Parking Management in UTP Campus

By

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16962

Dissertation submitted in partial fulfilment of

the requirements for the

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Universiti Teknologi PETRONAS

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CERTIFICATION OF APPROVAL

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Approved by,

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UNIVERSITI TEKNOLOGI PETRONAS

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September 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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MUHAMMAD IZHAR BIN BAKHTIAR

ABSTRACT

Every places needs a good parking management especially in the populated area. The number of people is getting higher throughout the year. Based on the statistics, the number of residents in the well-developed country is going to be increased drastically from 2015. People who are responsible needs to balance the demand and the supply of the parking. They are playing a very important role to overcome any problems regarding this matter. Without parking management, the parking problems will never be solved. This parking problem is not only causing frustrating and anxiety among the road users, it also influences them to cheat when it comes to park. This thing happened in most of the urban areas, even in the university campus, people would love to cheat by parking at the illegal places. There are so many parking abuses that can be found in the campus. It seems like the rules of parking in the campus are meaningless for them. That is why the main purpose of this project is to improve the parking management and reduce the parking problem in UTP campus. There are so many ways and solutions to solve the parking problem based on the research papers. Some of them are quiet suitable to be implemented in the university campus.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Parking is a common problem which faced by those who live in the urban areas. To find a parking space during the peak hours is nearly impossible. Everyone is frustrated with this stressful problem as they have to face it every day unless they stay at home. For almost a century, a group of professionals have discussed on "where to park the vehicles" problem (Shaheen, 2005). Even if the government try to increase the parking space in a certain area, this parking problem would not be faded easily and still haunting the people. According to Litman (2006), adding more parking spaces is not a good idea as it can be harmful in terms of growth rate. Developing countries such as Malaysia has a constant growth rate and the population of people is keep on increasing throughout the years as shown in Figure 1.1. Building more spaces for the sake of parking may solve the problem for a while. However, as the time goes by, people are going to face the same problem again and again because of this population factor.

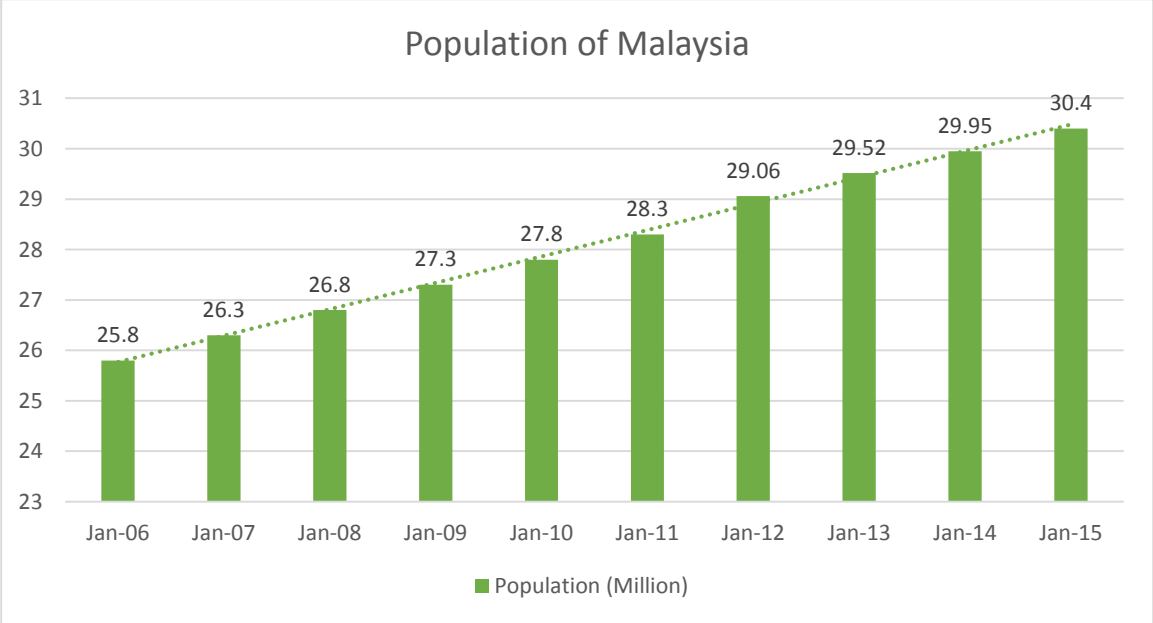

Figure 1.1: The population of Malaysia from January 2006 to January 2015

According to Shaheen (2005), a limited number of parking spaces can cause traffic congestion and frustration among the drivers. People tend to cheat when there is no available parking space. In the commercial area, it is a common thing for the drivers to double-park their car which blocking the other car from leaving the parking bay. For those who want to avoid the roadway congestion, they will park their vehicles in front of a house in the nearest residential area and take a few minute walk without knowing who is the owner. It seems like parking problem teaches people to become more creative in a wrong way.

Nowadays, people can make business by providing the parking facilities (Waerden et al., 2006). The owners will charge a certain amount of rate for the parking users. In Malaysia, normally the parking areas are built near to the stations to encourage people to use the public transportations instead of using their own vehicles. However, a convenient parking facility will always attract so many drivers causing the parking spaces to be limited. Some of the owners will surely grab this opportunity to increase the parking fees as the parking demand is high. Table 1.1 shows the current parking rate of Light Rail Transit (LRT) stations in Kuala Lumpur.

Table 1.1: The Parking Rate per entry for LRT Stations

LRT Station	Parking Rate per entry (RM)
Kelana Jaya	3.00
Taman Bahagia	3.00
Taman Paramount	3.00
Asia Jaya	6.00
Taman Jaya	7.00
Bangsar	7.00
Pasar Seni	3.50
Ampang Park	3.30
Jelatek	3.00

Based on the research study carried out by Crowder and Walton (2001), people will use their vehicles for only 500 hours and at least 8000 hours used to park the vehicles every year. This statistic shows how important the parking facilities are. That is why parking needs to be managed well by those who responsible. Parking problems are not only exist in the urban areas, it is also happening in most of the universities right now. According to Shoup (2005), a large university can be considered as a city but with a smaller scale. A typical university campus usually consists of lecture halls, hostels, sports facilities, library, cafeterias, parking areas and laboratories. A crowded campus is always going to face this kind of problem.

There are so many strategies prepared to improve the parking management in university campus throughout the year. Parking management is actually a policy used to enhance the utilizing of current parking spaces. Parking management can also provide more parking supply, reduce the demand, decreasing the traffic congestion, reducing the pollution and finding more accessible lands (Litman, 2006). It is not an easy task to maintain the sustainability of the parking space in the university campus. University is a place where the students come frequently and spends most of their time there. The problem could be worse if the university has a limited available land or budget problems (Litman, 2015).

1.2 PROBLEM STATEMENT

Universiti Teknologi PETRONAS (UTP) is one of the Malaysian private universities which was established in 1997. The campus has an area around 4 km^2 located in Bandar Seri Iskandar, Perak. Compared to the other universities in Malaysia such as UiTM Puncak Alam, UTM Skudai or USM, this university can be considered as a small campus. However, the number of students in this campus is quite high by considering that there are only a few courses offered; engineering, business and ICT. Just like the other universities, a crowded campus is always going to face the parking problem.

Almost every students supported the claim that UTP has lack number of parking spaces. This is because it is nearly impossible to find any available or empty parking spaces in the campus especially during the peak hours. There is a parking area located between Village 5 residential blocks and Pocket C that is highly demanded by the students. It seems like they have to scramble with each other to park their vehicles since to get an empty space is too difficult. The parking becomes full early in the morning. Some of them just park their vehicles at the edge of the parking area. Anything goes as long as they did not block any other vehicles.

Secondly, some of the parking areas are located too far from the block. For example, if a student who lives in Village 5 cannot find any parking spaces at the nearest parking area, he or she does not have any options but to park at other villages parking area which is inconvenient for them. Supposedly, there should be enough parking spaces in the certain residential area to avoid the parking congestion in the campus. According to the Vehicle Parking Provision guidelines, the ratio between the people and the number of parking is 2 to 1. If there is increased number of people, the parking supply must be added too.

A barrier parking system is a very common but effective system used to prevent other people from entering or using the parking area. In UTP, they are already implemented this system at staff parking area so that the parking area could not be abused. Before they enter the parking area, they need to touch the card reader by using their identification card which is only applicable for staffs. Unfortunately, out of 8 staff parking areas in this campus, only 2 of them are using this barrier parking system while the rest are free to be

used by other people. This is something that cannot be ignored by the management. If not, majority of the staff parking area will be abused by the students.

If these problems are not handled properly, it will contribute to illegal parking among the drivers in the campus. If the student parking area is lack with spaces, students got no other choice but to park on the yellow line which is against the UTP rules. Some of them use the staff parking area even though they already knew it is illegal to park there. Since there are plenty of parking spaces in that area, they just park their vehicles there. Besides, most of the staff parking area are located near to the academic block. To avoid a 5 to 10 minute walk, students tend to park there because it is much more convenient. If students caught for parking illegally, they will be fined by the guards or their vehicles could be clamped. Figure 1.2 shows the number of summons issued between 2011 and 2014 in this campus. Furthermore, lack number of barrier parking system also could contribute to this problem. That is why, parking needs to be managed well not only in UTP, but for every universities.

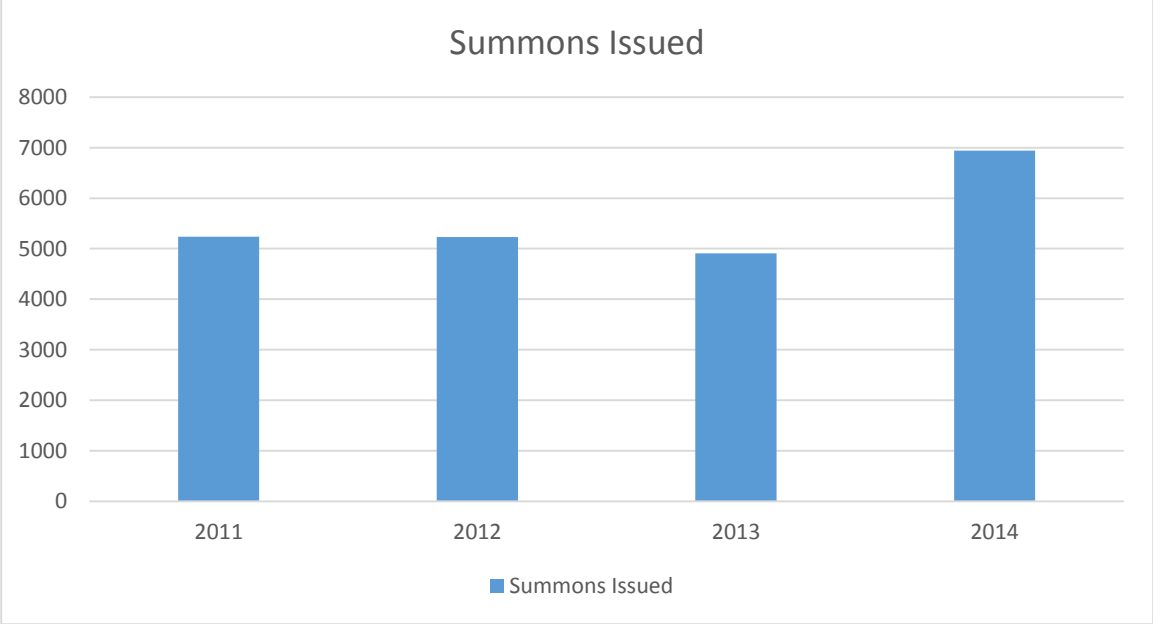

Figure 1.2: The number of summons issued in UTP from 2011 to 2014

1.3 OBJECTIVE

i. To determine the parking demand and supply in UTP campus.

ii. To observe the critical level of certain parking areas in UTP campus by making surveys.

iii. To provide solutions which capable of reducing the parking problems in UTP campus.

1.4 SCOPE OF STUDY

Universiti Teknologi PETRONAS (UTP) has been established almost 2 decades ago. The number of courses offered is less compared to other universities in Malaysia but still, the campus is crowded with people. UTP try to provide a sufficient number of parking spaces for students, staffs and vendors. Almost each part of the campus has its own parking area. There are certain parking areas that are prohibited for the students which is only allowed for the staffs. This is to ease the burden of staffs who mostly live outside of the campus.

Every students is allowed to bring their own vehicles in the campus regardless their status in the university. There is no any particular requirement to bring the vehicle. However, students have to pay RM 5 to register their vehicles at the security services. Once they have registered, they will be given a sticker which needs to be displayed in the car. Without the stickers, security guards have the power to fine the students or not allow them from entering the campus. The sticker can only last for 1 year and has to be renewed by paying another RM 2.

The number of parking spaces for automobile and motorcycle is 2923 and 1447 respectively. Supposedly, the parking spaces should be sufficient enough since not all registered students are in the campus. This is because some of the students are maybe having a semester break or going for the internship. Even a few number of staffs are also having the 4 months break. Hence, the parking problem should not be existed. Nevertheless, parking is still one of the main problems in UTP due to a few factors.

For overnight parking, the vehicles are not necessarily need to be parked at the hostel parking area. They can be parked at any other area as long as it is legal. For example, village 1 students can use the main hall parking area if there is no empty spaces left in the parking area provided. For village 3 and village 5 students, they can also park their cars on the roadside as long as they are not on the yellow line. Otherwise, they could be fined by the security guards. Students also are not allowed to park their vehicles at any reserved spaces. Those spaces are mainly for securities, vendors or wardens. Occupying the reserved spaces can cause delay in their work.

