

A GREENWAY NETWORK FOR UNIVERSITY CAMPUS

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1.0 Introduction

Provision of quality living and learning setting is crucial for staff and students in university campuses. Buildings and roads are essential infrastructure to ensure safety, security and comfort to the campus users. Inasmuch, greenway also plays a crucial role for healthy and responsive working and learning environment. Greenway network is greenery and interconnected linear open spaces formed by treed streets, waterways and drainage ways around and between urban areas, at all spatial scales (Little, 1990; Smith, 1993; Gobster and Westphal, 2004) where people can use it to reach places of work or study (Toccolini et al., 2004). Thus, campus greenway composed of treed street, walkways, drainage ways, lake corridors and trails (Dober, 2000; Tan, 2006). It connects and organized every fragmented open spaces or buildings as well as facilitates people movement in and around campus under safe and comfortable conditions in natural settings. The greenway allows campus residents to undergo their daily activities such as walking, jogging, biking, experiencing nature, watching people, meeting friends, displaying artworks and many more. According to Tzoulas et al. (2007), in campus, it can be greenery that promotes healthy society. This means greenery and open spaces are not just amenities but also an interconnected network of ecological systems that conserve air, water, microclimate, energy resources and enriches human quality of life. Tolley (1996), suggested that students might prefer a university with a vast green area as their conducive places to study. Campus greening is one of the approaches taken to achieve environmentally

good campus through improving and maintaining all the landscape elements in campus as well as other recreational facilities (Habib and Ismaila, 2008). Campus greenway can be an instrument for greening a campus by connecting every open spaces with other spaces, as an alternative route to facilitate users' movement and social space for community integration in comfort and pleasant settings (Conine et al., 2004; Tan, 2004). Greenway in campus may also offer an opportunity to preserve the remnant green spaces, which almost disappear from a campus scene due to a development pressure.

1.1. Problem Statement

Campus is a unique place with a distinctive community with green spaces such as streets, squares, amphitheaters, courtyards, small gardens and lakes. It also accommodates buildings such as student centers, offices, halls, childcare facilities, shops and sports arena. The activities conducted in and around these buildings, physically and socially occur throughout the day (Balsas, 2003) and consequently the campus tends to suffer from the pressure of development in order to cope with the rapid emergence of communities demand for their facilities and amenities. Habib and Ismaila (2008) explained that campus sustainability has become a global issue among the university administrators, policy makers, planners as well as stakeholders. Thus, Balsas (2003) suggested that the development for campus infrastructure should be provided or maintained without jeopardizing the quality of campus environment.

Since 1970s, many universities in Malaysia have gone through many physical changes. Inevitably, campus is losing its green spaces due to the needs of more spaces for parking, new buildings and off-campus housing area (Balsas, 2003). Shuhana et al. (2007) found that most of universities in Malaysia are practicing scattered development pattern. This piecemeal fashion of development fragmenting all spaces and has caused highly demanded areas in campus such as clinics, sports

center and recreational area isolated and difficult to access by the users. Dober (2000) suggested that campus may be perceived as a landscape environment which can be designed or redesigned. One can enter the campus gateway and traverse in and around it and as such it should be connected. Connectivity and continuity is important because it allows users to move from one space to another. It also provides a transition from one type of landscape element to another to form a landscape structure. For example, a row of shady trees along the roadside gives a sense of direction for the users. Connectivity can be disrupted by the breaks that occur along the route or corridor. A landscape with several numbers of breaks is a lack of connectivity and is considered as suffering from fragmentation (Thorne, 1993). Serrano et al. (2002), have defined that fragmentation is “the landscape's lack of connectivity, the mechanism that causes it and the subsequent alteration of ecological processes”. Ville and Rosea (2001) noted that the number and severity of breaks along a given stretch of corridor determine connectivity. The lack of connectivity may lead to the difficulties of user's accessibility (Shuhana et al., 2007). Eventually, according to Quayle (1995) this scenario is turning some spaces to be neglected or confused.

