting space utilization in HEIs as well as further research for implementation purpose.

*Keywords*: Space utilization model, higher education institution

## Abstrak

Kertas kerja ini membentangkan pembangunan model pemanfaatan ruang untuk menampung permintaan ruang akademik yang semakin meningkat di institusi pengajian tinggi (IPT) dan juga mengatasi kekurangan kesedaran, pengetahuan dan kemahiran terhadap pemanfaatan ruang. Model ini dibangunkan melalui temubual dan perbincangan kumpulan berfokus. Pembangunan sistem kitaran hayat (SDLC), disesuaikan dengan menggunakan gambarajah aliran data (DFD) untuk menghasilkan prototaip model pemanfaatan ruang. Model ini membantu dalam memberikan pemahaman yang lebih baik serta menggalakkan penggunaan ruang di IPT serta penyelidikan selanjutnya bagi maksud pelaksanaan.

*Kata kunci*: Model pemanfaatan ruang, institusi pengajian tinggi

## 1.0 INTRODUCTION

Globalization today has given a positive effect to the global demand for higher education. As a result, the needs' of academic spaces in higher education institutions (HEIs) increased. The increase was attributed mainly to the increasing number of students and academic activities that take place inside HEIs. In addition, changes of HEI status also contributed to the increasing number of students and academic activities. This because, teaching universities requires more teaching and learning room types, i.e. lectures rooms or halls. Meanwhile, as a research university, more working stations for postgraduates are required compared to a teaching university. Thus, the changing status of university could contribute to the changing demand of space for both types, to go higher or lower. However, the

changing demand for the space can be overcome with the implementation of space utilization.[1, 20, 21, 37] This could help when the existent space are examined for it utilization; weather they are underused or fully utilized. From that, the management of HEIs could tell how many spaces they really needed and which space of existing stocks can be utilized to accommodate the space demands. However, due to lack of awareness and knowledge among those involved in the space management of academic spaces, the space utilization option is given low attention. The low attention on using it in HEIs space management also appears in the academic for it has the low number of study towards this topic.[1, 13, 20]

Thus, the lack of awareness, knowledge and referral among academics and non-academic related to space utilization can be accommodated. Therefore, this paper presents the results of the study to develop a model of academic space utilization at HEIs.

## 2.0 SPACE UTILIZATION – FROM DEFINITIONS TO INTERPRETATION OF THE UTILIZATION RATE

This section discusses the components in implementation of space utilization in HEI. Before that, the existing model of space utilization is discussed to give an overall view on what are being practiced.

In practice, the existing models of space utilization mostly focusing in the rate of space utilization achieved and the interpretation of the rate, i.e. NAO,[21] SCHEV,[35] SMG,[33] Linariza *et al*.[12] Meanwhile, the process to derive the rates and what to do for the achieved rate are discussed separately as a standards of difference research, by NAO,[21] SCHEV,[35] SMG.[33] However, this study will look into an overall process on conducting the space utilization survey until the process of suggesting the remedies for the rates achieved.

With reference to the literature review, the elements of which can be considered as a model of space utilization are, the implementation of the alternative space utilization survey consists of thirteen components, namely, definition, the purpose of survey, analysis, budget, timeframe, method, executor, types of data, space category, and maximum hours of space usage, the database, and interpretation and remedy of space utilization rate achieved. [1, 9, 12-17, 20-21, 23-24, 29, 32-33, 35, 37] The findings as represents by the Table 1 are maintained as found from the literature.

**Table 1** The components of space utilization

| APKPR space utilization alternatives | |
|---|---|
| 1 | Definition and terminology for space utilization survey |
| 2 | The purpose of the implementation of space utilization survey |
| 3 | The type of data required for analysis of space utilization survey |
| 4 | The type of analysis required in space utilization survey |
| 5 | The budget for the implementation of space utilization survey |
| 6 | Implementation period space utilization survey |
| 7 | method of implementation of space utilization survey |
| 8 | Executor of space utilization survey |
| 9 | Categories of academic space in space utilization survey |
| 10 | Maximum hours of room usage space utilization survey |
| **PDKPR space utilization database** | |
| 1 | PDKPR - Required Data for space utilization survey |
| 2 | PDKPR - Required Information for space utilization survey |
| **INTREPRU Interpretation, consideration and remedies** | |
| 1 | The interpretation for the rate achieved |
| 2 | The remedies for the interpretation of the rate |

Table 1 concludes the components needed in implementation of space utilization in HEI. They are 1) definition, 2) purpose of the survey, 3) the data, 4) analysis, 5) budget, 6) survey timeframe, 7) method, 8) executor, 9) space category, 10) maximum hours of space usage, 11) the database, and 12) interpretation and 13) remedy of space utilization rate achieved. However, all thirteen components can be divided into three groups which are alternatives of implementation of space utilization survey (APKPR), space utilization survey database (PDKPR) as well as the interpretation and remedies of the achieved utilization rate (INTERPRU). The discussion about them will take the next three subsections.