CHAPTER 2

LITERATURE REVIEW

Parking is a very common problem that happened in majority of the urban areas in the world. The rise of human population contributes to the increase of demand while the supply is decreasing. In so many years, engineers and planners have come out with a variety of ways on how to overcome this problem. Just like the urban areas, universities are also facing this kind of problem. Each semester, the intake of students is getting more and more causing the higher demand in the campus. Figure 2.1 shows the comparison between student enrolments in 2011 and 2014 in a few local universities. Based on the statistics, the number of students enrolled in 2014 is higher than 2011. Obviously, the number of transportation users will be increased. This is why parking needs to be managed well in all universities. Parking management is a program to improve the utilizing of current parking spaces (Bowerman, 2006). Besides that, Litman (2006) stated that the parking management can also reduce the demand, traffic and pollution, and to provide more accessible lands and significant financial savings.

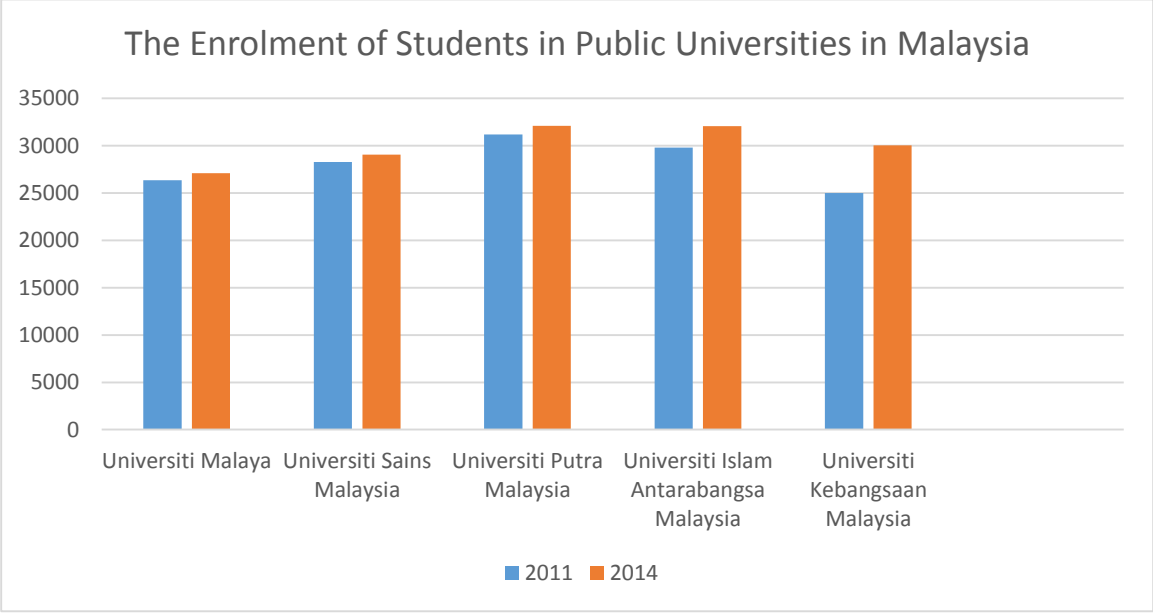

Figure 2.1: The enrolment of students in Public Universities in Malaysia

The basic step to solve the parking problems in university campus is to increase the parking spaces. If the number of students is keep on increasing throughout the year, surely the parking demand is getting higher among them. By adding more parking spaces or building new parking area, this problem could be solved for at least a few semesters depends on the intakes of the students in a university. Creating a new parking space doesn't mean they have to be built on a new land, it can also be on the existing area. In Smith College, there are no empty spaces available for constructing new parking area due to preservation of green spaces. Hence, they identify some potential existing areas around the campus that are suitable to be used as parking area. Some of the areas identified are field opposite stable area like in Figure 2.2 and tennis court access road. Around 50 to 150 spaces could be accommodated in those areas. Adding more parking spaces at the existing area is much convenient rather than constructing on a new land which requires a high cost and time.

Figure 2.2: The stable area in the Smith College

In United Kingdom, a Parking Cash Out program has been conducted at laboratories owned by Pfizer Corporation (Shoup, 2005). In this program, employees who drive to the office have to pay an amount of £2 by using their identification card. When they touch on the card reader at the parking lot, the value will be deducted automatically from their account. However, when they use their identification card to enter the building, they will be given a credit of £2 into their account. Basically, the net value of the credit is zero. What makes it more interesting is, for those who come to the office by using public transport or walk will receive an extra £2 because they don't use the parking space. At

the end of the month, the cash value will be added into their salary. This is a very good program since it encourages employees to search for other alternatives rather than driving alone. Supposedly, this program should be conducted in every universities in Malaysia as it is not only gives benefits to the students, but it can also reduce the number of vehicle usages among them. Students can use their matric identification card as shown in Figure 2.3.

Figure 2.3: UTP Matric Card for cash out program

Illegal parking is always happened in the campus. Some students really love to use staff parking area due to their own personal reasons. Parking at the wrong place is an action that against the rules and regulations of university. In a highly restricted area such as parliament and military base, they use a system known as Automatic Number Plate Recognition (ANPR) to avoid any other cars from entering to their place without permissions. ANPR is a system created for vehicle identification by detecting the plate number of the vehicles (Qadri & Asif, 2009). Basically, the ANPR system detects the type of vehicle that is going to enter the area and captures the image of its plate number. To recognize the character on the image, they use an optical character recognition technique. Then, it will display the information of the owner and the place of registration in the computer. If the system could not find any information about the plate number detected, the vehicle is not allowed to enter the area. This system could be very useful as it can determine the status of the vehicle. However, things are going to be very difficult

if the registered car is actually a stolen one and driven by unknown people. There was a test conducted by Tatale and Khare (2011) to determine the effectiveness of the ANPR system. The number of plate used in this test is 137 plates. Table 2.1 shows the result of the test. Based on the result, 45% of the number plates were captured clearly, 30% were captured blurry and the rest were skewed.

Table 2.1: The plate recognition of the ANPR system

Plates	Total number of Plates	Total number of Characters
Clear	62	425
Blurred	41	324
Skewed	34	264

In the University of North California, they encourage the students to cycle in the campus (Bowerman, 2006). Cycling is not only reducing the automobile parking space demand, it is affordable and can save the expenses of the students as they don't have to pay for vehicle petrol. To attract their students to cycle in the campus, they improve the travel facilities such as building bike lanes and widen the shoulders. They also enhance the quality of bicycle parking by providing a shaded area parking to make it more comfortable and secure. According to a research study conducted by Pucher et al. (2011), cycling has become a trend in North America countries. In urban areas particularly, the rate of cycling is much higher compared to a couple of decades ago. By enhancing the facilities and providing the promotional events of cycling, the number of people who cycles will be increased. Figure 2.4 shows the increased of bike paths and lanes per 100 000 population from the year of 2000 until 2010.

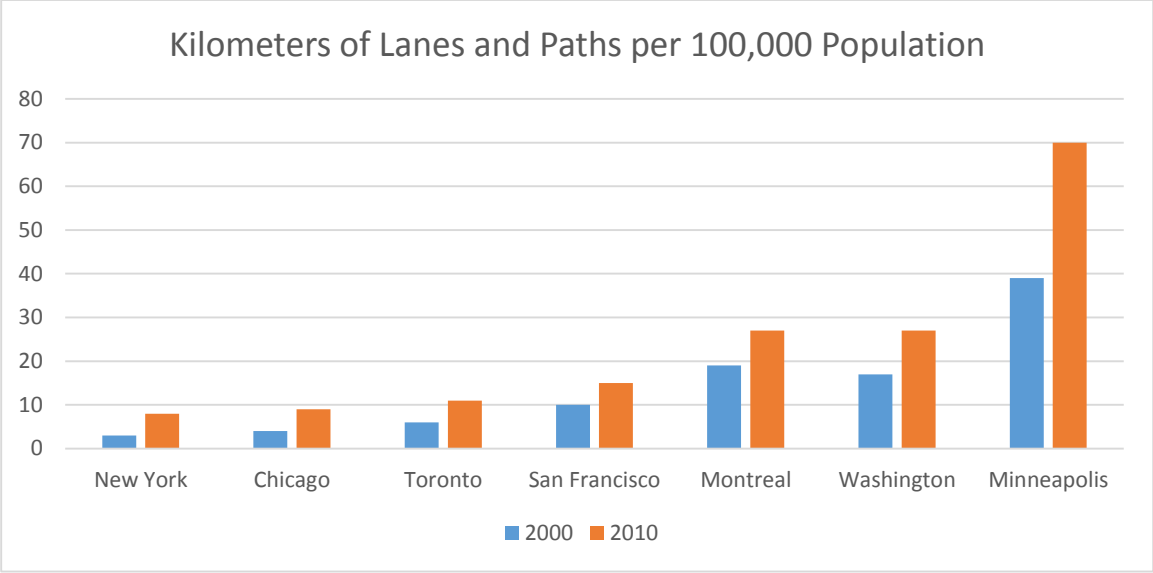

Figure 2.4: Trend in bike paths and lanes per 100,000 population in 7 large North American Cities, 2000 - 2010

Some local universities provide shuttle bus service in their campuses. Usually, they use a small bus or van for the mobility of the students. This service is quite suitable to be used for short trips like in the university campus. However, people in Malaysia prefer to drive by themselves instead of using the bus service. Majority of them argued that the bus services in this country are lack in so many aspects. There was a survey conducted to determine why people not using the bus often across Scotland (Rohani et al., 2013). The respondents were asked to give their ratings on a few bus service elements provided. Figure 2.5 shows the result of the survey conducted.

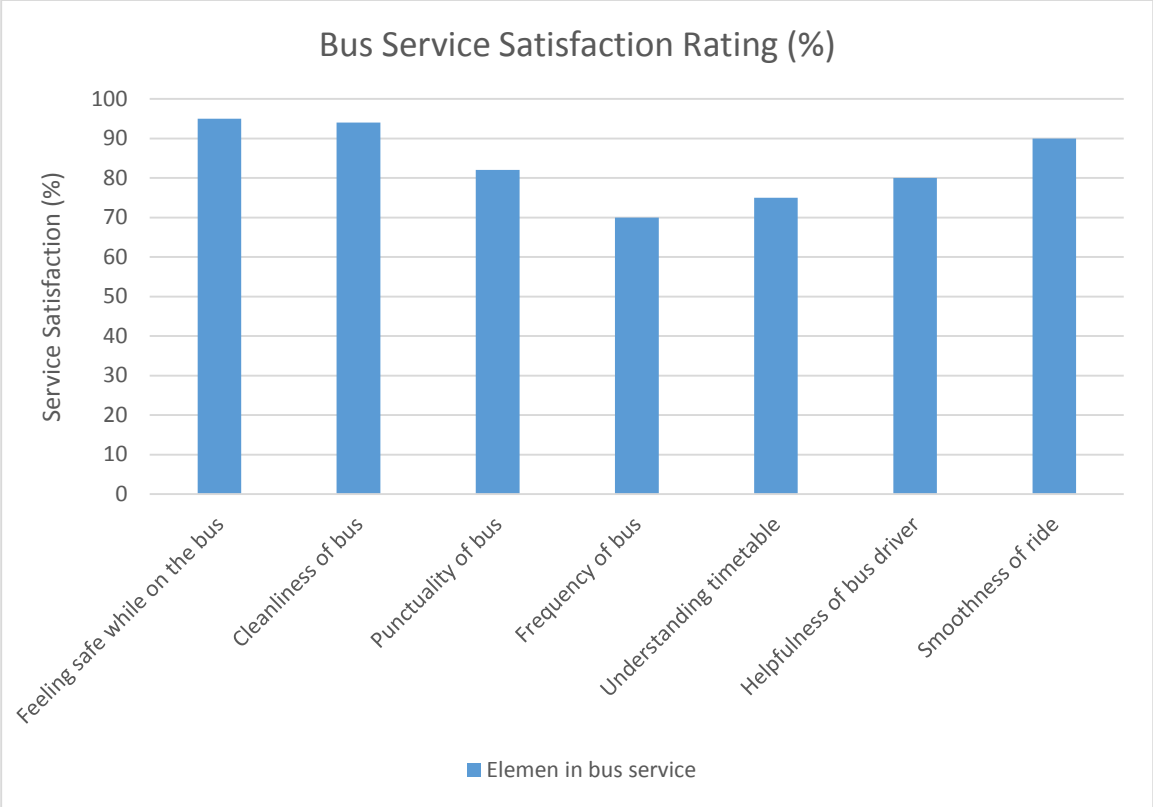

Figure 2.5: Bus Service Satisfaction Rating (%) in Scotland

Rotary parking system is a highly sophisticated parking technology created as shown in Figure 2.6. It has been practiced in some other countries like China and UAE. The main advantage of the system is to provide more parking spaces while minimizing the land space required (Hildebrand & Wernli, 1995). Basically, the construction requires only a couple of parking spaces but it can increase them to more than 10 parking spaces depending on the design. Besides, it requires just a simple concrete base and easily installed. If there is no available land for parking spaces, this rotary parking system could be the answer.

Figure 2.6: Rotary Parking System

There are only a few universities in Malaysia that provide multi-storey parking. This type of parking needs 2 important things; land and fund. A new parking area can always be built if there is any available land in the campus. However, the construction work cannot be carried out without the fund. In University of California, their current parking areas are in bad situation and need to be repaired. Because of that, The Michael K. Hooker Higher Education Facilities Financing Act agreed to finance a new parking area while enhancing the existing ones (Bowerman, 2006). The fund needed for the construction is around $700 million. Building the parking are not necessarily a good thing because most of the parking spaces are taken for the construction works. Hence, the drivers will find it difficult to park as the parking supply is decrease. Figure 2.7 shows the construction site of multi-storey parking.