Disorganized campus expansion is the second factor, which caused green spaces, to be converted to buildings and roads. Lim et al., (2006) explained that due to the urgent need of facilities, many natural assets in Universiti Sains Malaysia such as undulating terrain, huge heritage trees and water bodies were destroyed to give way to the new buildings and parking spaces. According to Balsas (2003), campus expansion has resulted campus user's to rely too much on motor vehicles as their mode of transportation, thus contributed to the reduction of air quality, increased traffic congestion and the gradual loss of campus greens to allow more parking spaces. The loss of green spaces in campus may affect campus microclimate. At the National University of Singapore, Wong et al. (2007) found that there are ‘hot’ and ‘cool’ spots at many parts of the campus. By using thermal satellite image, cool spot indicated by the green color, which means that the area is highly vegetated area and yellowish color indicates ‘hot’ spot, which means the area, is less or no vegetation. This study also noted that the temperature differences between these two areas are as

high as 4°C in the afternoon and 3.3°C at mid-night. Clearly, the greenery plays an important role for keeping the campus microclimate is comfortable and gives more benefits for user outdoor activities.

At present, none of the 23 governmental universities has applied the concept of greenway network successfully. Much of the land use zoning and buildings as well as open spaces are not connected by the green network that affords well being, physically and socially.

1.2. Research Gap

From a literature of review in greenway, it is found that there is lack of study on a greenway in campus planning as a green linkage for every open space and other space particularly in campus context (Conine et al., 2004; Tan, 2004; Khalid, 2006; Parker et al., 2008). A study on campus environment done by Tolley (1996) emphasized on domination of private car usage in campus, which has affected the quality of its environment. Inasmuch, his study suggested a bicycle-friendly campus because it is environmental friendly transportation mode as it produces no air or noise pollution, acquires little space, and is fast and cheap. Similarly, Balsas (2003) added that sustainable transportation planning strategy on college campuses is necessary, such as by changing a commuting mode from cars to walking and bicycling. His study suggested too that by walking or cycling is much faster and at no costs and has health benefits too. In addition, Shannon et al. (2005) explained that walking, cycling and using public transport are physically active transportation form. These activities will reduce demand on parking space as well as can improve campus community's health. Aldrin et al. (2006) added that walking is a good culture and practice for a healthy lifestyle for campus community. The walking culture can be created through an integrated planning and creation of pedestrian network in a campus garden-like setting.

In sum, based on previous studies it can clearly be understood that many researches only focused on promoting a walkable and bicycle-friendly campus environment without any consideration on the need to link every space in campus by using landscape elements and structures, which can be incorporated into the greenway. Once the network of open spaces and green spaces is established, it may help to elevate the ambience of the whole settings for generating campus communities' life and activities. Therefore, there is a need to study the role of campus greenway as a linking element to connect every space in campus for the benefits of campus environment and its community – physically and socially.

1.3. Aims and Objectives

The aim of the research is to study a greenway network as a strategic approach for linking all fragmented spaces and buildings in university campus to enhance and create campus quality and identity. To achieve these aims, the following research objectives are formulated:

- i. To understand the concept of greenway and its multifunctional benefits as a formative device for linking all the fragmented spaces in university campus.
- ii. To formulate the typology of greenway for future campus planning in relation to its physical characteristic and spatial distribution.
- iii. To establish multiple role of a greenway network in a university campus as a space connector, alternative route and communal space.

1.4. Scope of Study

The context of the study will focus on governmental university only. The main reason of selecting on governmental university is the availability of land for the development of campus greenway compared to private university. The study will only investigate physical characteristic and spatial distribution of landscape elements and structures in greenway. Linkages are a key characteristic of greenway (Little, 1990) and are formed by natural or man-made structures such as roads, pedestrian walkways, drainage ways and lake corridor. Therefore, this study will examine what are the type of elements and structures that link every space in campus, which characterized the greenway. For example, an element such as tree will be examined according to its size, density or its continuity while walkway will be examined according to its type of surface, width, length or distance. The research will also investigate the degree of connectivity of the corridor because it will affect user's accessibility and the continuity of the corridor. The investigation may look into the identification of what are the fragmentary element occurred along the greenway corridor that affect the degree of connectivity between two or more points connected by the greenway. Eventually, the study will recommend design criteria and its typology for a campus greenway planning.

