ANALYSIS OF BUS SERVICE BASED ON THE PASSENGER DEMAND USING PTV VISSIM: MAIN CAMPUS OF UNIVERSITI TUN HUSSEIN ONN MALAYSIA, PARIT RAJA

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DEDICATION

To my beloved supervisor, Assoc. Prof Madya Dr Munzilah Binti Md. Rohani

To my co-supervisor, Dr Basil David Daniel

To my beloved father and mother, Nor Azlan Bin Osman, Aidah Binti Md Som

To my lovely husband, Muhammad Syarafuddin Bin Shariff

To my little son, Muhammad Nadir Syakir Bin Muhammad Syarafuddin

To my little daughter, Nur Maisarah Safiya

To my family in law, Shariff Bin Rahmat, Latifah Binti Haron Rashid

To my sibling, Muhammad Nor Hakkim Bin Nor Azlan

To my sister-in-law, Nurul Nadhirah Binti Shariff

My dear friends, Laila Wahidah, Rasyidah, Nur 'Amirah, Phylisa and Noorazila

To WUS Group, En Faiz Bin Sharifuddin

To Manager Microscopic Simulation PTV Group, Dr –Ing. Jochen Lohmiller

To PTV Vision Certified Trainer PTV Group, Torsten Beutin

To my cousin, Rabiatul Adawiyah

For giving me infinite love, care and blessing

Thank you from bottom of my heart for being my inspiration

Thank you for your endless support to me

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ABSTRACT

Universiti Tun Hussein Onn Malaysia (UTHM) on-campus bus service is the internal bus service to transport students within university residential areas and the UTHM campus. The bus service is intended to fulfil UTHM students' travel demand. UTHM has designed a bus trip schedule based on the needs of students. Several common issues presented in this research, include, the actual bus journeys are usually behind the schedule and the bus service does not comply with passenger demand, especially students who are depended on the bus for travel. These can be seen that the number of student influence bus service demand. Regarding these issues, the objective of the study is made to measure UTHM passengers' demand, measure actual bus headway at UTHM and to simulate the existing bus headway based on passengers' demand. This research presents PTV VISSIM to provide the benefits of simulation modelling in bus routes and determine the headway to meet the passengers' demand. Based on the analysed data, it shows that BS 15 at the Residential College of Tun Dr Ismail and BS 1 located at the Residential College of Perwira were the highest passengers' demand in UTHM. Meanwhile, BS 2 located at Dataran Anggerik is the highest bus demand along the bus route. Throughout in this research, the actual headway is still under control although it only several minutes departs earlier and depart behind the timetable. It can be concluded that most of students who are stayed in the residential college were alight and board the bus on daily is the highest passengers' demand. Accurate passenger demand is the fundamental of a bus scheduling and has important implication in improving bus service in UTHM.

ABSTRAK

Perkhidmatan bas di kampus Universiti Tun Hussein Onn Malaysia (UTHM) adalah perkhidmatan dalaman bas untuk pengangkutan pelajar di dalam kawasan Universiti dan kampus UTHM. Perkhidmatan bas ini bertujuan untuk memenuhi permintaan perjalanan pelajar UTHM. UTHM mempunyai jadual perjalanan bas rekabentuk berdasarkan keperluan pelajar. Walau bagaimanapun, dalam banyak situasi perjalanan bas sebenar dibentuk menjadi tidak mengikut jadual. Selain itu, perkhidmatan bas juga tidak sepadan dengan permintaan penumpang semasa waktu kemuncak, terutamanya pelajar yang bergantung kepada bas. Ini dapat dilihat bahawa bilangan pelajar mempengaruhi permintaan perkhidmatan bas. Berkenaan isu-isu ini, objektif kajian dibuat yang adalah bertujuan untuk mengukur permintaan penumpang UTHM, untuk mengukur lorong bas sebenar di UTHM dan untuk mensimulasikan kemajuan bas sedia ada berdasarkan permintaan penumpang. Penyelidikan ini membentangkan PTV VISSIM untuk memberikan faedah pemodelan simulasi dalam laluan bas dan menentukan kemajuan untuk memenuhi permintaan penumpang. Berdasarkan data yang dianalisis, ia menunjukkan bahawa BS 15 di Kolej Kediaman Tun Dr Ismail dan BS 1 yang terletak di Kolej Kediaman Perwira adalah permintaan penumpang tertinggi di UTHM. Sementara itu, BS 2 yang terletak di Dataran Anggerik adalah permintaan bas tertinggi sepanjang laluan bas. Sepanjang penyelidikan ini, kemajuan sebenar masih terkawal walaupun hanya beberapa minit berlepas awal dan bertolak belakang jadual waktu. Dapat disimpulkan bahawa kebanyakan pelajar yang tinggal di kediaman kediaman turun dan menaiki bas setiap hari adalah permintaan penumpang tertinggi. Permintaan penumpang yang tepat adalah asas penjadualan bas dan mempunyai implikasi penting dalam meningkatkan perkhidmatan bas di UTHM.