Figure 2.7: Constructing the new multi-storey parking

The barrier parking system should be implemented in every university campuses. According to Zayas (2001), the function of this system is to prevent any unauthorized use of the certain parking area. In university, students are not allowed to park their vehicles at staff parking area. To ensure that they do not park illegally, the university provide the barrier parking system at staff parking area. Figure 2.8 shows one of the barrier parking system in a parking area. Basically, there is a sensor provided like in that figure. By putting the identification card on that sensor, the barrier will allow the driver to enter the parking area.

Figure 2.8: The barrier parking system

There was a research conducted by Shang, Wenji and Huang (2007) to make a parking survey in Beijing University of Aeronautics and Astronautics. There are 2 objectives of the survey; the first one is to count the number of vehicles entering and exiting the campus. The data of entry and exit times of all vehicles are collected by the surveyors. Those vehicles can be recognized by recording its last 3 plate numbers. The second objective is to identify which parking area is the most critical. The university has 6 parking areas. According to the result in Figure 2.9, parking area D is the most critical compare to the others. The parking bays in that area are almost reach its maximum during the periods 8am - 12pm and 2pm - 5.30pm. From 12pm to 2pm, the number of vehicles are less because some of the people are going for lunch.

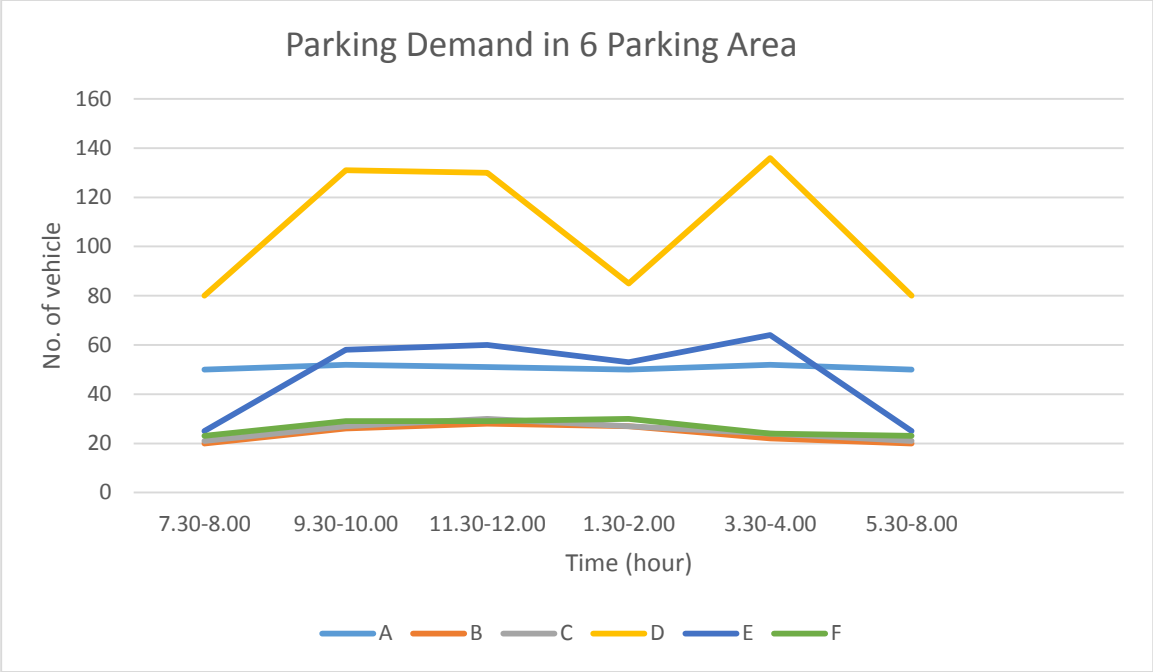

Figure 2.9: Parking survey result

Parking problem is a very serious matter in today's world. This problem could not be taken lightly as the human population is keep on increasing every day. Without any concern regarding the matter, a packed and crowded city could possibly exists. Almost every universities in the world are also facing the same problem as the number of students are getting higher. Hence, people who responsible should play their part properly. There are thousands of ways and ideas that can be used to overcome this parking problem.

CHAPTER 3

METHODOLOGY

There are 3 objectives listed for this parking management project. To achieve all those objectives, a good methodology needs to be prepared. The methodology can be used as a guideline throughout this project. For this part, all the steps required for this project are well prepared.

3.1 Objective 1: To determine the parking demand and supply in UTP campus.

3.1.1 Calculating the total number of parking spaces in the campus (demand):

There are 32 different parking areas in all parts of UTP campus including the academic block and hostel area. The demand can be determined by getting the exact number of the parking spaces by referring to the plan drawing of the campus. The drawing can be taken from the draftsman. Table 3.1 shows the number of parking spaces in certain area.

Table 3.1: Number of parking spaces for certain areas

Parking area	Number of Parking Spaces (Car)	Number of Parking Spaces (Motorcycle)	Description
Main entrance	38	20	Staff, Student & visitor
Block B	84	55	Staff & student
Islamic Center	15	25	Staff & student
CIMB Bank	16	17	Staff & student
Basement Chancellor Hall	11	30	Staff

3.1.2 Calculating the total number of vehicle users in the campus (supply):

The people in the UTP campus can be divided into 3 groups; students, staffs and vendors. It is hard to get the exact number of vehicle users in the current semester among these 3 groups since some of them are having a semester break or going for the internship. However, the number can be obtained by using a ratio method. The data needed for the calculation are:

- The overall number of students
- The number of students in the current semester
- The number of students who registered their vehicles
- The number of staff's registered vehicles
- The number of vendor's registered vehicles

With these data, the total number of vehicle users for current semester can be obtained. For example:

x = number of students in the campus for current semester

y = number of overall students

The percentage of students in the campus (%) = (x/y) × 100;

Number of students who own the vehicles for the current semester = (x/y) × 100 × number of students who registered their vehicles

To determine whether the parking spaces are sufficient for all vehicle users, compare the number of users and the total parking spaces. If the number of users are lesser, it proves that the number or parking spaces in UTP are sufficient.

3.2 Objective 2: To observe the critical level of certain parking areas in UTP campus by making a survey.

3.2.1 Make a questionnaire survey among the people in the campus:

The importance of this step is to get the opinion of the people. In this questionnaire survey, there will be 10 simple questions prepared for them to answer. Those questions are:

1) Every university needs a good parking management system in order to avoid any parking problems that could happened in the campus. Do you think UTP has a good parking management system?
2) Do you think UTP provided a sufficient number of parking spaces in the campus?
3) Barrier parking system is a common system used to prevent other people from entering the parking area. Do you think it should be implemented more in the campus?
4) There are 32 parking areas provided in the campus. Do you think UTP should build a new one?
5) Do you agree if UTP makes an exception for students who stay outside of the campus to use the staff parking area?
6) In your opinion, is it necessary to reduce the number of vehicle users among the students in the campus?
7) Do you think UTP should encourage their students to cycle instead of using motorcars or motorcycles?
8) Which parking area in the campus can be considered as critical?
9) In your opinion, why do some students tend to park their vehicles at the illegal places?
10) Do you have any idea on how to solve the parking problems in UTP campus?

The questionnaire is divided into 2 parts; multiple choice (question i to vii) and single text box (question viii to x).For the multiple choice questions, the

respondents will only have to choose yes, no or maybe. However, they can give their own opinion or idea to solve the parking problems in the campus in the last 3 questions. Any brilliant ideas will be helpful. The questionnaire can be distributed through online method such as Facebook. This is to ease the respondents to answer those question rather than using pen and paper as it is costly and quite wasteful.

3.2.2 Observe the critical parking area in the campus:

From the plan drawing of the campus, there are 32 parking areas in this university. Some of them are congested during the peak hour and some may not be used at all throughout the day. The word "critical" is typically used for the congested parking area and it can also be used for parking area that rich with illegally parked vehicles. For this observation, a few number of critical parking areas around the campus need to be identified. After making a deep thought and careful consideration, 4 number of parking areas are chosen for the observation. They are:

- Block I (Chancellor Hall)
- Block P
- Village 5 P7
- Block 13 & 14

This observation doesn't requires so many procedure. Some of the things that need to be highlighted are like:

- Number of total space (both automobile and motorcycle)
- Duration of time of the observation (peak hours)
- Number of vehicles coming in and out

3.3 Objective 3: To provide solutions which capable of reducing the parking problems in UTP campus.

For this part, all possible solutions for the parking problems should be listed. Any designs and calculations will be included to show the effectiveness of a solution. Then, a decision matrix of these solutions listed need to be created. The purpose of the decision matrix is to check the suitability of the solutions. There are 6 criteria listed in this project, the Table 3.2 shows the decision matrix that is going to be used in this project. Solutions A – G represent the solutions of parking problems. Each one of them will be given a score based on the ranking.

Table 3.2: Decision matrix for solution

Solution	Cost	Time required	Implementation difficulty	Ease of maintenance	Duration of solution	Acceptance by people
A						
B						
C						
D						
E						
F						
G						

The scoring is based on the ranking;

- Cost = lowest cost (6) – highest cost (1)
- Time required = shortest time (6) – longest time (1)
- Implementation Difficulty = easy to implement (6) – hard to implement (1)
- Ease of Maintenance = easy to maintain (6) – hard to maintain (1)
- Duration of solution = can be used for long term (6) – can be used for short term (1)
- Acceptance by people = more (6) – less (1)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Objective 1: To determine the parking demand and supply in UTP campus.

4.1.1 Calculate the total number of parking spaces in the campus:

Table 4.1 shows the number of parking spaces for both automobile and motorcycle for each parking area in the campus. Most of the area are can be used by everyone but there are some areas prohibited for the students. This data can be taken at UTP Security Services Department.

Table 4.1: Number of parking space in every parking area in UTP campus

No	Parking Area	Type of Vehicles		Description
		Automobile	Motorcycle	
1	Main entrance	38	20	staff and student
2	Sport Complex	76	0	staff and student
3	An Nur Mosque	100	202	staff and student
4	Block B	84	55	staff and student
5	Village 6	49	120	staff and student
6	Oval Park	27	18	staff and student
7	Islamic Center	15	25	staff and student
8	Main Hall	268	46	staff and student
9	Registry/ACS Office	60	38	staff and student
10	Multipurpose Hall	39	73	staff and student
11	CIMB Bank	16	17	staff and student
12	Lecture Hall Block K	17	19	staff and student
13	Block I (CH)	110	28	staff and student
14	Block I	32	58	staff and student
15	Block J	94	0	staff and student
16	Block I (Staff)	102	0	staff only, barrier parking system
17	Village 1	49	46	staff and student
18	Village 2	100	167	staff and student
19	Block P(Infront)	38	40	staff
20	Block P(Behind)	58	0	staff and student

21	Village 3	56	0	staff and student
22	Village 4	147	182	staff and student
23	Village 4(Field Area)	364	0	staff and student
24	Village 5(Cafeteria)	125	63	staff and student
25	Village 5(P7)	182	33	staff and student
26	Village 5A	243	0	staff and student
27	Basement Chancellor Hall	11	30	staff only, student vehicles are prohibited to enter
28	Block 2 Staff Parking Area	115	127	staff only, student motorcycles are allowed
29	Block 23 Staff Parking Area	61	13	staff only, barrier parking system
30	Block 15-19 Staff Parking Area	109	0	staff only, student vehicles are prohibited to enter
31	Block 5 Staff Parking Area	61	17	staff only, student vehicles are prohibited to enter
32	Block 13-14 Staff Parking Area	77	10	staff only, student vehicles are prohibited to enter

Total number of automobile parking space = 2923 spaces

Total number of motorcycle parking space = 1447 spaces

4.1.2 Calculate the total number of vehicle user in the campus:

- **Total number of students:** The students in UTP can be divided into 3 groups; foundation, undergraduate and postgraduate. The data below shows the whole number of students registered in this university including those who are having semester break or going for internship. This data is obtained from Registry & Management Services Department.
  - Foundation = 759 students
  - Undergraduate = 5325 students

- Postgraduate = 1641 students
- **Total** = 7725 students (100%)

- **Total number of parking spaces:** The data is taken at Security Services Department.
  - Automobile = 2923 spaces
  - Motorcycle = 1447 spaces
  - **Total** = 4326 spaces (100%)

- **Number of students in current semester:** The data shows the number of students for this current semester, excluding those who are having semester break and going for internship program.
  - **Total** = 3922 students

- **Number of students who own vehicles in current semester: (ratio method)**
  - Number of student's registered vehicles (Automobile) = 3594 unit
  - Number of student's registered vehicles (Motorcycle) = 1390 unit
  - Percentage of students in the campus = (3922/7725)*100 = 51%
  - Automobile = (51%)*3594 = 1833 students
  - Motorcycle = (51%)*1390 = 709 students

- **Number of staffs in the campus for current semester: (ratio method)**
  - Number of staff's registered vehicles (Automobile) = 1920 unit
  - Number of staff's registered vehicles (Motorcycle) = 265 unit
  - Automobile = If 1 staff owns 2.5 vehicles, then 1920/2.5 = 768 staffs
  - Motorcycle = 265 staffs

- **Number of vendor's registered vehicles:**
  - Automobile = 290 vendors

- Motorcycle = 340 vendors

- **Total vehicles used in the current semester:**
  - Automobile = 1833 + 768 + 290 = 2891 vehicles (Maximum number of parking spaces = 2923 spaces)
  - Motorcycle = 709 + 265 + 340 = 1314 vehicles (Maximum number of parking spaces = 1447 spaces)

The data obtained shows the parking demand is lower than the parking supply for both automobile and motorcycle. Mathematically, there should not be any excuses regarding lack of parking spaces in the campus. However, do they supply a sufficient number of parking space in the demanded areas? Some of the parking areas like Main Hall and Village 4 (field area) have a lot of parking spaces but quite a few of drivers who use them. Compared to other parking area such as CIMB for example, that area has only 16 and 17 parking bays for automobile and motorcycle respectively but the area has a high demand of parking spaces among the vehicle users. This is why the parking areas that are considered as critical need to be observed.