### 2.1 The Alternatives of Implementation of Space Utilization Survey (APKPR)

#### 2.1.1 Definition

There are three definitions available for the space utilization consists of general, specific and a comprehensive definition. The general definition is a process to measure the level of space utilization[19, 20]. The second definition is a process which used in measuring the level of space usage based on the frequency rate or the occupancy rate.[1, 36, 34] It also can be defined as a process to measure the space utilization based on frequency rate and the occupancy rate. [1, 4, 10, 12, 14-21, 23-24, 26-27, 29, 33-35, 37]

#### 2.1.2 The Purpose of Conducting Space Utilization Survey

Space utilization survey is always conducted to meet academic and non-academic needs. [1, 9, 12, 14-17, 20-21, 23-24, 26-27, 32-33, 35-37]

For academic purpose, space utilization survey is carried out as part of the R&D or innovation project as well as by the students in *fulfillment of degree requirements*.

Secondly, for the non academic purpose, the survey is useful for the strategic plan; while preparing or reviewing the existing plan. For example, the use of space utilization survey during preparation of a strategic plan may avoid the unwanted consequences such as the increase of students' enrolment and the available spaces are not enough to accommodate them. It is also useful as a tool for measuring the performance of a building during its life cycle; planning, acquisition, usage and disposal or refurbishment stage. For example, during planning and acquisitions stages, the space utilization rates can be used as a proof that the existing space is overcrowded. Therefore, new space is required. This practice can encourage the HEIs to improve their space utilization rate.[34, 36]

### 2.1.3  Space Utilization Analysis

The form of analysis is vital to set to ensure the report prepared comply with the organization requirements. There are two types of analysis. The first is to accumulate the total hours of room usage and the total occupants for each hour used. This lead to the second analysis; space utilization analysis as indicates by Table 2.[1, 9, 12, 14-17, 20-21, 23-24, 26-27, 32-33, 35-37]

**Table 2** Data analysis in space utilization study

| Types of rate, % | Descriptions |
|---|---|
| Frequency Rate (%F) | The F rate is the percentage % of total hour usage in a week than total hour of maximum usage to a space in a week.<br>**E**xample:<br>**T**otal hours of **room** usage in a week = 25<br>**T**otal maximum hours **of room** usage **allowed** in a week = 40**.** Hence, [25/40 x 100] = 63% |
| Occupancy Rate (%F) | The O rate is **the** percentage of total space occupancy for a week than total space capacity for a week.<br>Example:<br>Total occupancy occupant for a week= 750 occupant**s**.<br>Space capacity per hour  = 35 occupant**s**<br>Total hours of maximum usage for a week = 40<br>Therefore, Total occupancy/ Space capacity per hour*Total hours of maximum usage in a week  x 100<br>= 750/35*40 x 100 = 54% |
| Utilization Rate (%UFO) | The **%**UFO rate is referred to the %F times by the %O.<br>**E**xample:<br>% F = 63<br>% O = 54<br>Hence, the %UFO = [63*54/100] = 34 |

### 2.1.4  Budget Resources for Space Utilization Survey

This sub-section will outline the choices of budget resources for the space utilization survey. The budget is vital because it is one of the main factors that the space utilization survey is not broadly used; due to the financial constraints.[33, 35-36] There are internal and external resources of budgets as well as the combination budget from the former and latter.

The internal resources are from the HEIs top management office, or the internal budget of the faculty/ department. Meanwhile for the external budget consists of four resources. They are from the Federal Government, the State Government, statutory departments and any other parties. The next choice is from the combined budget from both internal and external parties. The budget is required for data collection, data analysis and to prepare the report of the space utilization survey.

### 2.1.5  The Timeframe For Space Utilization Survey

There are three categories for the implementation timeframe of the space utilization survey. They are continuous, periodic and ad hoc basis. Meanwhile, a common timeframe for space utilization survey in the U.S, U.K and Malaysia HEIs is a full week.[1, 12, 15-17 20-23, 29, 32-33, 35] The full week surveys are usually conducted during the peak period in a semester, i.e. after the course registration completed[33, 35]

The continuous space utilization survey usually carried out for the whole year or for a whole semester. For space utilization survey that conducted in periodic timeframe, the survey took place weather once in three months or four months. The third choice for conducting the survey is ad-hoc basis. This unplanned way of conducting survey may took place at any time to meet any fulfill sudden needs of the HEIs of faculty/ department.

