DOCTORAL DISSERTATION

A STUDY ON URBAN MASS TRANSIT NODE BASED ON PASSENGER EVALUATION

by

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Abstract

Urban mass transit is significant to the urbanization of cities, and the demand for public transit has rapidly increased. Bangkok, the capital of Thailand, is experiencing an imbalance between demand and supply. Bangkok is facing a transportation problem, especially Bangkok seems to have an urban transit system in which urban and transport planning is not necessarily executed in the interest of the people in terms of public transport because Bangkok suffers from many standalone projects across the city, which can cause troubles with urban design efficiency. The provision of rapid transit to serve people as mass transit mode could not solve transport issues in Bangkok. Transit node is one of the issues that should be addressed as soon as possible, as it is one of the most important aspects of mass transit system. Therefore, the existing affordable mass transit station in term of transit node stations had been placed to investigate and review. The three mass transit node's stations, Mo Chit station, Victory Monument station, and Saphan Taksin station was investigated based on passenger evaluation and compared transit performance in different aspects.

Gathered information of three stations by questionnaire and field survey were analyzed with statistical method approach. 46 variables associated with service, safety, environment, accessibility, operation, and facilities revealed that passengers' satisfaction of Saphan Taksin station could be improve the quality of transit service, safety, environment, and station facilities as high beta coefficient value. Meanwhile, Mo Chit station could improve the convenient access, and transit operation as lower satisfaction score and high beta coefficient. These influenced factors are specially synthesis on three aspects; transit service performance analysis with feeder modes at transit station, accessibility in order to create convenient access to transit station, then the facilities has been analyzed to identify activities during passengers' transfer and the provision of facilities that can be useful to provide the facilities in transit station. To deal with mass transit node development, we need to understand how passengers do concern on mass transit system with the different aspects and different passengers' characteristic. High income and middle income passengers prefer fast and flexible access to transit nodes, while low income passengers pay

attention to the transit cost. The passengers who purpose their trip for work and study concerned about service time and frequency of the vehicle. Moreover, passengers preferred more facilities at transit station to spend their time during their transfer. It is very useful for the authorities of public transit to promote and enhance a transportation project to all passengers.

The results of this research provide unique information from which improvements in future mass transit node projects could be made. The results of research into the influenced factors of case study may assist the authorities of public transit to prioritize specific actions. This result enables analytical platform of in-depth mass transit node study to identify the way in improving the quality of transit for passengers through convenient access and service condition.

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Chapter 1

Introduction

1.1 Research Background

Urban mass transit is the main way for passenger transportation in many cities. Urban mass transit networks consist of nodes and lines to represent their layout. The nodes are called stops, the lines are called links or route segments. The node of urban mass transit in various transit have different characteristics from those in a road network or transport system. With the rapid development of urbanization, the urban mass transit network is expanding and the trip distance of passengers is increasing, which could lead to more transfer for passengers in one transit trip.[1] The urban mass transit node (transit station) is a critical part of the connection trip. However, in many urban mass transit systems, there are many problems caused by inconvenient transit trips from several transfers, long walking, waiting time and crowded environment in vehicles. Travel times and distances travelled are increasing in urban areas, resulting in fewer destinations that can be reached with in a limited time. [2]

The quality of a public transport system depends on many aspects, such as the standard of the connections between different transport modes. [3] The quality of public transport system for transit station that improving the transfer experience could significantly benefit public transport. [4] And also investment in multimodal transit station is a critical element of this wider enhancement of public transport infrastructure and can contribute to achieve greater sustainability in travel at the city, metropolitan and regional scales. [5] Transit station is crucial for the integration of multiple systems into one efficient system. But the compresence of multiple system is not enough for transit station, transit station approach should focus on transfers, comfort and also yields a sharp distinction between transit stations. [6]

In recent years, Thailand and especially Bangkok have experienced rapid economic development, which has led to Bangkok's high-speed expansion. Today, Bangkok is facing problems based on this rapid development. Traffic congestion is a major issue, especially in the Central Business District (CBD) at peak times, affecting the majority of the people who work in this area. One can spend hours in traffic jams, moving only a few kilometers. The other major effect that traffic jams have on the city is the air pollution from the vehicles. Both problems result from the lack of decent infrastructure planning and the poor availability of public transportation. Thus, future infrastructure planning should endeavor to develop public mass transit that can solve these issues.

Bangkok's transport problem is enormous, encompassing the unreliability of public transportation, bad management, congestion, and poor-quality walkways. According to the Office of Transport and Traffic Policy and Planning (OTP), the average speed during rush hour on Bangkok's main road in 2014 was around 16.5 km/h [21]. Changes in transportation have not appropriately matched transport policy and urban planning, a failure that has been fatal because the urban structure and public transport were not compatible. The mass motorization of Bangkok started in the 1960s, when Bangkok had buses operating in mixed traffic and at high density levels [22]. The inadequate planning caused highly visible negative impacts on the rapid increase of motorization, including congestion, sprawling, and high pollution. Bangkok is highly volatile, and action must be taken now, as it is a car city. Bangkok has long favored the car as its main mode of transportation but should now be transitioning to a transit city. Bangkok seems to have an urban transit system in which urban and transport planning is not necessarily executed in the interest of the people. Bangkok suffers from many standalone projects across the city, which can cause troubles with urban design efficiency.

This thesis aims to investigate the potential of services at mass transit node station, and to explore the effects of passengers' satisfaction to attitudes concerning mass transit node connectivity among different passenger's groups. And also evaluate and compare accessibility performance across transit stations in Bangkok's mass transit nodes and to interpret transit mode connection behavior according to the road systems on an urban scale and the design space in the architectural aspect. The findings will contribute a better understanding of the service in difference aspects of transit stations and their relationship with their surrounding environments; the results can also be useful for improving transit stations or ongoing transit projects and for similar transit systems in other cities.

1.2 Research Questions

The main questions of this research are;

1.2.1 What is significant factor in contributing passengers' satisfaction of six dimension?

1.2.2 What is existing condition of mass transit node station and how passengers are satisfied on their travelling by public transit?

1.2.3 What is the difference when comparing three transit node stations with different station's characteristic through six dimensions; service, safety, environment, accessibility, operation, and facilities.

1.3 Research Objective

This research focuses on users' satisfaction of urban mass transit node for propose a useful methodological framework to identify the potential strengths and weaknesses of urban mass transit nodes' stations and to improve quality of transit station;

1.3.1 To explore an existing mass transit nodes' stations and mass transit node's characteristics that how they have different satisfaction level and to find out a key factor for contributing their satisfaction.

1.3.2 To combine and integrate transit nodes of various transit modes for efficient intermodal transfer.

1.3.3 To investigate and analyze the key influence factor on three dimensions; service, facilities, and accessibility that would contribute passenger satisfaction and enhance quality of mass transit nodes especially to make the urban mass transit nodes attractive for all users

1.4 Scope of Research

The scope of the research is listed below;

- Investigation and analysis of passenger's satisfaction are focused on the mass transit nodes' stations in Bangkok and compare between each transit node stations.
- Focus three dimensions on the mass transit node evaluation; service, facilities, and accessibility. Furthermore, an accessibility route for planning and space design improvement of mass transit node such as the location of facilities, planner and designer is involved for calculation to understand a current situation.
- The specific analysis based on significant factors will be extent studied and it is mainly focusing the mass transit node's stations as quality and transit condition.

1.5 Research Outline

CHAPTER 1:

This chapter aims to explain the background of the study together with problem statement of research. Moreover, the objective and the scope of study are also explained in this chapter.

CHAPTER 2:

The literature reviews of this dissertation are illustrated, a lack of consideration from other studies is drawn in details including mass transit system situation in Bangkok, urban mass transit node as well as the transit systems in Bangkok. The analysis framework is integrated and fulfilled by the study of Chapter 4, Chapter 5, Chapter 6, Chapter 7, and Chapter 8, respectively.

CHAPTER 3:

This chapter aims to explain the case study and study process of research with the framework of integrated evaluation of Bangkok mass transit nodes to deal with good accessibility and quality of use. This chapter also describes the step of analysis approach in terms of qualitative and quantitative research. The research framework is provided for understanding the whole process.

CHAPTER 4:

Passenger's characteristics and trip pattern were indicated significant influence factor of the mass transit nodes' stations which could raise satisfaction level of passengers. Therefore, in this stage, passenger's characteristics and their trip patterns were analyzed with filed surveying and using satisfaction method to identify what variables are important.

CHAPTER 5:

This chapter is to study clarify focusing passengers' attitude as the result from Chapter 4. By investigating, how difference passenger groups satisfied with their transit trip. Especially, the passengers' attitude in accessibility aspect that effects to mass transit node planning and design. The result of this chapter would be noted to planner and designer paying attention to improve mass transit node.

CHAPTER 6:

Bangkok mass transit node in term of service will be described on physical condition including service time, feeder modes at transit node stations, ticket fare. A field survey of passengers' satisfaction based on feeder modes at transit node stations is used to understand the passengers' attitudes and feeder modes service quality by showing influence factor of satisfaction of three passenger's income level.

CHAPTER 7:

This chapter aims to evaluate and compare accessibility performance across Bangkok's mass transit nodes stations and to interpret transit mode connection behavior according to the road systems on an urban scale and the design space in the architectural aspect. The findings will contribute a better understanding of the accessibility of transit stations and their relationship with their surrounding environments; the results could also be useful for improving transit stations or ongoing transit projects and for similar transit systems in other cities.

CHAPTER 8:

This chapter aims to identify the facilities and activities in transit node, especially the facilities along the corridor spaces, and interpret the transit mode connection behavior according to the design space and activities. Transit station planning and design guidelines, especially in terms of the components of activities expressed through the architectural structure were also investigated.

CHAPTER 9:

The conclusion of this dissertation is drawn in this chapter. Also a benefit and barrier to implement and improve the quality of accessibility, service, and facilities for Bangkok mass transit node station are summarized of this chapter. This chapter would contribute to further study for mass transit stations especially transit node's stations in Thailand.

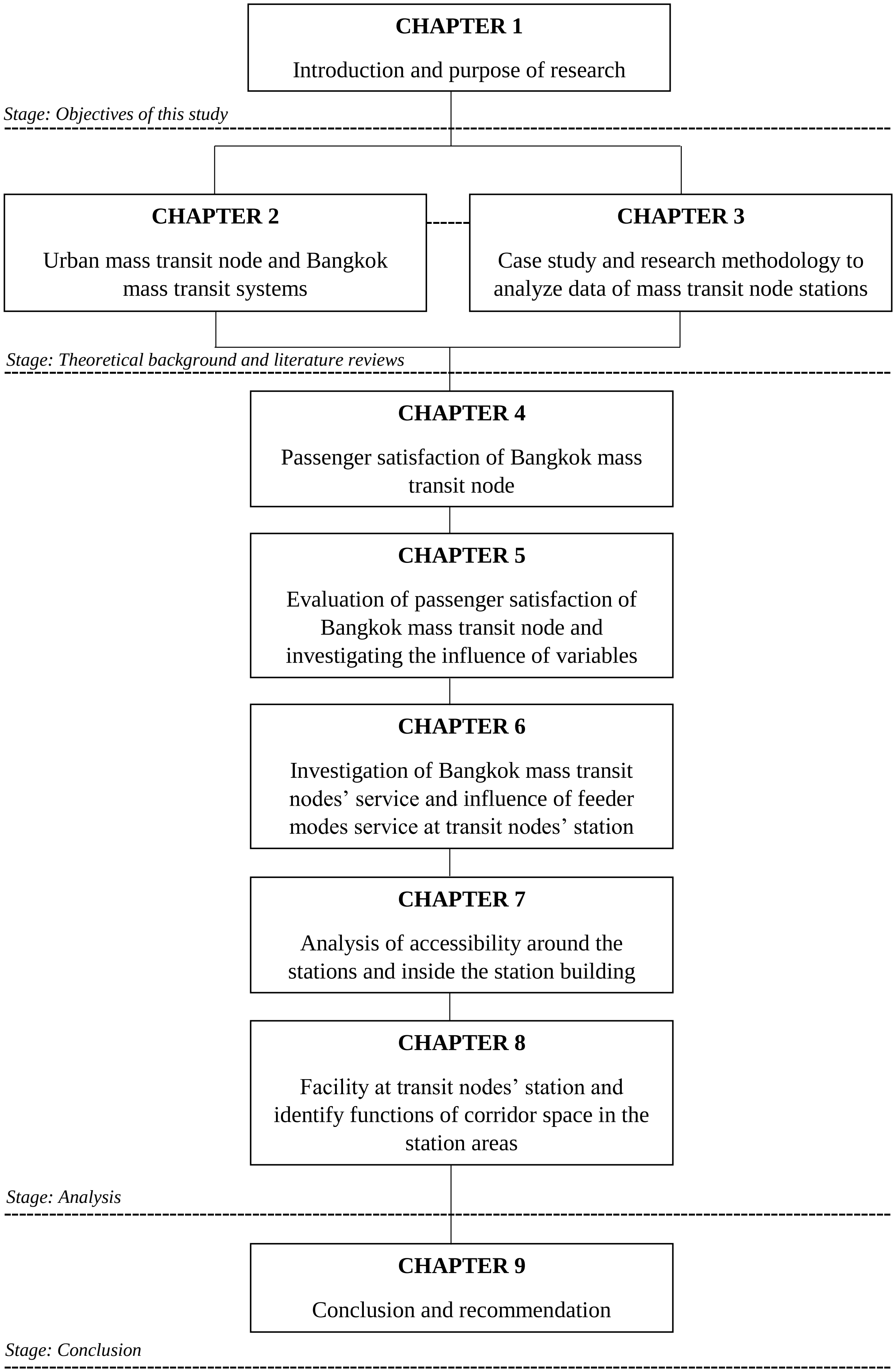


Figure 1.1 Research Outline

Chapter 2

An Overview of Urban Mass Transit and Evaluation

2.1 Review of Urban Mass Transit Node

2.1.1 Node and Mode in Urban Mass Transit

‘Node’ is an area in a transport sector where people are able to enter public transport or switch between different modes. ‘Mode’ refers to the different types of transport options available. One can measure accessibility applying only some elements of the transport system, more significantly, only to the nodes along the route of a certain mode [23]. Rodrigue discussed that “Accessibility is a good indicator of the underlying spatial structure as it takes into consideration location as well as the inequality conferred by distance to other locations.” A high number of route options at a node increase accessibility, but also decreases it at the same time. This is due to interchange and the prolonged mode travel time due to more stops, which might be relatable to the total number of passengers. A high number of unpleasant transfers add uncertainty and incentivizes the commuter to use private vehicle transportation instead. Vuchic [24] also discussed that “Transfers are endemic in the public transport system, especially in large multimodal networks”. Operators are aware of the inconvenience transfers can cause, however there has been a lack of research on this matter [25]. Guo, et al [26] explain how there are numerous transfer experience assessment difficulties. Firstly, the analysis is based on stated performance (SP) and reliance on mode choice. As SP gives low predictability for the different transfers and the difficulty in distinguishing between mode choice and (non) preference for transfers can cause biased in the data. Secondly, there are definitional issues such as how to measure “transfer” [27]. Thirdly, transfer experience is not solely determined by the waiting time, there are other factors such as the transfer environment that can play a vital role on the overall experience [28]. “There are a number of interchange attributed desirable to commuters; personal security, travel info, ticket arrangements reliability, short waiting time, reduce institutional and organizational barriers.” [29]

2.1.2 Urban Mass Transit Node characteristic

Urban mass transit node is considered as the driver of urban development. The transit node can be seen as the cities within the cities, combine the multiple functions. The users need transit node to be comfortable, accessible and easy to use. Transit node is a critical part of the connection trip, particularly where the trip has multiple links. It can help to develop the public transport trip as a valued activity, providing the means of linking public transport services to a network form, and creating a better integration and transfer between same or different modes. Trips need to be conceived and developed as coordinate, productive, integrated, enjoyable and easy to use, removed or reduced the points of friction within and between different modes. [7] The trip can involve instrumental, attitudinal and affective, so these areas need to be improved to enhance the trip experience. If transfers between services can be easier, quicker, more convenient, more enjoyable, more frequent trips are likely to be made by public transport. [8] Time spent at transit station and on the whole connection of public transport trip can be design such as eating and drinking, listening to music, become much easier to undertake, as valued activities. [9] These activities can often be facilitated by the emerging information and communication technologies on offer. [10]

Based on transit node or transit station modes and location, the empirical work was classified transit node’s typology into 2 typologies. Two different typologies from the qualitative analysis;

1. *Same modes jointly*

   Two or more public transport in the same system can be served by different transit lines. When only one mode is to be planned, there is no overlapped population any longer. The same mode jointly is a simple form, for example bus-bus, subway-subway, and other.

2. *Different modes jointly*

   Two or more public transport modes can be served by different transit modes. When it comes to different modes jointly is the largest target, it serves a great number of people, which offsets the impact of high land price. [11] For example, we classified the different transport modes as show in the Table 2.1 and 2.2. Table 2.1 shows transit station between two different transport modes and Table 2.2 shows transit station between three different transport modes.

Table 2.1 The interchange between two different modes

	bus	train	subway	sky train	boat
bus					
train	I_1				
subway	I_2	I_5			
sky train	I_3	I_6	I_8		
boat	I_4	I_7	I_9	I_{10}	

Table 2.2 The interchange between tree different modes

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
bus										
train		I_{14}								
subway	I_{11}									
sky train	I_{12}	I_{15}			I_{18}					
boat	I_{13}	I_{16}	I_{17}		I_{19}	I_{20}				

Multi modes of interchange are very different scale in the public transport system. The specification of facilities differs according to the nature scale of the connection node.[14] Fig 2.1 shows a hierarchy of interchange in the public transportation.

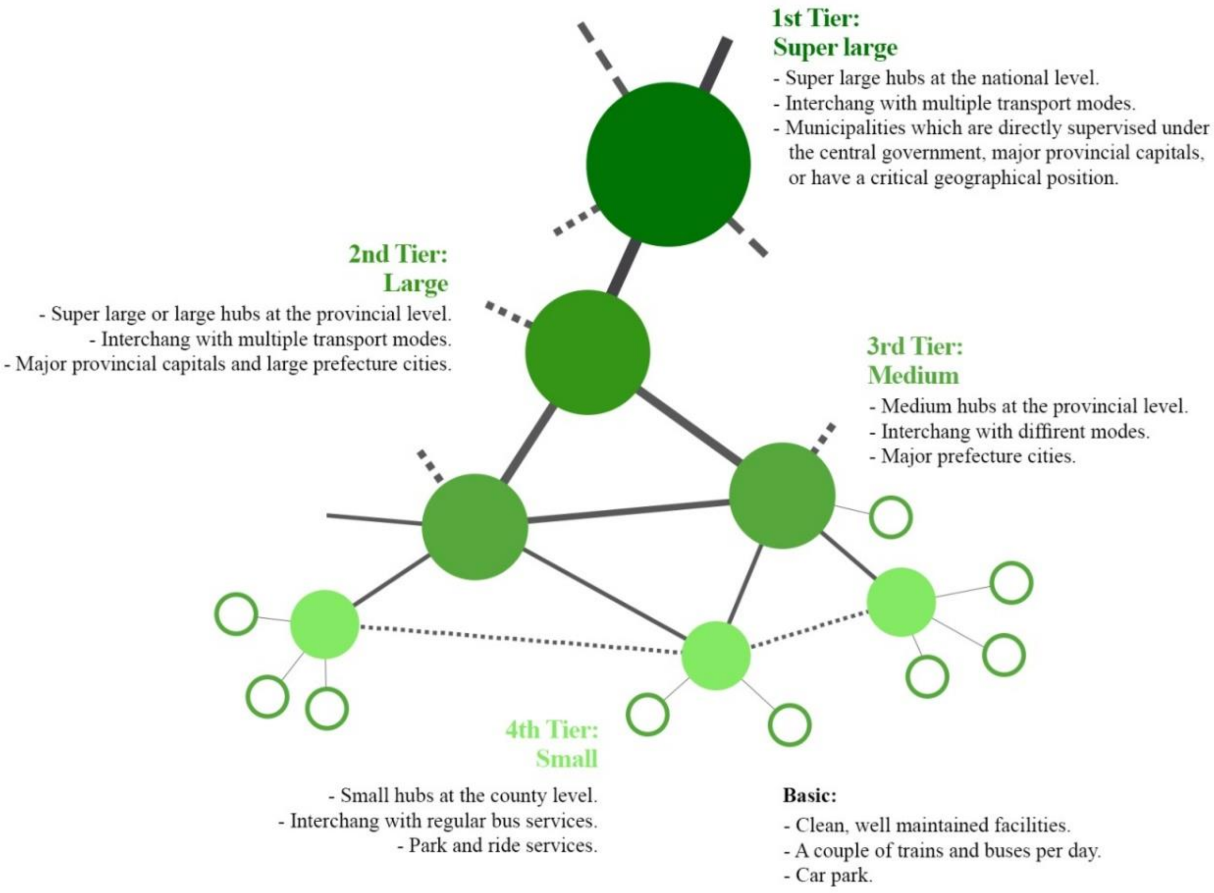


Figure 2.1 A hierarchy of interchange in the public transportation [4]

2.1.3 Planning and Design of Transit node

Planning and design of transit node or transit station should enable to reach continuity between the surrounding area and transit station. Accessibility to transit station by means of smooth transfers from one mode to another mode the attractiveness and enables high accessibility for all users. Enhancing accessibility of transit station should cover a range of different aspects of planning and design activities. Effective access to transit station’s services and facilities, allowing easy and fast movements within transit station as well as the surrounding area, should be properly addressed through careful planning and design of the local built environment recognizing the user’s needs and requirements. [12]

Transit station should be located and build in an urban area into which transit station has to be functionally and aesthetically integrated. [13] Transit station should be located in strategic positions within the city. It is important to locate transit station in an attractive urban environment for users as well as conveniently integrated functionally and aesthetically in the urban environment. Transit station should be effectively connected with infrastructures around the station and transport network as well as its buildings of the surrounding urban area. [14] Enhancing urban and mobility integration of transit station should be properly addressed during the planning, design as well as construction of transit station. Enhancing mobility integration of transit station should mean its effective connection with the arterial road network, feeder modes as well as transit station’s main public transport modes. For transit station design prospective, it is very important to design a station able to reach short transfers between the different transport modes, both in terms of time distances and effort. [15]

Urban Mass Transit Node’s planning

A. *Sustainable system*

   With the rapid transportation development in developing countries, there were lack off good transportation’s plan and urban planning’s plan, there are problems posed by accident, traffic jam and pollution. That has affect to the people who live there. Thus, urban transport system should be sustainable planning and design.

   The mass transit system is the main way for sustainable transportation, that system is efficienct, convenient, faster, save energy and reduce pollution. [16] However, mass transit system’s development should consider to surrounding area and accessibility because the accessibility affects ridership and users satisfaction. [17][18] The problem in travelling to the mass transit station for example: unsafe atmosphere prevailing along routes to the station and at the station, inconvenient and long access routes, and high travel expenses that problems decreasing the user. The concepts of sustainable transportation that promote walking, cycling and urban mass transportation was then used to develop recommendations as to how improve the station's environments and access.

B. Accessibility

With the urban mass transit development, how the station's accessibility is the most important. Accessibility to the station is the main factor of the transportation efficiency and affect to the passengers, the convenient accessibility attracts many passengers. Thus, the development of the station's accessibility could improve transportation efficiency and increase the passengers, that is cheaper and worth, it is better that develop all of the system. The way to get go the station should be sustainable that promote walking, cycling and public transit. [19][20] Based on the previous research, the main way for access the public transportation can be divided into 4 ways as; car, bus, walking and cycling.

Access by car; requires parking space and drop off space. However, parking area increases the cost to service provider. Due to the large parking space, there is affect to surrounding environment and increase traffic around the station.

Access by public bus: that can decrease traffic jam and pollution around the station. [10] However, the passengers have to spend more time for traveling to the station because they need to wait for the public bus. It was found the important factor to attract the passengers to the station by public bus was bus fee, traveling time and punctuality. Thus, there should have the station planning for convenient access and should have time schedule related to each transit system.

Access by walking: the development of the pedestrian around the station is the most important to attract the passengers to the station. [11] The environment of the pedestrian such as safety and security, convenience, and easy for access more attract the passengers, the success of the public transportation depends on how to access the station especially by a pedestrian. [12]

Access by bike: could attract the passengers more than the pedestrian system and cost for developing the access area to the station less than access by car. [9] Cycling could be traveling to the station faster than walking and do not waste time to wait for the bus that could reduce traveling time [13] and reduce pollution around the station.

Accessibility to the station by means of smooth transfers from one mode to another mode the attractiveness and enables high accessibility for all users. Passengers may arrive at the station by many ways include walking, arrive in a private vehicle, being dropped off from a car, public bus, biking, or from another transit mode. Station planning and design should include features necessary for providing access to the station by all common modes of transportation. Normally, the last mode of transportation before boarding the transit vehicle is walking. Planning and design criteria should ensure seamless and safe movements of pedestrians as they interact with other modes at the station.

Figure 2.2 shows arrival modes at transit node. Typically, the last mode of all of the transportation before boarding the transit vehicle is walking. By definition, the pedestrian is any person who walks or using a wheelchair. Passengers arriving at the station by several transport modes other than walking will change modes to the pedestrian mode before accessing a transit vehicle. The passengers who riding buses will use a sidewalk to walk toward the platform after unloading from buses.