4.2 OBJECTIVE 2: To observe the critical level of certain parking areas in UTP campus by making a survey.

4.2.1 Make a questionnaire survey among the people in the campus:

Figure 4.1 to Figure 4.9 shows the result of the questionnaire.

1) Every university needs a good parking management system in order to avoid any parking problems that could happened in the campus. Do you think UTP has a good parking management system?

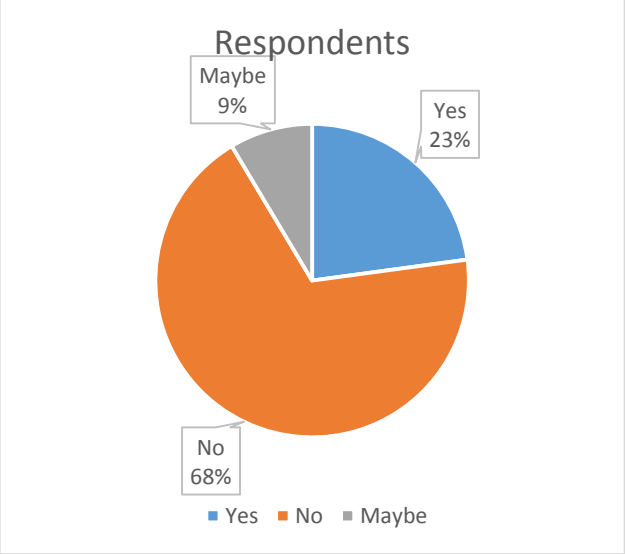

Figure 4.1: Result for question no1

2) Do you think UTP provided a sufficient number of parking spaces in the campus?

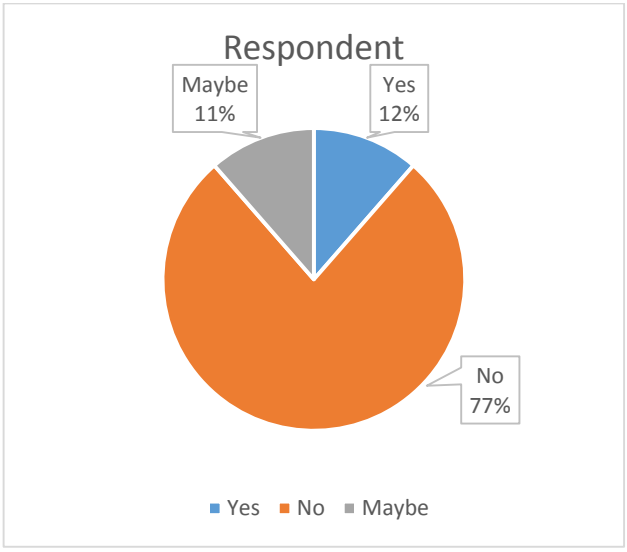

Figure 4.2: Result for question no2

3) Barrier parking system is a common system used to prevent other people from entering the parking area. Do you think it should be implemented more in the campus?

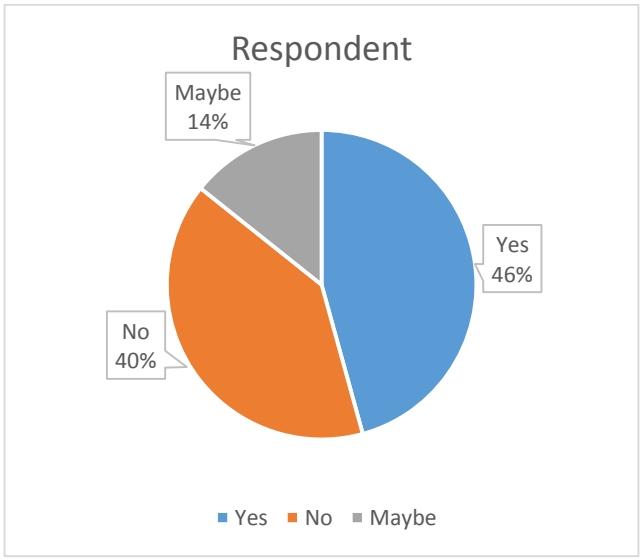

Figure 4.3: Result for question no3

4) There are 32 parking areas provided in the campus. Do you think UTP should build a new one?

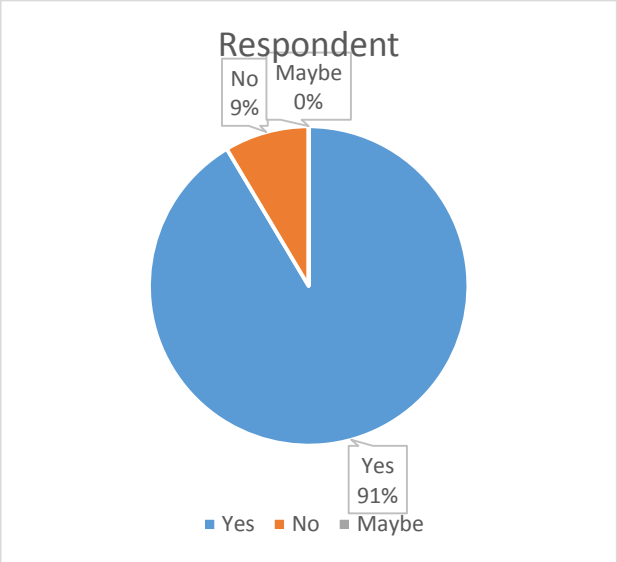

Figure 4.4: Result for question no4

5) Do you agree if UTP makes an exception for students who stay outside of the campus to use the staff parking area?

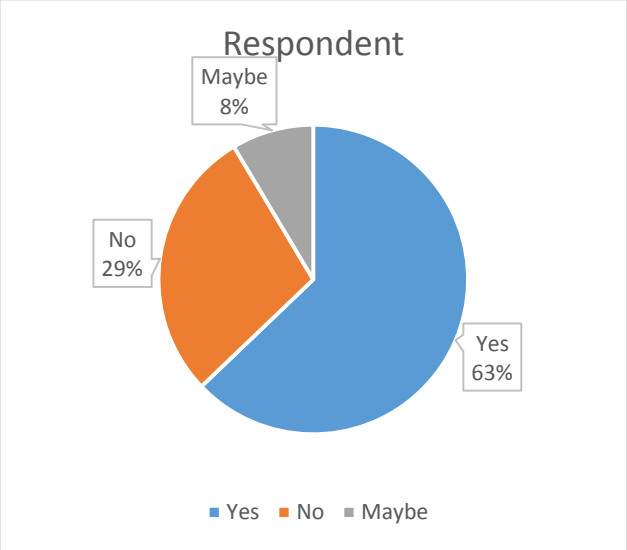

Figure 4.5: Result for question no5

6) In your opinion, is it necessary to reduce the number of vehicle users among the students in the campus?

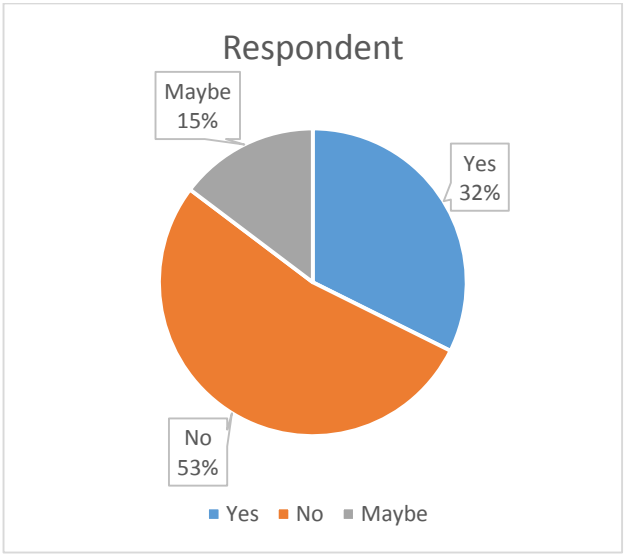

Figure 4.6: Result for question no6

7) Do you think UTP should encourage their students to cycle instead of using automobiles or motorcycles?

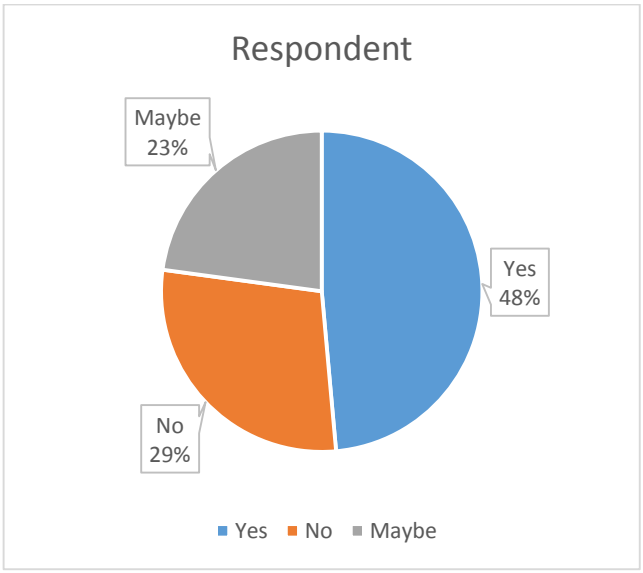

Figure 4.7: Result for question no7

8) Which parking area in the campus can be considered as critical?

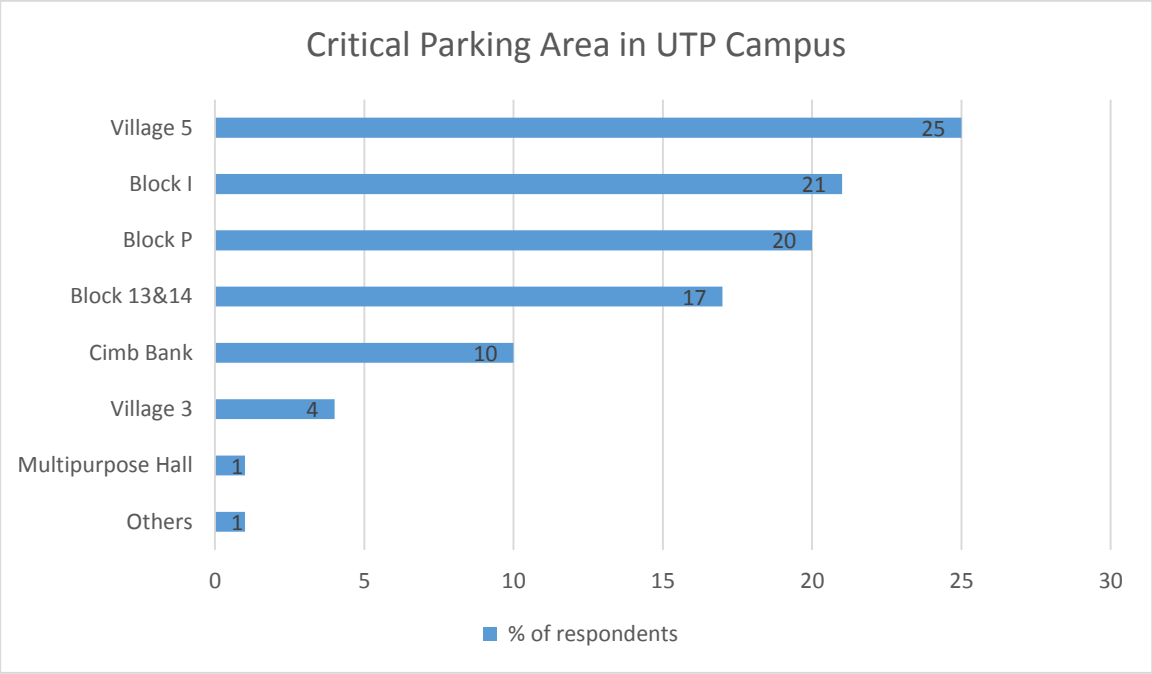

Figure 4.8: Critical Parking Area in UTP campus

Out of 70 respondents who answered the questionnaire, Village 5 parking area is considered as critical parking area by most of the respondents with 25% based on Figure 4.8. The other critical parking area chose by the respondents are Block I (Chancellor Hall) and Block P with 21% and 20% of the respondents respectively. The Civil Engineering Department parking area; Block 13 & 14 is also considered as critical by 17% of the respondents. Besides that, 10% of the respondents said CIMB parking area, which has only 16 parking bays for automobile is critical due to its small size of area followed by Village 3 (4%), Multipurpose Hall (1%) and other parking areas (1%).

9) In your opinion, why do some students tend to park their vehicles at the illegal places?