### 2.1.6  Methods of Space Utilization Survey

Space utilization survey methods can be divided into three.[19] The survey can be conducted using space timetable, booking record, and space usage record.[9, 12, 14-17, 19-21, 23, 32-35] The data can be obtained through web, e-mail, faculty/ department or walkthrough visits.

### 2.1.7  Space Utilization Survey's Executor

In conducting space utilization survey, the executor is one of the main aspects to be considered by the HEIs management. There are three categories for the executor, consists of internal, external and the cooperation from the first and second parties.[1, 9, 12, 14-17, 20-21, 23-24, 29, 32-33, 35-37]

For the internal executor, the staffs and students of the HEIs usually will play their part in the survey. Meanwhile, external executor can be from the existing services staffs appointed by the HEI, consultants, or government agencies such as the

Department of Survey and Building Audit. The executor of the third category is a combination of the above two categories. The selection of survey executor depends on the purpose of the survey as well as the financial constrains of the HEIs.

### 2.1.8 Data for Space Utilization Survey

Three types of records or data needed for the space utilization survey; the implementation records, space identity (ID) as well as the space utilization records. The data can be found in schedule form, booking records or actual space usage. It also can be attained in softcopy or hardcopy. [1, 9, 12-17, 20-21, 23-24, 29, 32-33, 35, 37]

For the first type of data (the implementation record), they are consists of when the space utilization survey was conducted, the executors ID, and the method of implementing it. The second is the space ID records, i.e. building number or name, the space name, room category and, etc. The third type of data required includes space total frequency, total occupancy as well as the maximum hours of room usage. Diversity of data is essential in creating a variety of analysis and data manipulation.

### 2.1.9 Categories of Academic Space

In general, an academic space includes rooms for teaching and learning (T&L) i.e. lecture rooms/ halls, seminar room/ halls, computer labs etc. Meanwhile, research laboratories, studios, postgraduates working stations are falls under the research room type. There are also academic spaces that designed for specific use, function or purpose only such as, examination hall; auditorium and 24-hours study room. Meanwhile, the third category is the seminar room and lecture room.

### 2.1.10 Maximum Hour of Space Usage

Lastly, this subsection is to determine the maximum hours of space usage that has been applied in the space utilization surveys. The maximum hours of space usage per week set by the university plays a very important role in fluctuation of obtained space utilization rate[20]. There are seven groups of maximum hours of space usage consists of from 0 to 19 hours, 21 to 29 hours, 30 to 39 hours, 40 to 49 hours, 50 to 59 hours, 60 to 69 hours, and the use of more than 70 hours a week.[1, 9, 12-17, 20-21, 23-24, 29, 32-33, 35, 37] Of that, the 30 to 39 hour a week is the common maximum hours set by many HEIs.

### 2.2 Database of the Space Utilization Survey (PDKPR)

The database of space utilization is a place where the storage process, updating, analysis and data manipulating to occur[19, 20]. PDKPR contains record of the implementation of space utilization survey, space utilization records as well as space ID records. [1, 9, 12-17,

[20-21, 23-24, 29, 32-33, 35, 37] The records include raw data and information from the data analysis.

### 2.3 Interpretations and Remedies of Space Utilization Rates (INTERPRU)

The last component for the space utilization model is the interpretation and remedies for the achieved space utilization rates. The interpretation of the utilization rates are as follows:

i)     25%, accepted[30]
ii)    not satisfy, <25%, satisfy, 25-35%, good, > 35, [33,15-24]
iii)   50% %F, 65% and %O, 77%[35]
iv)   F,66%, equitable[4]
v)    30% - merely accepted[10]
vi)   Not satisfy, satisfying, good, and excellent. This refers to the level of space's condition[11]
vii)   Under-to Low, <20%, Low-to-Reasonable,20-40%,Reasonable-to-Intensive, 40-80%, Intensive-to-Over, 80-100%[12]

Meanwhile, the available remedies are, building new space, space renovation, space sharing, space relocation, space refurbish or retrofit, space upgrading, renting out of the underutilized space, increasing the utilization of the existing space. [1, 9, 12-17, 20-21, 23-24, 29, 32-33, 35, 37]

From this, it can be concluded that to interpret the space utilization rate, four categories of interpretation can be proposed, which are unsatisfactory, satisfactory, good and excellent. Meanwhile, nine choices of remedy consist of space refurbish or retrofit, renting out, space sharing, space renovation, space upgrading, apply for room sharing, apply for leasing of academic space and lastly to apply the additional space or new building.