On the other hand, the passengers arriving by personal vehicle will have to use crosswalks to cross circulation roads at the parking facility before reaching the sidewalk on the way to the platform. Procurement of transit node's facilities should ensure seamless, safety and security, and convenient interaction of all mode of transportation as they access and egress the station. [14]

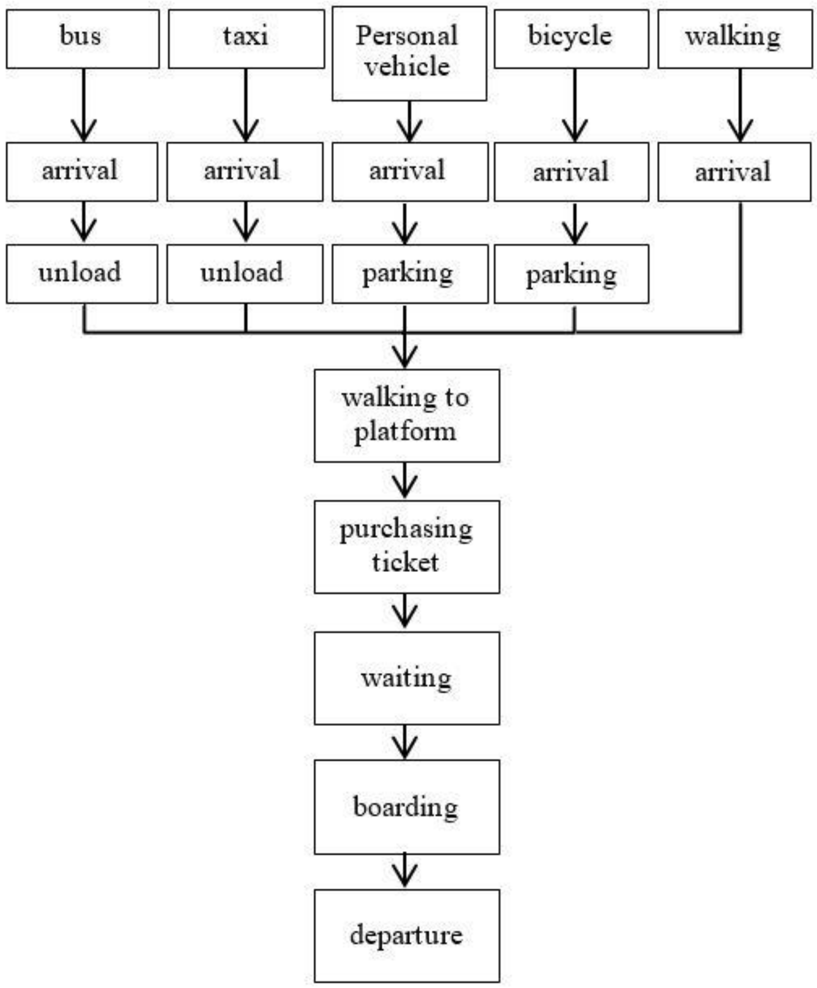


Figure2.2 Arrival modes at transit node

2.1.4 Transfer in transit node

The most obvious barrier to seamless transit services are transfers. A typical journey using transit involves chain of steps that can include a walk and a wait to access a vehicle, a ride, followed by a transfer that usually includes another walk and wait to board the next vehicle, a second ride, and finally an egress trip where the passenger walks to his/her final destination, illustrated in Figure 2.3.

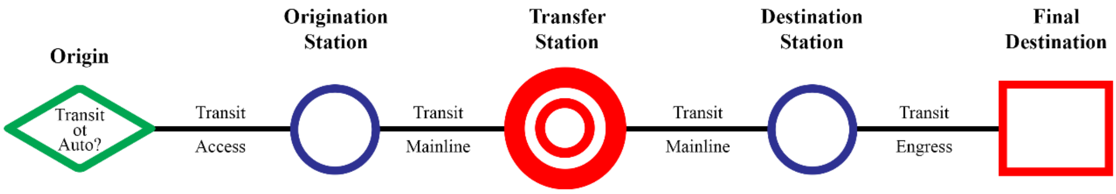


Figure 2.3 The typical components of transit trip [30]

Each step in Figure 2.3 can have a unique influence on a customer's perception of a particular trip. [31]. A common formula that considers each step in a transit journey as un-weighted may take the form of Equation 2.1;

$$T_{O\text{-}D} = t_a + t_{wa} + T_1 + t_e$$

Equation 2.1 Un-weighted Transit Journey

where TO-D is the total trip time from origin to destination, ta is the time from the rider's origin to the station, t_{wa} is the wait time, T1 is the in-vehicle time, and T_e is the time spent from the egress point to the final destination [31].

Improvements to intermodal service are sometimes justified by customer satisfaction, but more commonly by the amount of time or money it would save individuals using a particular combination of modes or transit systems. The out of vehicle components of the trip in Equation 2.1 -such as walking and waiting - are not normally considered as 'un weighted' or actual (i.e. the actual amount of time spent walking or waiting).

Transportation research normally expresses these out of vehicle components in how they are perceived by a passenger. Determining how quality of service attributes can influence a transit riders mode choice and their perception of costs is called 'disutility analyses' and has been studied so extensively, relative OVTTs (out of vehicle travel times) can be considered rules of thumb for transport agencies [32] depending on circumstances specific to each transfer. Understanding how transfers can influence passengers behavior is an important aspect of improving intermodal service. Transfer penalties are used to represent the time, labour or monetary expenditures experienced when waiting, walking, and worrying about comfort and safety when accessing or egressing transit, or transferring from one vehicle to the next [31].

The disutility that each component of every transit journey poses is often reported as relative in vehicle travel time (IVTT). Li [33] justifies using private automobile travel time as the benchmark for which all other modes are compared against because private vehicle travel is a door-to-door service, avoids transfers, provides a real (or imagined) sense of security and utilizes the driver's cognitive processes that may otherwise be left idle and bored. For these reasons a commute in an automobile may be perceived as faster than using transit. Pioneering the work in examining the individual's sliding scales of time perception during travel was Alan Horowitz, who hypothesized that the value of time "is a surrogate measure of the time, comfort, convenience and reliability of the travel experience" and that the perception of costs is fluid across a range of factors concluding that one minute spent driving in a car is not equal to one minute spent standing on a bus which in turn is certainly not equivalent to one minute spent walking in the rain [34]. Later work included the use trade off experiments that asked bus riders to rate their journeys compared to their immediate transit experience. Although the experiment controlled for travel experiences by surveying riders on routes where only a limited number of transfers were possible, it did not directly estimate the magnitude of disutility. The research determined that even short transfers significantly diminished the overall satisfaction with transit services. He also found that doubling the time spent transferring, from 5 to 10 minutes, did not significantly change the overall satisfaction with transit [35]. Although, in this particular instance, actual magnitudes of IVTT were not estimated, his findings formed the foundations for numerous studies on transfer penalties.

Other study on transfer penalties has been carried out to determine how the perceived burdens can vary under specific circumstances. Liu et al [36] assessed how mode choice can be influenced by travelers who must transfer from one train to another or from their car to a commuter train. The authors concluded that inter modal (car-to-rail) transfers were in almost all cases considered far more onerous than switching between a single mode (rail-to-rail). The result found that customers changing from one train to another experienced a transfer penalty of approximately 5 minutes of IVTT, while individuals' perceived car to rail transfers were perceived to take 15 minutes or more of IVTT equivalents. The results are supportive of providing transfer environments that minimize the effort and discomfort traveler's experience while switching modes or vehicles.

Guo and Wilson [37-38] examined how characteristics of the built environment exert influence on users' willingness to change metros or to walk. It was found that across all estimated models that passenger will on average only transfer if doing so saves them approximately 10 minutes of walking. Factors thought to influence the quality of the pedestrian environment included sidewalk width, the presence of open space, land use and topography. These studies are the only researches this author is aware of that integrate station environmental characteristics within a transfer penalty framework. Guo and Wilson [37] acknowledge the difficulty of including variables that quantify station or surrounding area pedestrian accessibility within a choice model and limited their selection of attributes to an arbitrary number of four that were thought to influence walking behavior. They found that quantitative attributes (wait time, walk time etc) were the most influential factors that persuaded people not to walk. However, after controlling for these, poor walking environments increased the transfer penalty by an additional 6-9 minutes. Guo and Wilson [37] conclude that qualitative variables, such as the pedestrian environment, are important components of transfer penalties that individuals consider before transferring. Therefore previous estimations of the true cost of transfers that do not control for these factors may over or underestimate the true cost of transfers.

In Thailand, Park et al [39] modeled choice behavior of 1500 commuters accessing canal boat services on the Nonthaburi Pier in Northern Bangkok. The study aimed to determine the causal forces prompting people to drive, take a bus, or walk to access commuter boats. The results using maximum likelihood estimations determined that cost and walking distances were the most significant factors informing modal choice. In vehicle travel time was valued at approximately $1.40 per hour, while OVTT were evaluated as significantly more costly at $3.30 per hour. This is not particularly surprising as walking conditions in Bangkok can be exceedingly poor and can aggravate the perceived costs of having to walk to access services. The study also found that improvements to bus services by upgrading pedestrian access would expand the catchment area buses can draw passengers from as well as increase the market share of bus modes relative to mini buses and taxis. Significantly the study also found that many passengers would be willing to pay for some of the incremental service upgrades. The findings of Park et al [39] mesh with research conducted by Townsend and Zacharias [40] who examined the egress trips of 1500 MRT and BTS passengers at 6 stations in Bangkok. They found that walking distances involving a modal change were higher than expected, despite poor quality of pedestrian infrastructure.

Many studies have shown that transfers are widely perceived as an impediment to using public transport and that many passengers may be willing to pay for incremental upgrades that minimize some of the penalties [41]. Users often exaggerate the quantitative aspects of travel, perceiving that OVTT is greater than the actual time passengers are forced to wait or walk [34, 42]. More recent studies have also shown that pedestrian environment and qualitative variables are also barriers to make transfers or utilizing different modes or services [36-37]. These penalties are well understood and clearly demonstrate that while transfers are a necessary part of an efficient transit system, transit providers can control to some extent the negative aspects of OVTT and switching vehicles. Discrete choice models have estimated that specific improvements to OVTT can make transfers less onerous with improvements to some service attributes [39, 41, and 43]. Given the disproportionate effects transfers and OVTT can have on a user’s willingness to use a service, controlling as best possible the negative aspects of a transfers could increase overall satisfaction with a transit journey and thus attract additional customers while cementing existing ridership [44]. Diminishing the penalties associated with transfers can be done by improving the services attributes that transit users identify as both deficient as well as important.

2.2 Review of Bangkok Mass Transit

2.2.1 The history of transportation in Bangkok

Bangkok is the capital and the most populated city of Thailand. Also known as Krung Thep Maha Nakhon, the city is located in the Chao Phraya River delta in the central part of Thailand. In 2017 the official population was about 6.4 million and growing at rate of approximately 3.5% per year. This was 9.3% of total Thailand population. From the early 1960s to mid 70's the population and the amount of urbanized land more than doubled [45]. However, this phenomenal growth has taken place in a regulatory vacuum. Bangkok's extremely laissez faire land use policies and weak planning regimes have meant that growth has been unmanaged and lacking coordination or long term strategy. The lack of regulatory oversight has contributed to Bangkok's notorious traffic congestion and late development of efficient and rapid transport which is described by some as an almost existential threat to the city future and wellbeing [46-47]. This section will briefly describe the historical development and present state of Bangkok's transportation networks, and outline some of the obstacles the city faces to providing alternative public transportation that is efficient and reliable.

2.2.1.1 Transportation in Bangkok from canal to road system

Bangkok was founded as the seat of a new royal dynasty following the overthrow of King Taksin in 1782, and the downfall of the earlier Chakkri monarchs who had ruled for 400 years from the old capital of Ayutthaya to the north. Water transportation had long been the primary mode of trade and travel in the region, and successive rulers extended Bangkok administrative and economic hold over the surrounding provinces through networks of laterally canals running off the Chao Phraya River [48]. Although originally built for defence, the expansive canal and river borne transportation infrastructure allowed commercial enterprise to flourish in Bangkok and helped shape the grid system of roads which forms the modern layout of the old city center today [48].

European demand for faster and more efficient trade initiated the first major program of road building in the mid 1850's which accelerated Bangkok's transformation from a feudal outpost on the Chao Phraya River to a more global center of trade and enterprise. Partially to appease the concerns of European business interests and partially out of a desire to conform to an ideal of technological modernity, Bangkok's urban environment was drastically reconfigured under the wished of successive monarchs [47]. The first of the city's canals were filled in to be turned into roads, electric tramways began operations, and a French designed main rail station was constructed at Hua Lamphong between King Chulalongkorn and his successors Rama VI and VII (1868-1925) [48]. New and larger roads were extended further from the river initiating a distinctly western style of settlement patterns alongside the chaotic and piecemeal slums that began to flourish by the 20th century. This growth assumed a life of its own, where unplanned dead end “sois” were built off of main roads producing a fragmented and uncoordinated network of city streets, particularly on the rapidly expanding urban fringes [48].

Following Second World War, Thailand got strong support from the United States owing to the military led government’s strident opposition to communism. Thailand secured and early entry into the United Nations allowing the country access to Word Bank funding which prompted the first mega infrastructure projects that were largely funded through foreign loans. The regional highways were built connecting Bangkok to more distant rural areas under American advice, further accelerating rapid urban growth. During this time, many of the city’s canals were removed to be converted to sewer systems that drained into the Chao Phraya, and automobile transportation slowly replaced the historically dominant canal boats.

It is tempting to assume that western development models proscribed a distinctly American form of urban planning that sealed Bangkok’s fate as an automobile city. However, this implies that the correct regulatory forces existed to guide and plan growth in the first place. Automobiles ascended to the apex of the transportation hierarchy with implicit support from industry, Thai royalty and the growing middle class who demanded the appearances commercial success and western modernity. Meanwhile, the real forces behind Bangkok’s urban morphology lies in the hand of wealth property interests that to this day, for better or for worse, shape all major development within the city, and this usually in the interests of a select upper class.

Thailand’s governments have also been remarkably unstable for nearly a half century, with frequent coup, often spearheaded by the military. The county’s political class has been divided by the near constant power, infrastructure development has been consumed by nondemocratic and unregulated processes, largely governed by personal interests, political connections and desire. The vacuum of effective regulation or democratic oversight has meant land use decisions have rarely been made in step with transportation investments

2.2.1.2 Road Systems in present day

Today Bangkok is an automobile saturated city. Urban transportation infrastructure investment in Bangkok has facilitated personal mobility and private vehicle ownership for some segments of society at the expense of collective transport. The first large scale transportation plan produced in the early 1970’s acknowledged the absence of an efficient mass transit system and rapid public transportation, but those suggestions were ignored and investments were directed to a system of orbital freeways. The first freeway in Bangkok was completed in 1982, and over 300 kilometres of high-speed limited access highways had been built within the metropolitan area in 2006, a large proportion of these operating as private toll routes. Other priorities included elevated intersection flyovers, to allow through traffic on busy arterial roads to bypass traffic signals, and 12 of these flyovers were constructed on major inner city arterial streets in 1992 [49].

Despite the nearly exclusive commitment of transport resources to expanding street capacity, supply of road space has not kept up with the rapidly growing fleets of private automobiles and severe traffic congestion persists. There were approximately 2.5 million vehicles used on Bangkok streets in 2000 [50], and there were 3.1 million vehicles, with an additional 800 being registered every day in 2005 [51]. Between 1990 and 2000, for every three percent growth in the automobile fleet, road capacity was expanded by less than one percent [52]. The major road building operations in the absence of efficient and reliable public transport alternatives has only induced the demand for cars which quickly eliminates any spare capacity. For example, during the most frenzied rush to build new roads, average network speeds in the city proper remained flat at approximately 10 kilometres per hour [53], while the number of street segments considered seriously congested continued to grow [54].

In spite of serious efforts to build their way out of congestion, the built urban form of inner Bangkok made failure a foregone conclusion. Bangkok's highly clustered commercial corridors, responsible for a great portion of motorized trip generation [45], are located in sections of city that are still reminiscent of the pre-automobile network of streets and sub-streets that were originally built alongside an extensive system of canals [46]. Figure 2.4 illustrates two different street network configurations found in Bangkok. On the right is the Bangkok Metropolitan Area with all freeways and arterial streets highlighted in black. Most of Bangkok's postwar inner suburbs, a small portion is shown in the top inset of Figure 2.4 can be characterized as having a tree or fish scale type street network [52], vulnerable to disruption because it lacks the redundancies of a grid where travelers can circumvent temporary obstacles, delays or disruptions. There is also no clear hierarchical ordering where smaller streets can efficiently feed into larger ones. The historical city center shown in the bottom inset of Figure 2.4 has more grid type street pattern, but the dense configuration of buildings and relatively narrow streets precludes accommodating high traffic volumes. Both areas are typical inner of Bangkok, and both are unsuitable for mass auto-mobility and would be better served by public transit. The city's nearly complete reliance on roads has exposed the mismatch between Bangkok's historical built form and the transportation policies meant to bring the city into the future. The results have extracted enormous tolls on Bangkok society. Traffic congestion is not only a source of misery for commuters, but is also serious drain on the economy, environmental quality and the city's overall livability [47].

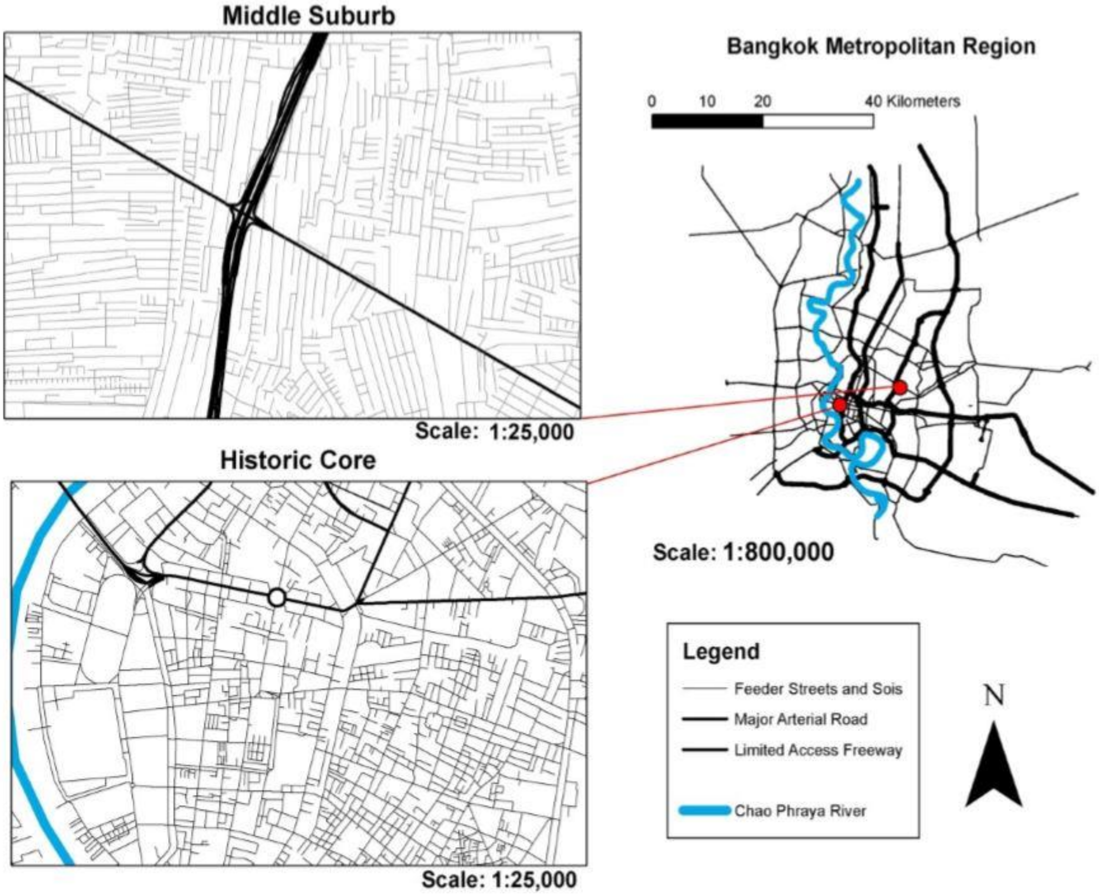


Figure 2.4 The Bangkok Metropolitan Region and example street networks [55]

Bangkok's notoriously bad traffic has been helped along by the remarkable lack of coordination between the dozen or so government agencies responsible for planning, building and tendering transportation projects within the city [56]. An indicator of this is that master transportation plans have flourished, between 1988 and 2003 four have been produced, all by separate actors and each proposing grand and conflicting mega projects, often with no clear strategies for integration with existing infrastructure or acknowledgment of existing or ongoing projects.

Bangkok's traffic dilemma was a slow motion emergency for decades that became a full-fledged disaster by the 90's. Bangkok's auto oriented growth is typical of other middle income developing world cities and is a perfect example of how poor planning can cause real harm to a society [47]. However, there is reason for some optimism. Bangkok's concentrated corridors of commercial activity and long wide arterial streets are well suited for public transportation [46]. Although the present concentration of activity nodes makes supply of road space to growing fleets of automobiles impossible, with proper prioritization and financial commitment, a greater allocation of space for buses could conceivably provide far more efficient access to currently congested city space.

2.2.2 Bangkok Mass Transit systems

Nowadays Bangkok is facing many traffic problems; lack of reliable public transport, congestion, bad quality walkways and lack of rules and enforcement are just some of major concerns. Although private automobile growth has been a constant obstacle to efficient mobility, Bangkok has a wide variety of alternative transportation options that can be flexible and affordable. Bangkok seems to have an urban transit system in which urban and transport planning is not necessarily executed in the interest of the people. Bangkok suffers from many standalone projects across the city, which can cause troubles with urban design efficiency. The BMTA (Bangkok Metropolitan Transportation Authority) provides inexpensive, often poor quality bus services throughout the city region. Since 1999, the Bangkok Skytrain (BTS) has operated to serve people as a mass transit mode in the Bangkok Metropolitan Region (BMR), which comprises the Bangkok Metropolitan Area and five surrounding provinces (Samutprakan, Nonthaburi, Nakhonpathom, Pathumtani, and Samutsakhon). Five years later, the Mass Rapid Transit Subway (MRT) began operating in 2004. Both systems were built in the Central Business District (CBD) of Bangkok, including the downtown areas of Sathorn, Silom, Siam, and Sukhumvit Road. And Airport Rail Link (ARL) serves the passengers between Suvarnabhumi International Airport in all totaling 81 kilometres of track and 53 stations. However, the relatively constrained size of the entire system means that rapid transit service coverage is not adequate to offer service to all Bangkok residents. Figure 2.5 shows the map of the mass transit systems in the Bangkok Metropolitan Region. In 2010, a single bus rapid transit (BRT) route has commenced operations extending relatively fast transport southward from the BTS green line. Plans to expand rail rapid transit are significant with 291 additional kilometres of track planned with some of this currently under construction. On top of these public and private systems, Bangkok also has vast and varied illegal para-transit services ranging from commuter vans for longer travel to motorcycle taxis and converted pickup trucks for shorter distances. Informal transit, in the absence of a personal automobile, is sometimes the only reasonable method of accessing some of Bangkok's sprawling, poorly connected and dense suburbs that do not have any regular transit service. The remainder of this section will briefly describe each of the major components of Bangkok's mass transport systems, and some of the service barriers between the separate systems that hinder coordination.