1.5. Significance of Study

Over the next decades, with the uncertainty in future campus development, it is anticipated that universities will continuously adding new buildings and facilities in their campuses to accommodate more students with the increase in faculty and staff. According to Lim et al. (2006), campus is growing each year with the enrollment of new students, more spaces needed to accommodate hostels, road signage for managing traffic flows, new schools for new courses as well as parking space. In addition, Turner (1984) explained that the uncertainty in the student's enrollment was complicated as the university is changing in an unpredictable ways. This possibly twists the campus into a clog development area. Speculatively, introduction of greenway network will organize the site planning of the buildings, open spaces and

road systems as well as structuring community (Tan, 2004; Khalid, 2006). It means that the network enables the campus planners to create a quality physical environment that provides conducive milieu for working and learning as well as establishes identity to the institution (Dober, 2000). Simultaneously, the planning of the network maximizes non-vehicular travel which emphasizes the planning of integral pedestrian routes. In other words, the green network connects one cluster of buildings and spaces to another that facilitates users to walk with ease and safe under shaded and pleasant conditions, which associated, to campus quality and identity.

Alternatively, the greenway may also play a significant role in campus planning. It is able to adapt in many different contexts whether it is in urban, rural or town area, it plays multiple role such as for environmental protection, ecological protection, recreational, educational, expression and alternative route. In campus, the greenway may function as a space connector to encounter a space fragmentation due to campus development and expansion. It also may provide an alternative route for pedestrian and cyclist to boost health benefits via contact with nature when they use the greenway and promotes 'green' transportation mode. Greenway in campus also may become a communal space because it offers an opportunity to congregate and communicate through a simple greetings and smiling (Bischoff, 1995).

1.6. Research Design

Conceptualization of this study is divided into five sections: (1) Literature Review, (2) Data Collection, (3) Data Analysis (4) Results and Findings and (5) Conclusion. Figure 1.3 illustrates a flowchart of the research design.

1.6.1. Stage 1 : Literature Review

A review of literature covers two chapters. Firstly, the study of greenway network which traces the historical background, the evolution, definitions, categories, properties and attributes, the usage, potentials and benefits of greenway network activities which have been implemented throughout the world at all spatial scale. Secondly, the study of campus planning will look into a history of campus planning and its two basic common planning approaches namely, spatial arrangement and land use zoning. This stage will investigate primary vegetation, circulation route and water bodies, which structured the green character of the campus to function as a niche for an academic community. The arrangement of the land uses and its components such as roads alignment, car park area, buildings, natural features or open spaces and other spaces affects peoples who live and function in it. Thus, this literature is relatively important for planning and designing a campus greenway as a space connector, alternative route and communal space in the campus for the benefits of its users; students, faculty member, staff and visitors.

1.6.2. Stage 2 : Data Collection

The research will gather three types of data from the university campus master plan including:

- i. Existing land use pattern in University Technology of Malaysia campus in relation to its greenway distribution.
- ii. Existing greenway network such as roads and its reserves, lake-corridor, walkway and cycle-way which link element of interest or nodes such as car park, bus stop or campus gateway present in the area. The nodes may represent the origin and destination for campus users to enter and to exit the greenway.
- iii. Fragmentary elements on the existing network such as roads junctions, drainages, fences, lighting pole or directional signage and steep slope or split-level.

