

TEACHING AND LEARNING SPACE ALLOCATION IN HIGHER EDUCATION INSTITUTIONS

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**TEACHING AND LEARNING SPACE ALLOCATION IN HIGHER
EDUCATION INSTITUTIONS**

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ABSTRACT

Allocating space for teaching and learning is one of the facility management main elements in universities. Increased in the number of students, courses and programmes are the main contributing factors that generate teaching and learning space allocation. Lack of management will reduce the effectiveness of teaching and learning process. The faculty's administration also does not have any computerized system that may help deliver information about teaching and learning space. A computerized system is needed for space allocation information to help the faculty to make good decisions. Thus, this research has three objectives. The first objective is to develop a conceptual framework for teaching and learning space allocation according to user's requirements. The second objective is to develop a prototype system for teaching and learning space allocation information based on the conceptual framework of user's requirements. The final objective is to test run the system based on the user's requirements analysis. In developing the prototype system, firstly, this research analyses user's requirements in teaching and learning space allocation. Next was the process for developing the system consisting of data management, analysis and presentation of teaching and learning space allocation information system. Finally, the system underwent a test run incorporating user's teaching and learning requirement that has been determined earlier. In conclusion, the system is capable of helping the faculty's administration in delivering the information about teaching and learning space as systematic manner. Recommendations for future research includes consideration of other aspects of user's requirements of teaching and learning facilities, system's technical improvement, method of determining the user's requirements and more advanced spatial analysis for development of a better system.

ABSTRAK

Pengagihan ruang pengajaran dan pembelajaran merupakan salah satu elemen utama pengurusan fasiliti di kebanyakan universiti. Peningkatan bilangan pelajar, kursus dan program, merupakan penyumbang utama kepada pengurusan pengagihan ruang pengajaran dan pembelajaran. Pengurusan yang lemah boleh mengganggu proses pengajaran dan pembelajaran yang efektif. Pihak pengurusan fakulti juga tidak mempunyai sistem berkomputer untuk membantu penyampaian informasi ruang pengajaran dan pembelajaran. Sistem berkomputer diperlukan untuk pengagihan maklumat ruang bagi membantu pihak fakulti dalam melakukan keputusan yang baik. Lantaran itu, kajian ini mempunyai tiga objektif. Objektif pertama ialah membentuk sebuah konsep rangka kerja untuk pengagihan ruang pengajaran dan pembelajaran berdasarkan keperluan pengguna. Objektif kedua ialah membangunkan sebuah model sistem bermaklumat untuk pengagihan ruang pengajaran dan pembelajaran berdasarkan rangka kerja keperluan pengguna. Objektif terakhir adalah untuk menguji sistem berkenaan berdasarkan kajian keperluan pengguna. Dalam membangunkan model sistem berkenaan, pertama, kajian ini menganalisis keperluan pengguna terhadap pengagihan ruang pengajaran dan pembelajaran. Seterusnya adalah proses membangunkan sistem dengan mengambilkira pengurusan data, analisis dan persembahan sistem maklumat pengagihan ruang pengajaran dan pembelajaran. Akhir sekali, sistem tersebut diuji berdasarkan keperluan pengajaran dan pembelajaran yang telah dikenalpasti pada peringkat awal. Rumusannya, sistem ini berkemampuan membantu pihak pengurusan fakulti dalam menyampaikan maklumat terhadap ruang pengajaran dan pembelajaran secara bersistematik. Cadangan kajian masa hadapan yang diutarakan termasuklah mengambilkira keperluan-keperluan lain pengguna terhadap fasiliti pengajaran dan pembelajaran, meningkatkan keupayaan teknikal sistem, kaedah mengenalpasti keperluan pengguna dan analisis spatial lanjutan untuk pembangunan sistem yang lebih baik.

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

“Good planning comes from good information and good information comes from a good system”

Calkins, (1972) in Hamid B. Hj. Mar Iman, (2006)

Considerable development in IT can bring benefit to the FM industries especially in business support process (Mawson 1994; Hinks 2002). Facilities managers are now looking forward for information technology (IT) due to the potential of IT in delivering good decision making, better support for core objective, greater control of the assets base, reducing overhead cost, increasing facilities performances, improving transparency in monitoring and competitiveness (Lunn & Stephenson 2000; Swift 2000; Pitt & Hinks 2001; Wan & Chan 2007). The role of IT has turned the data in FM to be important for the users and its management as it enhances innovative businesses through the management of the operations, supply chains, business supports and customer satisfactions.