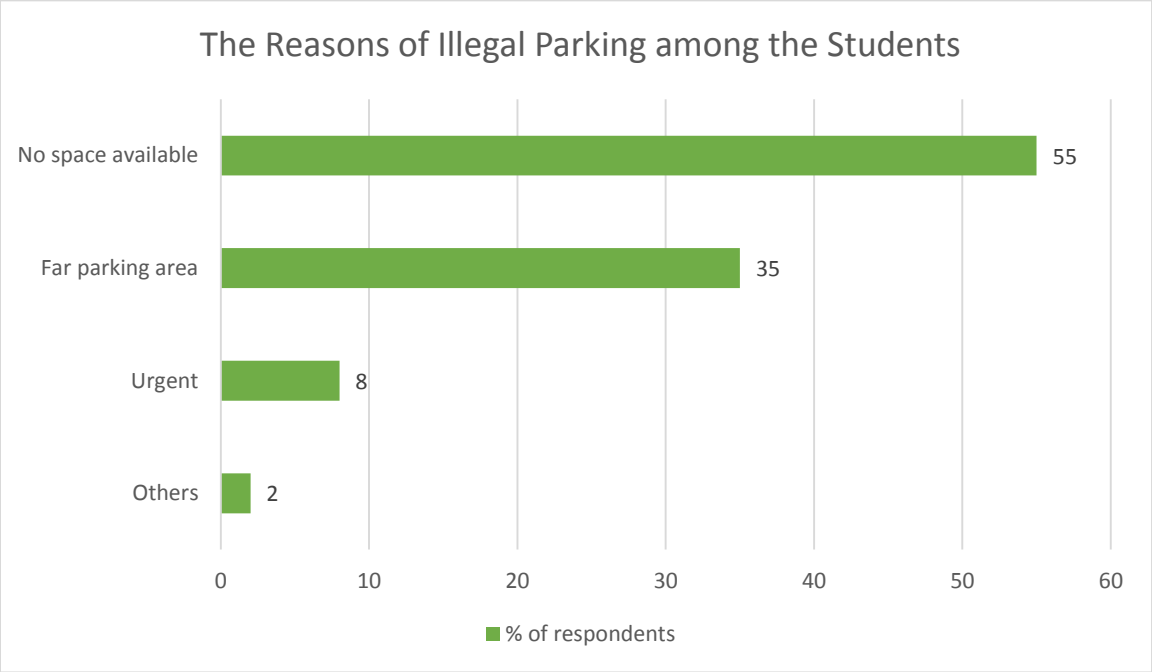

Figure 4.9: The reasons of illegal parking among the students

Based on Figure 4.9, 55% of the respondents answered that there is no available parking space for the students. According to them, most of the parking areas provided are for staffs. When the students park their vehicles at staff parking area, the security guard will have the right to sue them or even clamp their vehicles. Sometimes, the parking area provided for students is full which gives them no other choices but to park on the yellow line or at the staff parking area. Besides that, some of the student parking area is quite far from the academic block. For example, students who have lectures in Pocket C and Block 13 & 14 need to use Village 5P7 parking area for parking. This requires 5 to 10 minute walk for the students to go to the class which is not really convenient for them. Because of that, some of the students tend to park their vehicles at staff parking area.

Based on the result, 32% of the respondents answered far parking area is the cause of illegal parking among the students. Staff parking areas in UTP campus are convenient as most of them are located near to the lecture halls

or classrooms. That is why students would love to park there. Saving more time, easy to park and there are plenty more parking spaces available. Urgencies can also influence the students to park illegally according to 8% of the respondents. Submitting assignments to the lecturer and meeting their supervisors are some of the typical excuses given by the students. They are lucky enough if the security guards are not there to fine them. But still, a rule is created to be obeyed not broke. There are other reasons given by the respondents such as the security guards rarely monitoring the parking area and the students don't bother about paying the summons received.

10) Do you have any idea on how to solve the parking problems in UTP campus?

These are the ideas given by the respondents for this question:

- **Build new parking area**

  Basically, any ideas that can reduce the parking problems in the campus is acceptable. Building a new parking area either single or multilevel parking space are believed to be the most ideal way by looking at the current existing land in this university campus. There are a few available land spaces that can be used to build another parking area like in Village 4 football field for example.

- **Improve cycling facilities**

  Many universities in other countries especially in Europe encourage their students to cycle in the campus. In University of Maryland, they improved the bicycle lanes, added more bicycle parking spaces and made programs for bicycle management to increase the number of bicycle users among their students. There is nothing wrong for local universities to do the same thing as long as it gives benefits to both sides.

- **Shuttle bus in the campus**

  Shuttle bus in campus is already being operated in some other local universities such as UiTM. Since the academic block department is too far from the residential area, the university provided this service to ease the burden of the students. If this shuttle bus facility is carried out in UTP campus, at least the number of vehicle users among the students can be reduced.

- **Implementing more barrier parking system**

  Implementing more barrier parking system in the campus is mainly used to prevent the students for parking illegally. Since there are some students who love to park at illegal place, barrier parking system is always the best solution as it only allows certain drivers to enter the parking area.

- **Reduce the number of car users**

  Some of the respondents said the number of vehicle users among the students are too large because the university allows every one of them to bring the vehicles including the foundations and first year undergraduates. Some of them wants the university to update the rules and regulations by not allowing them to drive in the campus. This is not a new thing as a few other universities had already done this. They will only allow students who persuading 2nd year and above to bring their car.

4.2.2 Observe the critical parking area in the campus:

The observation is being done mostly during the working days. One parking area had been observed in the weekend, but it did not achieved the critical level as the expected. Obviously, people are not going to use the parking space that much during the weekend unless there is an event happening in the campus. For this

observation, there are 4 parking areas chosen which are Block I Chancellor Hall, Block P, Village 5 P7 and Block 13 & 14.

1) Block I (Chancellor Hall)

Total parking spaces:

- Automobile = 110 spaces
- Motorcycle = 28 spaces

The reason why this parking area is chosen for the observation is because this is the main parking area for everybody including staffs, students, vendors and even outsiders to park their vehicles here. There are 138 parking spaces in total available in this area where 110 for automobiles and 28 for motorcycles. This parking area is strategically located as it nears to the Chancellor Hall, library, Chemical Engineering Department Blocks, Fundamental & Applied Science Department Blocks and Block I. Hence, it is not surprise if this parking area becomes critical during the peak hour.

This observation is conducted from 8 am until 12 pm, the time where most of the people come to work or attending the lectures. For this parking area, 2 observations had been carried out to compare the critical level of parking between the weekdays and weekend. Tables 4.2 and 4.3 show the results for weekend and weekdays respectively.

Table 4.2: Block I Chancellor Hall observation data during weekend

Time	Automobile				Motorcycle			
	enter	out	net	Cumulative	enter	out	net	Cumulative
< 8am	0	0	0	20	0	0	0	2
8-8.29am	9	0	9	29	2	0	2	4
8.30-8.59am	8	2	6	35	1	1	0	4
9-9.29am	6	3	3	38	3	0	3	7
9.30-9.59am	4	3	1	39	1	1	0	7
10-10.29am	3	1	2	41	1	1	0	7
10.30-10.59am	2	1	1	42	0	0	0	7
11-11.29am	3	3	0	42	1	1	0	7
11.30-12am	1	1	0	42	2	0	2	9

Table 4.3: Block I Chancellor Hall observation data during weekdays

Time	Automobile				Motorcycle			
	enter	out	net	Cumulative	enter	out	net	Cumulative
< 8am	0	0	0	40	0	0	0	3
8-8.29am	12	1	11	51	2	0	2	5
8.30-8.59am	21	1	20	71	1	1	0	5
9-9.29am	33	2	31	102	1	0	1	6
9.30-9.59am	19	12	7	109	8	1	7	13
10-10.29am	2	2	0	109	3	0	3	16
10.30-10.59am	3	1	2	111	2	0	2	18
11-11.29am	2	3	-1	110	1	1	0	18
11.30-12am	1	1	0	110	2	0	2	20

Based on the Table 4.2, the net parking for automobile is 42 spaces out of 110 spaces. It is approximately 38% of the total parking spaces in that area. For the net parking of the motorcycle, there are 9 parking spaces out of 28 parking spaces which is only 32% used for the parking purpose. By making a simple conclusion, this parking area is actually a non-critical parking area during the weekend.

However, the parking area changes drastically during the weekdays. According to the result shown in Table 4.3, there are already 40 automobiles parked in the Block I parking area before 8 am, almost the same number as the net parking during the weekend. The net parking area for automobile is 110 which is 100% of the total parking spaces provided. The parking area became full between 9.30am and 9.59 am. That is why the number of automobiles coming in reduced after 10 am because there is no parking space available in the area. So for those who wants to go to the library, Block I and Chemical Engineering Block, they got no other choice but to park somewhere else unless they can find any available parking space there.

For the motorcycle, 20 parking spaces out of 38 had been used. It is around 52% of the total parking spaces. This should not be any problem for the motorcyclist as there are still a lot more parking spaces for them to use.

2) Block P

Total Parking spaces:

- Automobile = 96 spaces
- Motorcycle = 40 spaces

Block P parking area is located in Pocket D, near to the research department. Block P parking area is be divided into 2 which are; in front and behind. According to the rules, Block P in front is for staffs only while behind is for students. However, since the parking space demand of the students increase throughout the year, the in front parking area is opened for students too. Students who have class in Pocket D and Fundamental & Applied Science Department usually park their vehicles there.

Since the parking area has a very high demand, the observation should be carried out there. The time interval of this observation is from 8am to 12pm, the time where most of the students go to the class. The total parking spaces for automobile and motorcycle are 96 spaces and 40 spaces respectively.

Table 4.4: Block P observation data

Time	Automobile				Motorcycle			
	enter	out	net	Cumulative	enter	out	net	Cumulative
< 8am	0	0	0	75	0	0	0	20
8-8.29am	23	1	22	97	5	1	4	24
8.30-8.59am	19	10	9	106	2	4	-2	22
9-9.29am	42	32	10	116	11	9	2	24
9.30-9.59am	24	21	3	119	9	1	8	32
10-10.29am	19	22	-3	116	8	4	4	36
10.30-10.59am	23	19	4	120	7	5	2	38
11-11.29am	16	20	-4	116	5	9	-4	34
11.30-12am	9	6	3	119	4	2	2	36

What makes this parking area interesting is before the observation started, there are already 75 parking spaces had been parked by automobiles. That is 78% of the total. There should be only 21 spaces left for other automobiles. Based on Table 4.4, this parking area became full between 8 am to 8.29 am but surprisingly, there

are still a lot of people entering the area to park their vehicles. Those who cannot find any parking spaces, they will park their car at any available space in the area as long as they did not double park their automobiles as it could burden other drivers. The net parking for automobile is 119 spaces, 23% more than the total. Obviously, this parking area is considered as critical and needs a good parking management in the future.

The motorcycle parking spaces are quite critical too. This is because before the observation started, 50% of the total parking spaces have been used. Besides, the net parking for motorcycle is 36 out of 40 that is 90% of the total. The result shows how risky this Block P parking area is. Without a good and effective management, it is going to be too congest.

3) Village 5 P7

Total Parking space:

- Automobile = 182 spaces
- Motorcycle = 33 bays

After completed 2 academic blocks parking area, the project continued by doing the observation in 1 residential parking area. That parking area is Village 5 P7, located near to female's hostels, Pocket C and Civil Engineering Department. To be honest, there are some other residential parking areas that can also be considered as critical, but the reason why this parking area is chosen because it can be used for 2 purposes; going to the academic block and overnight parking. By assumption, the number of students who are going to park in that area is very high, which can lead to congestion.

Usually, most of the students who use this parking area are those who stay outside of the campus and female students who stay in Village 5. From the total of 215 parking spaces provided, 182 spaces are for the automobiles and the rest are for the motorcycles. The time interval for this observation is from 8 am until 12 pm. The result of the observation is shown in the Table 4.5.

Table 4.5: Village 5 P7 observation data

Time	Automobile				Motorcycle			
	enter	out	net	Cumulative	enter	out	net	Cumulative
< 8am	0	0	0	170	0	0	0	16
8-8.29am	26	2	24	194	6	0	6	22
8.30-8.59am	12	3	9	203	5	2	3	25
9-9.29am	28	11	17	220	6	3	3	28
9.30-9.59am	26	23	3	223	8	6	2	30
10-10.29am	22	22	0	223	3	7	-4	26
10.30-10.59am	16	14	2	225	3	1	2	28
11-11.29am	12	15	-3	222	5	4	1	29
11.30-12am	10	9	1	223	7	3	4	33

From the result, this parking area is much worse than Block P because approximately 93% of the total parking spaces have been used which is 170 out of 182 spaces before 8 am. Like what had mentioned before, this area is used for overnight parking and for attending lectures. The parking area became full between 8 am and 8.29 am but still a lot of drivers kept on entering the area after that period. So the question is where do they park their car? It is simple, they just park at the edge of the road. As long as their vehicle does not block other driver's way, it is acceptable then. At the end of the observation, the total number of automobile parked in that area is 223, approximately 23% more than the total spaces.

The result for motorcycle is different to the automobile, where the parking spaces look sufficient enough at the beginning of the observation where only half of the total are being used. However, the whole parking spaces provided for the motorcycle became full at the 11.30 am to 12 pm. There is no doubt that this Village 5P7 parking area is too critical. Without a proper parking management, there will be so much trouble for many years to come.

4) Block 13 & 14

Total Parking space:

- Automobile = 86 spaces
- Motorcycle = 10 spaces

Parking area is considered as critical if the demand is high such as Block I Chancellor Hall. Plus, the term 'critical' can also be used for parking area that has high number of illegal parking among the vehicle users especially the students. This is why the Block 13 & 14 parking area are chosen for the final observation. Block 13 & 14 parking area is prohibited for the students and is only available for the staffs. Students who park their vehicles there could be fined or clamped by the security guards. The owner of the car who got clamped needs to pay a release fee of RM100.

The observation is being carried out from 8am until 12pm. Basically, this observation has the same procedure with previous one but this time the data collected is the number of students who park at this area. This parking area has 86 parking spaces for automobile and 10 spaces for motorcycle.