The former gathers data from the master plan will be observed on site to identify and verify each of the elements. A checklist form is used to record every elements or structures which exist along the greenway. This will help the study to determine and to understand the physical characteristic of existing greenway network in the study area. The variables used for this study are safety, connectivity, naturalness and variety of features (Untermann, 1984; Dober, 2000; Strange and Banning, 2001; Tan, 2004; Toccolini et al., 2006). Safety is fundamental and without question in many design consideration for people. Therefore, it will be a prime variable to be measured in this study in order to ensure that existing and future greenway is and will consider this. The degree of connectivity is a second important variable to be measured because designing a routes for movement because it allow user's to move from one space to another. Thirdly, the study will observe on the aspect of naturalness as to provide a restorative opportunities through greenway for campus community (Gobster and Westphal, 2004). Finally, the variety of features is recorded to identify whether it is available or not available along the greenway such as benches or shelter for the users to rest and pause, fountains, planters, bicycle racks, area for art display or books selling (Dober, 2000; Bischoff, 1995). According to Untermann (1984), an adequate provision of these features will contribute to a good pedestrian environment. This

variable will also help to strengthen the sense of place of the greenway as a social space.

1.6.3. Stage 3 : Data Analysis

The data will be analyzed using and Archview, a derivative of Geographical Information System (GIS) as a tool. These will assist:

- i.To identify zones and nodes that demand connectivity. They are located separately and with different types of user's activities. For instance, student's residential zone, commercial zone and recreational facilities. They need to be linked to serve as an origins and destinations of the potential greenway.
- ii.To define elements which should be included, improved or maintained whether it is natural or man-made. The physical characteristic of each element will be analyzed such as trees and its distribution, type of landscape features, corridor width and length (Tan, 2004; Parker et. al., 2008).
- iii.To determine which route has or in need of a high, moderate or low connectivity according to the number and type of breaks occurred along the corridor (Conine et al., 2004)

The checklist will rank all the recorded elements, with respect to the priority to be incorporated into the greenway system. According to Dawson (1995), the greenway is characterized by strong interrelationships between their component parts. Therefore, only physical characteristics are consider to contribute to campus greenway definition. Relative values of 1-5 are assigned for each criterion. For

example, trees are value in relation to its density, maturity and continuity of the arrangement (Tan, 2004). Table 1.1 below is an example of checklist for recording every element that has been divided based on individual characteristics:

Physical Characteristics
Surface <ul style="list-style-type: none"> • Paved • Unpaved
Width <ul style="list-style-type: none"> • < 1m • 1-2m • 2m
Legibility <ul style="list-style-type: none"> • Legible • Barely legible
Status <ul style="list-style-type: none"> • Good • Reasonable • Poor
Dangerous Section <ul style="list-style-type: none"> • For pedestrian • For cyclist
Accessibility Access <ul style="list-style-type: none"> • Free • Restricted • Prohibited
Practicability Pedestrian <ul style="list-style-type: none"> • For all • Easy • Demanding Cycle <ul style="list-style-type: none"> • For all • Easy • Demanding

Table 1.1: Greenway Network Classification (Toccolini et al., (2006))

All the data is inserted in the GIS to allow the different layers to be overlaid so as all the components which form the greenway in UTM campus can be identified and mapped. It is then will possible to identify and map the network of route that connecting with each node and zone. This will represents the characteristics of good, moderate of poor greenway.

1.6.4. Stage 4 : Results and Findings
Accommodation Zone

Legend

This stage will discuss on the results and findings based on the assessment and analysis of each elements and structures from the previous stages. The result will suggest a good physical characteristic of the routes which will generate a greenway to play it multiple roles as a space connector, alternative route and social space. Areas which demand high connectivity such as administration zone, academic zone and residential zone will represent a higher priority for linkages than other areas and should be well connected by the greenway. Based on hierarchy of network, the greenway in campus may be divided into primary, secondary and tertiary greenway. The primary greenway will link zones with other zones, while secondary greenway will link zones with other nodes and tertiary greenway is linking nodes with other nodes. Hence, the entire network will run throughout the campus that will encourage campus users to accomplish their daily activities as well as promoting quality campus environment, which associated to campus identity. The greenway may therefore be composed of treed street, pedestrian walkway, cycle path, jogging track, lake or stream corridor accompanied by variety of features such as seating, shelter, fountain, portal or signage for them to learn the riches of landscape and socializing before reaching their destinations. Figure 1.1 and 1.2 conceptualize the schematic model for campus greenway.