In higher education institution, educational facility is the attractive key to encourage research as well as to fasten knowledge creation (Price et al., 2003). Facilities managers should not only aim to optimize the running cost of building but also to increase the efficient use of its assets and facilities. The question is how to link the needs of the users to the space management within the existing physical environment? Grimshaw (1999) argues that for a change towards a better facilities management system, organization, employees and information must be linked together. This is further supported by Alexander (2003) that adaptation to change in management and measurement issues in FM is a key for effective facilities implementation of future organization. Thus, efficiency can be created by linking the organization with its physical environment in which it operates (Amaratunga & Baldry, 2000). Therefore, this research carried out a combination of user requirements on facilities issues and the needs of information technology on helping the management process.

Research focus is the resource service in higher education environments which the scope is the teaching and learning (T&L) space allocation. The research will gathered out the requirements from the user's perspective on allocating the T&L space. With the result and finding on the user requirements analysis (URA), it will lead to a development of a conceptual framework. This result will be success factor of the research which will explain what the requirements on users view are. After the conceptual constructed, these will be the basis of the information system developments which the second focus of this research. The system may focus on delivering and display the information to its users as the purpose of allocating the teaching and learning space in the university. Therefore, with the system develop it will help the administration as decision making for managing the T&L space systematically and ultimately satisfying the need of the users.

1.1 RESEARCH PROBLEM STATEMENT

“The distribution of the available areas of space among a number of objects with different sizes so as to ensure the optimal space utilization and the satisfaction of additional requirements and/or constraints” (Burke et al., 2001)

Marmolejo (2007) cite that two of ten critical higher education facilities issues from the APPA (Association of Higher Education Facilities Officers, 2006) are the resource scarcity and affordability and the information technology. The main resource in higher education institutions is their teaching and learning (T&L) space. T&L space must be managed properly by the facilities manager. The reasons for managing and planning the space are to optimize its physical resources, to assist in time table planning, as well as to support the teaching and learning of subjects (Fauzi A. Wahab, 2005). Therefore, space strategies have to get involved in facilities management, thus, the quality of the space can be achieved and influences the performance of the people (McGregor, 2000).

Space allocation problem is not a new issue within higher education environment. It has been discussed and researched, by many researchers from all over the world including Sharma & Kumar (1985) - issues on space allocation in academic departments high rise building, Burke & Varley (1998)- issues on higher education requirements, Beynon (1997)– issues on physical higher education facility requirements, Schaerf (1999)– issues on automated time table for higher educational institutes, Burke & Varley (1999) - issues on automating space allocation, Burke et al. (2001)– issues on space allocation process, Silva & Beng (2003) – issues on Meta heuristic and multi objective approaches for space allocation and Beyrouthy et al. (2007)– issues on space allocation splitting problems. These researchers tried to find out the best solution and requirements to fill in the gap in space allocation planning of higher educational institutions. Indeed, the user’s requirement is very important in the facility management in higher educational institutions (Burke & Varley, 1998). Improvement in the

operational flexibility necessitates that facilities have to meet the needs of the clients (Douglas et al., 2008). Therefore, the challenge is how to manage the resources and meet with the user's requirements.

According to Burke & Varley (1999) there are three main constraint satisfactions on allocating the space such as resource specific requirements, ensuring grouping and close proximity of resources and ensuring distance between conflicting resources. The requirement has been explain in technical report by Varley (1997). However the requirements from the users view is still less inform in the articles and each university will have its own constraints and opinions as to what requirements should be satisfied to make a good allocation of space. Thus, the facility managers have to understand the business that property resource is supporting the academic faculties or department needs According to Housley (1997), there is conflict of understanding of the need of users in institution between estate directors and academic faculties. He suggested that it is important all parties to be involved in the facilities management. Hafizal B. Ishak (2009) found that space allocation has to consider the requirement of its users. From the research he found that there are several requirements from the user in T&L space allocation such as space location, class timetabling, class capacity and equipments which highly required by the lecturers and students and were not fully provided by the faculty administration. Therefore, the challenge is how to manage the resources and meet with the user requirements.