Table 4.6: Block 13 & 14 observation data

Time	Automobile				Motorcycle			
	enter	out	net	Cumulative	enter	out	net	Cumulative
< 8am	0	0	0	17	0	0	0	1
8-8.29am	6	0	6	23	3	2	1	2
8.30-8.59am	9	3	6	29	6	3	3	5
9-9.29am	5	4	1	30	5	4	1	6
9.30-9.59am	6	3	3	33	6	7	-1	5
10-10.29am	3	1	2	35	6	3	3	8
10.30-10.59am	5	0	5	40	5	3	2	10
11-11.29am	6	2	4	44	2	1	1	11
11.30-12am	8	3	5	49	0	2	-2	9

Table 4.7: Number of Automobile & Motorcycle Illegal Parking at Block 13 & 14 Parking Area

Time	Illegal Parking (Automobile)	Illegal Parking (Motorcycle)
< 8am	0	0
8-8.29am	1	0
8.30-8.59am	1	0
9-9.29am	0	2
9.30-9.59am	0	2
10-10.29am	0	1
10.30-10.59am	0	1
11-11.29am	1	1
11.30-12am	0	0
Total	3	7

According to the result of this observation as shown in Table 4.6, it was found that the automobile parking spaces are sufficient enough and well provided. This is because the total number of parking space used by the automobile is 49 spaces which is about 57% of the total. Hence, the parking area is not crowded and there are a lot more parking spaces available. However, the motorcycle parking spaces are quite critical since it achieved its maximum at 10.30am to 10.59am. It seems like the parking spaces provided for motorcycle are not enough.

Based on Table 4.7 which shows the number of illegal parking among the vehicle users, there are 3 automobiles and 7 motorcycles parked illegally in this parking area. Supposedly, all of them was supposed to be fined for breaking the university rules but luckily, the security guards are not there to make a spot check. Even though the number of illegal parking are not as much as expected, but still this problem should be vanished.

4.3 Objective 3: To provide solutions which capable of reducing the parking problems in UTP campus.

There are lots of solutions and methods can be found in the research paper. All of them have their own capabilities in solving the parking problems. For this project, 6 solutions are listed. They are:

- Multi-storey parking:

It would be quite interesting if a new accommodation building with multi-storey car park provided in the campus. This project does not really necessary needs to be built on a new land, as it can also be constructed on the existing parking area such as Village 5 P7. This parking area has an area of 2 acres approximately. The number of parking spaces for both automobile and motorcycle is 182 and 33 spaces respectively. Based on the observation result, this parking area is too critical and needs a proper management.

According to the university rules, students who are going for the internship in the following semester need to occupy the SIBC hostel which is located outside of the campus. With this new residential building with multi-storey car park, those students do not have to stay outside anymore as the new building is sufficient enough to be accommodated by them. Besides that, the site area is located near to Pocket C. Hence, students do not have to drive to go for lectures.

For this part, the multi-storey parking lot is designed by using "*Vehicle Parking Provision in Development Proposals Code of Practice"* as the guideline. According to the design, the number of parking spaces for both automobile and motorcycle is 596 spaces and 74 spaces respectively. Figure 4.10 shows the designed parking lot.

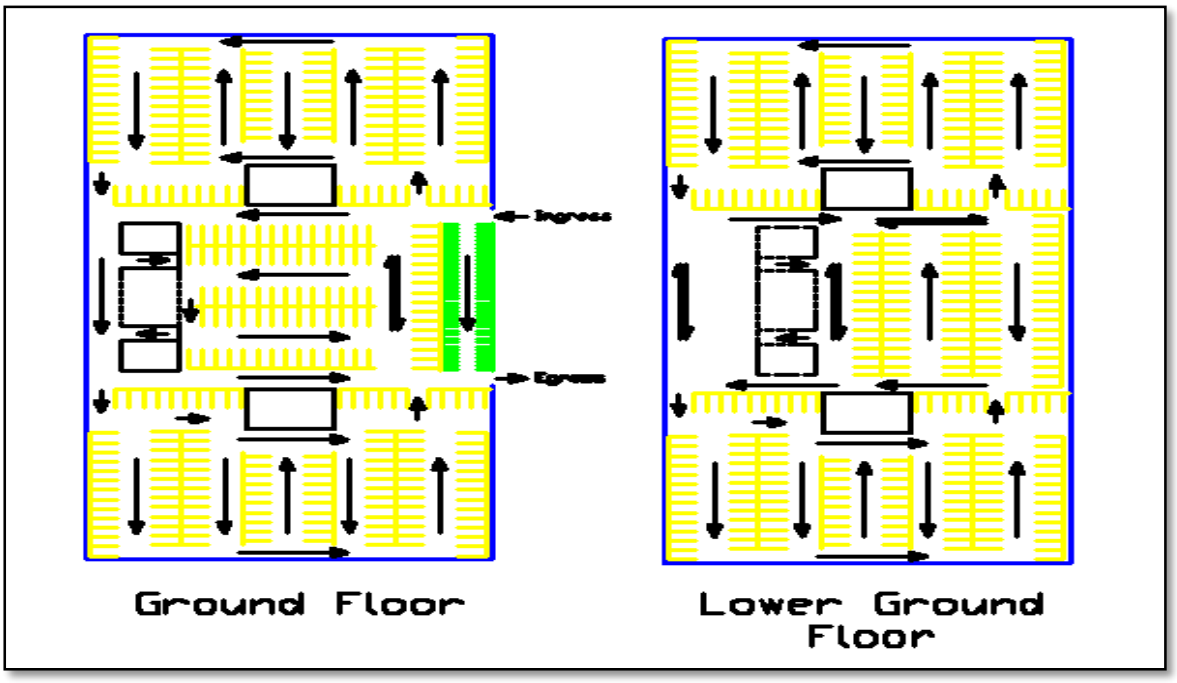

Figure 4.10: Multi-storey design layout

- Rotary parking system

This type of parking system has been used in a few countries like India, China and Egypt. What makes this parking system effective is that it provides at least 8 parking spaces on an area that can supply only a few parking spaces. Just imagine how many parking spaces can be supplied if this system is implemented in university campus.

Figure 4.11 shows the example of rotary parking system designed for this project. The system has a width of 5.7 m approximately and consists of 8 platforms. The operation is very simple, the driver needs to park his vehicle at the ground level platform. Then the vehicle will be automatically lifted up by the system once the driver leaves. The empty ground level platform is available for the next driver.

Applying this rotary parking system can increase the number of supply drastically without the need of big spaces. Let say if the Block I Chancellor Hall parking

space are placed with this rotary systems, how many parking spaces will be added? By assumption:

- Number of parking space at Block I Chancellor Hall = 110 spaces
- Width of a single parking space = 2.4 m
- Width of rotary parking system = 5.7 m (requiring 3 parking spaces)
- Number of rotary system can be placed = 110/3 = 37
- Number of parking spaces available = 37 × 8 = 296 spaces
- Additional spaces = 296 – 110 = 186 spaces

Additional of 186 spaces are a real bargain. This rotary parking system is very suitable to be used for the long term purpose. If an existed parking area is undergoing some construction or renovation, the parking supply will be reduced. But with this rotary parking system, there should not be any problem regarding the supply. Besides, the system takes only just a matter of time to be installed.

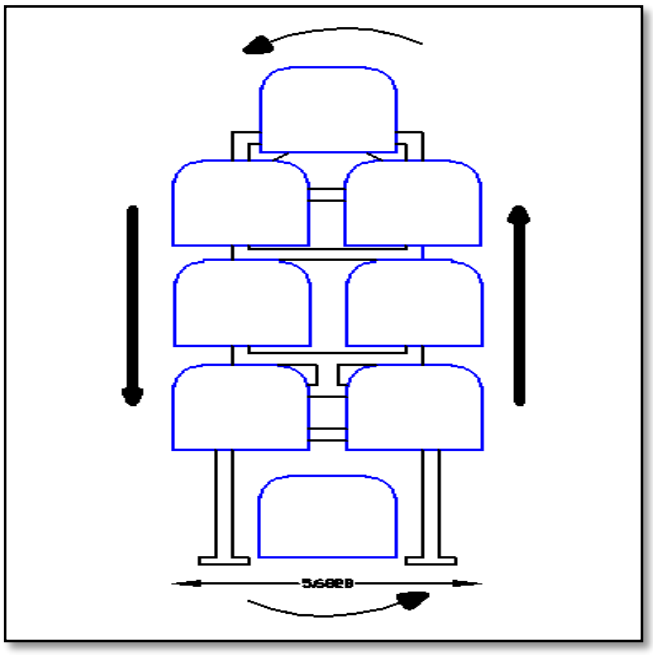

Figure 4.11: The rotary parking system

- Bicycle facilities

Most of the universities in other countries have good bicycle facilities like bicycle lanes and shaded bicycle parking. They also held a promotional event to

encourage their students to cycle in the campus. The importance of these facilities is it can reduce the automobile parking demand among the people. Building bicycle lanes is much simpler and easier compared to road construction. It does not have any specific requirement to design. Usually, the width of the bicycle lanes is between 1.5 m to 3.0 m.

Most of UTP students prefer to drive or ride their own motor vehicles. Even though the university is provided with bicycle parking around the residential buildings, but only a few of them who cycle in the campus. One of the reasons is the campus is lack with bicycle facilities. There is no specific lanes for cycling purpose. The cyclists have no other choice but to cycle on the main road. Building the lanes could guaranteed the safety of the cyclist while lessen the parking demand.

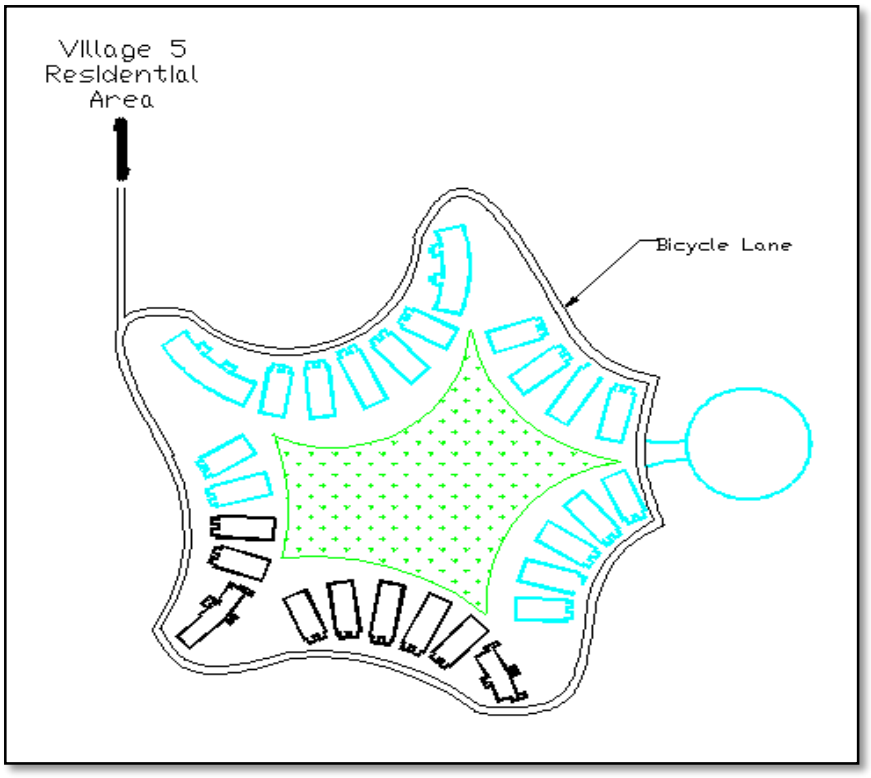

Figure 4.12: Bicycle lane around the academic block

Figure 4.12 shows the location of bicycle lane proposed. The lanes are built around the academic blocks. They are also connected to the residential area, make

it easier for the students to cycle from the hostel. Besides, each academic blocks should be provided with bicycle parking to ease the bicycle users. The width of the lane is 3 m, sufficient enough for 2 way cycle track purpose.

- Barrier parking system

The observation of Block 13 & 14 parking area proved that the illegal parking is still exist among the students. By implementing the barrier parking system in all staff parking area, the number of illegal parking will be zero. There is no chance for the students to enter the parking area since only staff is allowed. However, it would be a good suggestion for those who stay outside of the campus to be given the permission to use the staff parking area. Some of the staff parking areas have so many spaces available even during the peak hour. To make sure that the spaces are not wasteful, UTP should allow the students to use the remaining spaces but of course they will have to pay for a ticket or pass to enter the parking area.

- Shuttle bus

Usually, a large university campus is provided with shuttle bus to ease the mobility of the students. In UiTM Puncak Alam, student's residential area and academic buildings are separated with 60 m height of stairs approximately. Since the distance is quite far, the university provided a few rapid kl buses inside the campus. The students can also get a ride to the nearest town. One way trip will cost RM 1 each.

UTP has implemented this shuttle bus service for those who stays at SIBC hostel. The bus will only stops at one place which is the Chancellor Hall. It would be better if they can provide the same service inside the campus too. Even some of the students who stay inside of the campus tend to attend the lectures by their own transport due to far distance. With this shuttle bus service, their problem can be solved as they do not have to drive anymore and can save more money. The service of the shuttle bus must achieve consumer's satisfaction, if not, students will not use the service.

By referring to the "*Bus Stop Design Guide"*, the location and the number of bus stops around the campus can be determined. Figure 4.13 shows the design proposed. There are 11 bus stops that can be located including the Security Services Department, the starting point of the buses. The location of bus stops must be near to the high demand areas such as Chancellor Hall, academic block, sports complex and residential area. Otherwise, the service will not well-received by the students.