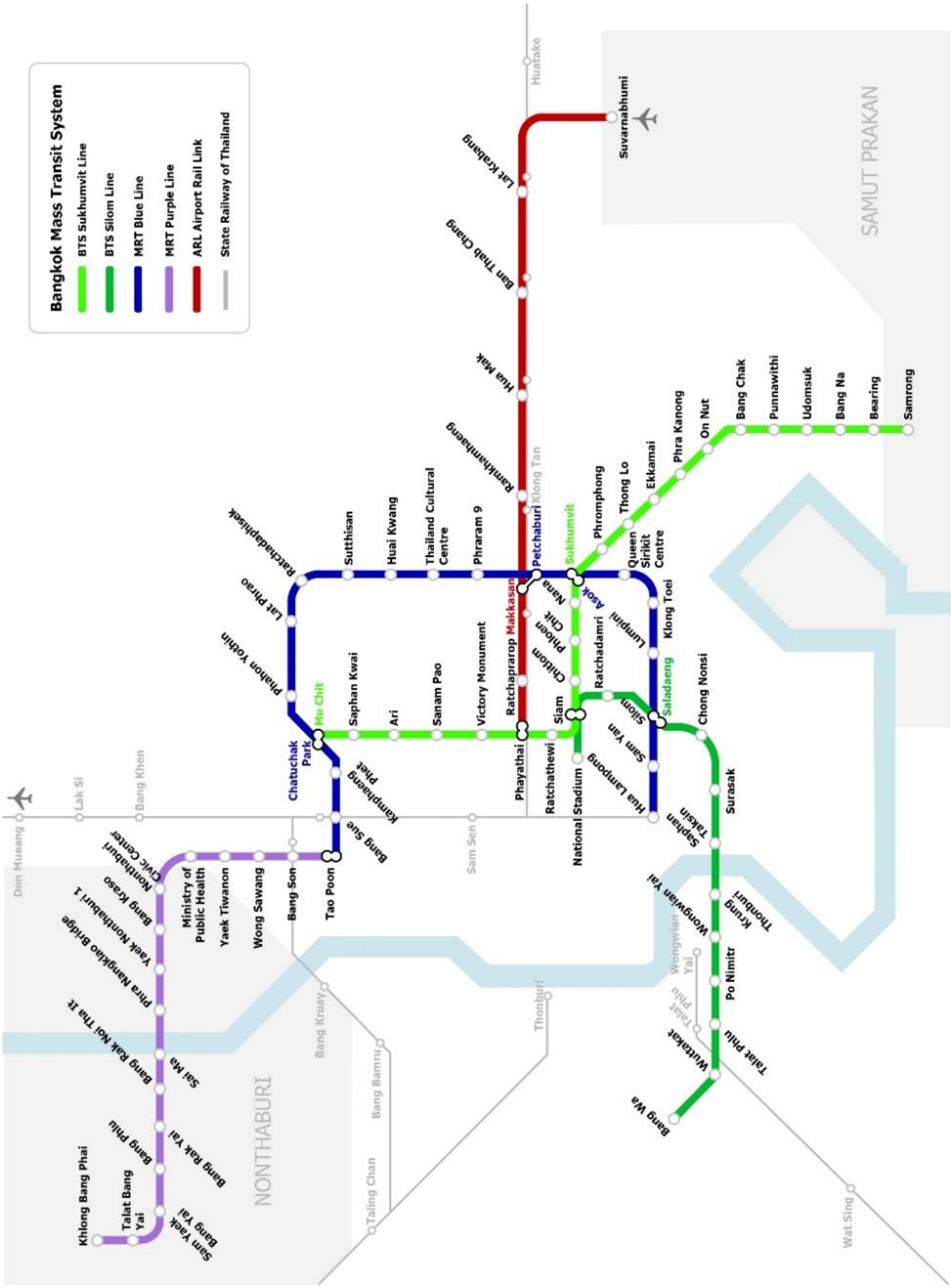


Figure 2.5 Map of mass transit systems in Bangkok

2.2.2.1 Buses

In the mid 1970's, Bangkok's bus system was reformed as the previous consortium of private companies faces insolvency from spiking energy costs and was bought out entirely by the state run enterprise of BMTA. Currently all buses are either owned or operated by the BMTA, or routes are specially licensed by its regulatory body to private operators which run an assortment of bus types and express routes. The BMTA is responsible for all bus operations in the entire greater Bangkok region with a fleet of approximately 3500 buses, 2000 of which are newer air conditioned models (BMTA 2009). The BMTA has granted operating licenses to 3500 other vehicles under private ownership for public transit purposes, mostly smaller low quality buses [52]. In practice the BMTA has a monopoly on the provision of all bus services, either directly operating them or licensing private operators on its routes, a clear conflict of interest in its role as regulator and operator [51]. The introduction of heavy rail has likely not displaced the BMTA as the only choice of transportation for many of Bangkok's residents. Daily wages for many Bangkokians are insufficient to ride either the MRT or BTS and as of 2007, buses carried 12× the number of daily passengers than the MRT and BTS combined [51]. However the introduction of more quality conscious heavy rail operators has further marginalized the bus system as a third class alternative to use the newer rail based transport and para transport options.

Figure 2.6 and 2.7 illustrates the buses generally operate two different vehicle types; air conditioned and non-air-conditioned. Typically both types of buses operate on the same routes, with air conditioned buses charging a premium, albeit still marginal, fare.

Figure 2.6 Non-air conditioned buses of BMTA

Figure 2.7 Air conditioned buses of BMTA

2.2.2.2 Rapid rail transit

Some traffic condition issues have been solved by the addition of rapid rail transit systems in the last ninety years. Rapid rail transit here refers to elevated or underground fully segregated rail borne transit services, often called metros. Rail rapid transit can be distinguished from commuter rail systems by the distance between stations, usually between 500 and 2000 meters apart. The system's tracks are for the exclusive use of the single transit provider [31].

BTS (Bangkok Mass Transit System)

The BTS is skytrain lines which a private, for profit elevated rail rapid transit system. The BTS was built privately in exchange that the BMA provide free access for the land and space necessary to construct the elevated system over top of some Bangkok's busiest arterial streets, while indigenous banks and land development corporations provided the financing necessary to construct, equip and operate the system. The BTS system consists of 35 stations along two lines: the Sukhumvit Line running northwards and eastwards, terminating at Mo Chit and Samrong, and the Silom Line, which serves Silom and Sathon Roads, the central business district of Bangkok, terminating at the National Stadium and Bang Wa. It serves more than 900,000 passengers each day. The lines interchange at Siam Station and have a combined route length of 38.7 kilometers (24.03 kilometers in the Sukhumvit Line and 16.67 kilometers in the Silom Line) [57]. Subsequently, an additional 95.7 kilometers of new lines were secured: the Northern and Southern Green Line extensions (from Bearing to Samut Prakarn and from Mo Chit to Khu Khot) in March 2017, as well as the Pink Line (from Khae Rai to Min Buri) and the Yellow Line (from Lad Prao to Sam Rong) in June 2017. The network coverage will increase by approximately three times its current coverage (38.7 kilometers) in the next three to four years when all these lines become operational [57-58].

MRT (Mass Rapid Transit)

The MRT system is subway lines which privately operated publically owned heavy rail system that opened in 2004, it has 35 operational underground stations along 43 kilometers with two lines. The system serves more than 410,000 passengers each day (Blue Line, 360,000, and Purple Line, 50,000). The Blue Line was the first of the two lines to operate from mid-2004, officially known as Chaloem Ratchamongkhon. It runs eastward from Tao Poon Station along Kamphaeng Phet, Phahon Yothin, and Lat Phrao Roads, then turns south following Ratchadaphisek Road, then west following Rama IV Road to Hua Lamphong station. The second line, MRT Purple Line, officially known as Chalong Ratchadham Line, began operating in 2016, connecting Tao Poon with Nonthaburi Province in the northwest, and there is a planned 19.8-kilometer southern extension from Tao Poon and Phra Pradaeng. Passengers will be able to interchange from the MRT Purple Line to the Blue Line Extension at Tao Poon station [59]. Figure 2.5 shows the map of the mass transit systems in the Bangkok Metropolitan Region.

2.2.2.3 Paratransit Services

Congested roads and uncoordinated street hierarchies have left some areas of Bangkok impenetrable for efficient delivery of city bus services, allowing private vehicle operators to fill gaps in service wherever they may exist.

Bangkok has a wide variety of legal and illegal entrepreneurial informal or paratransit services patrolling city streets ranging from luxurious intercity vans (Figure 2.8) and converted pickup trucks (Song Taeo) (Figure 2.9), privately operated mini buses running on BMTA routes, motorcycle taxis and three wheeled motorized vehicles (tuk-tuks)(Figure 2.10). Generally a two-tiered service regime exists between the different varieties of service. Expressways, major roads and more distant locations are served by metered taxis, mini buses and intercity vans while more local, short distance trips on feeder roads and sois are provided by motorcycles [52].

When taken together Bangkok's informal para-transit modes have an enormous amount of service capacity with over 7000 vans and minibuses, 60,000 metered taxis and well over 50,000 motorcycle taxis operating in the BMA on any given day [60].

Motorcycle taxis congregate on street corners, major bus transfer points and more recently at heavy rail station exits. Figure 2.11 shows a motorcycle taxi stand operating in front of BTS exit at Mo Chit station. The lack of coordination between the BMTA and heavy rail operators provide motorcycle taxi drivers with ideal opportunity to offer faster and more convenient services than buses at present can provide.

Figure 2.8 Van taxi in front of BTS exit

Figure 2.9 Pickup truck (Song Taeo) taxi in front of BTS exit

Figure 2.10 Tuk-Tuk in front of BTS exit

Figure 2.11 Motorcycle taxi in front of BTS exit

2.3 Passengers' Satisfaction

To deal with the external problems caused by urban transport including worsening environment pollution, traffic congestion, etc., promoting the usage of public transit is a critical but challenging task. For one thing, every time before traveling, an individual traveler needs to choose among a group of alternative transport modes. That is, he/she makes a decision about whether to pay and use a specific mode, either private or public. In this respect, public transit is considered as one type of service/product since it competes with private transport methods such as car and motorcycle during the mode choice decision-making process. It is therefore reasonable to treat individual travelers as customers in public transit research, and their mode choice as a special form of consumption. For another, in the field of marketing, customer loyalty is defined as "a deeply held commitment to repurchase or re-patronize a preferred product or service in the future" [61], which has been commonly acknowledged as a proxy for actual customer purchase behavior in the long-term. Due to the substantial impact of loyalty on customer retention and firm profitability [62], service industries have been endeavoring to foster and enhance customer loyalty. As a consequence, understanding the factors influencing passengers' loyalty to PT service is believed to be important since it could help public transit managers, marketers, and practitioners design effective strategies to satisfy passengers' requirements, to maintain existing users as well as to attract new ones from private vehicles [63].

On the one hand, the Satisfaction-Loyalty Theory has been extensively adopted to explain passengers' loyalty to specific forms of public transit services across geographic regions, for example, a light rail transit service in the Metro of Seville, Spain [65] and a city bus service in Shaoxing, China [65]. It has been found that passengers' perception of PT services and overall satisfaction are significant antecedents of their loyalty, while at the same time perceived public transit services exert a positive impact on satisfaction [66]. Lierop et al. [67] provides a comprehensive review of the literature regarding the causes of satisfaction and loyalty in public transport, showing that a bunch of service factors such as passengers' value perceptions and image of public transport is closely associated with loyalty. On the other hand, it is proposed that consumers' decision-making is a complex and comprehensive process, which further underscores the need to adopt a more systematic view towards loyalty [68]. Among a large number of relevant theories, Expectation-Confirmation Theory (ECT) stands out as being robust for modeling repurchase behavior and recommendation intention in marketing research [69], both of which are important components of loyalty. Two affective factors including expectation (i.e., customers' ex-ante beliefs about a product/service itself or its performance) and confirmation (i.e., the extent to which one's actual experience is consistent with his/her initial expectation), are used to explain customer satisfaction within ECT [70-71]. In contrast, constructs associated with Satisfaction-

Loyalty Theory, such as perceived service quality and perceived value, are basically cognitive [67]. More importantly, it has been explicitly argued that the two ECT concepts and explanatory factors from Satisfaction-Loyalty Theory have distinct roots and are based on a different set of antecedent variables [72]. Each of them individually provides a partial explanation of passenger's intention/loyalty to public transit services. Considering all the above arguments, it is expected that the integration of Satisfaction-Loyalty Theory with ECT might provide a more holistic perspective to understand public transit passengers' loyalty. Coincidentally, Cronin et al. [68] implicated the need for further consideration of composite models for behavioral intention, especially the inclusion of additional variables as consumers' expectation, which is exactly part of what is to be done in the current study. Given the gaps in the knowledge of the determinants of passengers' loyalty to public transit, the prominent objective of this study is to improve understanding of customer loyalty in the context of public transit services by extending the standard Satisfaction-Loyalty Theory with two expectation – confirmation theory (ECT) related constructs (i.e., expectation and confirmation), as well as perceived value and corporate image. Specifically, a series of relationships among expectation, confirmation, customer satisfaction, perceived service quality, perceived value, corporate image, and loyalty of interest, are theoretically hypothesized and empirically examined. What is more, to capture the complex and multidimensional nature of public transit service, a hierarchical factor structure is established, in which overall service quality is represented by three sub-dimensional service areas and further a group of specific attributes. Methodologically, a three-step approach, namely Confirmatory Factor Analysis (CFA) – Structural Equation Model (SEM) – Multigroup SEM, is conducted. That is, (1) CFA is first applied to identify the reliability and validity of measurement indicators, (2) SEM is then conducted to examine whether the hypothesized relationships are supported such that the framework would be finally determined, and (3) as an additional contribution.

2.4 Urban Mass Transit in Developed Country

2.4.1 Railway stations in Japan

To construct the new railway lines in Japan progressed rapidly from the late 1800s due to competition between the government and private railways. The first railway in Japan was constructed in 1872 between Shimbashi and Yokohama with a journey time of 53 minutes stopping at six stations. Built with British help using a British locomotive, it was a single track for a steam locomotive that traveled at a top speed of 20mph. The rails were set 1,067 millimeters apart, establishing the gauge that remains in use today. To link the main cities along the old Tokaido (Eastern Sea Route) by rail, it took 17 more years, so that in July 1889 one could travel the entire way from Tokyo to Osaka by train. A single departure per day made the 515 kilometer journey in 20 hours [94]. In 1908, the most private lines were nationalized to become part of the government network and the government railways were again restructured into the public corporation called Japanese National Railways (JNR) in 1949. Again in 1987, the JNR privatization and division split the business into six private regional passenger operators (JRs) and one freight operator. Nowadays, passenger railways in Japan consist of 20,000 kilometers of tracks belonging to the six JRs and 3250 km belonging to 22 non-JR private railways companies [95].

The terminal stations at Shimbashi and Yokohama were designed by an American architect. Both stations building were different in scale, the exteriors resembled the Gare de I'Est in Paris. Each had ticket windows, waiting room, toilets, and left luggage offices. Many early Japanese railway stations were simple single-storey wooden structures because transport volumes were inconsistent and a key of feature of early Japanese railways was that they were constructed mainly to carry passengers. However, the Railway Bureau presented standard design drawings dividing stations into five classes in 1898. Many stations were probably built based on these drawings.

Design of new station and station building

In 1900s, construction of elevated and electrified urban railways were started. The industrialization at that time created significant increases in number of urban rail passengers that requiring stations compatible with the new railway facilities. Japan's first under the elevated tracks station was operated in 1910, Yurakucho Station. 4 years later, Tokyo station was completed as the central station for Japan. It was designed by Kingo Tatsuno, however the floor plan layout have been proposed by Franz Balzer. It had an entrance on the south side and an exit on the north side, as well as a gate for the Imperial household at the centre [95]. The third floor was destroyed in an air raid during the Second World War, and the station has been used with a two-storey 'temporary' restoration for 65 years until recently. In 2011, the station was constructed to restore the station to its original three-storey form with cupolas at the north and south ends.

Many second generation and later stations were blend of Japanese wooden and Western architecture with steady exports during Second World War. However, most were lost to later station upgrades and only a few survive today. The major facilities were ticket windows, waiting rooms, and left luggage offices for long distance travelers. The average life span of those stations was thought to be about 50 years.

The Ministry of Railways Construction Department created the first architectural section to deal primarily with building design and management in 1920. The first design standards for stations were established, along with sizes for waiting rooms and passengers. In 1923, the stations were changed from wood or stone and brick structures to reinforced concrete and steel with aseismic designs because of tremendous damage from the great Kanto earthquake. Ochanomizu Station was rebuilt to a new design after the earthquake. It was completely different from previous station structure because it was only for commuters. Flows with passengers moving without stopping by exiting directly to the street formed the design foundation for later urban commuter stations [100].

Development of urban railways increased since the 1920s. Elevated stations with concourses where people pass freely under the tracks were built to separate road traffic from railways. Kobe, San'nomiya, and Hyogo stations designed the main part of the station outside the elevated track. Wide outer concourses were created under the elevation, and passengers passed through the ticket gate to reach the platform. The broad outer concourse had free passages to come and go under the elevated track. The design allowed free access and was easy to understand, so it was often seen in Japanese under the tracks stations. A typical example is Nagoya Station that was built in 1937.

Station buildings intended to increase passenger convenience with restaurants and shops while increasing railway operator income started appearing at the same time. Umeda Station in the Kansai region is the first station building in Japan was a five-storey building with 11,000 m^2 of floor area built in 1920 by the private Hankyu Railway. The ground floor was let to a department store; there were restaurants on the first floor, and higher floors were used for offices. This was followed by the Tenjinbashi Station Building added to an elevated station by the private Shinkeihan Railway in 1925. In 1931, Tobu Station building in Asakusa in the Kanto region was the largest of its day with a department store as the tenant. It had eight floors with an area of 35,000 m^2. Trains arrived at the second floor platform, which was connected to the ground floor by an escalator [94, 100-102].

In 1945, Japan's Second World War defeat marked the start of reconstruction of bombed and worn out facilities. The government railways were reorganized as JNR with the sole purpose of running railway. Restoration of facilities, such as tracks, took priority and there was little budget for station restoration [95]. The pace of urban reconstruction was astounding, and demand from communities for station renovation was strong because station formed the town face. In these tight conditions, private capital was used to fund station reconstruction. Specific methods were local government taking over JNR debt, constructing station building using private capital, and petitioning for station construction using 100% private capital [95].

In 1949, Toyohashi Station in central Japan opened as the first general public station with the ground and underground floors housing station facilities as JNR assets and the first and higher floors as private assets where fees for property use were paid to JNR. Many stations nationwide underwent renovation using this general public station method. They are similar to the station buildings built independently by JNR. JNR's previously government-regulated business scope was relaxed in 1971 as debts worsened to allow JNR to construct its own profitable station buildings [95]. By the privatization and division, JNR had converted about 50 stations into station buildings in 1987. Naturally, private railways also actively developed station buildings with commercial facilities [94].

Over the tracks stations

Station users from the opposite side of the tracks must cross to get to the station because Japanese stations tend to be on one side of the tracks and passengers pass through the ticket gate to access the platform. Building stations over the tracks and creating a free passage between the station sides was a method to solve this inconvenience and to renovate stations. JNR's first over-the-tracks station was built in 1954. Many stations thereafter were built in three concurrent parts: over- the-track construction, passage construction, and station building construction [95]. The process started with a plan to construct a free passage above the tracks to rejoin the community split by the station. Since the existing station interferes with construction of the free passage, the over-the-track station was constructed at the same time. Then the space freed up by relocating the ground-level station was used to construct the station building. The community bore most of the cost for the free passage and over the-track station construction [94, 101].

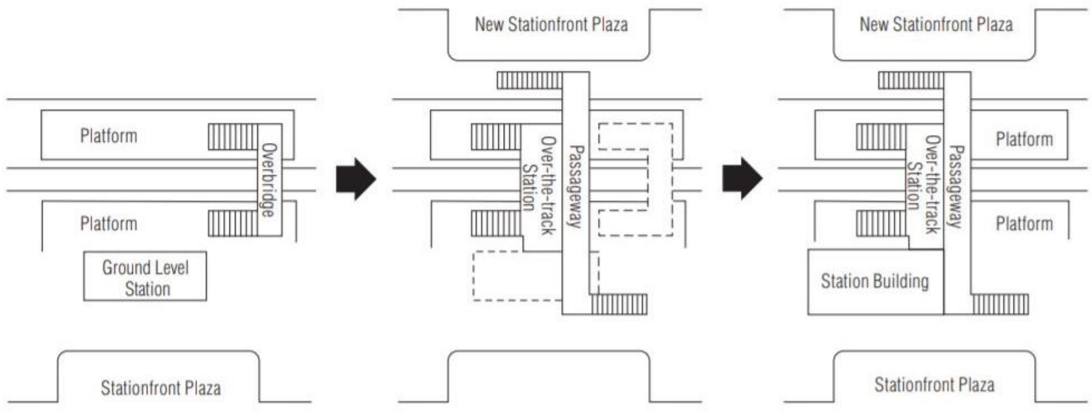


Figure 2.12 Over track station evolution and free passageway [95]

The factors of station changes

The main facilities of early railway stations were waiting rooms and left luggage offices because the stations were for long-distance passengers. However, the increase in commuters using passes changed the station floor plan from a waiting style to a more fluid form. Station functions and features also developed according to customer character, equipment advances, railway company policy, and social demands. The biggest change involves the ticket gate and seat reservation systems started appearing with the spread of computers in 1964. Ticketing facilities underwent a change with mutual advances in automatic ticket vending machines and automatic ticket gates. Recent changes from cardboard tickets to pre-paid IC cards have made transfers easier and route changes. Although mobile phones and the internet allow reservations to be made easily outside the station, however, there is still some demand for conventional cardboard tickets, hindering major changes in station layouts. Left luggage handling has also undergone a major change. Railways no longer handle luggage transport; in Japan at least, private delivery companies have taken on that role. Temporary luggage storage has shifted to coin lockers.

The legal requirement is the greatest factor that has changed stations to become barrier free in recent years. In 2009, approx. 23 % of Japan's population was age 65 years or older. Installation of elevators and escalators in stations handling 5000 or more passengers a day became mandatory with a completion target of 2010. Now, there is a demand to install elevators in stations with less than 5000 passengers. Installation of people movers by modifying the concourse in a way that does not interfere with passenger flow is underway. Many major station renovations have been made in conjunction with such construction work. Providing passenger information is one of issue that has plagued railways for a long time. Methods including monitors displaying information about train delays have been tried. Nowadays, the internet is a convenient source of the shortest routes and quickest transfers, but effective in-station methods have yet to be achieved. The information has proved particularly difficult for users to understand in stations with commercial facilities due to crowding, displays mixed with commercial advertisements, and high noise levels [95].

Recent stations

Nowadays, Japan is facing a greying society, and economic growth is also stagnant. Primary industries in particular are declining due to a lack of successors, and population continues to concentrate in urban areas, causing rural depopulation. Regional urban areas are also seeing a hollowing out of the city center with the development of large-scale suburban commercial facilities. This has resulted in a remarkable decline in the number of station users and poor business conditions for station buildings. There have been various efforts to revitalize the community using station renovation. Stations can be classified mainly as: metropolitan stations where commercial facilities are viable; hollowed- out major urban area stations; regional city stations in the process of deterioration; commuter stations in residential areas; and mostly unmanned stations. It is important to first stimulate the community for hollowed-out major urban area stations. Existing city areas are important assets, there is a movement to make use of that existing infrastructure and change it into an urban structure meeting the needs of the aging population. This has already been started in Toyama and Aomori cities by forming a compact city concentrating urban functions within walking distance of stations and transport hubs [94, 100].

The station in regional city itself is often made into a local tourist destination in addition to the aforementioned revitalization. Fortunately some railways have a firm railfan base, and stations in small to mid-size cities have been made into distinctive scenery using local subject matter and images as measures going beyond revitalization. The typical examples are Kochi Station on the Dosan Line covered with a large wooden shed in 2008. Ryuo Station on the Chuo main line in a motif of local crystal, and Iwamizawa Station constructed with used rails in 2009.

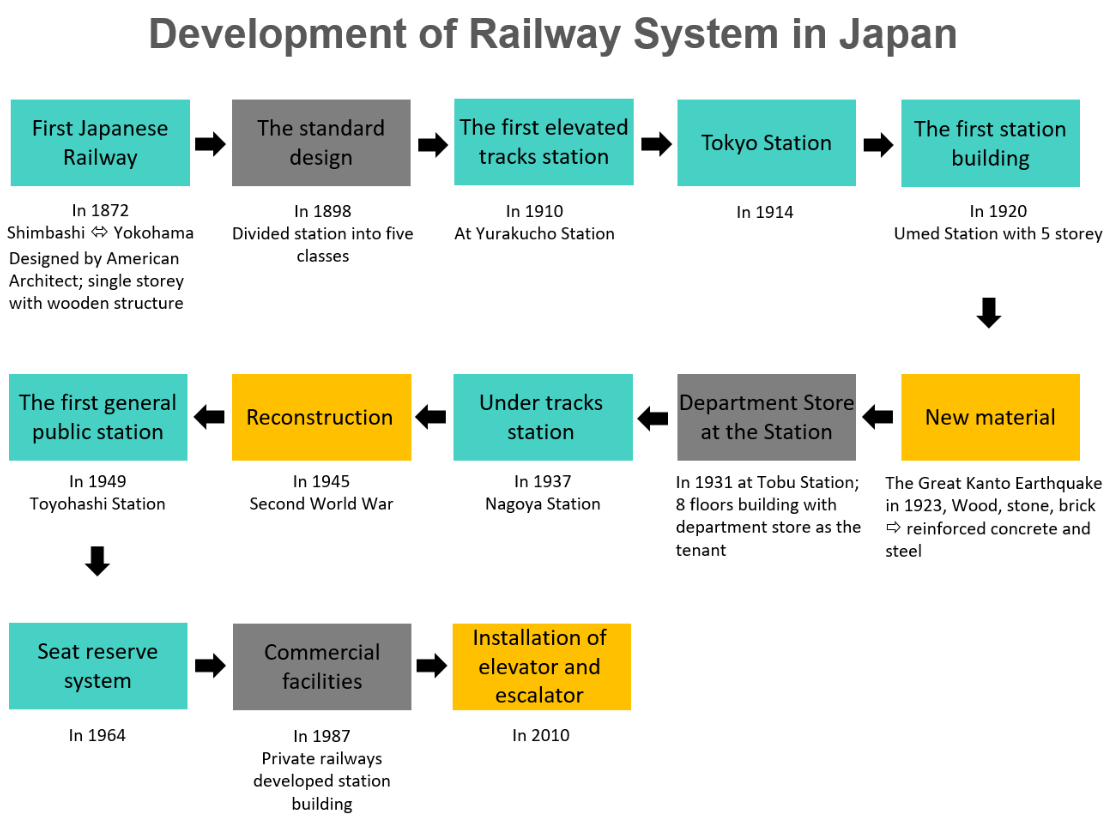


Figure 2.13 Timeline of Development of Japan Railway System

2.4.2 Shinjuku Station

Shinjuku Station is located in the south west of central Tokyo in the Shinjuku district of the capital. Shinjuku Station was operate in 1885, opening as a stop on the Akabane-Shinagawa Line operated by Nippon Railway, Japan's first private rail company. Shinjuku Station grew with the additions of the Chuo Line in 1889, the Odakyu Line in 1923, and the Keio Line in 1951. The line would eventually become the Yamanote loop line, the most famous in the country. Shinjuku Station continued to expand in the postwar period, adding subway services with the Marunouchi Line in 1959, the Toei Shinjuku Line in 1980 and the Toei Oedo Line in 2000. These form part of five satellite stations that orbit the massive complex that formed around the original station from 1885. The entire facility now has over 50 platforms and more than 200 exits, with some of its many intercity, commuter rail and subway services operating from 4:30 A.M. until 1 A.M. the following morning. Shinjuku Station was certified by Guinness World Record in 2011 as the busiest station in the world, with an average of 3.64 million passengers per day. In term of size, Shinjuku Station is the second largest station building in the world after Nagoya Station in Aichi Prefecture. Shinjuku's ascendant economic stature was transformed into political power when the new city hall for Japan's capital, the Tokyo Metropolitan Government Offices, was built west of the station in 1991. A City Hall reflects Shinjuku as the power center of Tokyo, Shinjuku Station continues to one of the most important places in Japan to feel the pulse of the nation - TV news crews report from its South Exit in times of severe weather, natural disasters, political elections, and transport disruptions [99].