Today, higher education institutions are facing with the new millennium challenge in facilities management. The increasing number of students, departments, courses, staffs, facilities and assets are the factors of why a system must be revisited for better facilities management (National Assets and Facilities Convention, **NAFAM**). According to Esparcia-Alcázar et al. (2008), problem on allocation are the lack of suitable tools to perform the task which still using hand base method (manual approach). Amaratunga & Baldry (2000) cite the main problem in facilities management in higher education institution is the ongoing use of traditional management control and one of it affecting the misleading information on decision making Waheed & Fernie (2009)

explained that traditional perception in role of physical assets and related service is exploiting for the effectiveness of core competency. Thus, they purpose a new perception which is the role of physical assets and related service must have it core competence itself.

Albicini et al. (2006) discussed the problems in work prioritization processes. Generally there are ten problems highlighted, but it can be categorized into four main aspects which are maintenance, financial system, customer response and record keeping. These are the areas identified to be solved by the computerized processes. Research by Wan & Chan (2007) shows that facilities management (71%) is the most requested as compared to the campus helpdesk (25%), tenancy (3%) and remote operation centre (1%) by the campus users. In other findings, however, they showed that user also require services in terms of access to campus system, PC application, e-mail and files service. However, according to Michael (2004) until recently, higher education still paid little or no attention to data that can aid in their management for decision making. This is supported by Hamid B. Hj. Mar Iman (2007) said that the information storage in people is ineffective because they tend to forget easily. Therefore, the traditional method has proven to be a problem in many aspects of management and it has been debated for over than ten years.

As discussed above, the research focuses on two main issues which are the higher education environments issues and the traditional method of managing the facilities. In higher education environments, the research will lead into two aspects which are the strategy aspect that highlighting the need of determining the user requirements and the second aspect are the space management which focusing on the space allocation perspective. These two aspects (user requirements and space allocation) are much related to each other as for allocating the T&L space as required by the users. Base on the pilot study held in several faculties, user's (lecturers) usually change their timetable provided by the faculty because of the timetable is not suitable with their requirements such as room not suitable with user numbers, not suitable with subject teach, room location is not necessary, room installed with non suitable equipments and

furniture and the equipments is not available and lack of numbers. These problem shows that room allocated for the users are not suitable which is not according to the users need and may lead to inconvenient environments of study.

The statements are supported on the lecturer’s survey on their perceptions on the T&L space in the faculties and timetable suitability provided by the administration. Crosstabs is use as for the analysis method and the result shows that half of the respondent do not agreed with the time table provided with 17/30 respondents. The unsuitable timetable provide by the faculty lead to the needs of changing time slot with 23/30 respondents agreed. Therefore, the problems on allocating the space without taking consideration on the user requirements are exist within these faculties.