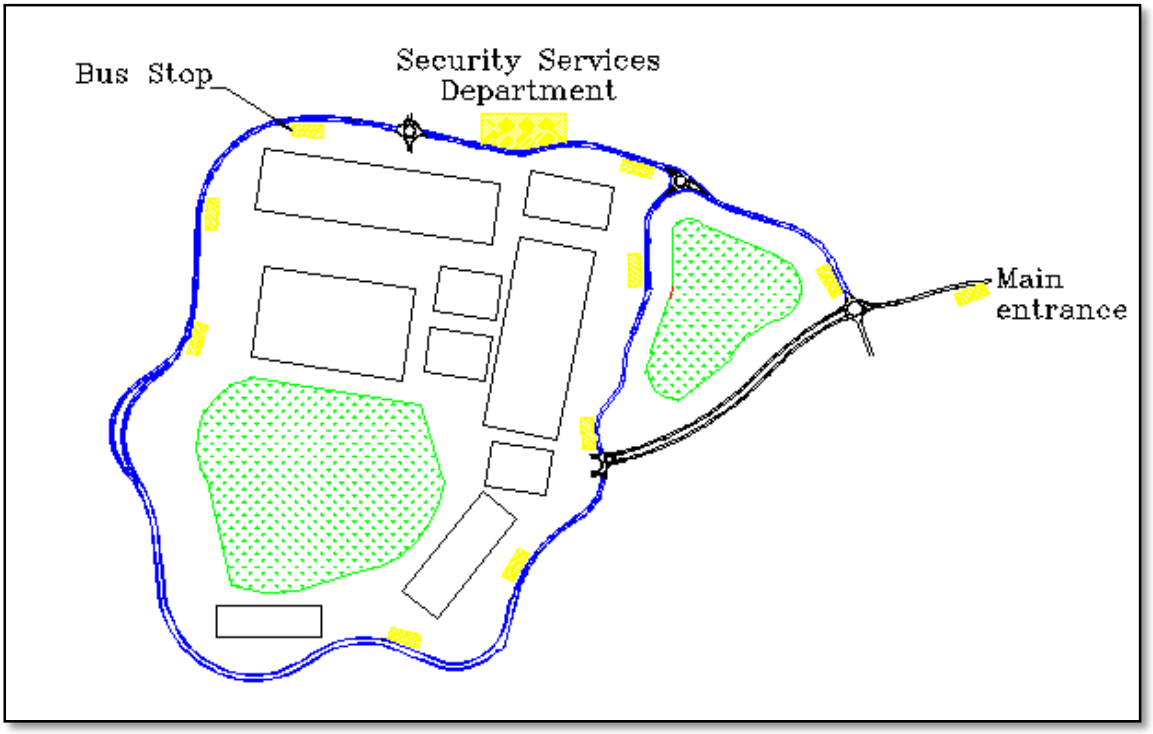

Figure 4.13: The location of bus stops around the UTP campus

- Updating the rules and regulations:

  i. Change of parking

  Block 13 & 14 parking area is provided with only 10 parking spaces for motorcycle. From the observation, these parking spaces are considered as critical because the parking is became full at 10.30am. Since there are no

available parking spaces, some of the motorcycle user just double park their motorcycles.

Figure 4.14 shows the Block 13 & 14 parking area. There are 2 different locations of automobile parking spaces; side parking spaces (9 parking spaces) and 90 degree parking spaces (68 spaces). The automobile parking spaces are not critical because only 57% of the total parking spaces are used during the observation. In this case, it would be better if all side parking spaces turn into motorcycle parking spaces since they are more critical and have higher demand. By assumption, the number of motorcycle parking spaces added can be determined:

- Number of side parking spaces = 9 spaces
- Length of 1 side parking space = 5.4 m
- Total length of side parking spaces = 9×5.4 m = 48.6 m
- Width of 1 motorcycle space = 1 m
- Number of motorcycle spaces could be added = 48.6 m/1 m = 48 spaces (approximately)
- Total number of motorcycle parking spaces = 48 + 10 = 58 spaces

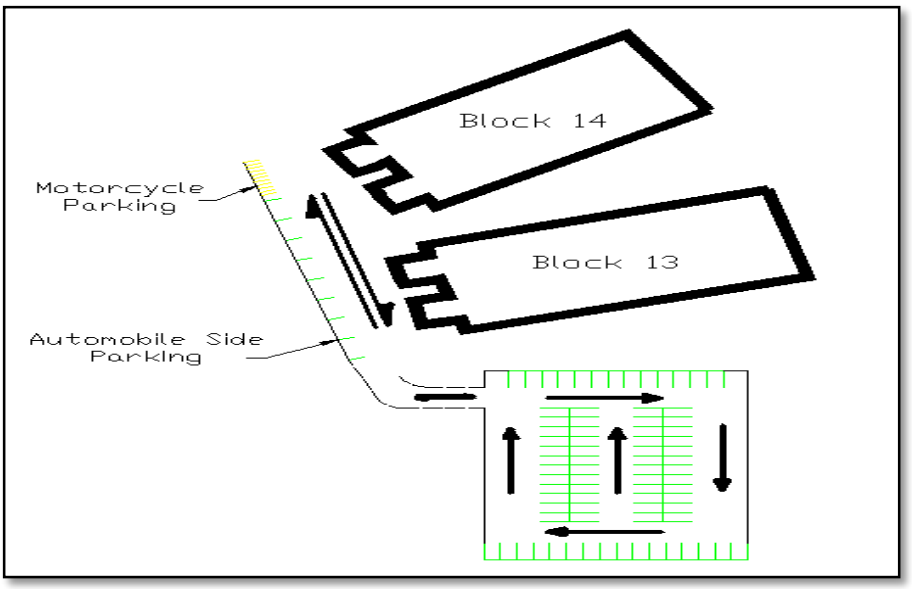

Figure 4.14: Block 13 & 14 parking area

ii. Restriction on foundation students

Everybody is allowed to bring their own transportation to the campus regardless of their status. Even the "L license" users are welcomed to drive as long as they pay for the vehicle sticker. Without this sticker, the driver will be accused for bringing illegal transportation and could be fined by the security guard. Majority of the L licensed driver are foundation students and some of them are not used to drive. There are plenty of road accident cases happened either inside or outside of the campus involving UTP students. Figure 4.15 shows the number of accident cases happened for both in and out of UTP campus. Most of the victims are foundations. This is a very serious matter because it can cause injury or even fatal to the students.

As a solution, it would be better if foundation students are not allowed to drive in the campus due to safety purpose. Besides, reducing the vehicle users among the students can help to lessen the parking demand in the campus. Low demand means less critical parking area.

Figure 4.15: Statistics of accident cases involving UTP student

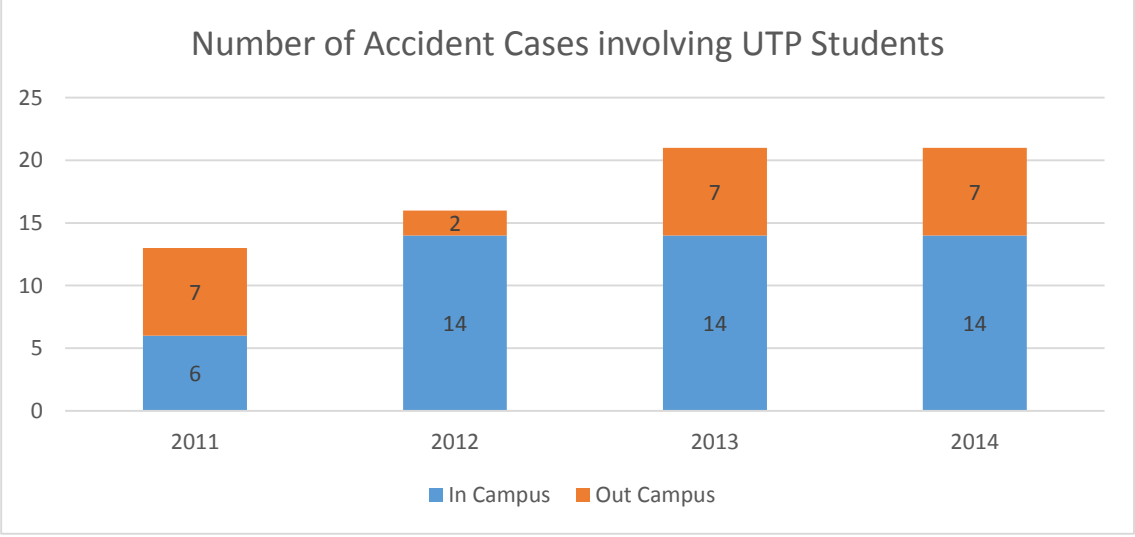

Table 4.8: Decision Matrix for all possible solutions

SOLUTIONS	CRITERIA						
	Cost	Time required	Implementation difficulty	Maintenance	Duration of solution	Acceptance by people	Total Score (36)
Multi-storey Parking	1	1	1	1	6	6	16
Rotary system	2	4	4	4	1	5	20
Bicycle Facilities	4	3	3	3	3	1	17
Barrier System	5	5	5	5	5	3	28
Shuttle Bus	3	2	2	2	2	2	13
Updating the Rules & Regulations	6	6	6	6	4	4	32

According to the Decision Matrix scoring in Table 4.8, updating the rules and regulations is likely to be the most reasonable solution with the score of 32 out of 36. It does not required any cost or maintenance to be implemented. Most of the people agreed some of the automobile parking spaces should be changed into motorcycles' and UTP disallow the foundation students to drive in the campus. The new accommodation with multi-storey parking facilities is the people's number one choice even though the score is low. This option is more suitable for the long term purpose due to its high cost, time required and maintenance. The rotary parking system is quite new to the university, despite its high cost, it can be used as the temporary parking if the current parking area is being renovated or repaired. Besides, it does not take a very long time to be constructed.

Bicycle facilities can be considered as an average solution based on the scoring. The cost of this facility is much lower compare to rotary parking system and multi-storey parking.

However, UTP will have to encourage their students to cycle if they are going to implement this facility in the campus because the number of bicycle users are too small. Barrier parking system is quite cheap and can be bought anywhere. There should not be any problem in implementing this solution in the campus. From the data, only 6 staff parking areas that have not use the barrier system. Lastly, the shuttle bus has the lowest score among all the possible solutions. To provide this service in the campus, a few number of buses are required. They should also build bus stops around the campus to make sure that the shuttle bus service is being used frequently.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

The first objective of this project is to determine the parking supply and demand in the campus. Based on result, the parking supply is more than the demand mathematically. However, the critical parking areas are still exist due to insufficient number of parking spaces in certain areas. Some areas may be provided with a lot of parking bays and some are lack with parking bays. By making a survey, parking areas that are high demand or not could be identified.

For the second objective, a questionnaire survey is created to get the opinion of the people regarding the parking problems in UTP campus. By making a simple judgment, majority of the people thinks the parking management in this campus needs to improve. A good parking management is not only covers the current parking situation but it also plays a vital role in the future. Students argued that they cannot find any parking spaces especially during the peak hour which forcing them to park illegally. This questionnaire also gave the opportunity to the people to contribute some ideas on how to produce a good parking management.

From 4 parking areas that had been observed, those areas are in too critical condition. Village 5 P7 parking area for example is used for 2 purposes; to go for lectures and overnight parking. The parking area almost reach the maximum even before the office hour starts. This is something that cannot be ignored because as the time goes by, the parking area could be worse without the proper management. Block 13 and 14 parking area may not be critical in terms of the parking supply but there are a number of students who tend to park there even though it is only for the staffs. To reduce the number of illegal parking among them, a number of solutions should be provided in this project.

The third objective is to provide solutions or methods to reduce the parking problem. In this part, 6 possible solutions are listed to be implemented in the campus. All the designs and calculations are based on the standard guidelines. For example multi-storey parking and shuttle bus service designs are referred from "*Vehicle Parking Provision"* and "*Bus*

Stop Design Guide" respectively. All data and requirements can be obtained from those guidelines. Besides, a table of decision matrix is prepared to determine the suitability of all solutions listed. Those solutions can be divided into short term and long term or even both. Short term solutions are like updating the rules and regulations and constructing the rotary parking system. Both of these solutions are easy to be implemented. Multi-storey parking, bicycle facilities and shuttle bus service are described as the long term solutions by considering the time required and the difficulty to implement. The barrier parking system is believed to be for both short and long term solution since it is easy to get and implement and very useful for the future.

From the total of 32 parking areas, only 4 of them are observed in this project. This is because of 2 reasons; lack of time and human limitation. If the time given is longer, more parking areas around the campus could be observed. There are more parking areas that can be described as critical such as Chemical Engineering Block Department, Block 5 and Village 5A parking area. By observing more, the result of the data could be more accurate. Besides that, going to the site areas to take the data for the observation requires a lot of time. In some other places, they use a camera to save more time in doing the observation. By putting cameras in all parking areas, they can record all the movement of vehicles in those areas at the same time. They can just collect the data from the video recorded. This way is much more convenient as it is not only saving more time, but more areas can be observed.