Transit in Shinjuku Station

Shinjuku Station serves 13 train lines including; five JR lines (JR Yamanote Line, JR Chuo-Sobu Line, JR Saikyo Line, JR Shonan-Shinjuku Line, JR Narita Express), three Shinjuku subway lines (Toei Oedo Subway Line, Tokyo Metro Marunouchi Subway Line, Tokyo Metro Shinjuku Subway Line), Narita Express train, Odakyu Shinjuku Station, Keio Shinjuku Station (Keio Line, Keio New Line), and Seibu Shinjuku Station. Highway buses also serve at Shinjuku Station. Shinjuku Station is an important highway bus terminus for buses to various destinations in the Kanto region and throughout Japan. Most buses leave from Busuta Shinjuku bus and taxi terminal across from the south exit of Shinjuku Station, but a few buses leave from the west exit bus stops as well. Among the many buses that leave from Shinjuku are buses to Takayama, Toyohashi, Nagano, Matsumoto, Hakuba, Kofu, Sendai, Osaka, Nagoya, Kyoto, and Kobe.

Station building facilities

Shinjuku Station is a sprawling complex housing the world's busiest train station as well as a collection of satellite stations, department stores, shopping centers and underground passageways. Shinjuku Station has hundreds of exits and many platforms spread out over a large area, along with department stores covering nearly all sides. However, the main entrances and exits are at the west, south, and east gates. The east and west gates are surrounded by department stores [99].

- Tokyo Tourist Information Center

  The center located on the south side of Shinjuku Station, it is the places to get travel information which the newly opened Tokyo Tourist Information Center in the Basuta Shinjuku Expressway Bus Terminal. The center is on the third floor of the building beside a taxi bay and a large LCD screen showing travel destinations, as well as a money exchange ATM and Delivery Luggage Storage and Delivery service run by Sagawa Express. There's also a travel and ticket booking counter here run by JTB.
- JR East Travel Service Center

  The center is located next to the New South Gate exit on the south side of Shinjuku Station. The JR East Travel Service Center is for Japan travel information as well as info related to JR railways. Visitors can exchange vouchers for Japan Rail Passes here and get regional JR passes (such as the JR East Pass or JR Tokyo Wide Pass) as well as tickets for Shinkansen bullet trains and other services. There's also a money exchange ATM here.
- Lost and found

  There is a lost and found office operated by JR East near the East Gate at Shinjuku Station.
- ATM Cash Machines at Shinjuku Station
- Currency exchange
- Police box

  The police boxes are located in Shinjuku Station West Exit, East Exit, and East Exit Railway. Police in Japan often help give directions to locals and tourists alike. There are several police boxes (koban) at Shinjuku Station. Some staff can speak English, but everyone should be able to point you in the right direction to landmarks, large hotels and addresses.
- Shinjuku Station Lockers – Luggage Storage and Delivery

  There are hundreds of coin lockers at Shinjuku Station. Coin lockers at Shinjuku Station can be found throughout the enormous complex of the main JR Shinjuku Station as well as its satellite rail, subway and bus stations including the Odakyu and Keio railways. The prices generally range from 100 to 800 yen depending on size. They can be operated either with coins or with Suica or Pasmo stored-value cards used on the Tokyo subway, rail and bus network.
- Shinjuku Station Hotels

Figure 2.14 Shinjuku Station Map and location of facilities in the station
https://www.jreast.co.jp/e/stations/e866.html

Development of Shinjuku Station

JR East has considered plans to develop the Shinjuku Station East-West Public Access Passage together with Shinjuku Ward. The Shinjuku Station East-West Public Access Passage is a corridor that will enable passage between the east and west sides of the station. It was developed by expanding the width of the existing passageway (North Passage) linking between the East and West exit ticket gates within the ticketed area, and relocating the existing ticket gates. This would help to enhance accessibility for pedestrians in Shinjuku Station and surrounding [96-97].

The Shinjuku New South Exit Building has constructed by JR East as a new landmark for the Shinjuku area, on the site of the former JR Shinjuku New South Exit Station House. The new building would be a multi-purpose facility consisting of leased offices, retail stores and cultural exchange facilities. JR East plans to integrate the development of the building with the ongoing construction of the Shinjuku Transportation Hub by lead project developer MLIT. JR East were thereby contributed to attractive town development by creating a new hub of interaction where people can gather and move around freely.

To improve accessibility of Shinjuku Station and area surrounding, JR East installed a passage allowing free movement of people in an east-west direction across Shinjuku Station, in order to enhance the accessibility of the station and surrounding [96, 98]. JR East would thereby contributed to more attractive town development and to the formation of pedestrian networks in Shinjuku Station and surrounding. Moreover, to enhance customer convenience by expanding the width of the concourse in the ticketed area, while changing the location and direction of some staircases, JR East worked to alleviate congestion in the concourse and passages in this area. In addition, JR East installed four new elevators leading to the train platforms, and also conduct barrier-free renovation along the routes from the underground concourse to the train platforms. These plans schedule to finish around 2020 [96].

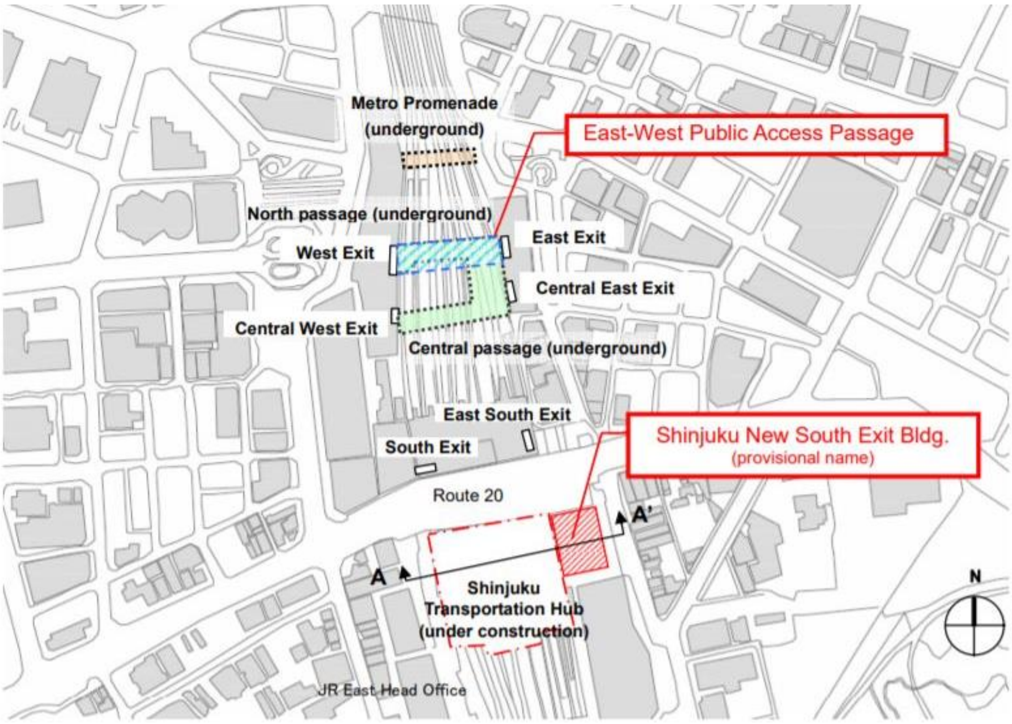


Figure 2.15 Map of Shinjuku Station [96]

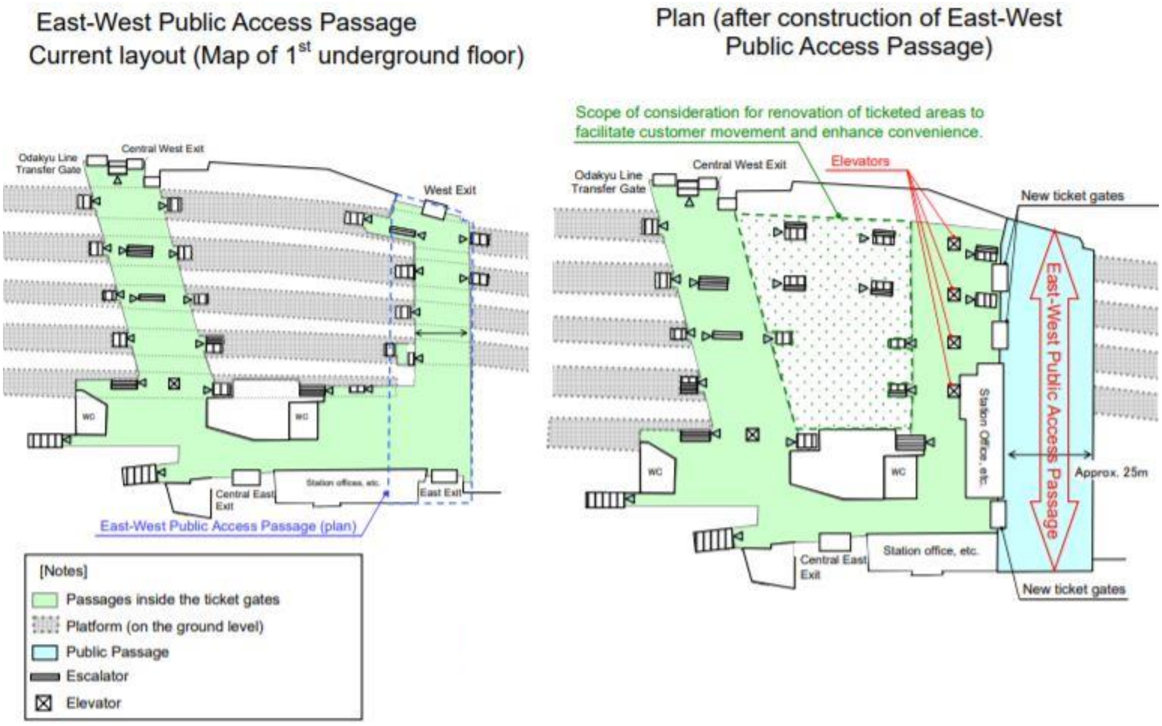


Figure 2.16 The plans currently available and are subject to changes in layout, design and other

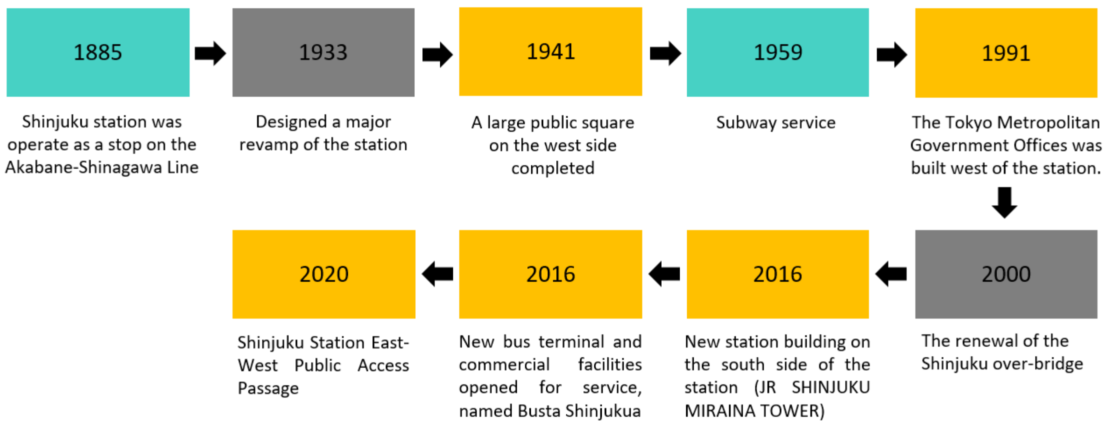


Figure 2.17 Timeline of Development of Sinjuku Station

Chapter 3

Research Methodology

3.1 Case Study

3.1.1 Site selection

The key criterion used for site selection was each station's ability to give a variety of connectivity, especially, different transportation modes. In addition, site selections must be located in the transit node of each Bangkok zone, such as the big transportation node in the north of Bangkok. After pre-survey, three BTS Skytrain stations (Mo Chit, Victory Monument, and Saphan Taksin) were selected to assess transit accessibility performance in Bangkok, Thailand. All the stations were located in business or commercial areas. The stations presented different characteristics regarding their functions, including station building, interchange area, and transit systems.

3.1.2 Overview of selected stations

'Mo Chit Station' is a Skytrain station on the Sukhumvit Line located in Mo Chit transit node, which is fed by several transit modes on Phahon Yothin Road. The station is an important interchange station in northern Bangkok where passengers can directly connect to Chatuchak Park subway station (MRT blue line) and inter-city buses at Mo Chit Bus Terminal, the biggest bus station in Bangkok, which connects the North, Central, Eastern, and Northeastern provinces to the city. The station is also located near Bang Sue Railway Station, also known as Bang Sue Junction, where the train is bound for northern and northeastern Thailand. Moreover, Bang Sue Station will be Thailand's new railway hub, replacing the current Bangkok railway station at Hua Lamphong as the terminus for all long-distance rail services from Bangkok. It will increase the number of passengers at Mo Chit Station when the new Bang Sue railway is operational.

'Victory Monument Station' is a Skytrain station on the Sukhumvit Line located on Phaya Thai Road to the south of the Victory Monument, one of Bangkok's landmarks. It is near the major traffic circle at the intersection of Phahonyothin Road, Phaya Thai Road, and Ratchawithi Road, which has long served as one of the busiest transportation nodes in Bangkok. The station is linked to all four exits of the traffic circle by the skywalk and almost stretches around the monument. The station is an important interchange station in central Bangkok, with a major Bangkok Mass Transit Authority (BMTA) bus stop as well as van terminals connecting to suburbs and provinces around the capital.

'Saphan Taksin Station' is a station on the BTS Silom line in Sathon District. It is located at the entry ramp to Taksin Bridge below Sathon Road and east of the Chao Phraya River. The station was established in a highly developed area with business and commercial uses. The diversity of uses near a station is a major driver of intense activity centers that can enhance accessibility. The population, housing, and physical surroundings density at the stations are very high. Saphan Taksin Station is the only rapid transit station in Bangkok whose passengers can transfer to a river pier for the ferry to Thonburi and the Chao Phraya Express Boat service. That makes the station popular for both daily passengers and tourists sightseeing on river boats in the historical area around the Chao Phraya River, as shown in Figure 3.1.

Figure 3.1 The location of the selected stations

Based on site surveys, the selected stations presented a variety of feeder modes, including Skytrain, subway, local train, bus, passenger van, taxi, hired motorcycle, boat, and other para-transit modes. Some stations had good-quality access facilities and available elevators, staircases, and escalators. However, not all stations presented good-availability and -quality facilities. This situation makes access difficult to disadvantaged groups such as the elderly, pregnant women, and disabled people, as shown in Table 3.1.

For pedestrian access, all selected stations were found to have sidewalks between 1 and 3 meters wide (Table 3.2). Parking was offered at Mo Chit Station only. Except for Saphan Taksin Station, all stations provided an elevator to access the station building, but did not provide priority for disabled users and adequate signage for the blind. Victory Monument Station provided a skywalk to access the station, and it was the main way passengers accessed the station building. The feeder connectivity was found to be different at the different stations. Saphan Taksit station was the only station with feeder by river transport, as shown in Table 3.2.

Table 3.1 The available facilities at Bangkok mass transit node

Available Facility			
	Station		
	Mo Chit	**Victory Monument**	**Saphan Taksin**
Bicycle parking	Yes	Yes	No
Parking area	Yes	No	No
Stair	Yes	Yes	Yes
Elevators	Yes	Yes	No
Escalator	Yes	Yes	Yes
Skywalk	No	Yes	No
Time table	Yes	Yes	No
Priority way for disable users	Yes	Yes	No
Information for disable and elderly users	No	No	No
Adequate signage for blind	Yes	Yes	No

Table 3.2 The connectivity at Bangkok mass transit node

Size of pedestrian			
	Mo Chit	**Victory Monument**	**Saphan Taksin**
Sidewalk (width)	Between 1 and 3 m.	Between 1 and 3 m.	Between 1 and 3 m.
	Mo Chit	**Victory Monument**	**Saphan Taksin**
Bus lines	40 lines	77 lines	11 lines
Boat	No	No	Yes
Train	No	No	No
BRT (Bus rapid transit)	No	No	No
MRT Subway	Yes	No	No
BTS Skytrain	Yes	Yes	Yes
SRT (Suvarnabhumi Airport Rail Link)	No	No	No
Paratransit	Yes	Yes	Yes

3.2 Data Collection

The data collection of this research study includes both primary data and secondary data. Qualitative and quantitative methods were consisted of the primary data; questionnaires, interviews, observation, case studies of experiments. These data were more described in detail below this section. For secondary data, the related information to public transportation in Bangkok, mass transit node, transit station floor plan, Bangkok public transportation services report, and development plan of mass transit in Bangkok were collected.

3.2.1 Site survey

The criteria for select site station was belong to ability to be visible monitored and examined the city accessibility characteristics, factors and impacts based on data supporting research process.

3.2.2 Questionnaire survey

The users' questionnaires were completed by 450 transit station passengers at Mo Chit Station, Victory Monument Station, and Saphan Taksin Station. Data collection was administered in various times on different days of week. The question in the survey were meant to find out the attitudes of the passenger who use the transit station. The questionnaires were therefore composed of four parts related to; individual characteristics such as gender, nationality, age, and other; trip pattern such as trip purpose, duration, and other; satisfaction part for feeder modes at transit node station such as waiting time, riding/driving quality, on demand service, and other; and the last part is satisfaction at transit node station such as service, safety, environment, accessibility, operation, and facilities. Survey participants were chosen randomly within the station. The data were disaggregated by different social group including men, woman, the elderly, Thai and foreigner.

In the general question, the respondents were asked about their personal information and frequency of using mass transit. In the mass transit access trip, the respondent were asked to explain their trip patterns and detail of access to transit station such as waiting time, and their activity at transit station. Moreover, all of respondents were asked about their attitudes with service, safety, environment, accessibility, operation, and facilities at transit station. All respondents were requested to rate their attitudes on five-point satisfaction scale, with rating ranging from "1 = very dissatisfied", "2 = dissatisfied", "3 = average", "4 = satisfied", "5 = very satisfied".

3.2.3 Sampling size

Sampling size of questionnaire survey was calculated based on Taro Yamane technique [73] from a total of 3 transit stations of Bangkok mass transit stations with 95% confidence level.

$$n = \frac{N}{1+Ne^2}$$

Where, n = Sample size

N = Total of daily ridership of Bangkok mass transit (697,900)

e = the acceptance of probability of error (equal to 95%)

Total respondents $n = \frac{697,900}{1+697,900x(0.05)^2} = 399.77$

Therefore, making a simple number of respondents, this study conducts with a group of 450 passengers in total for three transit stations (150 passengers in each station). Also a random sampling technique is applied for questionnaire distribution that the occupant selected be representative of Mo Chit Station, Victory Monument Station, Saphan Taksin Station.

3.3 Method and Analysis Techniques

Qualitative analysis

It includes the data from site survey, and field observation. Data analysis includes interpretation of the opinion of the respondents to identify the issue for improving mass transit node. Usually, descriptive and explanation the result by content analysis were adapted.

Quantitative analysis

Quantitative analysis of questionnaires as general information on personal background (socioeconomic, i.e., trip purpose, the frequency of use) were presented by descriptive statistic such as ratio, percentage, frequency, mean, and standard deviation (SD). T-test, one-way ANOVA, chi-square were employed for identify satisfaction to test differences of score based on independent groups. Correlation and regression analysis is a mainly tool for significant evidence of transit station performances in term of predicting factors. Statistics Package for the Social Sciences (SPSS) is mainly technique of qualitative data analysis.

3.3.1 Reliability test

Reliability (internal consistency) is important fundamental aspect of questionnaire measurement in form of Likert-type scales. The instrument's reliability by using Cronbach's alpha is a first-step to estimate all possible ways of splitting the test items in an inter-item correlation matrix.

$$\alpha = (k/(k-1))*[1-\sum (s_i^2)/ s^2 \text{ sum}]$$

Where, α = reliability of questionnaire instrument

K = number of question

s_i^2 = summary of variance score of each item

s^2 sum = variance score of questionnaire instrument

Cronbach's alpha reliability coefficient normally rages between 0 and 1. The closer Cronbach's alpha is to 1.0 the greater internal consistency of the items in the scale [19] There is a reliability degree as the following rules of thumb: "> .9 – Excellent, > .8 – Good, > .7 – Acceptable, > .6 – Questionable, > .5 – Poor, and< .5 – Unacceptable". Therefore, it should be noted the coefficient reliability is considerable to be acceptable when Cronbach's alpha > 0.7 [20]. Reliability of the 30 variables was tested by using Cronbach's alpha. The result was .93 for Klong Chan Flat and .95 for Buengkum Baan Eur Arthon. These are higher than the acceptable level of Cronbach's alpha at .70 [74].

3.3.2 Independent Sample t-test

This test is applicable when independent variables are interval or ratio scale. The hypothesis should be set up to explore whether respondents in term of socio-economic background such as gender, age, etc. as long as the tested members of each group are different satisfaction. For example, male and female in different transit stations (independent variable) are different satisfactions in significant. So the null hypothesis should be: H0: Male ≠ Female and H1: Male = Female. P-value is used to determine the significant value if the value falls below the standard of ".05," it can declare a significant difference between groups.

$$t = \frac{M_x - M_y}{\sqrt{\frac{\left[\left(\sum x^2 - \left(\frac{\sum x^2}{N_x}\right)\right) + \left(\sum y^2 - \left(\frac{\sum y^2}{N_y}\right)\right)\right] \cdot \left[\frac{1}{N_x} + \frac{1}{N_y}\right]}{N_x + N_y - 2}}}$$

Where, $\sum$ = sum the following scores

M_x = mean for Group A

My = mean for Group B

X = score in Group 1

Y = score in Group 2

N_x = number of scores in Group 1

N_y = number of scores in Group 2

3.3.3 One–way ANOVA

The one-way ANOVA compares the means between the groups that researcher are interested in and determines whether any of those means are significantly different from each other. However, the one-way ANOVA returns a significant result, we accept the alternative hypothesis (HA), which is that there are at least 2 group means that are significantly different from each other. At this point, it is important to realize that the one-way ANOVA is an omnibus test statistic and cannot tell you which specific groups were significantly different from each other, only which at least two groups were. To determine which specific groups differed from each other, you need to use a post hoc test. The test has its own formula:

$$F = (SSE1 – SSE2/m) / SSE2 / n\text{-}k$$

Where, F = variance of the group means/ mean of the within group variances

SEE = residual sum of squares

m = number of restriction

k = number of independent variables

3.3.4 Correlation

Correlation test examines the relationship between two or more variables separately, meaning that relationship between two variables is independent of other variables. These variables measure the strength and direction of the linear relationship between the two variables. The correlation coefficient can range from -1 to +1, with -1 indicating a perfect negative correlation, +1 indicating a perfect positive correlation, and 0 indicating no correlation at all (Diamond, 2006). However, to select variables for next regression model for a validate regression model, a correlation coefficient should be more than 0.3 or above denoting a strong relationship and those variables is required a p-value of less than .05 to indicate statistically significant [75].

3.3.5 Regression

Linear Regression Model

A liner regression was employed as casual method based on the assumption that the variable to be forecast (dependent variable) has cause-and-effect relationship with one or more other (independent) by linear trends [76]. The formula for a regression line is:

$$Y = a + bX$$

Where; X = the explanatory variable

Y = the dependent variable

b = the slope of the line

a = the intercept (the value of y when x = 0)

Multiple Regression Model

Multiple regression is an extension of simple linear regression analysis and uses to assess the association between two or more independent variables and a single continuous dependent variable. The general form of the multiple regression equation can be used as the following equation:

$$Y = \beta 0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon$$

Where, Y = the dependent or response variable

$X_1, X_2, X_3, \ldots, X_k$ = the independent or predictor variables

$E(Y) = \beta 0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$ = is the deterministic component of the model

β_i = the contribution of the independent variable X_i

ε = a random error of the model

Firstly, the variable in the model is a linear relationship between the dependent and dependent variables. Secondly, the independent variables must be linearly independent. Thirdly, there is no highly correlated among the variables (multicollinearity test). And finally, the error distribution should also be normal [75].