## 3.0 METHODOLOGY

The methodology used is a qualitative approach. Three interviews and six focus group discussions (FGDs) [2, 4-8, 13-15, 18, 26, 31, 35-39] carried out as data collection methods. For the data collection of objective one, literature review, an expert interview trough emails and two FGD were used. The first FGD was participated by eight academics, an industry player, four PhD candidates and a Master's students. This followed by five academics of multiple Malaysian universities for the second FGD. Following that, the third FGD of this study was conducted as a data collection start point of the second objective. It involved the first FGD participants. After that the fourth FGD conducted which participated by twenty four members of Directors of Works Council of Malaysian Public Universities/ *Majlis Mesyuarat Pengarah-Pengarah Pembangunan IPTA* (MPPIPTA) of seventeen Malaysian public HEIs. This followed by interviews on field experts before the fifth FGD took place which involved the same participant from the

first and third FGD. The data flow diagram (DFD) used to design the model which represents the components inside the model and the working process invovles[31].

To verify, validate and evaluate this study and its findings, a FGD and a group interview were conducted. All data were analyzed using content analysis which inductively grouped the respondent's statements into thematic groups. [2, 4-8, 13-15, 18, 26, 31, 35-39] The findings are discussed, in the Section 4.0.

## 4.0 FINDINGS AND DISCUSSIONS

### 4.1 Space Utilization Model for HEIs

The space utilization model for HEIs consists of three main components and five process of implementation. The five processes are an adaptation of the system development life cycle SDLC model.[32, 3] Table 3 shows the components as well as the processes of the implementing space utilization. This further shown in Appendix 1, which used DFD to explains the processes inside the model.

**Table 3** Work Flow for the MPRA

1. Start, after an order received by the management
2. Identification of the type of survey needed by the management
    2.1. Complete survey continue to number 3
    2.2. Manipulating existing data continue to no.5.1.4
3. Formulation of alternatives on how space utilization survey will take off
    3.1. Selecting the implementation alternatives of SUS (APKPR)
        3.1.1. Selected alternatives
4. Implementation
    4.1. Pilot survey
        4.1.1. Selected alternatives testing
        4.1.2. Review on the selected alternatives
    4.2. Working process calibration
        4.2.1. Working process
    4.3. On-site SUS
5. Evaluation
    5.1. SUS database (PDKPR)
        5.1.1. Data entering
        5.1.2. Data updating
        5.1.3. Data analyzing
        5.1.4. Data manipulating
    5.2. Interpretations and remedies(INTREPRU)
        5.2.1. Interpretation of the rate achieved
        5.2.2. Remedies for the interpretation
6. Verification
    6.1. Report preparation
    6.2. Report verification
    6.3. Report distribution and acknowledgement on further action.
7. End/ start new back to no.1 of 5.1.4

Table 3 shows that the model started with two options in implementing the space utilization, weather through space utilizaion survey or using the existing records of space utilization. If the first option is choose, there are five stages regarding the implementation of space utilization. They are identification of the needs to space utilization survey, APKPR formulation, implementation of the space utilization survey, data evaluation and verification of the space utilization survey report and further action upon the achieved rates. However, for the second option, the utilization process from this model can be implemented at the forth stage which is evaluation. As shown in Table 3, APKPR is one of the main components for this model APKPR must be formulated to carry on the utilization survey. The formulation process must decides on the definition, the purpose of survey, type(s) of analysis, budget resources, the period of survey, the method of implementation, executor, types of data, types of space and the maximum hours of room usage that will be used for the space utilization survey. Meanwhile, the second and third component of the model is the space utilization database (PDKPR), as well as the interpretation and remedies of space utilization (INTERPRU).

From the FGDs and interviews conducted, good reviews received and this model is well accepted (refer to Table 3 and App. 1). The suggestions received during the FGD, are listed in the Section 5.0. This again, shows that the finding is appreciating the previous literature.

## 5.0 CONCLUSION

This study has developed a model for implementing academic space utilization in public institution of higher education. Three main components of the model found, consisting of the alternative of the implementation of the space utilization survey (APKPR), the space utilization survey database (PDKPR) and the interpretation and remedies of the achieved utilization rate (INTERPRU). These components are the result from literature review, FGDs and interviews that were analyzed using content analysis. Meanwhile, the system development life cycle (SDLC) and DFD were adapted in model development. Thus, with all three components, this model completed by five processes to implement space utilization, which are the identification of the needs to space utilization survey, APKPR formulation, implementation of the formulated APKPR, evaluation of the survey output through PDKPR and space utilization survey report verification based on INTERPRU. This asserted shortfall-related referral in implementation of space utilization in HEIs. This in turn can increase the number of academic studies and related references. Besides, this model are creating opportunities for it to be applied in other type of space or buildings in different industry such health facilities, as well as for further researches.

## Acknowledgement

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**APPENDIX 1:** Space Utilization Model for HEIs