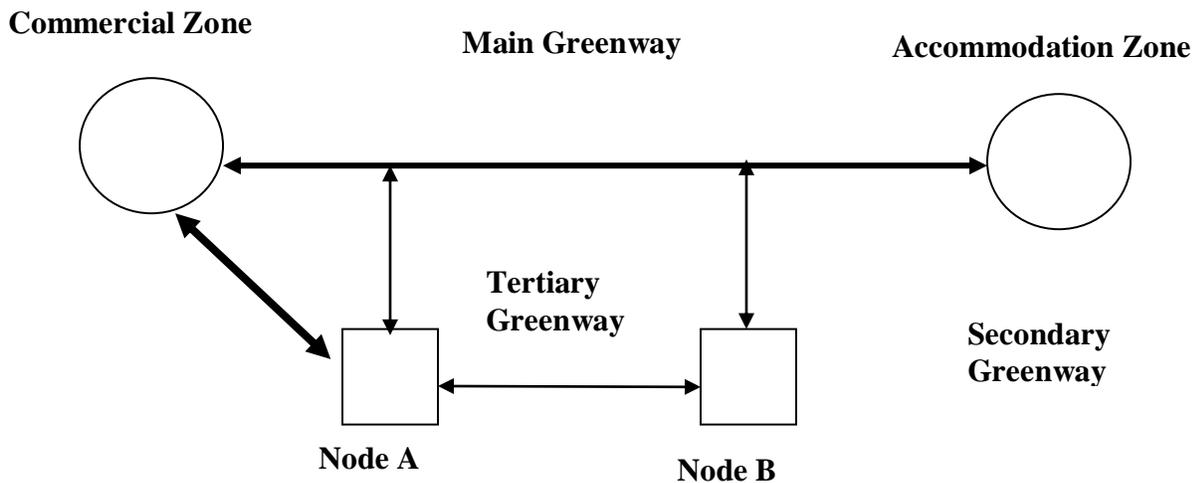


Figure 1.2 : Schematic Diagram of Hierarchy of Greenway In Campus