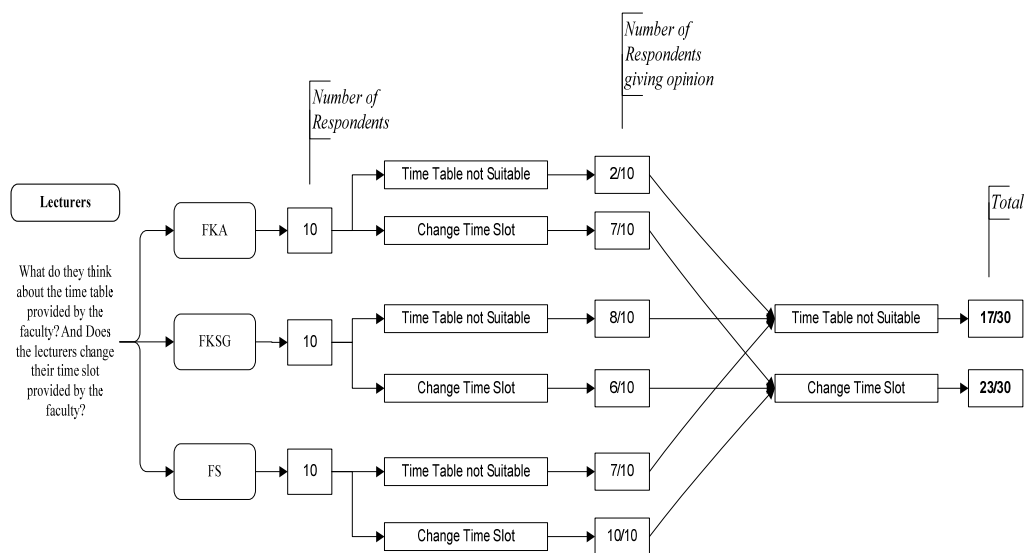


Figure 1.1: Lecturers Perception Analysis on Timetable Aspect in Selected Faculties

The second aspect of the research is focused on the traditional method of managing the facilities in the university. The administration is using manual method to pass on information and space allocation. Base on the survey from the staff in charge in managing the T&L space in the faculties, they still using manual method on allocating T&L space, hence they do get a lot of misleading information to the users. Thus, they require a more efficient system that can bring information to their users.

According to the SMG (2006) survey revealed that many space managers working centrally within HEIs may not know full details of room capacities and the number and type of workplaces, particularly in specialist areas or in non-centrally timetabled parts of the estate. They may not know real demand for space in terms of how many hours of what type of activity, or be involved at an early stage of developing strategic plans.

Based on 17 responses from HEIs through the telephone survey, access for managers to base data on contact hours and group sizes is mixed. Some do not have access. Some could have access but didn't use the data. One respondent could get the data if necessary, but would need to go to four different sources. Others have partial information, such as for lecture theatres, but not for how many hours the specialist space is needed and what group sizes will occupy it. They may not know the number of workplaces available in different types of space. There is often even less information about how nonteaching areas are used. Similarly in UTM, based on the survey from the staff that in charge on managing the T&L space in the faculty's shows that they still using the manual method on allocating their T&L space and received many lack of misleading information to the users. Thus, they required a system that can give information to their users as for T&L space purpose. **See Table 1.1.**

Table 1.1: Pilot Study among Selected Faculties on Staff Perception.

Num.	Faculty	Manual Method Used	Report on Lankness Information	Comments
1	Faculty of Science (FS)	√	√	The faculty needs to have a system that can bring information to the users especially the

				classroom.
2	Faculty of Civil Engineering (FKA)	√	√	Similarly with other faculties, they argue that a need of new system for allocating the space and meet the user requirements and time saving giving the room information to the users
3	Faculty of Geo information Science and Engineering (FKSG)	√	√	The faculties still base on manual method which lead to none standardize information to the users.

Therefore, the research are to identified what are the requirements from the user's for the allocating the teaching and learning space? What are the elements need to be considered on the requirements aspect? How to solve the lankness on giving the information? How it may help on delivering the information to the users? How a system can be developed? And what are the elements must be considered on the user requirements views for the system? The research issues and problems can be described in Figure 1.2.