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LIST OF ABBREAVIATIONS

BS -	Bus Stop
DA -	Dataran Anggerik
DSI -	Dewan Sultan Ismail
FKAAS -	Faculty of Civil and Environmental Engineering
FKEE -	Faculty of Electrical and Electronic Engineering
FKMP -	Faculty of Mechanical and Manufacturing Engineering
FPTP -	Faculty of Technology Management and Business
FPTV -	Faculty of Technical and Vocational Education
FSKTM -	Faculty of Computer Science and Information Technology
EWT -	Excess Waiting Time
JKJR -	Jabatan Keselamatan Jalan Raya
LRT -	Light Rail-Transit
MRT -	Mass Rapid Transit
ORICC -	Office of Research, Innovation and Commercialization
P2P -	Student Housing and Transportation Centre
PPH -	Development and Property Management Office
RFID -	Radio-Frequency Identification
UTHM -	Universiti Tun Hussein Onn Malaysia

ABSTRACT

Universiti Tun Hussein Onn Malaysia (UTHM) on-campus bus service was the internal bus service to transport students within university residential areas and the UTHM campus. The bus service was intended to fulfil UTHM students' travel demand. UTHM has designed a bus trip schedule based on the passengers' need. Several common issues presented in this research, include, the bus service does not comply with passenger demand. This research was focus on UTHM passengers' demand at each bus stop. Understanding the actual bus headway in UTHM and simulate the existing bus headway based on passengers' demand. The database consisted of detailed knowledge of the number of passenger alighting and boarding, the busiest stop and bus headway. The data was gathered using a manual count form and digital clock. This research presents PTV Vissim simulation to visualize the actual situation of bus movement along the route in UTHM main campus and the residential area. The finding of this research revealed that the busiest stops were located at The Residential College of Perwira (BS 1) and Dataran Anggerik (BS 2) and The Residential College of Tun Fatimah and Tun Dr Ismail (BS 15). 40 to 60 percent of the passengers boarding buses were focus at the busiest stops along the route. The average of the number of passengers alighting buses was 20 percent of the number of the passengers boarding. 70% of buses were operating according to the designated schedule. A 15-minute headway, the number of buses needed does not change in some demand range, between 4 and 5 pax/bus per hour on low frequency service. On a high frequency service, between 6 and 7 buses per hour to serve passengers alighting and boarding. However, the passenger demand in campus was influenced by the number of passenger alighting and boarding and bus headway. The increase of the number of passenger, the higher the passenger demand.