Logistic Regression Model

Logistic regression determines the impact of multiple independent variables presented simultaneously to predict membership of one or other of the two dependent variable categories. To predict positive impact on overall satisfaction in mass transit node stations the logistic regression equation can be used as the following equation;

$$\text{Prob (satisfied)} = \frac{1^{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p}}}{1+e^{-\left(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p\right)}}$$

Where, Prob = the probability that a case is in a particular category

e = the base of natural logarithms (approx. 2.718)

β_0 = the constant of the equation and

β_1 = the coefficient of the predictor variables

Or $\quad \text{Prob (satisfied)} = \frac{1}{1+e^{-z}}$

Where, $\quad z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$

3.3.6 Space syntax

Space syntax is an architectural theory proposed by Bill Hillier that studies the correlation between space and human societies with the space organization concept. Space syntax is also defined as a graph-based theory used to examine how the spatial layout of buildings and cities influences the social, economic, and environmental outcomes of human movements and social interactions [77]. Its techniques offer precise quantitative descriptions of the way in which the built spaces of a setting are organized [78].

Space syntax is related to three concepts: convex space, axial line, and isovist field. Convex spaces include (a) spaces exhibiting non-linear behavior and (b) the buildings and common spaces among them, as well as the interior arrangement of houses [79]. Axial line analysis is usually used in the analysis of structures in cities, villages, or neighborhood units [80]. A connection graph is defined depending on how each line connects to its surroundings.

This research chose the method of axial analysis to analyze the accessibility of the station buildings. In this method, according to spatial perception, a large-scale space is divided into a series of small-scale spaces. The relevant index of each axis represents the convenience of movement, transfer, forward, and other capabilities. All lines in a spatial layout have a certain distance from all other lines in the system, and travel along the axial direction is the most economical and convenient movement.

For station buildings' analysis, the space in the architectural sense is three-dimensional. It is assumed that the person is active on the floorplan, and the function of the building space is mostly related to the floorplan. Therefore, the space is assumed to be two–dimensional, summarized by its plan view and the calculated relationships between the spaces. Restoring the building's floorplan to a connected convex space and enclosing the spaces in a closed curve are the functions of software simulation analysis.

Depthmap is analysis software associated with two strands of thought: isovist analysis and space syntax. In the software, visibility is used as an independent variable derived from the connectivity graph. Connectivity (C_i), as defined by Jiang et al. [81], is the first variable as a direct connection of nodes (k) to each individual node in the connectivity graph, as shown in formula:

$$C_i = k$$

The second dependent variable is step depth, defined as the number of steps from one node to the other nodes. Then, if *i* to *j* is the shortest distance (d_{ij}) in a connectivity graph, total depth is the sum of steps from *i* to *j*, and the mean depth of a whole graph is as in formula:

$$\sum_{j=1}^{n} d_{ij}$$

The third variable (formula 3) is an integration, and the focus is HH-integration, that is, the integration developed by Hillier and Hanson [77]. Integration defines the degree to which a node is integrated in or segregated from a system as a whole (global) or partially (local). The values from integration represent how easily a space can be reached from the street. The summary of variables measured in Depthmap software is shown in Table 3.3.

$$\text{MDi} = \frac{\sum_{j=1}^{n} d_{ij}}{n-1}$$

Table 3.3 The Summary of variables measured in Depthmap software

Independent Variable	Dependent Variables
Visibility	Connectivity Step Depth Integration-HH

3.3.7 Betweenness

To measure the connectivity space performance in transit stations, the study found common paths by using the betweenness index in the Urban Network Analysis (UNA) toolbox that runs in Rhinoceros software [82]. The betweenness index was particularly used to simulate the spatial relationship between the street network and the surrounding architectures, which represents the trajectory on which trips might occur according to the subjected network.

$$\text{Betweenness } [i]^r = \sum j, k \ \in G - (i), d[j,k] \leq r \frac{n_{jk}(i)}{n_{jk}} . W_{[j]}$$

Where; i = network

j = origin location

k = destination location

r = search radius

n_{jk} = the number of shortest paths between origin (j) and destination (k)

$W_{[j]}$ = the weight of destination j

By calculating the shortest path between origins and destinations within the assigned network, the normalization of the betweenness index is defined as formula. The study counted the number of activities located around the nearest connection route between the entrance/exit gates and the staircases connected to the platform on the upper floor by representing them as an observer point function in the UNA tool. The observer points were counted as the number of trips that passed by each observer point. Then, the study used observer points to represent the location of each activity in the station area in order to interpret how activities along the corridor area impact the potential connection routes.

Moreover, the detour ratio variable was analyzed in this study through the interpretation of alternative route analysis on pedestrian accessibility. The study area that was investigated covered 30% of the detour ratio from the shortest paths of transit modes' connection paths, according to pedestrian behavior, which usually deviated around 10–20% above the shortest route [82]. The investigation did not limit the search radius to rule out the additional time spent on access that might occur due to other factors and to concentrate on the distance factor via the nearest route, and the detour ratio already included the limitation of time of accessibility.

Chapter 4

Passengers' Satisfaction of Bangkok Mass Transit Node

4.1 Respondent Profile

This section of research is to understand the passenger satisfaction in the condition of mass transit node. A mass transit node in Thailand; two case studies in Bangkok were selected including Mo Chi Station, Victory Monument Station. A passenger survey of three stations was direct interview at the stations. This will be basis information for improvements as preferred satisfaction based on passenger's assessment. Furthermore, to explore passengers' satisfaction to deal with ease of transit condition is also the key to enhance quality of transit.

A personal characteristic as a basic information to understand a passengers' background of Bangkok mass transit including gender, nationality, age, occupation, income, and vehicles in household shows in the Figure 4.1.

As shown in Figure 4.1, it was revealed that the majority of respondents of Mo Chit station, Victory Monument station, and Saphan Taksin station were females by the percentage were not quite different by representing 58.0%, 53.3%, and 59.3% whereas 42.0%, 46.7%, and 40.7% were males, respectively. More than 95% of respondents of all stations were Thai. The respondent's ages starts from 16 – 67 years in Mo Chit station, 15 – 61 years in Victory Monument station, and 14 – 65 years in Saphan Taksin station. 21- 30 years was indicated as a large group for all stations (66%, 66.67%, and 60.67%, respectively).

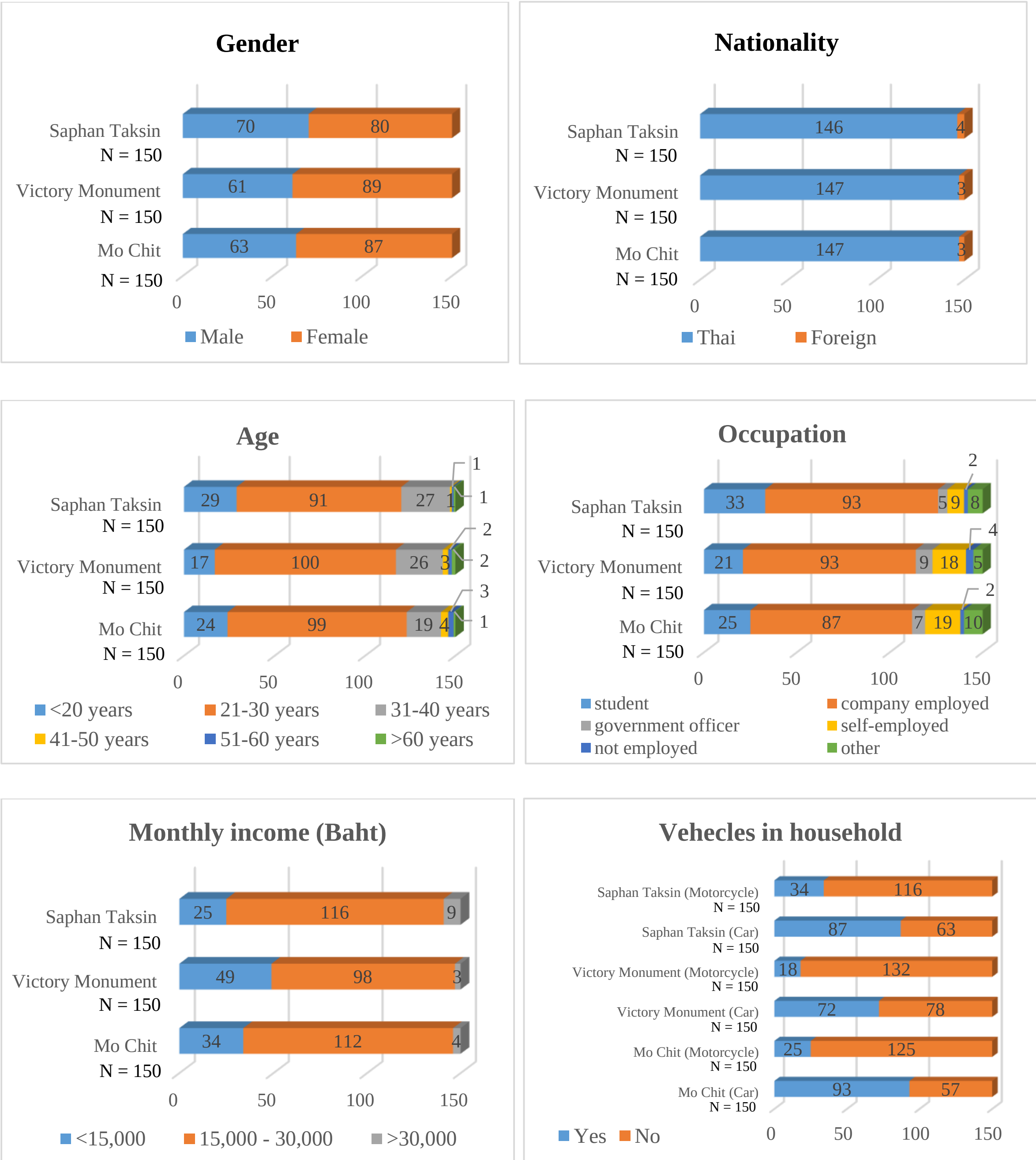


Figure 4.1 Respondents' profile

For occupation, it is evident from questionnaire information that most of respondents work for private company (58%, 62%, and 62%), Inferior to the company employee, the percentages of the student respondents were 16.67%, 14%, and 22%. Whereas the percentages of the respondents engaged in self-employed, government officer, and other employee were not quite difference. Income of respondents is one important that might affect the person's attitude and measure on economic conditions. The most monthly income of respondents ranged from 15,000 – 30,000 baht for 74.67%, 65.33%, and 77.33% of Mo Chit station, Victory Monument station and Saphan Taksin station. High late of low income passenger was found in Victory Monument station and Mo Chit station as 32.67% and 22.67%.

Vehicle in house hold is also one of key factor in mass transit system and represent an important measure on accessibility condition. More than 77% of respondents of three stations do not have motorcycle in their household, meanwhile the percentage of respondents who have and do not have car in household were not quite different in Victory Monument station by representing 48% and 52%. Whereas the percentage of respondents who have car in Mo Chit station and Saphan Taksin station were 62% and 58%.

Investigating the frequency of use the transit station was found 1 – 2 times per week mainly in Mo Chit station, Victory Monument station and Saphan Taksin station (42.67%, 48% and 34.67%). However, in Saphan Taksin station, the percentage of frequency of use the transit station between 1 – 2 times per week and only weekend were not quite different by representing 34.67% and 30%. Whereas the percentages of the respondents engaged in 5 – 6 times per week, every day and only weekday were not quite difference. As shown in Figure 4.2, it was revealed that the majority of trip purpose of Mo Chit station, Victory Monument station and Saphan Taksin station was 'work' by the percentage 50.67%, 46% and 50.67% whereas 25.33%, 17.33% and 26% were travel, respectively.

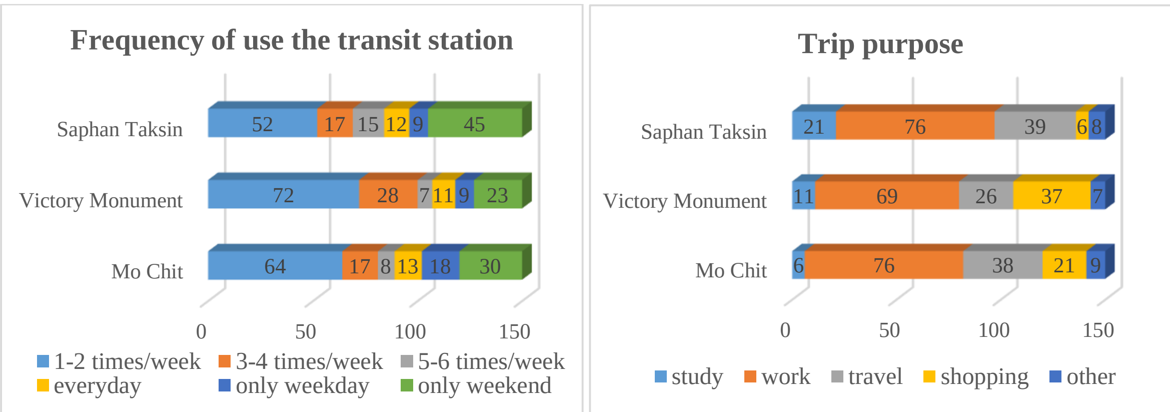


Figure 4.2 Respondents' profile on trip pattern

The respondent of frequency of transfer in one trip was found most of the respondent transfer only one time in their trip by representing 52% and 39% in Mo Chit station and Saphan Taksin station, while Victory Monument was the most respondent transfer for 2 times by the percentage 46%. However, the average transfer in one trip was found at 2 times in three stations. Investigating trip duration was found 15 – 30 minutes mainly in three stations, Mo Chit station, Victory Monument station and Saphan Taksin station by representing 51.3%, 36% and 44%. Whereas the percentages of the trip duration less than 15 minutes and 30 – 60 minutes were not quit difference in three station, by representing 22%, 27.3 and 21.3 were less tans 15 minutes meanwhile 20.7%, 22.7% and 20% were 30 – 60 minutes in Mo Chit station, Victory Monument station and Saphan Taksin station.

The average trip duration was 28.18 minutes in Mo Chit station, 34.09 minutes in Victory Monument station and 34.42 minutes in Saphan Taksin station. As shown in table 4.1, transfer duration was found 5 – 15 minutes mainly in Mo Chit station, Victory Monument station and Saphan Taksin station (40.7%, 39.3% and 40%) where less than 5 minutes was found for the second groups in three stations by representing 30.7%, 28%% and 32%. The average transfer duration in Mo Chit station, Victory Monument station and Saphan Taksin station were 13.58%, 15% and 13.21, respectively.

Table 4.1 Respondents' profile on trip pattern characteristic

Attributes	**Category range**	**Mo Chit**		**Victory Monument**		**Saphan Taksin**	
		N = 150	**%**	**N = 150**	**%**	**N = 150**	**%**
Frequency of transfer in one trip	1 time	78	52.0	60	40.0	59	39.3
	2 times	60	40.0	69	46.0	56	37.3
	3 times	10	6.7	16	10.7	16	10.7
	4 times	0	0.0	4	2.7	7	4.7
	>4 times	2	1.3	1	0.7	12	8.0
Average (times)		1.57 = 2		1.77 = 2		1.97 = 2	
Trip duration	<15 minutes	33	22.0	41	27.3	32	21.3
	15 - 30 minutes	77	51.3	54	36.0	66	44.0
	30 - 60 minutes	31	20.7	34	22.7	30	20.0
	1 - 2 hours	7	4.7	15	10.0	17	11.3
	>2 hours	2	1.3	6	4.0	5	3.3
Average (mins.sec)		28.18		34.09		34.42	
Transfer duration	<5 minutes	46	30.7	42	28.0	48	32.0
	5 - 15 minutes	61	40.7	59	39.3	60	40.0
	15 - 30 minutes	24	16.0	27	18.0	26	17.3
	30 - 45 minutes	13	8.7	15	10.0	11	7.3
	45 - 60 minutes	2	1.3	4	2.7	2	1.3
	>60 minutes	4	2.7	3	2.0	3	2.0
Average (mins.sec)		13.58		15.00		13.21	

Considered on accessibility characteristic, the mainly access to the station by walk was found in Mo Chit station (33.3%) where access by bus was found in Victory Monument station and the majority access at Saphan Taksin station was boat by the percentage 32.7%. Moreover, access to the station by Songtaew and boat were found only at Saphan Taksin station. Whereas access to the station by private car was found as a large group at Mo Chit station, it is unsurprisingly because at Mo Chit station they provide the large parking area next to station building.

The respondents of distance from the origin to transit station was found that 500 m – 1 km was indicated as a largest group in three stations, Mo Chit station, Victory Monument station and Saphan Taksin station by representing 42%, 31.3% and 43.3%. However, the average of the distance from the origin to transit station were found 0.97 km in Mo Chit station, 1.19 km in Victory Monument station and 1.17 km in Saphan Taksin station.

Table 4.2 Respondents' profile on accessibility characteristic

Attributes	**Category range**	**Mo Chit**		**Victory Monument**		**Saphan Taksin**	
		N = 150	**%**	**N = 150**	**%**	**N = 150**	**%**
Access mode	Walking	50	33.3	46	30.7	35	23.3
	Bus	33	22.0	59	39.3	18	12.0
	Taxi	12	8.0	16	10.7	6	4.0
	Motorcycle Taxi	12	8.0	2	1.3	21	14.0
	Songtaew	0	0.0	0	0.0	16	10.7
	Bicycle	4	2.7	0	0.0	1	0.7
	Boat	0	0.0	0	0.0	49	32.7
	Private car	23	15.3	1	0.7	4	2.7
	Van Taxi	16	10.7	26	17.3	0	0.0
Distance from the origin to transit station	<500 m.	47	31.3	41	27.3	31	20.7
	500 - 1 km	63	42.0	47	31.3	65	43.3
	1 - 2 km	23	15.3	39	26.0	28	18.7
	2 -3 km	11	7.3	14	9.3	19	12.7
	3 - 5 km	5	3.3	6	4.0	6	4.0
	>5 km	1	0.7	3	2.0	1	0.7
Average (km)		0.97 km		1.19 km		1.17 m	

4.2 The Results of Mass Transit Node Satisfaction

4.2.1 The overall satisfaction of mass transit node

First, the overall satisfaction of mass transit node was examined in six aspects included service, safety, environment, accessibility, operation and facilities. It was found that Victory Monument station respondents' satisfaction level in service, safety, accessibility and facilities were higher than Mo Chit station and Saphan Taksin station respondents, with scores 3.30, 3.30, 3.33 and 3.09 for Victory Monument station, 3.23, 3.27, 3.24, and 2.96 for Mo Chit station, and 3.14, 3.26, 3.24 and 2.88 for Saphan Taksin station, respectively. Whereas Saphan Taksin station receive a highest scores of 3.41 and 3.29 of satisfaction of environment and operation as shown in Table 4.3 and Figure 4.3. Three stations respondents' satisfaction level in all aspect were fair level at the score range 2.51 – 3.50.

Table 4.3 Mean scores of overall satisfaction on six aspects

Overall satisfied with six aspects	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
Service	3.23	1.603	Fair	3.30	1.616	Fair	3.14	1.589	Fair
Safety	3.27	1.610	Fair	3.30	1.616	Fair	3.26	1.607	Fair
Environment	3.35	1.629	Fair	3.25	1.605	Fair	3.41	1.647	Fair
Accessibility	3.24	1.604	Fair	3.33	1.624	Fair	3.24	1.605	Fair
Operation	3.23	1.603	Fair	3.27	1.61	Fair	3.29	1.614	Fair
Facilities	2.96	1.582	Fair	3.09	1.584	Fair	2.88	1.587	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

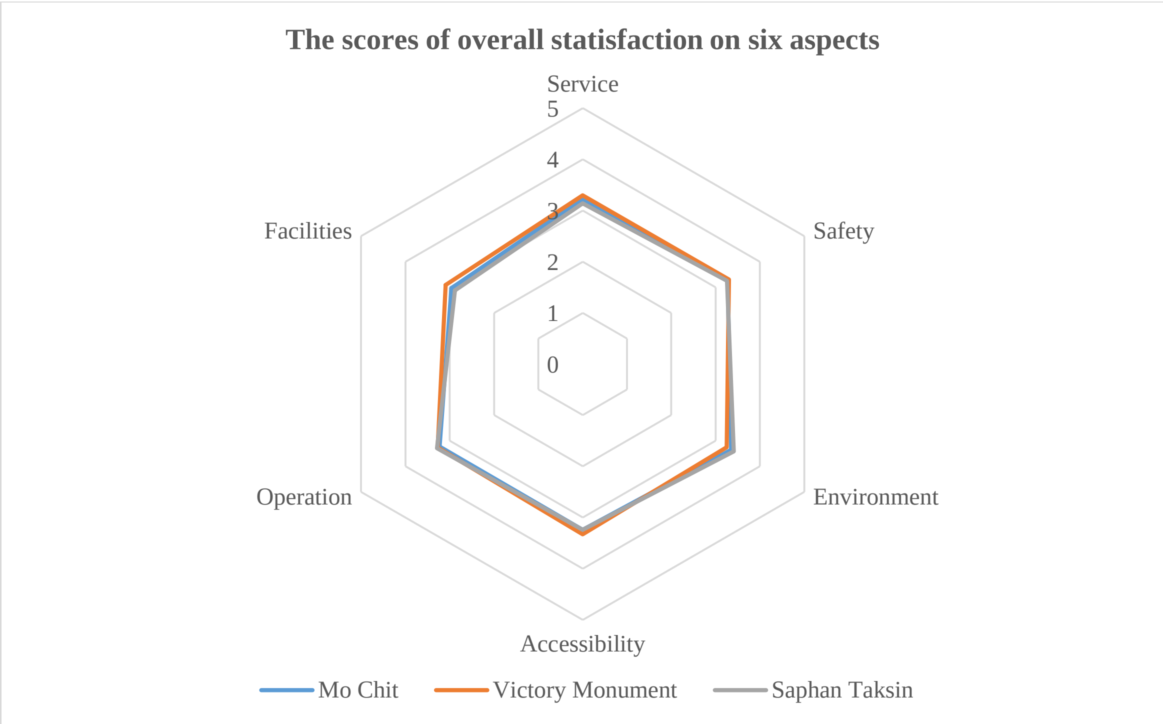


Figure 4.3 The scores of overall satisfaction on six aspects

4.2.2 Mass transit node satisfaction on 'Service'

The satisfaction on service was examined in twelve aspects and found that three stations respondents' satisfaction level in all aspect were fair level (2.51 – 3.50). Considering in each aspects, satisfaction level of the punctuality of the vehicle time at Mo Chit station (3.16) was higher than Victory Monument station (3.05) and Saphan Taksin station (2.84), it is unsurprisingly because Mo Chit station is the first departure station of BTS Sukhumvit line that mean the train at this station usually services on time. Whereas Saphan Taksin station was the lowest satisfied in this aspect, one of the reasons is Saphan Taksin has only one platform (Figure 4.5) that mean the trains cannot service by in opposite directions at the same time, if the train from Surasak station make a stop at Saphan Taksin station, the train from Thon Buri station have to stop before arrive at Saphan Taksin staion and wait until the train from Surasak station departs from Saphan Taksin station.

Moreover, satisfaction level of service time and the frequency of the train at Mo Chit station and Victory Monument station were also higher than Saphan Taksin station. According to table 6.1 – 6.4 in chapter 6 were found that the frequency of the service at Sukhumvit line is higher than Silom line which mean the frequency of the train at Mo Chit station and Victory Monument station higher that Saphan Taksin station. The availability during nigh time and early morning were found that Victory Monument station (3.09 and 3.32) was higher satisfied comparing with Mo Chit station (3.06 and 3.29) and Saphan Taksin station (2.91 and 3.13). The respondents of easiness of transportation service use were 3.22 of Mo Chit station, 3.28 of Victory Monument station and 3.08 of Saphan Taksin station. The satisfaction of ticket fare was found that Victory Monument station was the highest score (3.24) meanwhile Saphan Taksin station was 3.03 and Mo Chit station was 2.93.

Table 4.4 Mean scores of mass transit node satisfaction on service

Twelve variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
The punctuality of the vehicle time	3.16	1.592	Fair	3.05	1.582	Fair	2.84	1.591	Fair
What about the service time?	3.18	1.594	Fair	3.12	1.587	Fair	2.89	1.586	Fair
The frequency of the trains on your trip	3.01	1.581	Fair	2.99	1.581	Fair	2.81	1.595	Fair
Availability during night time	3.06	1.583	Fair	3.09	1.584	Fair	2.91	1.584	Fair
Availability in early morning	3.29	1.614	Fair	3.32	1.621	Fair	3.13	1.588	Fair
Easiness of transportation service use	3.22	1.601	Fair	3.28	1.611	Fair	3.08	1.584	Fair
What about the ticket fare?	2.93	1.583	Fair	3.24	1.604	Fair	3.03	1.582	Fair
Comfort of information in the station	3.05	1.582	Fair	3.09	1.584	Fair	2.88	1.587	Fair
The provision of information during the journey	3.11	1.586	Fair	3.06	1.583	Fair	2.89	1.586	Fair
Emergency information	2.95	1.582	Fair	2.82	1.593	Fair	2.80	1.597	Fair
Information about service delays or disruptions	2.76	1.604	Fair	2.86	1.589	Fair	2.82	1.594	Fair
The number and variety of shops in the transfer station	2.97	1.581	Fair	3.03	1.582	Fair	2.89	1.586	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

Regarding the information aspects which included comfort of information in the station, the provision of information during the journey, emergency information and information about service delays or disruptions, these variables were ranked on a fair level (2.51 – 3.50) for three stations. Mo Chit station was ranked the highest in ‘the provision of information during the journey’ and ‘emergency information’ at 3.11 and 2.95, respectively, whereas Victory Monument station was ranked the highest in ‘comfort of information in the station’ and ‘information about service delays or disruptions’, scoring 3.09 and 2.86, respectively. The respondents were fairly satisfied in the number and variety of shops in the transfer station, with scores of 2.97 for Mo Chit station, 3.03 for Victory Monument station and 2.89 for Saphan Taksin station, as shown in Table 4.4 and Figure 4.4.