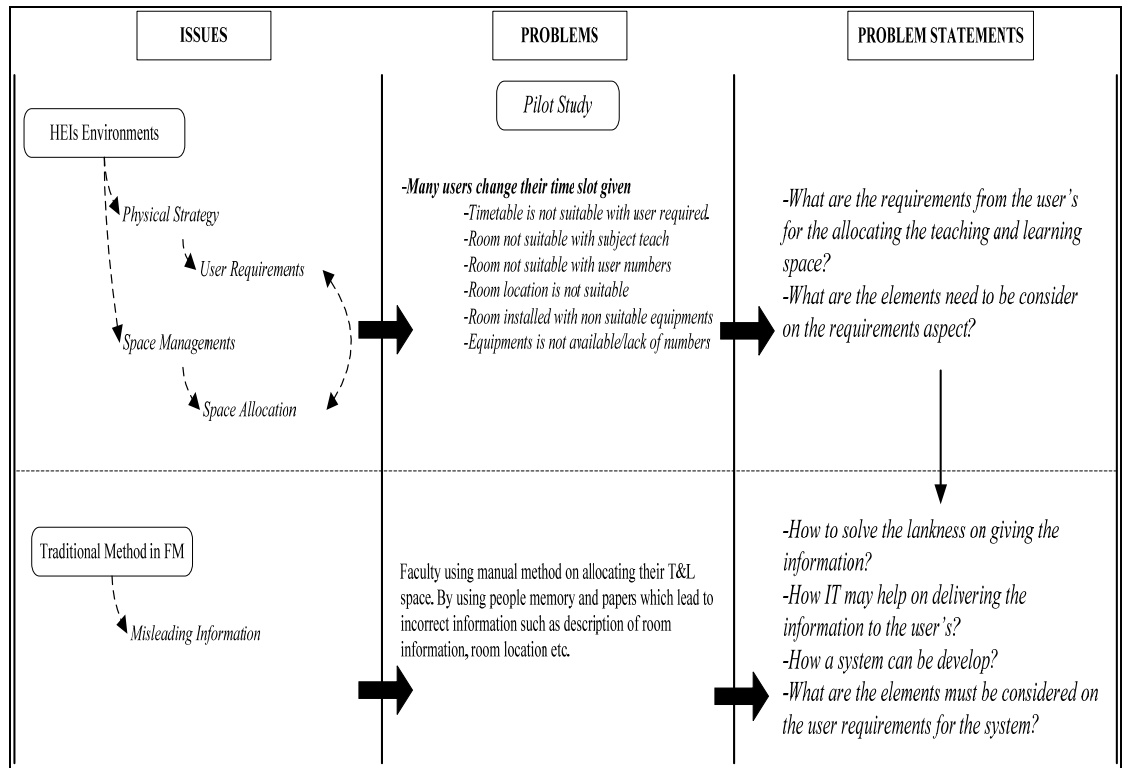


Figure 1.2: Research Issues and Problems Flow and Relation

Base on the previous research by Hafizal (2009), there are four main elements which are required the most by the users on allocating the teaching and learning space, such as space allocation, class timetabling, class capacity and equipments. Therefore, these elements are used again as basis of this research on allocating the teaching and learning space within higher education environment with additional scope of study. Previous research only highlighting the user requirements in Faculty of Geoinformation and Science Engineering which the basis is social science, however for this research, the scope are goes wider. The requirements for two other basis of study also been tackled, which are the pure science basis and pure engineering basis which lead for data collecting within additional two other faculties. Faculties selected are the Faculty of Science and Faculty of Civil Engineering which representing the two basis of study. Therefore, more requirements within different base of study are draw down for the user's requirements conceptual framework.

Since there are times constrain and budgeting for this research, the system only developed within Faculty of Geoinformation and Science Engineering. Similarly with late research by Hafizal (2009), with additional improvement of the system. Previous research is using the ArcView software as basis on developing the system. As for this research, the ArcGIS which is improved software by ESRI is used with combination with other software such as Microsoft Access and the HTML presentation. Therefore, the developed system is more users's friendly and advance capability compared to the previous system.

1.2 RESEARCH OBJECTIVE

The objectives of this research are:

- i. To develop a conceptual framework for teaching and learning space allocation according to the user's requirements.
- ii. To develop a prototype system for T&L space allocation information based on the user's requirements.
- iii. To test run the system based on the user's requirements analysis.

1.3 RESEARCH SCOPE

The scopes for this research are:

- i. The elements that are studied for this research are the four main elements on teaching and learning space allocation in higher education such as the space allocation, class timetabling, class capacity and equipments.
- ii. The research focuses on three faculties which are the Faculty of Science, Faculty of Civil Engineering and Faculty Geo-information Science & Engineering in

Universiti Teknologi Malaysia, Skudai, Johor only to determine the user's requirements.

- iii. In determining the user's requirements for space allocation, data collection involves only undergraduate students, lecturers and staffs in time table planning in those faculties as respondent for this research.
- iv. Only Faculty of Geo-information Science & Engineering in Universiti Teknologi Malaysia, Skudai, Johor is chosen as a case study for the prototype system development.
- v. Data such as site maps, building floor plan, and equipments data (i.e. numbers, condition, types etc) provided by the faculty are used for system database attribute.

1.4 RESEARCH LIMITATION

Limitations of the research are:

- i. This research is only taking into account T&L space allocation problem. Other problems in traditional facilities management in higher educational institutions are not being studied here.
- ii. Time table development is not being studied.
- iii. Time table for postgraduate classes will not be studied too.
- iv. Only one faculty is chosen to be studied (FKSG, UTM) for the prototype Teaching and Learning Space Information System development, while other faculties can be reviewed in future research.