ABSTRAK

Perkhidmatan bas di kampus Universiti Tun Hussein Onn Malaysia (UTHM) adalah perkhidmatan dalaman bas untuk pengangkutan pelajar di dalam kawasan Universiti dan kampus UTHM. Perkhidmatan bas ini bertujuan untuk memenuhi permintaan perjalanan pelajar UTHM. UTHM mempunyai jadual perjalanan bas rekabentuk berdasarkan keperluan pelajar. Beberapa isu biasa yang dibentangkan dalam kajian ini, termasuk, perkhidmatan bas tidak mematuhi permintaan penumpang. Kajian ini difokuskan kepada permintaan penumpang UTHM di setiap perhentian bas. Memahami bus sebenar di UTHM dan mensimulasikan kemajuan bas sedia ada berdasarkan permintaan penumpang. Pangkalan data ini terdiri daripada pengetahuan terperinci mengenai bilangan penumpang dan menaiki penumpang, perhentian bas paling sibuk dan bas kemajuan bas. Data dikumpulkan menggunakan borang kiraan manual dan jam digital. Penyelidikan ini mempersembahkan simulasi PTV Vissim untuk memvisualisasikan keadaan sebenar pergerakan bas sepanjang laluan di kampus utama UTHM dan kawasan kediaman. Penemuan kajian ini menunjukkan bahawa perhentian paling sibuk terletak di Kolej Kediaman Perwira (BS 1) dan Dataran Anggerik (BS 2) dan Kolej Kediaman Tun Fatimah dan Tun Dr Ismail (BS 15). 40 hingga 60 peratus bas menaiki penumpang difokuskan pada perhentian paling sibuk di sepanjang laluan. Purata bilangan penumpang yang turun dari bas adalah 20 peratus daripada bilangan penumpang yang menaiki bas. 70% bas beroperasi mengikut jadual yang ditetapkan. Kemajuan bas selama 15 minit, bilangan bas yang diperlukan tidak berubah dalam beberapa julat permintaan, antara 4 dan 5 pax / bas sejam pada perkhidmatan frekuensi rendah. Pada perkhidmatan frekuensi tinggi, antara 6 dan 7 bas sejam untuk berkhidmat penumpang turun dan menaiki pesawat. Walau bagaimanapun, perkhidmatan bas UTHM dipengaruhi oleh faktor, seperti jumlah Penumpang naik dan turun dari bas dan kemajuan bas. Semakin bertambah bilangan penumpang, semakin tinggi permintaan penumpang terhadap bas servis.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Public transport (PT) in urban areas has gained greater attention in recent years for improving sustainability and the quality of urban life. The economic and environmental performance of cities can be enhanced by connecting resources to destinations effectively and facilitating mass mobility. During the past two decades, a huge population growth is recorded in developing countries (Saif et al., 2018). Increase in population has caused an increase in the demand for mobility. Public transport can be more attractive by providing "Door to door mobility" and development of transportation services is an important factor of social quality (Putra and Sitanggang, 2016). The development of public transport is expected to make the people easier to travel with good service (Bohari et al., 2014), the transport system (Bachok et al., 2014), operational quality (Rohani et al, 2013) and performance (Liu and Sinha, 2007).

Government encourages people to use public transportation for reduction traffic congestion, environmental pollution and operating cost. In Malaysia, there various of public transport, include commuter train, bus, minibus, Mass Rapid Transit (MRT), Light Rail Transit (LRT) and taxi (APAD, 2019). Most public transport services operate within a specified the designated timetable.

Nowadays, bus is the most common modes of transportation aimed to provide better connectivity of people and location. Types and features of bus operation services are designed based to passenger need. There are various types of bus operation services in Malaysia. For example, Bus Rapid Transit (BRT), express bus service, shuttle bus services, internal and private bus services, tour bus services and school bus

services (Rohani et al., 2013). Most of bus services managed by express bus company that are clean and efficient, such as Transnasional Express, KKKL Express, S& S Express, Sani Express and many more. These bus companies extensively used for long distance travel to reach destination. In other cases, some organisations operate a bus for their own demands. For instance, Universiti Tun Hussein Onn Malaysia (UTHM) provide on-campus bus service to transport the passengers from the residential area to the main of UTHM campus. The passengers need bus service in campus to combat traffic congestion, parking problems and to improve sustainability of campus.

UTHM has appointed two bus companies, Mayang Sari Bus Companies and Sikun Jaya Bus Companies services to operate the bus service in the main campus. Each of bus have 40 seats, emergency door and two doors located at front and rear of bus. The type of bus is high floor level. Both bus services will cover the bus route from The Residential College of Perwira and Taman Universiti to UTHM campus accordingly in order to meet the total number of trips according to the designated schedule. Apart from that, 17 bus stops are located in UTHM and outside UTHM. The function of bus stops as a waiting area for passengers to board and alight from the bus.

Nowadays, the choice of on-campus bus service as a preferred mode of passengers' travel is mainly influenced by the quality of bus service. The passengers among the student university today are more demanding to the bus service, including the punctuality and reliability (Liu and Sinha, 2007). These factors have impact to the bus service. The simply understanding the needs of reliability of bus service is the availability of the bus as per the scheduled departure time during bus service hours (Napiah and Kamaruddin, 2011). Reliability includes regularity and punctuality of bus service operation. Regularity can be defined as the percentage of intervals between actual trips at a stop during the service. Regularity is addressed to passengers' concerns about the passenger waiting time from the time passenger arrive at the stop until the passenger board the bus as it is scheduled (Nakanishi, 1997). Meanwhile, punctuality is related to headway adherence. Headway adherence is the service reliability that measure the reliability on bus distance and time (Benn, 1995).