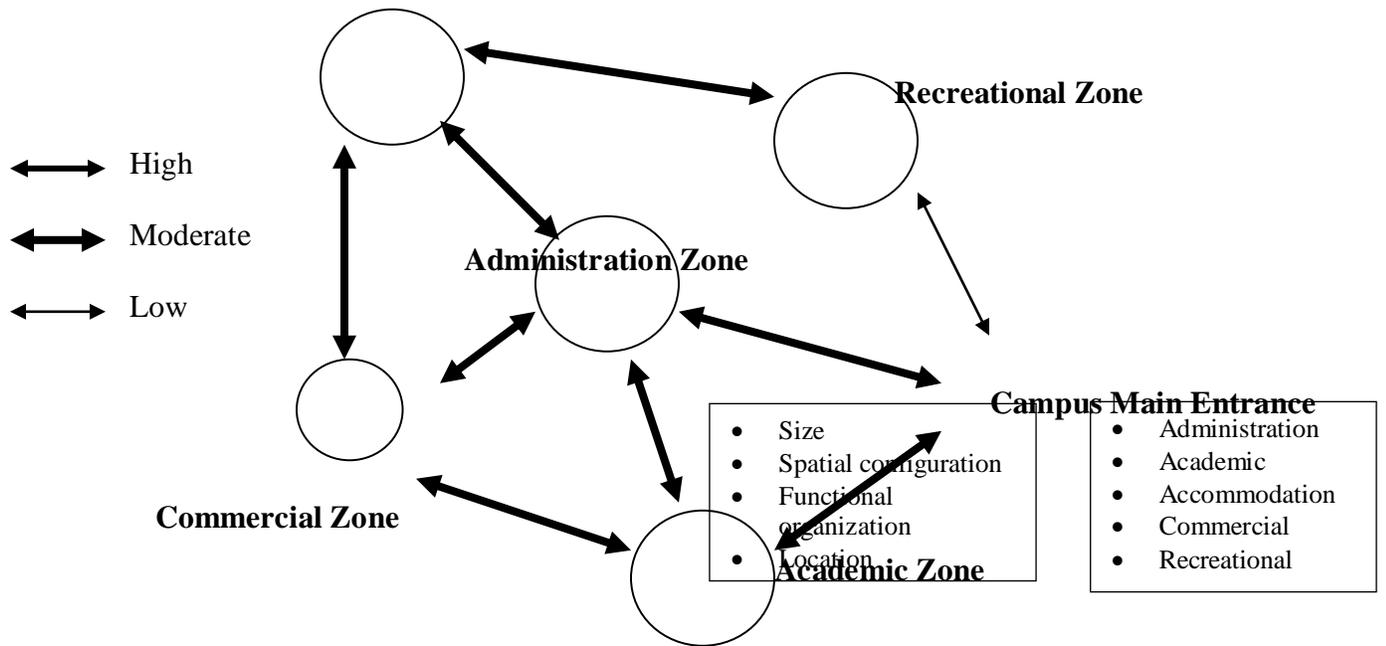
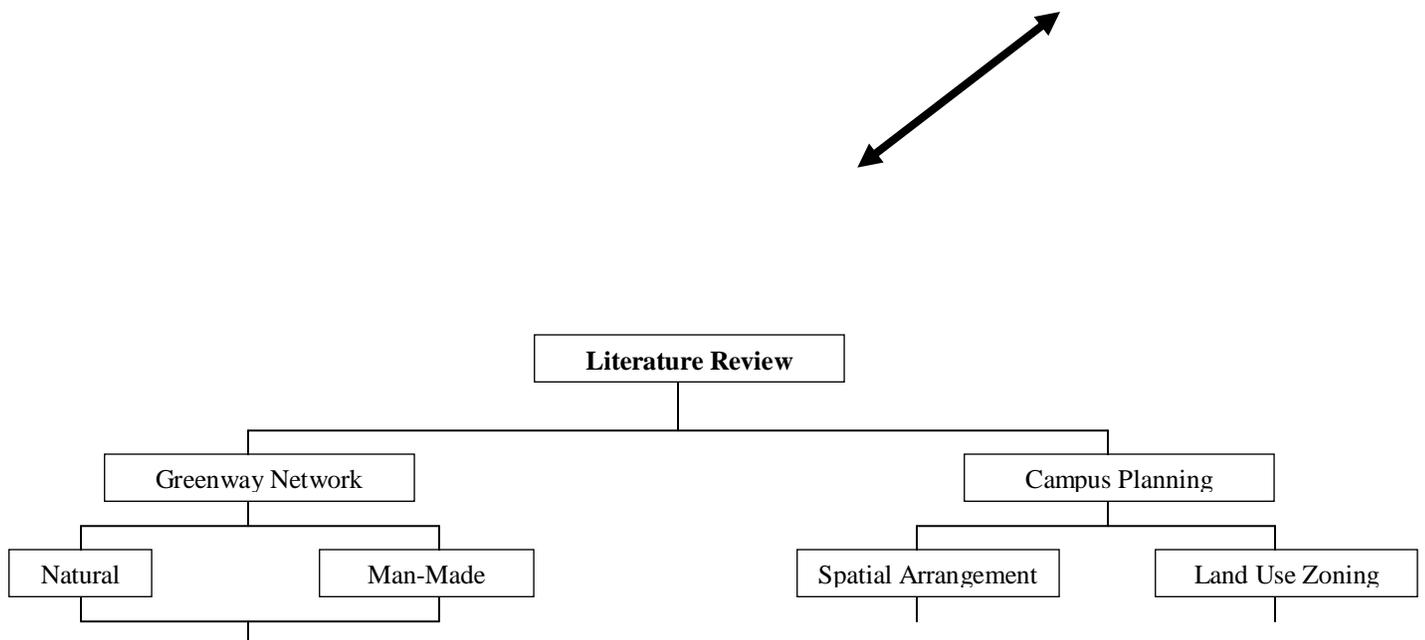