1.5 RESEARCH METODOLOGY

This research has four stages to complete:

1.5.1 Stage 1: Definition, Problem Statement, Concept and Objective of the Research

At this stage, the definition and concept of this research is identified. The research is the combination of facilities management on user's requirements and space allocation aspect incorporated with the information technology (IT) capability. The research will answer problems identified from the users for allocating the teaching and learning space. What are the elements needed to be considered on the requirements aspect? How to solve the lankness on giving the information? How it may help on delivering the information to the users? How a system can be developed? And what are the elements that must be considered from the user's requirements? Therefore, the question of the research leads to its objectives, such as to develop a conceptual framework for teaching and learning space allocation, to develop a prototype system for T&L space allocation information based on the user's requirements and to test run the system based on the user's requirements analysis. Thus, a clear view of the research will be generated and helps in organizing and managing the research to the end.

1.5.2 Stage 2: Data Collection on User Requirements (Achievement of First Objective)

At this stage, the user's requirements for teaching and learning space allocation have to be investigated and analyzed. The respondents are the users of the T&L space. The investigation is covering Faculty of Science, Faculty of Civil Engineering and Faculty Geo-information Science & Engineering in Universiti Teknologi Malaysia, Skudai, Johor only. According to Flavin (1981), user's requirements can be analyzed through user's interview and questionnaires. Therefore, as for the purpose in determining the user's requirements, interviews and questionnaires are used.

1.5.3 Stage 3: System Design and Development (Achievement of Second Objective)

After analyzing the user's requirements for the T&L space allocation at the faculties, the system can be developed. The design of the system has to be based on the conceptual framework. The system will be based on WEB and can be explored by using Internet Explorer. In addition, the system also is combined with a small portion of GIS capability; therefore one of the softwares used for running the spatial data system developments is the ARCGIS. With the system developed, the second objective of the research can be achieved.

- Spatial Data: Drawing of UTM maps and Faculties building floor plan (FKSG).
- Attribute Data: Facilities data (Room Information; Information of the inventories; T&L space location and its information).

Computer software involve for the prototype interface system development:

- *Arc GIS*: Converting the CAD drawing format to GIS application format.
- *Auto CAD*: Drawing the maps and building floor plan for the system.
- *Microsoft Visual Studios*: Scrip creation for Web base interface.

1.5.4 Stage 4: System Test Run (Achievement of Third Objective)

At this stage, after the prototype system has been developed, the system has to be tested. The test run concept is to determine whether the system is capable of delivering the information to the users. Elements to be considered on the system test run stage are the main four elements used for allocating the T&L space. Therefore, with the system developed, combined with the analysis of the user's requirements, the system can be test run based on those requirements.