1.2 Problem Statement

In UTHM, there is a highly student populated in the residential college and faculty in general, surround the university. Various forms of commercial development may also be located close to university to meet the university populations'. The density of the population creating the challenges and opportunities for the university and community transportation systems. Among the transportation problems that often occur in the university area, such as traffic congestion, accidents and high parking demand.

As a main campus that received an increasing of students' enrolment each year, this causes constraints on the student residential (Abdul Razak et al., 2017). UTHM has provided a residential college to students that can accommodate three or four peoples in a room for student convenience. However, UTHM administration has stipulated that first year students are required to stay in a residential college for two semesters, while senior students have to rent off-campus residential. Most students living off-campus do not have their own vehicles with long distances to campus causing students' time to be disrupted (Odugbesan, 2015). This is because students have to spend a lot of money to enter a class if student miss the bus. Sometimes students also ride with housemates by ridesharing, which also spend amount of students' money. Meanwhile, students living in residential colleges have many advantages such as buses provided to go to class. Therefore, the reason for being late and the long distance to go to campus does not arise.

UTHM has seen an increase in students' population over the years, resulting in high dependency on private vehicles that has cause parking problems. The demand for parking in UTHM is determined by the need for vehicles to commute to class or office. Based on a report from Sustainable Campus Office (2019), it can be seen 5700 cars enter UTHM campuses on daily basis. As a result of this situation, the number of cars and motorcycles in increasing rapidly during the weekdays (Razally et al., 2018). An important indicator of existing parking demand was peak parking on campus by user category, such as faculty and staff, resident students and commuter students. Other influences include the location of various activities within reasonable walking distance, the density of development and the need for automobile transportation

outside of class hours (Filipovitch and Boamah, 2016). This leads to a shortage of parking spaces in UTHM.

As UTHM is a public university in Malaysia that implemented the policy 100% accommodation in campus, bus services in university are highly recommended as it would solve residential problem to student and lack of parking. It is fairly seen that the bus service provided by UTHM has improved during these few years. UTHM also has provides a daily routine bus services around university compound. Bus service is one of the most important facilities required from students since most of UTHM students do not own any transportation in university.

However, some complaints from students that the bus service is not punctual that cause students to arrive late for classes. The reliability of the buses and the facilities of buses are also of concerns. This situation will discourage the students to use bus and will switch to use another vehicles, such as cars and motorcycles. To ensure the conducive environment in campus, these issues must be addressed thoroughly in order to obtain an optimal solution.

In response to this problem, this research will explore the factors that may affect the students' satisfaction of bus service in UTHM campus. By knowing the criteria of what students considered most, UTHM will be able to establish to improve the bus services to better accommodate the student reside in campus.

1.3 Aim and Objectives

The previous sections prelude to the hypothesis that the campus bus service affect the passengers' demand. Therefore, the specific objectives of this research are:

1. To investigate the bus passenger demand for UTHM main campus based on alighting and boarding at the bus stops.
2. To investigate the punctuality of the bus services at UTHM main campus based on arrival time and bus headway.
3. To simulate the bus headway based for bus routes of UTHM main campus using PT VISSIM.

1.4 Scope of Study

The study of this project is summarized as follows:

1. This study conducted within the UTHM on-campus bus route that covers from UTHM campus to Residential College of Perwira and Taman Universiti.