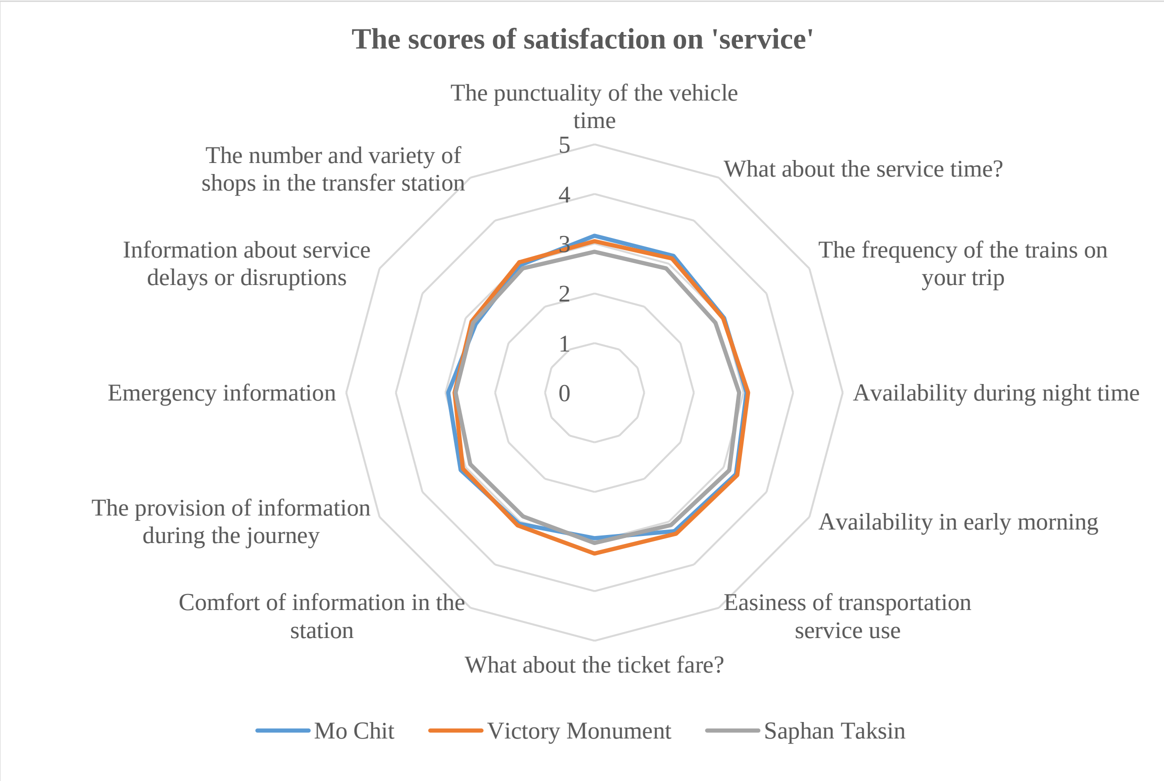


Figure 4.4 The scores of satisfaction on service

Station	Mo Chit	Victory Monument	Saphan Taksin
Platforms			

Figure 4.5 The station’s platforms

4.2.3 Mass transit node satisfaction on ‘Safety’

The satisfaction on safety was examined in six aspects and found that Mo Chit station, Victory Monument station and Saphan Taksin station respondents’ satisfaction level in all aspect were fair level (2.51 – 3.50). Indicating that the safety in and out the transfer station of Mo Chit station (at 3.28) is more satisfied than that of Victory Monument station (at 3.23) and Saphan Taksin station (at 3.04).

The respondents of the safety of stairs connection to the transfer station was found that Mo Chit station was the highest score at 3.38, while Victory Monument station was 3.29 and Saphan Taksin station was 3.22. The satisfaction of the number of security guards was found that Saphan Taksin station is more satisfied than Mo Chit station and Victory Monument station at 3.26, 3.23 and 3.22, respectively as shown in Table 4.5 and Figure 4.6.

The highest satisfied of ‘the reliability in safety systems of the transfer station’ and ‘the safety of the areas surrounding the transfer station’ belong to Mo Chit station at 3.23 and 3.17, meanwhile Victory Monument station was 3.22 and 3.11, and Saphan Taksin station was 3.16 and 3.07, respectively. Considered about night time security from crime, Saphan Taksin station is more satisfied than Mo Chit station and Victory Monument station at 3.08, 2.98 and 2.97, respectively.

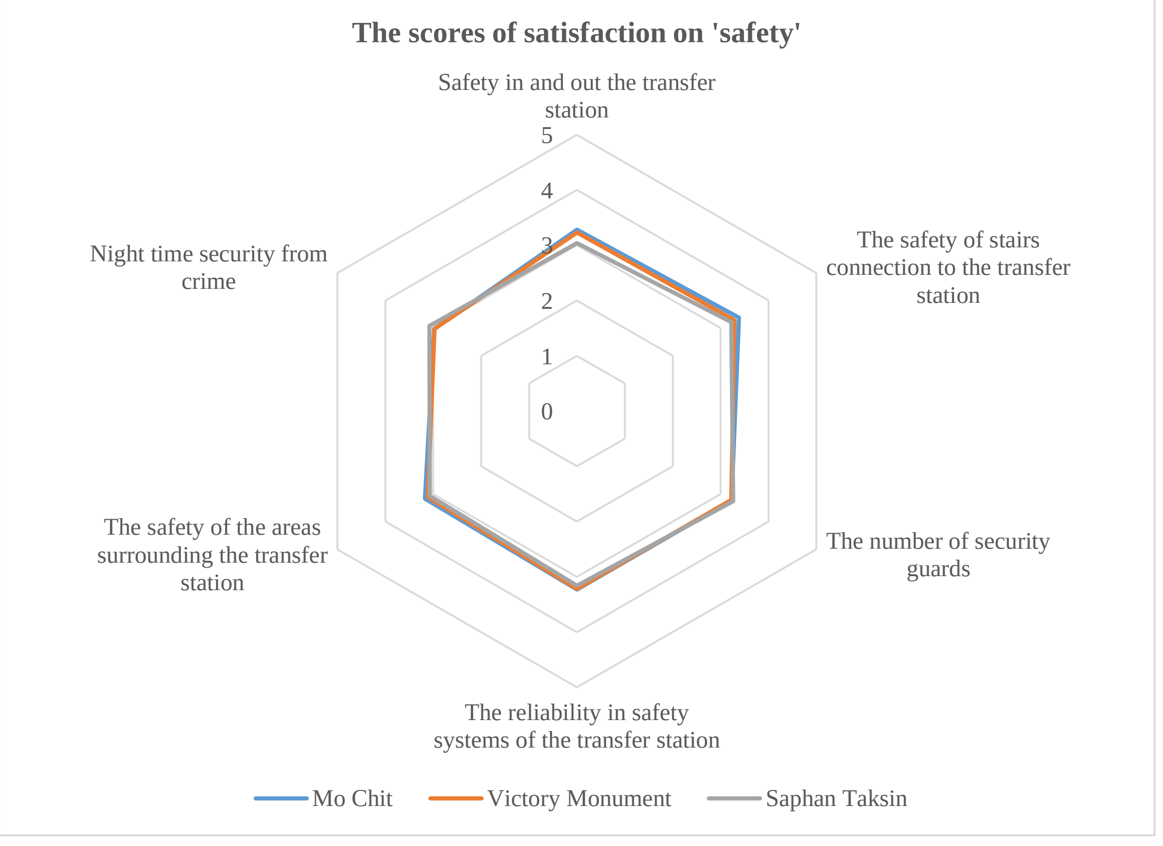


Figure 4.6 The scores of satisfaction on safety

Table 4.5 Mean scores of mass transit node satisfaction on safety

Six variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
Safety in and out the transfer station	3.28	1.613	Fair	3.23	1.602	Fair	3.04	1.582	Fair
The safety of stairs connection to the transfer station	3.38	1.637	Fair	3.29	1.614	Fair	3.22	1.601	Fair
The number of security guards	3.23	1.603	Fair	3.22	1.600	Fair	3.26	1.607	Fair
The reliability in safety systems of the transfer station	3.23	1.602	Fair	3.22	1.600	Fair	3.16	1.591	Fair
The safety of the areas surrounding the transfer station	3.17	1.593	Fair	3.11	1.586	Fair	3.07	1.583	Fair
Night time security from crime	2.98	1.581	Fair	2.97	1.582	Fair	3.08	1.584	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

4.2.4 Mass transit node satisfaction on 'Environment'

The satisfaction on environment was examined in six aspects and found that Mo Chit station, Victory Monument station and Saphan Taksin station respondents' satisfaction level in all aspect were fair level with the ranges of 2.51 – 3.50. Considering in each aspects, satisfaction level of 'air quality and pollution in the area surrounding the transfer station' at Mo Chit station (3.10) was higher than Saphan Taksin station (3.00) and was the lowest score for Victory Monument station at 2.99, it is unsurprisingly because Victory Monument station is the center of transportation in Bangkok which mean Victory Monument has the high pollution and heavy traffic from the vehicles that service in this areas especially in the rush hours as shown in Figure 4.8. Whereas Mo Chit station is surrounded by the large green parks in the west of the station that could absorb the pollution from the vehicle around the station areas and the large parking area in the east side of the station. Moreover, satisfaction score of 'air quality and pollution in transfer station' at Victory Monument station were also lower than Mo Chit station and Saphan Taksin station with scored 3.06, 3.29 and 3.14.

Regarding the design aspects, the interior design of the transfer station was found that Mo Chit station was the highest score at 3.30, while Victory Monument station was 3.24, and was the lowest score for Saphan Taksin station at 3.16. Mo Chit station also was the highest score of the exterior design of the transfer station at 3.19, meanwhile Victory Monument station was 3.16 and Saphan Taksin station was the lowest satisfaction at 3.14 as shown in Table 4.6 and Figure 4.7. The satisfaction of cleanliness of the transfer station was the highest at 3.42 for Mo Chit station, 3.38 for Saphan Taksin station and was 3.22 for Victory Monument station. Mo Chit station also was ranked the highest in ‘the temperature inside the transfer station’ at 3.24, whereas Victory Monument station ranked the lowest at 3.02 and 3.08 for Saphan Taksin station.

Table 4.6 Mean scores of mass transit node satisfaction on environment

Six variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
Air quality and pollution in the area surrounding the transfer station	3.10	1.585	Fair	2.99	1.581	Fair	3.00	1.581	Fair
Air quality and pollution in the transfer station	3.29	1.614	Fair	3.06	1.583	Fair	3.14	1.589	Fair
Interior design of the transfer station	3.30	1.615	Fair	3.24	1.604	Fair	3.16	1.591	Fair
Exterior design of the transfer station	3.19	1.595	Fair	3.16	1.591	Fair	3.14	1.589	Fair
Cleanliness of the transfer station	3.42	1.648	Fair	3.22	1.601	Fair	3.38	1.637	Fair
The temperature inside the transfer station	3.24	1.604	Fair	3.02	1.581	Fair	3.08	1.584	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

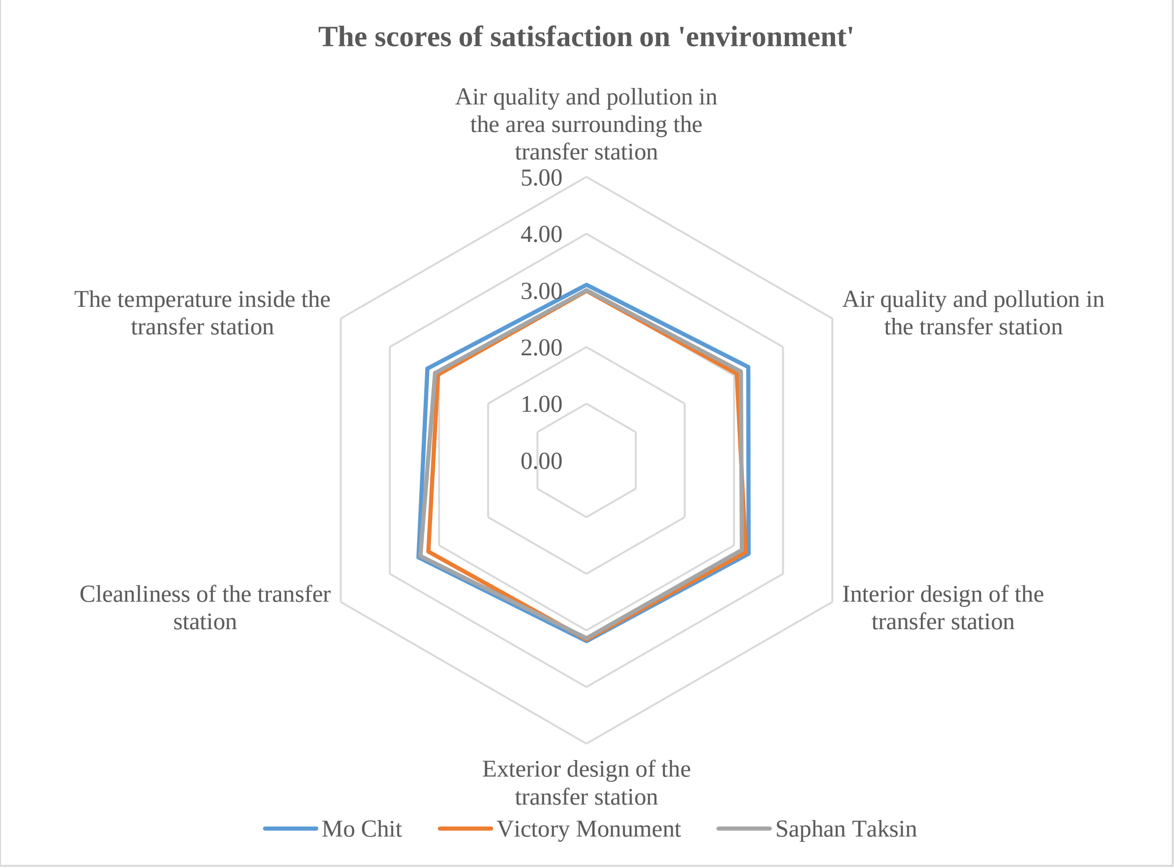


Figure 4.7 The scores of satisfaction on environment

Station	The existing areas around three stations		
Mo Chit Station			
Victory Monument Station			
Saphan Taksin Station			

Figure 4.8 The existing areas around three station

4.2.5 Mass transit node satisfaction on 'Accessibility'

The satisfaction on accessibility was examined in nine aspects and found that Mo Chit station, Victory Monument station and Saphan Taksin station respondents' satisfaction level in all aspect were fair level (2.51 – 3.50). Indicating that 'connection with other public transport systems' of Victory Monument station is more satisfied than Mo Chit station and Saphan Taksin station at scored 3.28, 3.23 and 3.19, respectively. The respondents of access to the transfer station was found that Victory Monument station was the highest score at 3.30, it is because Victory Monument station can access by several way. Especially the passenger who access the station from the Victory Monument roundabout which could access by the skywalk that links between station building and the areas surrounding as shown in Figure 4.9. Meanwhile Mo Chit station was 3.25, and Saphan Taksin station was lowest score at 3.17 for access to the transfer station. The satisfaction of rush hour inside the transfer station was found that Victory Monument station (at 3.07) is more satisfied than Mo Chit station (at 2.98) and Saphan Taksin station (at 3.03).

Station	Accessibility Conditions
Mo Chit Station	
Victory Monument Station	
Saphan Taksin Station	

Figure 4.9 Accessibility conditions at three stations

Table 4.7 Mean scores of mass transit node satisfaction on accessibility

Nine variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
Connection with other public transport systems	3.19	1.595	Fair	3.28	1.611	Fair	3.23	1.603	Fair
Access to the transfer station	3.25	1.605	Fair	3.30	1.617	Fair	3.17	1.592	Fair
Rush hour inside the transfer station	2.98	1.581	Fair	3.07	1.583	Fair	3.03	1.582	Fair
Number of elevators	2.77	1.603	Fair	2.94	1.583	Fair	2.91	1.584	Fair
Number of escalators	3.01	1.581	Fair	3.09	1.584	Fair	3.01	1.592	Fair
Number of stairs	3.20	1.598	Fair	3.30	1.617	Fair	3.17	1.581	Fair
Number of moving walkways	2.98	1.581	Fair	3.09	1.584	Fair	3.02	1.597	Fair
Distance from the entrance of the station to the platforms	3.15	1.59	Fair	3.26	1.607	Fair	3.20	1.599	Fair
The easiness of being able to get on/off from platform to vehicle	3.31	1.619	Fair	3.25	1.606	Fair	3.21	1.605	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51–5.00 = Highly satisfied.

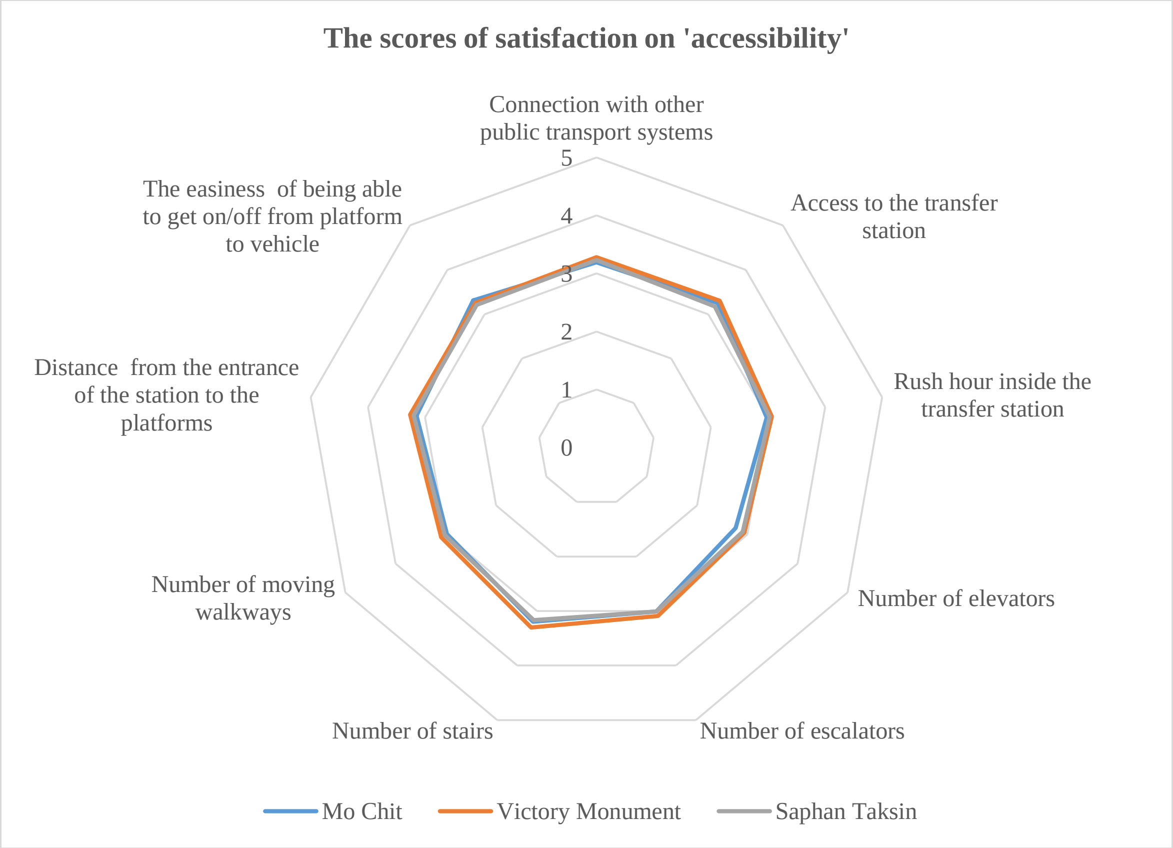


Figure 4.10 The scores of satisfaction on accessibility

Regarding the accessibility facilities which included the number of elevators, the number of escalators, the number of stairs, and the number of moving walkways, these variables were ranked on a fair level (2.51 – 3.50) for the three stations. Victory Monument station was ranked the highest satisfied in all variables at 2.94, 3.09, 3.30 and 3.09, respectively, whereas Mo Chit station was ranked the lowest satisfied in the number of elevators and the number of moving walkways at 2.77 and 2.98, respectively. Mo Chit station and Saphan Taksin station were the same scored in the number of escalators at 3.01.

As shown in Table 4.7 and Figure 4.10, the respondents were fairly satisfied in distance from the entrance of the station to the platforms, with scores of 3.15 for Mo Chit station, 3.26 for Victory Monument station and 3.20 for Saphan Taksin station. The satisfaction of ‘the easiness of being able to get on/off from platform to vehicle’ was highest at 3.31 for Mo Chit station, 3.25 for Victory Monument station and was lowest at 3.21 at Saphan Taksin station.

4.2.6 Mass transit node satisfaction on 'Operation'

The satisfaction on operation was examined in eight aspects and found that three stations respondents' satisfaction level in all aspect were fair level (2.51 – 3.50). Considering in each aspects, satisfaction scores of the maintenance of the station building at Saphan Taksin station was higher than Mo Chit station and Victory Monument station at 3.46, 3.31 and 3.30, respectively. The maintenance of the station platform was found that Saphan Taksin station was higher satisfied comparing with Mo Chit station and Victory Monument station, with scores of 3.37, 3.29 and 3.27, respectively.

Regarding the maintenance of the vehicles aspects which included train, bus and boat, these variables were ranked on a fair level (2.51 – 3.50) for Mo Chit station, Victory Monument station and Saphan Taksin station. Mo Chit station was ranked the highest in the maintenance of the train at 3.27, whereas Saphan Taksin station was ranked the highest in the maintenance of the bus at 2.88. The satisfaction of the maintenance of the boat was 2.92 at Saphan Taksin station.

The respondents were fairly satisfied in passenger managing system in the transfer station, with scores of 3.00 for Mo Chit station, 3.11 for Victory Monument station and 3.32 for Saphan Taksin station as shown in Table 4.8 and Figure 4.11. The attitude and helpfulness of the staff was ranked the highest in Victory Monument station and Saphan Taksin station, scoring 3.28, whereas Mo Chit station was 3.23. 'How well Transportation Company deals with delays' was found that Saphan Taksin station was higher satisfied comparing with Mo Chit station and Victory Monument station with scores 3.09, 2.92 and 2.98, respectively.

Table 4.8 Mean scores of mass transit node satisfaction on operation

Eight variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
The maintenance of the station building	3.31	1.618	Fair	3.30	1.617	Fair	3.46	1.661	Fair
The maintenance of the station platforms	3.29	1.614	Fair	3.27	1.609	Fair	3.37	1.633	Fair
The maintenance of the train	3.27	1.609	Fair	3.25	1.606	Fair	3.24	1.605	Fair
The maintenance of the bus	2.66	1.627	Fair	2.75	1.606	Fair	2.88	1.587	Fair
The maintenance of the boat	-	-	-	-	-	-	2.92	1.584	Fair
The passenger managing system in the transfer station	3.00	1.581	Fair	3.11	1.586	Fair	3.32	1.622	Fair
The attitudes and helpfulness of the staff	3.23	1.603	Fair	3.28	1.611	Fair	3.28	1.611	Fair
How well transportation company deals with delays	2.92	1.584	Fair	2.98	1.581	Fair	3.09	1.584	Fair

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

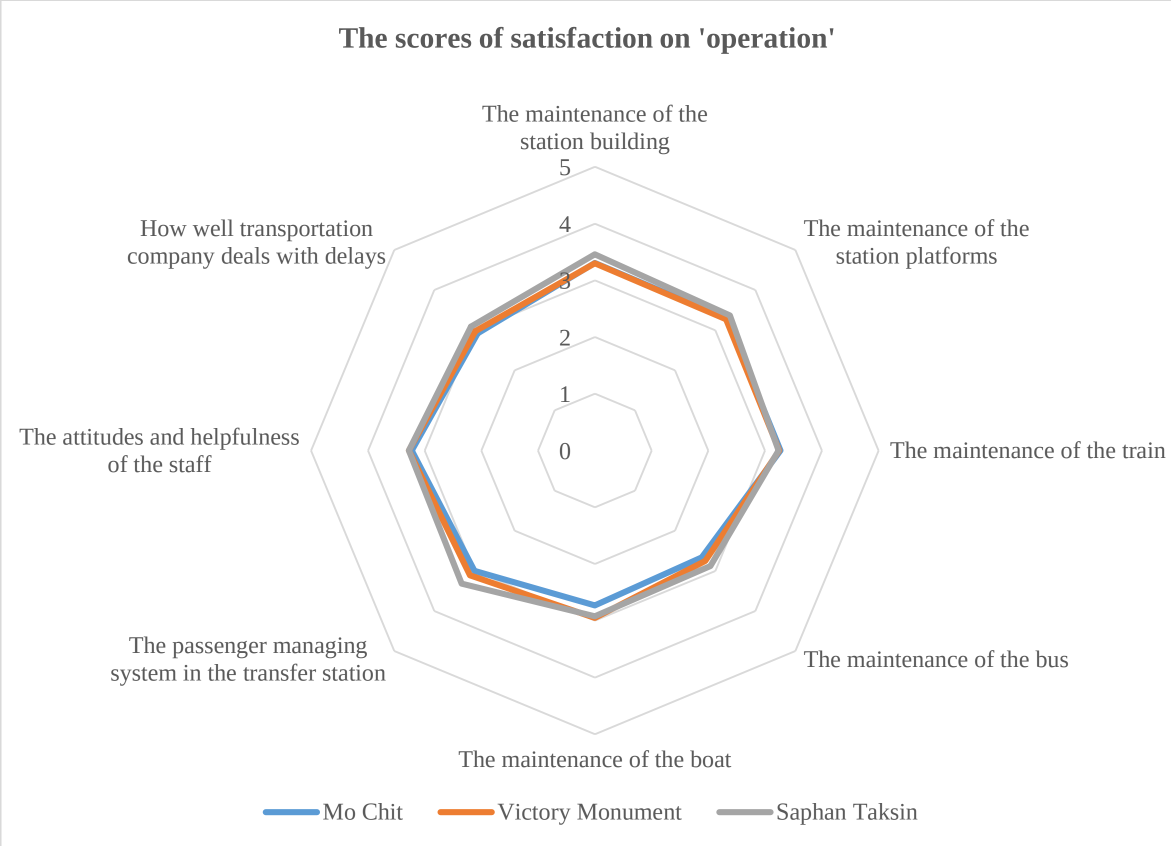


Figure 4.11 The scores of satisfaction on operation

4.2.7 Mass transit node satisfaction on 'Facilities'

For facilities aspects satisfaction, it was examined in five aspects and found that three station respondents' satisfaction level in all aspect were fair level, with scores between 2.51 to 3.50 except for the satisfaction of the toilet facilities in Saphan Taksin station was dissatisfied level. Mo Chit station was the lowest score of facilities for car parking at 2.87, whereas Victory Monument station and Saphan Taksin station were 2.98 and 2.97, respectively.