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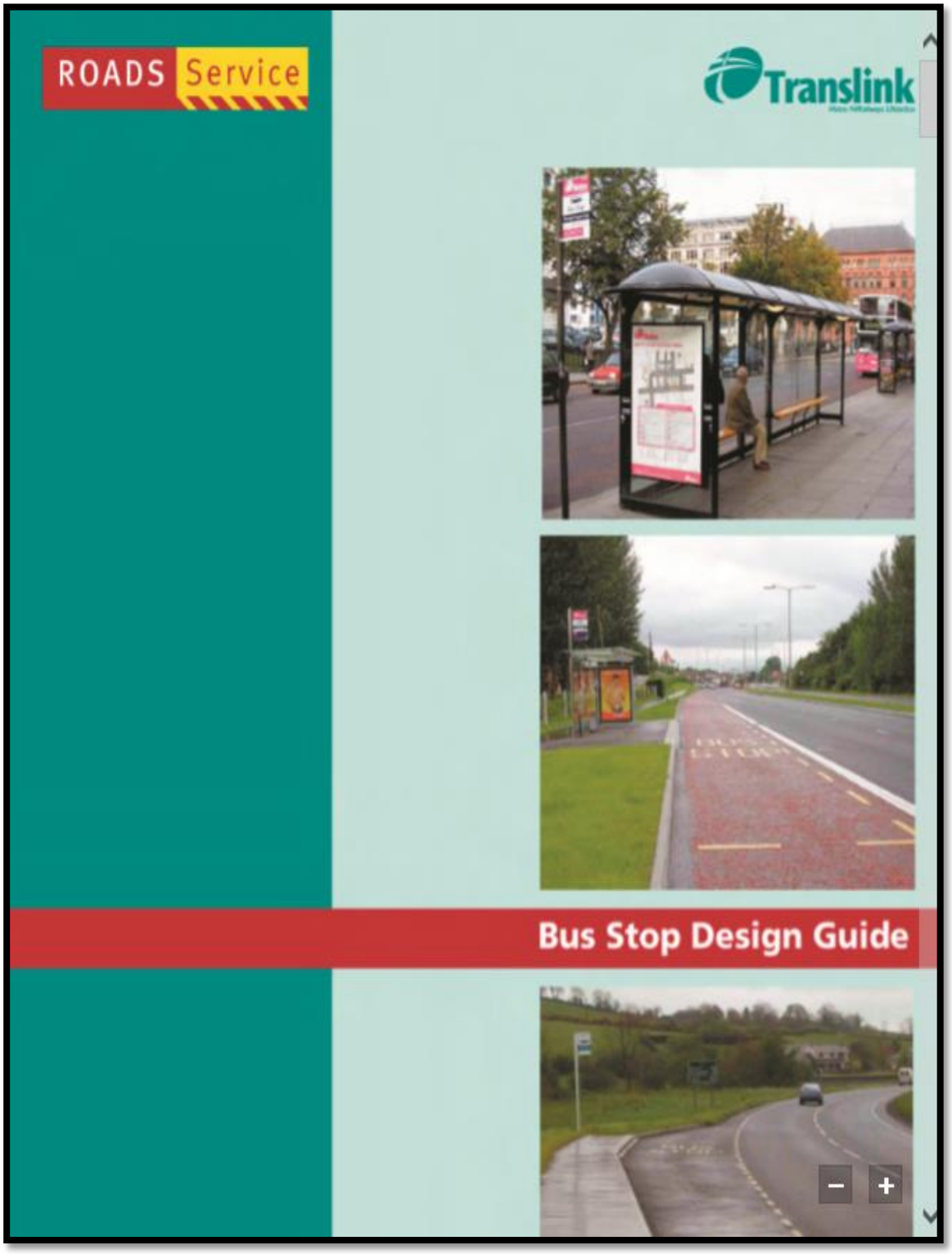
APPENDICES



CODE OF PRACTICE

VEHICLE PARKING PROVISION
in DEVELOPMENT PROPOSALS

2011 Edition

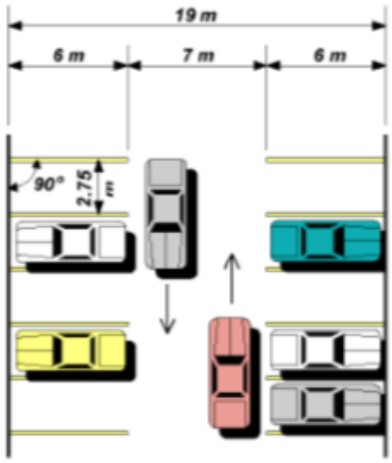
Development & Building Control Division

ANGLE 90°

- effective in low turnover rate or long term parking areas, the perpendicular, or 90 degree parking configuration is the most efficient and economical since it accommodates the most vehicles per linear meter.

- Standard dimensions for this configuration are:

Description	Dimension
Parking space width	2.75 meters
Parking space length	6 meters
Driving aisle width (2-way)	7 meters
Two rows plus aisle width	19 meters V
vehicles per 100 linear meter double row	82



Degree Parking Dimensions and Geometry

2.1 Car Parking Places

2.1.1 Minimum dimensions of parking stalls

A **Parking Stall** refers to the space for parking of one motorcar, that is, a car parking lot. The space of the stall should be rectangular. The longer side is known as length and the shorter side is the width. In parallel parking, the longer side is parallel to the parking aisle or driveway.

The minimum dimensions required of a car parking stall are as follows:

Stall width:	2400mm
Stall length:	4800mm
Stall length for parallel parking:	5400mm

The area of each stall shall be flat and free from kerbs and other encumbrances.

BUS STOP WALKING DISTANCES

Maximum distance to stop (3.6)	400m*
Average walking distance from majority of dwellings (3,6)	200m*
Maximum distance for elderly and mobility impaired (3.6)	100m*

* = With gradients – reduce distances by 10m for every 1m rise or fall

BUS STOP SPACING

General spacing between stops (3.10)	250 – 300m

BUS STOP SEPARATION

Minimum separation between opposite stops (tail to tail distance)36m (3.17)

BUS STOP SIGNS

Minimum height to bottom of sign (4.5)	2.5m
Minimum sign width (4.5)	450mm
Minimum sign height (4.5)	620mm
Maximum sign height (4.5)	780mm
Minimum area of sign that requires TAS check (4.5)	0.3m^2

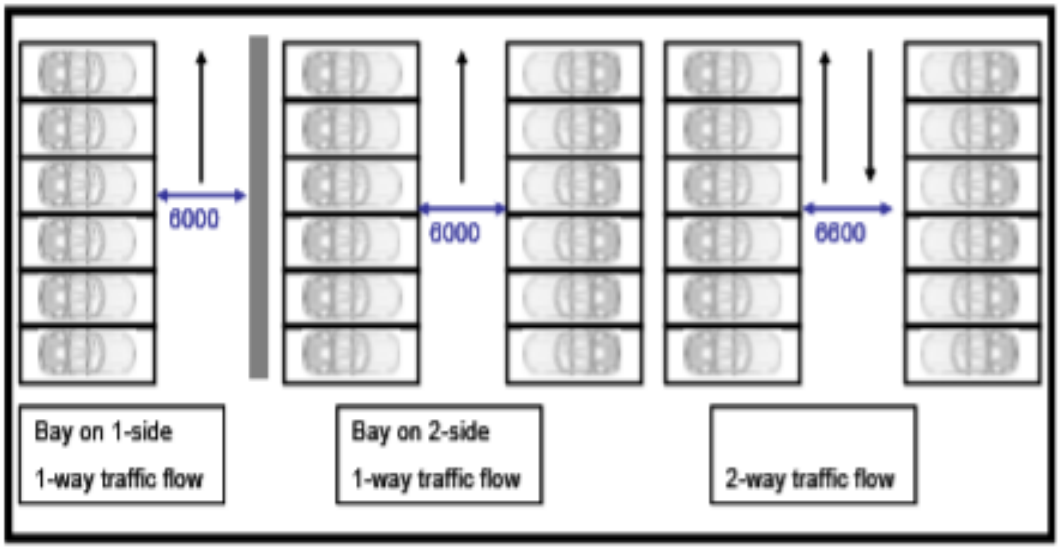
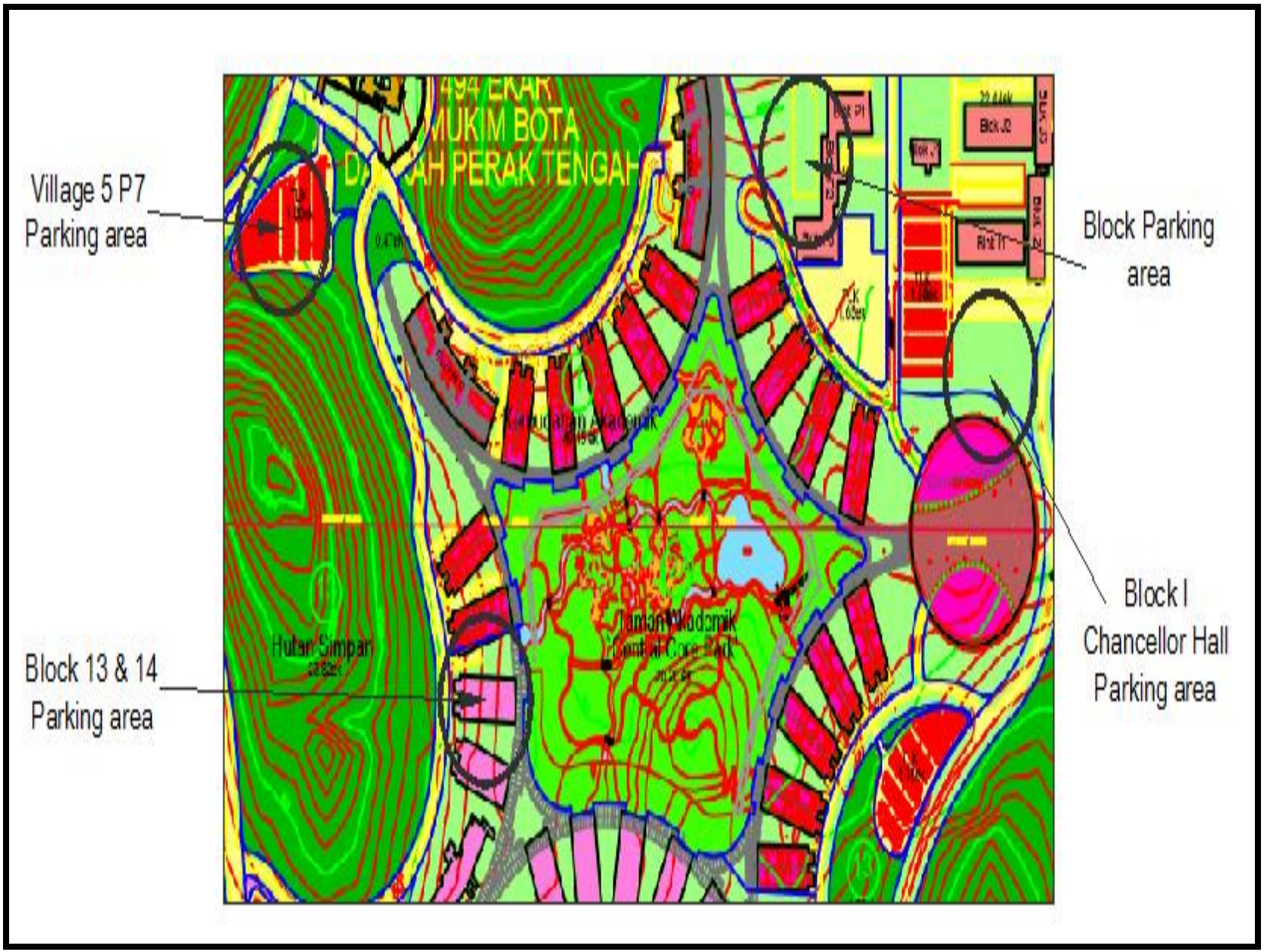


Fig 2.9 90°-Angled Parking Aisle

Decision Matrix/Selection Matrix Example

Criterion	Weight	Alternative A	Alternative B	Alternative C
Potential Impact on Company Performance	3	3 (X3) = 9	1 (X3) = 3	5 (X3) = 15
Ease to Implement	1	3 (X1) = 3	1 (X1) = 1	3 (X1) = 3
Benefit/Cost Relationship	2	3 (X2) = 6	3 (X2) = 6	5 (X2) = 10
Speed of Implementation	1	5 (X1) = 5	1 (X1) = 1	3 (X1) = 3
Acceptance by Associates	1	3 (X1) = 3	3 (X1) = 3	5 (X1) = 5
Negative Impact on Environment	2	5 (X2) = 10	3 (X2) = 6	3 (X2) = 6
Negative Impact on Health & Safety	2	3 (X2) = 6	1 (X2) = 2	5 (X2) = 10
Total Rating		42	22	52

scoring: 5 = high
3 = medium
1 = low


Village 5 P7
Parking area
Block 13 & 14
Parking area
Block Parking
area
Block I
Chancellor Hall
Parking area

Create your own free online survey

Parking Management in UTP Campus

Please answer all the questions below

1. Every university needs a good parking management system in order to avoid any parking problems that could happened in the campus. Do you think UTP has a good parking management system?

    - Yes
    - No
    - Maybe

2. Do you think UTP provided a sufficient number of parking spaces in the campus?

    - Yes
    - No
    - Maybe

3. Barrier parking system is a common system used to prevent other people from entering the parking area. Do you think it should be implemented more in the campus?

    - Yes
    - No
    - Maybe

4. There are 32 parking areas provided in the campus. Do you think UTP should build a new one?

    - Yes
    - No
    - Maybe

5. Do you agree if UTP makes an exception for students who stay outside of the campus to use the staff parking area?

    - Yes
    - No
    - Maybe

6. In your opinion, is it necessary to reduce the number of vehicle users among the students in the campus?

    - Yes
    - No
    - Maybe

7. Do you think UTP should encourage their students to cycle instead of using motorcars or motorcycles?

    - Yes
    - No
    - Maybe

8. Which parking area in the campus can be considered as critical?

9. In your opinion, why do some students tend to park their vehicles at the illegal places?

10. Do you have any idea on how to solve the parking problems in UTP campus?