Figure 1.1 : Schematic Diagram of The Degree of Connectivity For Each Zone



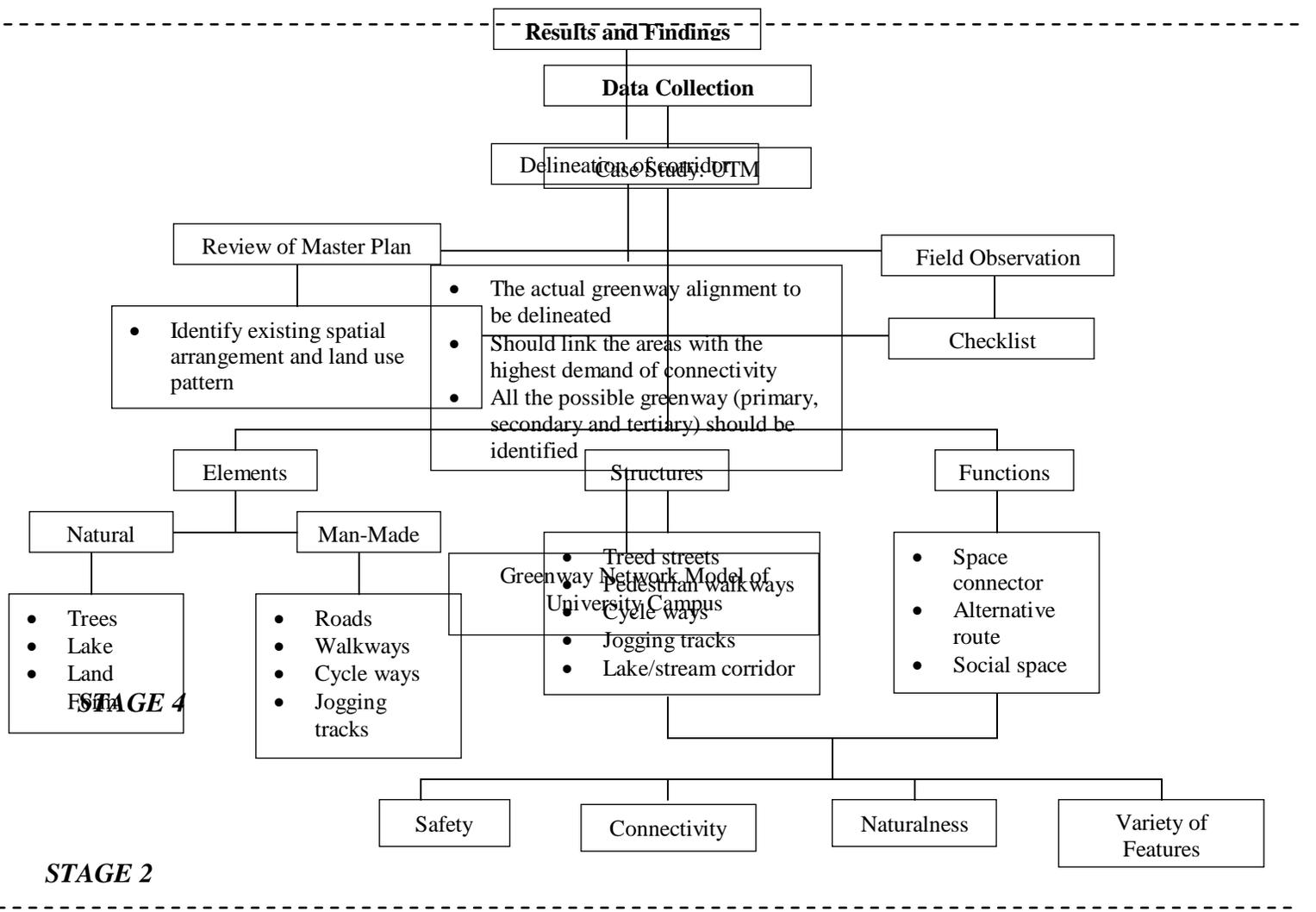
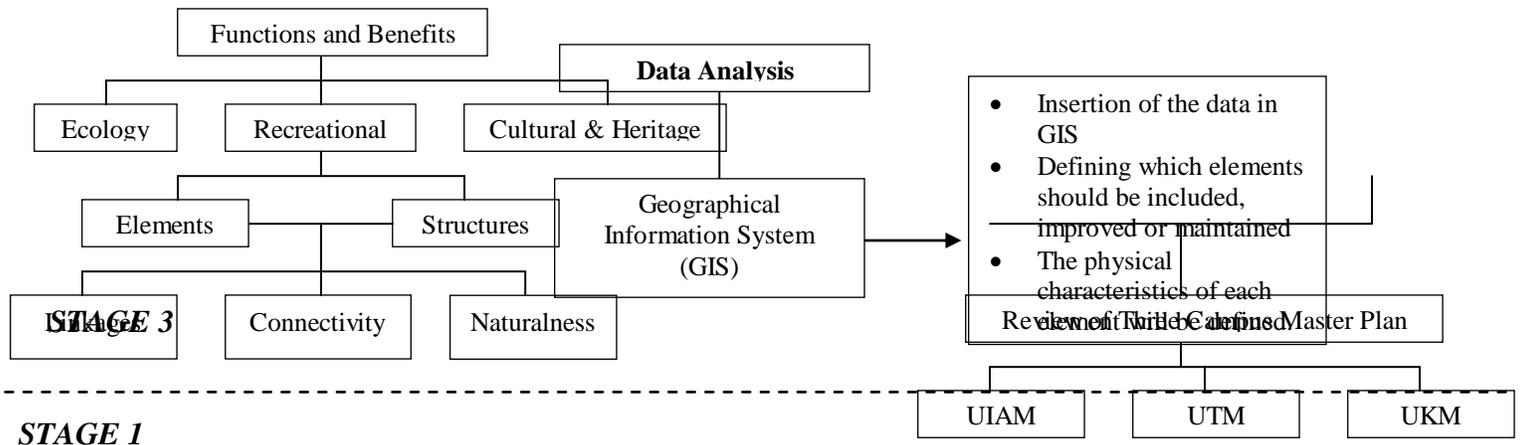