According to the interview, the most respondent were access to Victory Monument station and Saphan Taksin station by walk and public transit and they did not expect much of the parking space, while 15.3% of the respondents at Mo Chit station was access by private car that the reasons why the lowest satisfied belong to Mo Chit station. The satisfaction of ticket buying facilities at Victory Monument station was the first ranked of all aspects at 3.10, while Mo Chit station was 2.86 and Saphan Taksin station was 2.94.

As shown in Table 4.9 and Figure 4.12, the provision of shelter facilities was found that Victory Monument station was the highest score at 2.87, and Saphan Taksin station was the lowest score at 2.70. The respondents satisfied of the toilet facility was highest at 2.76 for Victory Monument station and 2.69 for Mo Chit station with fairly level, whereas Saphan Taksin station was the lowest at 2.50 with dissatisfied level.

Table 4.9 Mean scores of mass transit node satisfaction on facilities

Five variables	Mo Chit			Victory Monument			Saphan Taksin		
	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*	$\bar{X}$	SD	Level*
Facilities for car parking	2.87	1.587	Fair	2.98	1.581	Fair	2.97	1.582	Fair
Ticket buying facilities	2.86	1.589	Fair	3.10	1.585	Fair	2.94	1.582	Fair
The provision of shelter facilities	2.94	1.583	Fair	2.99	1.581	Fair	2.86	1.289	Fair
Availability of seats in the waiting area	2.80	1.597	Fair	2.87	1.588	Fair	2.70	1.616	Fair
The toilet facilities	2.69	1.619	Fair	2.76	1.603	Fair	2.50	1.677	Dis-satisfied

*Satisfied level: 1.00–1.50 = Highly Dissatisfied, 1.51–2.50 = Dissatisfied, 2.51–3.50 = Fair satisfied, 3.51–4.50 = Satisfied, 4.51−5.00 = Highly satisfied.

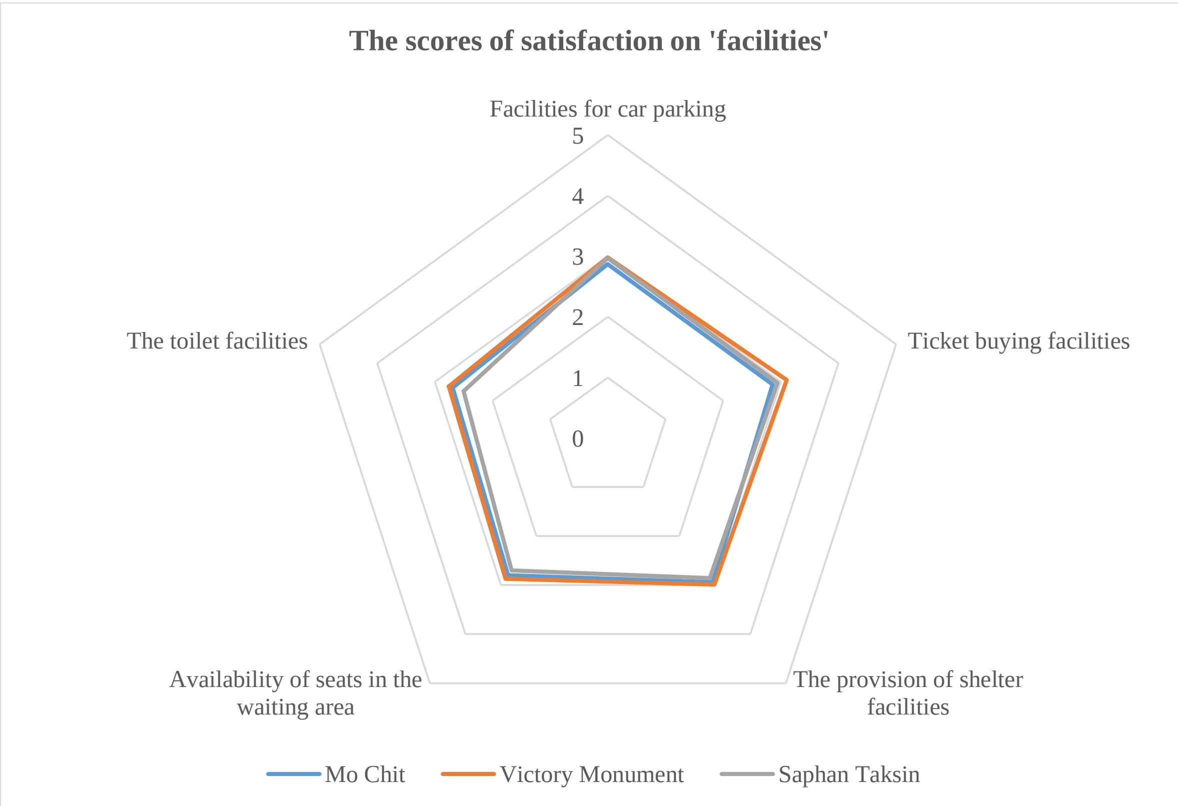


Figure 4.12 The scores of satisfaction on facilities

4.3 Conclusion

Mo Chit station, Victory Monument station and Saphan Taksin station were represented mass transit node station in Bangkok. 450 questionnaire were distributed to three stations to understand satisfaction by passenger evaluation. The result of questionnaire based on 46 variables in 6 aspects found that most of mean score satisfactions were fairly level.

Comparing the mean score of satisfaction in each aspects, Victory Monument was higher than Mo Chit station and Saphan Taksin station on service aspect, especially the ticket fare and the number and variety of shops in the transfer station. This implies that the passenger also preferred the commercial facilities in the station areas as Victory Monument station. Meanwhile Mo Chit station was the highest satisfied on safety and environment aspect, these satisfactions score could be confirmed that the surrounding areas could affect to the satisfaction of environment in and out of the station. Whereas the environment at Victory Monument station should improve in all environment aspects. For the respondents on safety aspect, it should improve the safety of the area surrounding the transfer station especially at Saphan Taksin station which concerned by the respondents, moreover, and night time security at Mo Chit station and Victory Monument also should improve. Victory Monument station was the highest satisfied on accessibility and facilities aspect which the central of transportation in Bangkok, Victory Monument station node provide many transit node that connected the central of Bangkok to suburb areas. Also the station building is connected to the surrounding building and surrounding areas by the skywalk that could convenient to reach the passengers to the station areas. Saphan Taksin station was higher than Mo Chit station and Victory Monument station on operation aspect with the smallest station size compare to other station and only one platform that easier to manage the passenger and maintain the station building.

The purpose of this section contribute to understand the respondents profile and basic information about their trip pattern of mass transit node. To examine a difference satisfaction between the respondent groups include gender, age, trip purpose, the number of transfer and the difference satisfaction aspects will be explain in chapter 8.

Chapter 5

Analysis of Passengers' Satisfaction of Bangkok Mass Transit Node

5.1 Analysis of Personal Information (demographic/socio-economic/trip pattern) with Overall Satisfaction of Mass Transit Node

Passenger satisfaction is influenced by individual perception, therefore, demographic, socio – economic, and trip pattern components as well as occupants' backgrounds been found related to mass transit node's satisfaction. According to Olivkova [83], the evaluating transportation quality and transportation alternatives could be measuring from the viewpoint of the passenger. Further, mass transit satisfaction is influenced various components including; age, gender, socioeconomic status; income, occupation, education, trip purpose. To examine satisfaction hoe between groups of independents groups are different satisfaction, independents of Olivkova [83] and Duangporn [84] as and available data of field survey were combine into 9 independents. Independent-Samples T-test and One Way ANOVA are main static methods. Nine independents variables were listed in category below:

Demographic:

Gender

Passenger satisfaction study by Duangporn [84] was done by using genders as predictors to find out safety perception of transit station. Therefore, gender status would include as one indicator of satisfaction.

Age

Duanporn [84] found that the teenager and middle age are more likely to be satisfied with accessibility than elderly people. This independent variable was involved as one parameter to analyze between groups toward satisfaction.

Socio-economic:

Occupation

Different occupation's types of respondents: student, private company officer, government officer, self-employed, unemployed as a socioeconomic status would affect different living satisfactions.

Income

A level of income would affect passengers' attitude toward their trip's cost. The affordable price would differ based on income level.

Vehicle in household

The passenger who has or do not have a vehicle in their household would have a different satisfaction level especially with accessibility and service of mass transit station.

Trip pattern

Frequency of transfer in one trip

The number of transfer time should include for satisfaction analysis. It is expected that there will be significant differences in respondents' satisfaction. Number of transfer from 1 – more than 4 times found in three questionnaire survey of transit stations will affect satisfaction.

Trip duration

To investigate the passengers on different trip duration in three stations those who have travel time short and long may assume that they would have different satisfaction.

Transfer duration

Transfer time would affect to trip duration, it may assume that they also would have different satisfaction

Trip purpose

The purpose of their trip is related to the limited time of their trip. It is expected that there will be significant differences in respondents' satisfaction. Thus, trip purposed is addressed to examine satisfaction relationship between the groups.

From above 9 independents, the hypothesis to test different between groups of independent variables and dependent variable (overall mass transit node satisfaction) is listed in Table 5.1.

Table 5.1 Hypothesis test of passenger satisfaction through the respondent background

Independent Samples T-Test : Gender, Age, Occupation, Income, Vehicle in household, Frequency of transfer, Trip duration, Transfer duration, Trip purpose
Hypothesis: H1: Gender variable affects on different passenger satisfaction in statistical significant. H2: Age variable affects on different passenger satisfaction in statistical significant. H3: Occupation variable affects on different passenger satisfaction in statistical significant. H4: Income level variable affects on different passenger satisfaction in statistical significant. H5: Vehicle in household variable affects on different passenger satisfaction in statistical significant. H6: Frequency of transfer in one trip variable affects on different passenger satisfaction in statistical significant. H7: Trip duration variable affects on different passenger satisfaction in statistical significant. H8: Transfer duration variable affects on different passenger satisfaction in statistical significant. H9: Trip purpose variable affects on different passenger satisfaction in statistical significant.
One-Way ANOVA : Gender, Age, Occupation, Income, Vehicle in household
H1: Gender variable affects on different passenger satisfaction in statistical significant. H2: Age variable affects on different passenger satisfaction in statistical significant. H3: Occupation variable affects on different passenger satisfaction in statistical significant. H4: Income level variable affects on different passenger satisfaction in statistical significant. H5: Vehicle in household variable affects on different passenger satisfaction in statistical significant.

From the result of Table 5.2 in demographic dimension found there was difference between the groups of gender at 0.006 of Victory Monument station, the male group were higher satisfied than the female, meanwhile the Saphan Taksin station was found different between the groups at statistical significant of 0.042 by female was higher satisfied that the male group. Whereas, age was no difference between the groups. Socio-economic dimension, occupation showed difference between the groups at statistical significant of 0.001 of Mo Chit station by government officer was satisfied than the other. Meanwhile, income has shown significant difference between the groups at 0.019 of Mo Chit station and 0.048 of Victory Monument station. However, the household income less than 15,000 baht shows higher satisfied at 3.12. In term of trip pattern (frequency of transfer in one trip, trip duration, trip purpose) of Victory Monument station found there were difference between the groups in statistical significant of 0.018, 0.024 and 0.044, the passenger who spent their trip less than 15 minutes have high satisfaction than other groups. Frequency of transfer in one trip, transfer duration and trip purpose of Mo Chit station were found higher satisfaction between the groups on significant difference at 0.041, 0.005 and 0.000, respectively. Transfer duration between 5 – 15 minutes, transfer 2 – 3 time in one trip, and purpose for study given high score of satisfaction than other groups. While, Saphan Taksin station was found the difference between frequency of transfer, trip duration and transfer duration in statistical significant of 0.017, 0.038 and 0.029.

Table 5.2 Comparative overall satisfaction of passenger's background

Overall satisfaction		Mo Chit station				Victory Monument station				Saphan Taksin station			
		$\bar{X}$	SD	f	P-value	$\bar{X}$	SD	f	P-value	$\bar{X}$	SD	f	P-value
Demographic													
Gender	Male	3.23	0.929	-0.13	0.061	3.29	0.849	-2.617	0.006*	3.04	0.745	2.563	0.042*
	Female	3.24	0.725			2.97	0.736			3.35	0.769		
Age	<20 years	3.37	0.649	1.876	0.373	3.38	0.805	2.099	0.383	3.29	0.757	0.896	0.850
	21 - 30 years	3.10	0.886			3.08	0.778			3.16	0.804		
	31 - 40 years	3.62	0.650			3.23	1.092			3.46	0.660		
	41 - 50 years	3.75	0.500			3.00	0.816			3.25	0.500		
	51 - 60 years	3.00	0.816			2.50	0.577			2.75	0.500		
	>60 years	4.00	0.478			3.00	0.648			4.00	0.425		
Socio - economic													
Occupation	Student	3.28	0.643	0.523	0.001*	3.21	0.843	0.367	0.749	3.21	0.779	-0.193	0.346
	Private company	3.19	1.076			3.15	0.807			3.23	0.865		
	Government officer	3.71	0.488			2.71	0.488			3.14	0.377		
	Self-employed	3.32	0.749			2.89	0.875			3.05	0.705		
	Unemployment	3.00	0.816			3.50	0.577			3.25	0.500		
	Other	2.73	0.786			3.45	0.687			3.54	0.687		
Income	<15,000 Baht	3.12	0.761	1.305	0.019*	3.05	0.848	0.662	0.048*	3.25	0.757	6.708	0.420
	15,000 - 30,000 Baht	3.04	0.999			2.95	0.621			3.18	0.404		
	>30,000 Baht	2.83	0.998			2.36	0.955			2.82	0.873		
Vehicle in household	Car (yes)	3.08	0.996	-0.772	0.235	3.14	0.816	0.026	0.102	2.89	0.962	0.047	0.481
	Car (no)	3.27	0.669			3.22	0.808			3.16	0.857		
	Motorcycle (yes)	3.22	0.808			3.16	0.857			3.17	0.724		
	Motorcycle (no)	3.30	0.734			3.18	0.800			3.11	0.900		
Trip pattern													
Frequency of transfer in one trip	1 time	3.17	0.847	1.233	0.041*	3.07	0.881	0.676	0.018*	3.19	0.741	1.197	0.017*
	2 times	3.30	0.803			3.22	0.719			3.26	0.750		
	3 times	3.30	0.675			3.10	0.675			3.20	0.843		
	4 times	0.00	0.000			3.17	0.776			2.89	0.994		
	>4 times	3.16	0.815			3.17	0.714			2.78	1.000		
Trip duration	<15 minutes	3.19	0.950	0.949	0.070*	3.42	0.731	0.908	0.024*	3.38	0.837	1.123	0.038*
	15 - 30 minutes	3.30	0.806			3.15	0.863			3.24	0.737		
	30 - 60 minutes	3.20	0.797			2.94	0.725			3.14	0.772		
	1 - 2 hours	2.86	0.690			2.86	0.69			2.57	0.786		
	>2 hours	2.66	0.866			0.78	0.667			0.56	1.013		
Transfer time duration	<5 minutes	3.09	1.100	-1.475	0.005*	2.95	0.824	-0.090	0.044*	3.21	0.750	-1.602	0.029*
	5 - 15 minutes	3.37	0.697			3.24	0.814			3.28	0.809		
	15 - 30 minutes	3.08	0.717			3.17	0.761			3.04	0.858		
	30 - 45 minutes	3.07	0.641			3.31	0.751			3.15	0.554		
	45 - 60 minutes	2.95	0.690			2.96	0.806			2.33	1.129		
	>60 minutes	2.84	0.688			2.84	0.801			2.84	0.801		
Trip purpose	Study	3.30	0.552	1.199	0.000*	3.39	0.829	0.538	0.017*	3.28	0.750	0.416	0.065
	Work	3.08	1.145			2.88	0.781			3.16	0.807		
	Travel	3.26	0.644			3.13	0.843			3.32	0.701		
	Shopping	3.29	0.848			3.06	0.755			3.23	0.562		
	Other	3.35	0.606			3.12	0.857			3.31	0.701		

* Significant at the 0.05 level/ and there is relationship at least between two groups

**Satisfied level: 1.00 – 1.50 = Highly Dissatisfied, 1.51- 2.50 = Dissatisfied, 2.51- 3.50 = Fair satisfied, 3.51 – 4.50 = Satisfied, 4.51 -5.00 = Highly satisfied

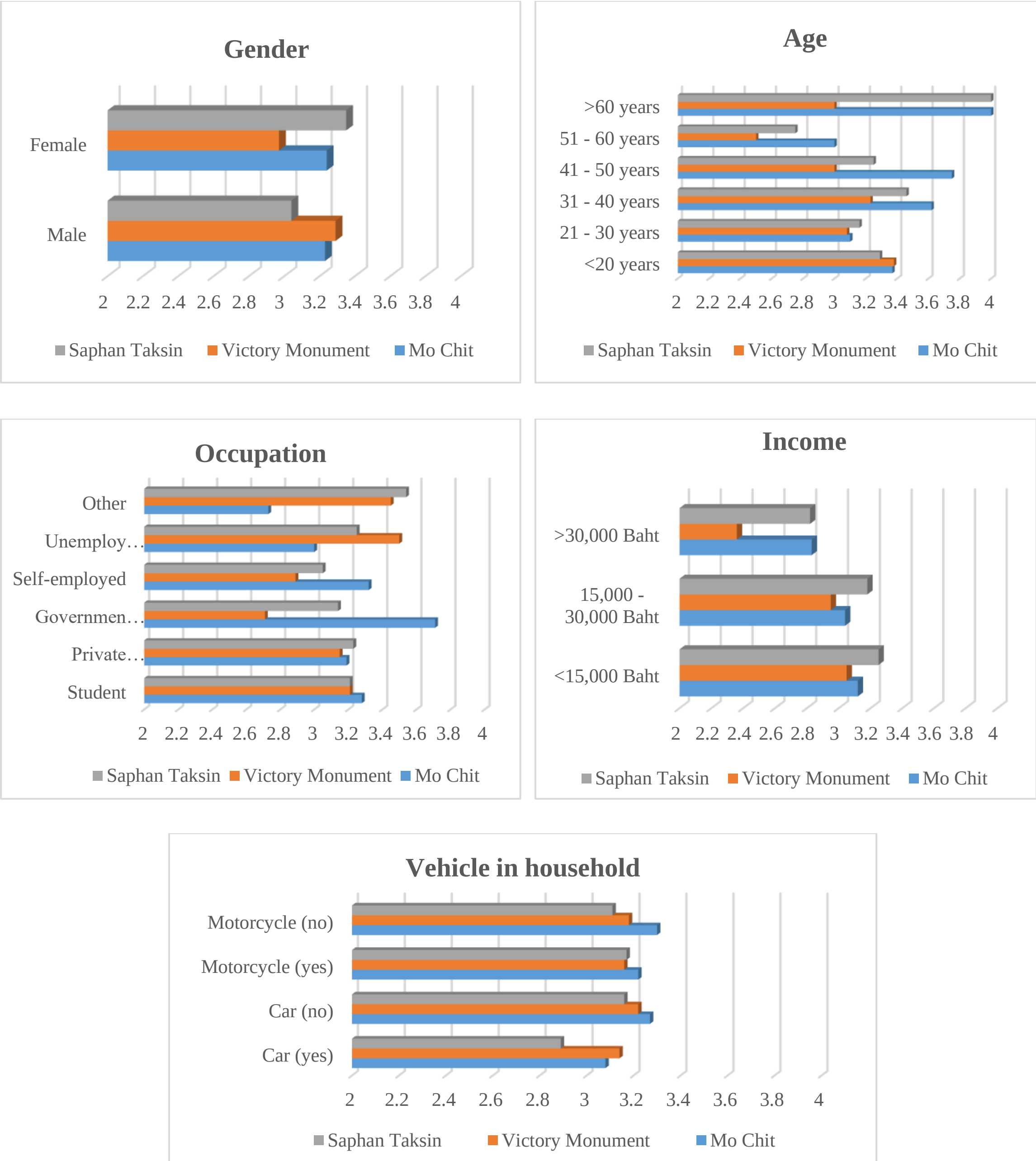


Figure 5.1 Overall satisfaction of passenger's background

For One-Way ANOVA analysis, using the demographic and socio-economic background of passengers revealed some variable related to satisfaction level at statistically significant based gender, age, occupation, income, and vehicle in household. This result shows important implications to approach passenger centered as the mass transit node performance is assessed according to the degree of satisfaction. Table 5.3 shows the result of satisfaction analysis by One-Way ANOVA which were significant between variable groups. However, determining variable factor that would be increase the level of satisfaction will be studied on the next part by regression for predicting factor of satisfaction.

Table 5.3 Satisfaction of six dimensions based on demographic and socio-economic by One-Way ANOVA

Independent variable	Satisfaction	F	Sig.
Gender	Ticket fare	5.363	0.021*
	The number and variety of shops in the transfer station	7.161	0.008*
	The safety of the areas surrounding the transfer station	7.136	0.008*
	Overall satisfaction with environment	4.423	0.036*
	The easiness of being able to get on/off from platform to vehicle	8.191	0.004*
	Facilities for car parking	8.866	0.003*
	Ticket buying facilities	6.844	0.009*
	Availability of seats in the waiting area	4.270	0.039*
Age	The punctuality of the vehicle time	3.513	0.004*
	Service time	2.807	0.016*
	The frequency of the train on their trip	2.881	0.014*
	Ticket fare	3.672	0.003*
	Comfort of information in the station	5.427	0.000*
	Emergency information	3.754	0.002*
	Information about service delays or disruptions	5.039	0.000*
	Safety in and out the transfer station	6.220	0.000*
	The safety of stairs connection to the transfer station	5.127	0.000*
	The reliability in safety systems of the transfer station	5.665	0.000*
	Night time security from crime	10.507	0.000*
	Overall satisfaction with safety	5.592	0.001*
	Air quality and pollution in the area surrounding the transfer station	3.298	0.006*
	Cleanliness of the transfer station	2.432	0.033*
	Connection with other public transport systems	3.271	0.006*
	Access to the transfer station	4.639	0.000*
	Rush hour inside the transfer station	3.285	0.006*
	Number of elevators	2.996	0.016*
	Number of escalators	2.996	0.011*
	Number of stairs	2.766	0.017*
	Distance from the entrance of the station to the platforms	6.310	0.000*
	The maintenance of the bus	4.345	0.001*
	The passenger managing system in the transfer station	3.553	0.003*
	Ticket buying facilities	3.972	0.001*
	Facilities for car parking	3.880	0.002*
	Availability of seats in the waiting area	3.606	0.003*
	The toilet facilities	3.593	0.003*
	Overall satisfaction with facilities	3.694	0.003*

Independent variable	Satisfaction	F	Sig.
Occupation	The punctuality of the vehicle time	4.093	0.001*
	Service time	5.969	0.000*
	The frequency of the train on their trip	3.880	0.002*
	Availability in early morning	4.501	0.000*
	Easiness of transportation service use	2.455	0.032*
	Emergency information	2.734	0.018*
	Information about service delays or disruptions	1.989	0.092*
	Safety in and out the transfer station	2.820	0.015*
	The safety of stairs connection to the transfer station	2.209	0.051*
	The safety of the areas surrounding the transfer station	3.118	0.008*
	Night time security from crime	4.021	0.001*
	Air quality and pollution in the area surrounding the transfer station	6.251	0.000*
	Air quality and pollution in the transfer station	4.960	0.000*
	Connection with other public transport systems	2.223	0.050*
	Rush hour inside the transfer station	3.006	0.011*
	Number of stairs	5.740	0.000*
	The easiness of being able to get on/off from platform to vehicle	6.948	0.000*
	The maintenance of the bus	2.785	0.017*
	The passenger managing system in the transfer station	5.270	0.000*
	Ticket buying facilities	6.929	0.000*
	Availability of shelter facilities	7.164	0.000*
	Availability of seats in the waiting area	8.807	0.000*
	The toilet facilities	6.046	0.000*
Income	The punctuality of the vehicle time	13.298	0.000*
	Service time	8.436	0.000*
	The frequency of the train on their trip	5.505	0.000*
	Availability during night time	3.872	0.002*
	Easiness of transportation service use	4.680	0.000*
	Ticket fare	4.665	0.000*
	Comfort of information in the station	8.027	0.000*
	Safety in and out the transfer station	4.154	0.001*
	The number of security guards	3.674	0.003*
	Air quality and pollution in the transfer station	4.665	0.000*
	Cleanliness of the transfer station	2.495	0.029*
	Connection with other public transport systems	3.693	0.003*
	Number of elevators	5.223	0.000*
	Number of escalators	4.391	0.001*
	Distance from the entrance of the station to the platforms	3.610	0.003*
	The easiness of being able to get on/off from platform to vehicle	3.129	0.008*
	The maintenance of the bus	4.478	0.000*
	The passenger managing system in the transfer station	2.848	0.015*
	Facilities for car parking	2.955	0.012*
	Ticket buying facilities	2.729	0.019*
	The provision of shelter facilities	4.385	0.001*
	Availability of seats in the waiting area	2.851	0.015*

Independent variable	Satisfaction	F	Sig.
Vehicle in household	The punctuality of the vehicle time	6.209	0.002*
	Service time	6.019	0.003*
	The frequency of the train on their trip	4.052	0.018*
	Availability during night time	4.576	0.010*
	Availability in early morning	6.193	0.002*
	Easiness of transportation service use	3.561	0.029*
	Ticket fare	3.901	0.021*
	The number of security guards	6.610	0.001*
	Overall satisfaction with accessibility	4.378	0.013*
	The maintenance of the bus	4.493	0.011*
	The passenger managing system in the transfer station	4.908	0.008*
	How well transportation company deals with delays	4.754	0.009*
	Facilities for car parking	6.048	0.002*
	Ticket buying facilities	3.300	0.037*
	The provision of shelter facilities	3.262	0.039*
	Availability of seats in the waiting area	3.646	0.026*

* Significant at the 0.05 level/ and there is relationship at least between two groups

Table 5.4 – 5.6 show the analysis between six dimensions and socio-economic background using One-Way ANOVA method of each transit station. To understand the significant of variables which affect to passengers' satisfaction.