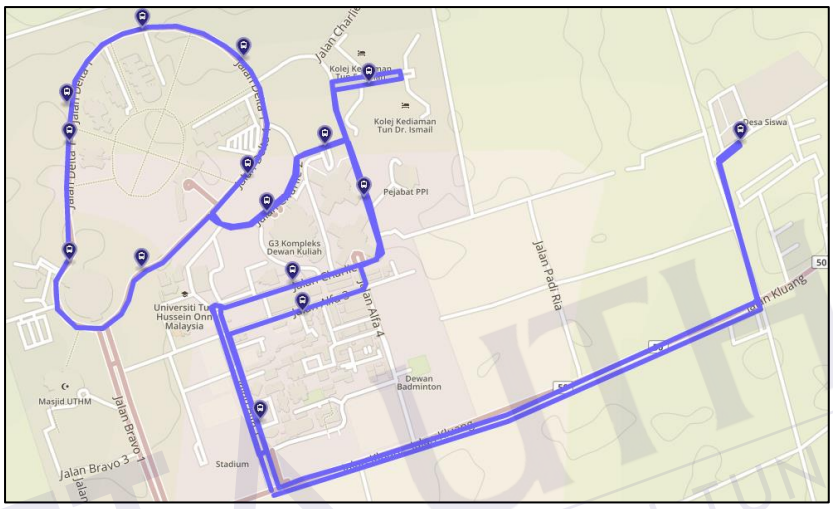

Figure 1.1 (a) : Bus Route from UTHM campus to the Residential College of Perwira (https://uthm.katsana.com/)

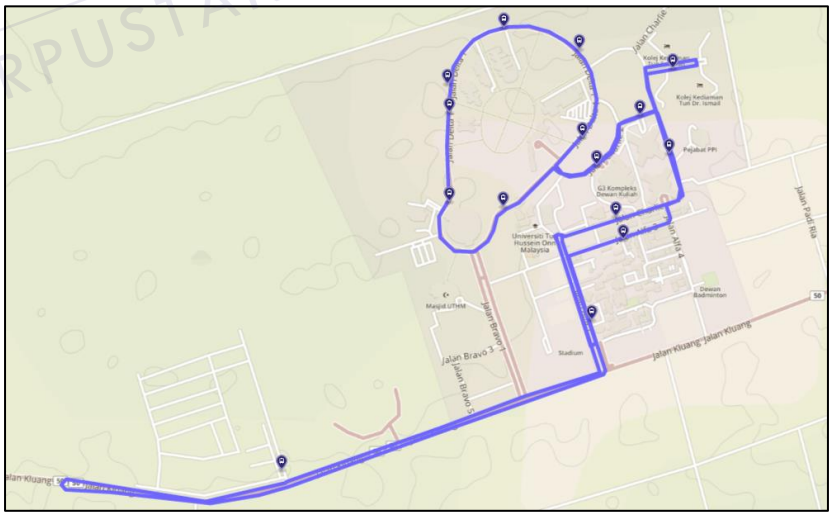

Figure 1.1 (b) : Bus Route from UTHM campus to Taman Universiti (https://uthm.katsana.com/)

2. The research was done during teaching and learning weeks on weekdays started at 7.00 am to 11.00 pm, including peak hour and off-peak hour.
3. The simulation model proposed developed using actual passenger demand. From the field visit during preliminary studies, the total number of alighting and boarding students and bus arrival time recorded to review the current situation of coverage area.
4. The software used in this study was PTV VISSIM that is used to design the simulation of UTHM on-campus bus service modelling. The data derived from the recorded details from the field measurement.

1.5 Significance and implications of the study

From the study, the author can learn and know the situation of the bus services in UTHM. Furthermore, this study plays it significant role to reassess the service and performances of UTHM on-campus bus service. The actual results were used to suggest plans of improvement so that the passengers can experience the best service during alighting and boarding.

It is important to improve bus service in order to keep the passenger prefer to choose bus service as the main of transportation in UTHM. The research focuses on the punctuality, which is one of the most important factors to determine student's satisfaction. Improvement of the punctuality of bus service does not provide benefits only to passengers but also to bus operation. For example, improving of the bus service will increase number of passengers and decrease the expense to bus operator because of reducing the bus waiting time at stops.

The simulation model developed in this thesis to design UTHM bus modelling used for comparison to the current situation of bus in UTHM. This approach gives a solution to integrate the bus service and the passengers within a microscopic model of traffic. This model has been applied and validated on a real case study. PTV VISSIM simulation are useful to use for the next future if there is some changes of the parameter of bus service and measures of the simulation tool to design new bus transportation solution.

1.6 Thesis Outline

This thesis was organized into five chapters:

- Chapter 1 provides an introduction to the focus of the study, including problem statement, objectives, scope of the study, significance and implications of the study which is followed by an outline of the thesis.
- Chapter 2 presents the literature review related to the study, such as passengers' demand and bus headway.
- Chapter 3 introduces the research methodology. This is followed by data collection on passenger distribution on time-period and PTV VISSIM elements.
- Chapter 4 presents and analyses results from the passengers' demand on bus service conducted in this study
- Chapter 5 summarises and provides s conclusion to the research findings and suggests recommendation for the future work

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