Figure 1.3: Flowchart of Research Design

1.7. Anticipated Findings

The delineation of existing and potential greenway network will allow the system to link every space together as well as facilitate user movement in and around

campus setting. This study anticipates creating a model as well as establishing the greenway network for a university campus in Malaysia. Based on the results and findings, the model of a campus greenway can be developed. The criteria for campus greenway could be:

- i. Linear element such as treed street, pedestrian walkway and cycle way, and lake corridor is linking every nodes in campus such as bus stop and car park to various zones such as administration and academic.
- ii. The arrangement of landscape elements in a greenway such as densely planted trees along the greenway will form a continuous shaded canopy which providing a pleasant condition for walker, jogger and cyclist. The continuity can also be achieved by eliminating or reducing the number of breaks such as road junctions, uncovered drain or buildings.
- iii. The campus greenway could contains variety of features such as seating area, gazebo, or fountain at a strategic section for resting and gathering as well as creating sense of place for community activities.
- iv. A pleasant surface for walkway will offer an attractive, safe and comfortable walking experience.
- v. The visible access points and landmarks such as fountain may encourage visibility and legibility to facilitate users movement in the greenway.
- vi. The hierarchy of greenway network will be determined according to its functions and locations. It may be a main, secondary or tertiary greenway. Main greenway is an axis while the secondary will act as a collector greenway before distributed to tertiary greenway. Eventually, the network system is running throughout the campus area and therefore,

the campus greenway network is established and making every space in campus more accessible to the community.

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