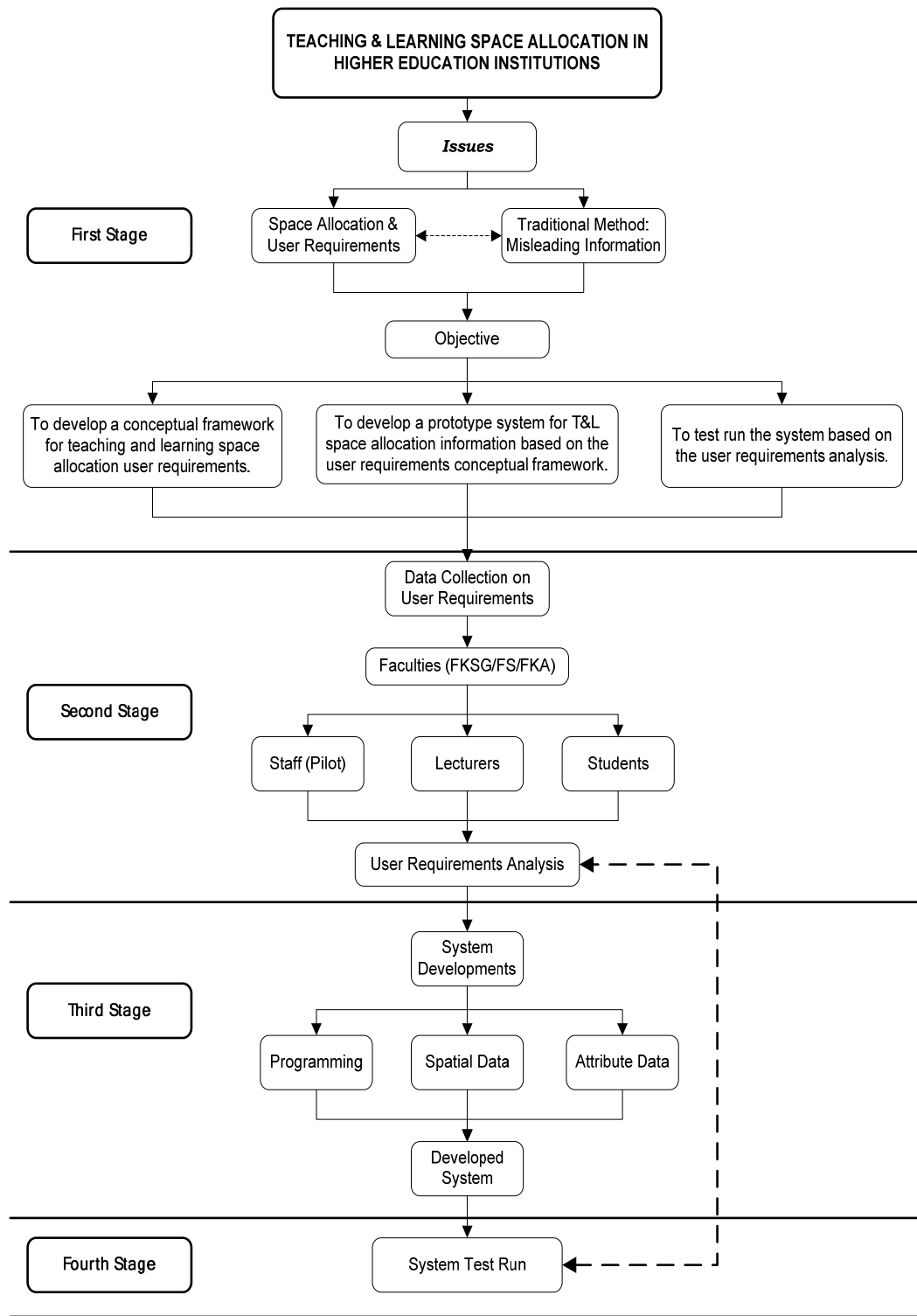


Figure 1.3: Research Methodology Flow Chart

1.6 STRUCTURE OF THE THESIS

Chapter 1: [INTRODUCTION].

This chapter gives an introduction of the topic of the research in the thesis. It presents the problem statement, research objective, overview of the research methodology, scope and limitation.

Chapter 2: [LITERATURE REVIEW].

This chapter presents the state-of-the-art literature review on topics related to FM. It also presents the role of facility manager in higher educational institutions, space allocation and user's requirements in higher education.

Chapter 3: [LITERATURE REVIEW].

This chapter presents the GIS application including the definition, elements, its benefits, integration with FM industries and its application to the higher education sector.

Chapter 4: [RESEARCH METHODOLOGY].

This chapter describes the method that is going to be used in this research. It shows how this research is conducted including discussion in questionnaire survey, interface system development and user's simulation method. Also discussed in this chapter is the background of the case study (UTM).

Chapter 5: [DATA COLLECTION AND ANALYSIS].

This chapter describes the data collected from the site. The data collection for user's requirements is discussed in this chapter and development of the conceptual framework for teaching and learning space allocation.

Chapter 6: [SYSTEM DEVELOPMENT]

In this chapter, the discussion will go through step by step in developing the prototype system for teaching and learning space allocation.

Chapter 7: [System Test Run].

This chapter discusses the test run of the system developed in Chapter 6. The test run will demonstrate on how to generate the information required in the system base on the conceptual framework.

Chapter 8: [CONCLUSIONS AND RECOMMENDATIONS].

This chapter will draw the main conclusions and summarizes them against the objectives set for the study.

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