Table 5.4 Satisfaction of six dimensions based on socio-economic of ***Mo Chit Station*** by One-Way ANOVA

Independent variable	Satisfaction	F	Sig.
Gender	Emergency information	5.442	0.021*
	Safety in and out the transfer station	3.962	0.048*
	The safety of the areas surrounding the transfer station	4.672	0.032*
	Night time security from crime	5.660	0.019*
	Overall satisfaction with safety	6.574	0.011*
	Air quality and pollution in the area surrounding the transfer station	9.422	0.003*
	Exterior design of the transfer station	4.568	0.034*
	Overall satisfaction with environment	6.571	0.011*
	Connection with other public transport systems	6.975	0.009*
	Rush hour inside the transfer station	7.943	0.005*
	Number of elevators	10.041	0.002*
	Number of escalators	9.198	0.003*
	Distance from the entrance of the station to the platforms	11.894	0.001*
	Overall satisfaction with accessibility	9.011	0.003*
	The maintenance of the station building	6.178	0.014*
	The maintenance of bus	5.652	0.019*

Independent variable	Satisfaction	F	Sig.
Gender	The passenger managing system in the transfer station	15.759	0.000*
	Overall satisfaction with operation	4.426	0.037*
	Facilities for car parking	5.524	0.020*
	Ticket buying facilities	8.676	0.004*
	The toilet facilities	6.872	0.010*
	Overall satisfaction with facilities	5.844	0.017*
Age	Availability during night time	3.065	0.011*
	Ticket fare	4.459	0.001*
	Comfort of information in the station	2.475	0.034*
	The reliability in safety systems of the transfer station	2.487	0.034*
	Access to the transfer station	2.446	0.036*
	The maintenance of bus	2.845	0.017*
Occupation	Ticket fare	3.171	0.009*
	Comfort of information in the station	2.648	0.025*
	The number and variety of shops in the transfer station	2.978	0.013*
	The safety of stairs connection to the transfer station	2.319	0.046*
	The number of security guards	2.463	0.035*
	The safety of the areas surrounding the transfer station	2.508	0.032*
	Connection with other public transport systems	3.963	0.002*
	Access to the transfer station	2.686	0.023*
	Rush hour inside the transfer station	3.237	0.008*
	Number of escalators	2.714	0.022*
	The easiness of being able to get on/off from platform to vehicle	2.839	0.017*
	Overall satisfaction with accessibility	2.714	0.022*
	The maintenance of the bus	2.744	0.021*
	The passenger managing system in the transfer station	2.933	0.015*
	Overall satisfaction with operation	3.191	0.009*
	Facilities for car parking	2.373	0.041*
	Availability of seats in the waiting area	2.336	0.044*
Income	Service time	4.463	0.001*
	Availability in early morning	2.796	0.019*
	Easiness of transportation service use	3.124	0.010*
	Ticket fare	2.424	0.021*
	Air quality and pollution in the area surrounding the transfer station	3.150	0.010*
	The maintenance of the train	2.364	0.042*
	The maintenance of the bus	3.453	0.005*
	The attitudes and helpfulness of the staff	2.500	0.033*
	Overall satisfaction with operation	2.627	0.026*
	Facilities for car parking	2.847	0.017*
	The toilet facilities	3.391	0.006*
Vehicle in household	Service time	3.299	0.039*
	The provision of information during the journey	5.706	0.004*
	The number of security guards	3.691	0.027*

* Significant at the 0.05 level/ and there is relationship at least between two groups

Table 5.5 Satisfaction of six dimensions based on socio-economic of ***Victory Monument Station*** by One-Way ANOVA

Independent variable	Satisfaction	F	Sig.
Gender	Easiness of transportation service use	6.316	0.012*
	Night time security from crime	5.043	0.025*
	Air quality and pollution in the area surrounding the transfer station	4.020	0.046*
	Air quality and pollution in the transfer station	9.145	0.003*
	The temperature inside the transfer station	5.402	0.021*
	Overall satisfaction with environment	4.923	0.027*
	The easiness of being able to get on/off from platform to vehicle	7.476	0.007*
	The maintenance of the bus	7.878	0.005*
Age	Ticket fare	2.728	0.020*
	Information about service delays or disruptions	2.918	0.013*
	The number and variety of shops in the transfer station	6.166	0.000*
	Safety in and out the transfer station	2.629	0.024*
	The number of security guard	4.207	0.001*
	The reliability in safety systems of the transfer station	3.151	0.008*
	Night time security from crime	6.753	0.000*
	Overall satisfaction with safety	2.747	0.019*
	Air quality and pollution in the area surrounding the transfer station	2.882	0.014*
	Air quality and pollution in the transfer station	2.990	0.012*
	Overall satisfaction with environment	2.465	0.033*
	Connection with other public transport systems	2.380	0.038*
	Access to the transfer station	3.889	0.002*
	Rush hour inside the transfer station	2.398	0.037*
	Number of escalators	2.253	0.049*
	Distance from the entrance of the station to the platforms	5.436	0.000*
	The easiness of being able to get on/off from platform to vehicle	2.954	0.013*
	The maintenance of the station building	2.877	0.015*
	The maintenance of the platforms	4.792	0.000*
	The passenger managing system in the transfer station	3.306	0.006*
	Ticket buying facilities	2.347	0.041*
	The provision of shelter facilities	3.602	0.003*
	Availability of seats in the waiting area	3.053	0.010*
	The toilet facilities	2.118	0.063*
	Overall satisfaction with facilities	2.926	0.013*
Occupation	Availability in early morning	2.294	0.045*
	Ticket fare	2.591	0.025*
	The reliability in safety systems of the transfer station	2.316	0.043*
	The safety of the areas surrounding the transfer station	2.867	0.015*
	Night time security from crime	2.947	0.013*
	Air quality and pollution in the area surrounding the transfer station	4.562	0.000*
	Air quality and pollution in the transfer station	2.600	0.025*
	Rush hour inside the transfer station	2.865	0.015*
	The maintenance of the bus	2.888	0.014*

Independent variable	Satisfaction	F	Sig.
Occupation	How well transportation company deals with delays	2.379	0.038*
	Overall satisfaction with operation	2.625	0.024*
	Facilities for car parking	3.583	0.004*
	Ticket buying facilities	3.833	0.002*
	The provision of shelter facilities	3.474	0.004*
	Availability of seats in the waiting area	2.603	0.025*
	Overall satisfaction with facilities	2.957	0.012*
Income	Availability in early morning	2.684	0.021*
	Ticket fare	2.292	0.045*
	The number and variety of shops in the transfer station	2.341	0.041*
	Safety in and out the transfer station	3.505	0.004*
	Night time security from crime	4.058	0.001*
	Air quality and pollution in the area surrounding the transfer station	3.329	0.006*
	Air quality and pollution in the transfer station	2.458	0.033*
	Connection with other public transport systems	2.246	0.049*
	Access to the transfer station	4.124	0.001*
	Rush hour inside the transfer station	3.968	0.028*
	The maintenance of the bus	8.367	0.000*
	The passenger managing system in the transfer station	2.355	0.040*
	Ticket buying facilities	2.610	0.025*
	Availability of seats in the waiting area	2.998	0.011*
	The toilet facilities	2.596	0.025*
Vehicle in household	Easiness of transportation service use	4.770	0.009*
	The number of security guard	8.339	0.000*
	The reliability in safety systems of the transfer station	5.030	0.007*
	The safety of the areas surrounding the transfer station	5.015	0.007*
	Connection with other public transport systems	3.510	0.031*

* Significant at the 0.05 level/ and there is relationship at least between two groups

Table 5.6 Satisfaction of six dimensions based on socio-economic of ***Saphan Taksin Station*** by One-Way ANOVA

Independent variable	Satisfaction	F	Sig.
Gender	Ticket fare	8.980	0.003*
	The number and variety of shops in the transfer station	8.346	0.004*
	Overall satisfaction with service	9.130	0.003*
	Safety in and out the transfer station	14.477	0.000*
	The safety of the areas surrounding the transfer station	9.225	0.003*
	Air quality and pollution in the transfer station	5.503	0.020*
	The temperature inside the transfer station	6.910	0.009*
	Connection with other public transport systems	5.400	0.021*
	Distance from the entrance of the station to the platforms	4.488	0.035*
	The maintenance of the boat	8.245	0.004*

Independent variable	Satisfaction	F	Sig.
Gender	How well transportation company deals with delays	5.683	0.018*
	Ticket buying facilities	13.535	0.000*
	The provision of shelter facilities	4.418	0.036*
	Availability of seats in the waiting area	6.281	0.013*
Age	The frequency of the trains on your trip	6.024	0.000*
	Availability in early morning	3.224	0.013*
	Comfort of information in the station	5.311	0.000*
	The provision of information during the journey	4.569	0.001*
	Emergency information	11.829	0.000*
	Information about service delays or disruptions	4.657	0.001*
	The number and variety of shops in the transfer station	6.128	0.000*
	Overall satisfaction with service	2.960	0.020*
	Safety in and out the transfer station	4.058	0.003*
	The safety of stairs connection to the transfer station	3.703	0.006*
	Night time security from crime	5.611	0.000*
	Air quality and pollution in the area surrounding the transfer station	3.395	0.010*
	Air quality and pollution in the transfer station	6.183	0.000*
	Connection with other public transport systems	4.060	0.003*
	Rush hour inside the transfer station	4.826	0.001*
	Number of elevators	2.567	0.038*
	Number of escalators	6.003	0.000*
	Distance from the entrance of the station to the platforms	5.373	0.000*
	The easiness of being able to get on/off from platform to vehicle	5.176	0.000*
	The maintenance of the bus	4.945	0.001*
	The provision of shelter facilities	2.449	0.046*
	Availability of seats in the waiting area	2.760	0.028*
	The toilet facilities	5.436	0.000*
Occupation	The punctuality of the vehicle time	6.750	0.000*
	Service time	4.201	0.001*
	Availability during night time	2.420	0.036*
	Availability in early morning	4.095	0.001*
	Ticket fare	6.408	0.000*
	Emergency information	4.534	0.001*
	Safety in and out the transfer station	3.884	0.002*
	The safety of the areas surrounding the transfer station	3.948	0.002*
	The maintenance of the boat	3.685	0.003*
	The passenger managing system in the transfer station	3.662	0.003*
	The toilet facilities	7.044	0.000*
Income	Availability in early morning	3.852	0.002*
	Ticket fare	11.351	0.000*
	Safety in and out the transfer station	2.988	0.012*
	The safety of stairs connection to the transfer station	2.697	0.021*
	The reliability in safety systems of the transfer station	2.326	0.042*
	The safety of the areas surrounding the transfer station	2.986	0.012*

Independent variable	Satisfaction	F	Sig.
	Night time security from crime	3.032	0.011*
	Access to the transfer station	2.468	0.032*
	Number of escalators	3.287	0.006*
	The maintenance of the train	2.627	0.024*
	The maintenance of the bus	2.405	0.037*
	The passenger managing system in the transfer station	2.517	0.029*
	Ticket buying facilities	2.563	0.027*
	Availability of seats in the waiting area	4.096	0.001*
	The toilet facilities	2.414	0.036*
Vehicle in household	Availability during night time	3.445	0.033*
	Availability in early morning	3.595	0.028*
	Ticket fare	3.383	0.035*
	Information about service delays or disruptions	4.063	0.018*
	The reliability in safety systems of the transfer station	4.649	0.010*
	Air quality and pollution in the area surrounding the transfer station	3.508	0.031*
	Rush hour inside the transfer station	3.367	0.036*
	Facilities for car parking	3.802	0.023*
	Availability of seats in the waiting area	4.454	0.012*
	The toilet facilities	2.917	0.055*

* Significant at the 0.05 level/ and there is relationship at least between two groups

5.2 Analysis of Trip Purpose with Mass Transit Node's Service Satisfaction

This section discusses the significant relationship between the variables of trip purpose and variables of service aspect of mass transit node's satisfaction in Mo Chit station, Victor Monument station and Saphan Taksin station.

From the result of table 5.7 in the punctuality of the vehicle time found there was different between the group of Mo Chit station and Saphan Taksin station at statistical significant of 0.016 and 0.024; purpose for 'other' was higher satisfied than the other for Mo Chit station while purpose of 'study' was higher than the other for Saphan Taksin station. Service time showed difference between groups of Victory Monument station and Saphan Taksin station in statistical significant of 0.003 and 0.020 by purpose for 'other' was satisfied than the other for Victory Monument station, and purpose for study was higher satisfied for Saphan Taksin station.

Table 5.7 Comparative the relationship between trip purpose and service satisfaction

Service satisfaction	Trip Purpose	Mo Chit station X	SD	f	P-value	Victory Monument station X	SD	f	P-value	Saphan Taksin station X	SD	f	P-value
	study	3.04	0.815			3.02	1.021			3.18	0.971		
	work	3.21	1.051			2.91	1.123			2.55	1.074		
The punctuality of the vehicle time	travel	3.16	0.886	-0.852	**0.016***	3.14	0.954	0.728	0.254	2.92	0.964	4.819	**0.024***
	shopping	3.12	0.928			3.21	0.719			2.55	0.791		
	other	3.41	0.618			3.05	1.036			2.80	0.768		
	study	3.19	0.778			3.19	0.750			3.15	0.746		
	work	2.96	1.008			2.88	1.045			2.66	1.157		
What about the service time?	travel	3.34	0.781	1.273	0.325	3.00	0.888	2.290	**0.003***	3.08	0.767	3.951	**0.020***
	shopping	3.41	0.795			3.28	0.643			2.54	0.504		
	other	3.18	0.728			3.40	0.672			2.80	0.768		
	study	3.02	0.715			3.07	0.884			3.12	0.811		
	work	2.94	1.174			2.79	1.097			2.58	0.933		
The frequency of the trains on your trip	travel	3.00	0.869	0.422	**0.000***	3.03	0.838	1.930	**0.005***	2.83	0.694	4.788	**0.002***
	shopping	3.24	0.752			3.03	0.858			2.45	0.791		
	other	3.00	0.866			3.10	0.900			2.80	0.768		
	study	3.17	0.851			3.20	1.026			3.27	0.934		
	work	2.87	0.981			2.81	0.927			2.69	1.240		
Availability during night time	travel	3.16	0.886	1.575	0.296	3.00	0.949	2.832	0.611	2.67	0.859	4.138	**0.000***
	shopping	2.88	0.781			3.31	0.799			2.73	1.064		
	other	3.24	0.970			3.20	0.939			2.80	0.768		
	study	3.30	0.785			3.56	0.966			3.39	0.817		
	work	3.00	1.050			2.88	0.975			2.79	1.067		
Availability in early morning	travel	3.42	0.826	1.584	0.123	3.31	0.914	4.907	0.659	3.42	0.767	4.925	**0.013***
	shopping	3.35	0.862			3.27	0.914			2.82	1.040		
	other	3.71	0.772			3.65	0.802			3.40	0.503		
	study	3.30	0.866			3.29	0.089			3.36	0.849		
	work	3.10	1.096			3.12	0.124			2.93	1.343		
Easiness of transportation service use	travel	3.24	0.786	0.980	0.053	3.41	1.017	1.171	**0.004***	3.08	0.767	2.984	**0.012***
	shopping	3.12	1.054			3.27	0.987			2.82	0.843		
	other	3.41	0.939			3.35	0.802			2.60	0.821		
	study	3.30	0.916			3.37	0.782			3.27	1.027		
	work	2.54	0.944			2.79	1.030			2.72	1.176		
What about the ticket fare?	travel	2.92	0.850	3.972	0.926	3.36	0.893	4.397	**0.029***	3.17	0.808	3.887	**0.033***
	shopping	2.76	1.033			3.31	1.063			2.82	0.947		
	other	3.18	0.951			3.50	0.599			3.40	0.503		
	study	3.13	0.859			3.12	0.829			3.18	1.002		
	work	2.87	0.959			2.88	1.089			2.69	1.153		
Comfort of information in the station	travel	3.08	0.712	1.358	0.257	3.22	0.923	1.677	**0.018***	2.83	0.694	3.564	**0.020***
	shopping	3.06	0.747			3.14	0.981			2.45	0.791		
	other	3.24	0.752			3.15	0.735			3.00	0.918		
	study	3.22	0.758			3.14	0.896			3.09	1.059		
	work	2.96	1.009			2.88	1.045			2.76	1.169		
The provision of information during the journey	travel	3.13	0.741	1.402	0.258	3.08	0.960	1.848	0.490	2.92	0.767	2.333	**0.033***
	shopping	3.00	0.707			3.24	0.779			2.64	0.990		
	other	3.29	0.919			2.95	1.036			2.80	0.768		
	study	3.00	0.966			2.85	0.975			3.24	0.892		
	work	2.77	1.016			2.67	0.963			2.45	1.041		
Emergency information	travel	3.00	0.697	1.120	0.132	2.92	0.960	1.258	0.983	3.00	0.715	6.405	**0.002***
	shopping	3.00	0.791			2.97	0.936			2.45	0.791		
	other	3.12	0.600			2.70	0.648			2.20	0.768		
	study	2.89	0.849			2.85	0.939			3.09	1.029		
	work	2.56	0.956			2.69	1.075			2.66	1.216		
Information about service delays or disruptions	travel	2.89	0.894	1.755	**0.037***	2.94	0.820	1.036	**0.023***	3.00	0.825	3.022	**0.005***
	shopping	2.65	0.606			3.03	0.725			2.45	0.901		
	other	2.76	0.970			2.80	0.883			2.40	1.046		
	study	3.13	0.749			3.19	0.773			3.15	0.992		
The number and variety of shops in	work	2.79	0.771			2.72	1.025			2.48	1.008		
the transfer station	travel	2.97	0.716	2.160	0.521	3.11	0.848	3.541	**0.000***	3.08	0.647	5.256	0.508
	shopping	3.00	0.866			3.07	0.588			2.81	0.947		
	other	3.00	0.866			3.05	0.677			3.20	0.410		
	study	3.30	0.553			3.27	0.823			3.36	0.813		
	work	3.08	1.145			3.28	0.929			3.10	1.189		
Overall satisfied with service	travel	3.26	0.644	1.199	**0.000***	3.53	0.731	-0.064	0.294	3.08	0.767	1.984	**0.000***
	shopping	3.29	0.848			3.21	0.554			2.73	0.758		
	other	3.25	0.606			3.15	0.579			3.00	0.918		

* Significant at the 0.05 level/ and there is relationship at least between two groups
**Satisfied level: 1.00 – 1.50 = Highly Dissatisfied, 1.51- 2.50 = Dissatisfied, 2.51- 3.50 = Fair satisfied, 3.51 – 4.50 = Satisfied, 4.51 -5.00 = Highly satisfied

In three stations, Mo Chit station, Victory Monument station, and Saphan Taksin station, the frequency of the trains and information about service delays and disruptions showed significant difference between the group at 0.000, 0,005 and 0.002 (for the frequency of trains) and 0.037, 0.023 and 0.005 (for Information about service delays and disruptions), respectively.

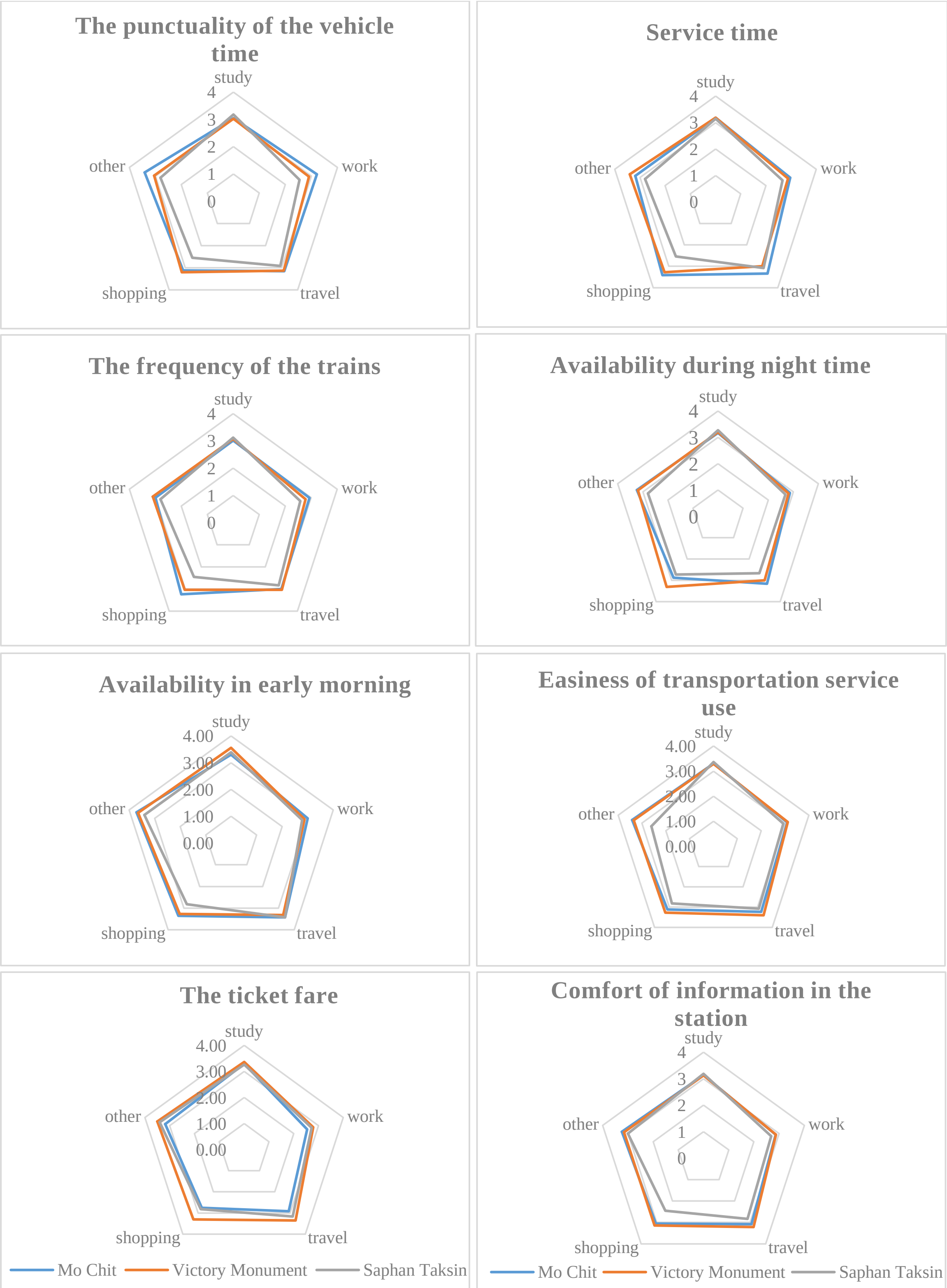


Figure 5.2 Satisfaction level of trip purpose with service (A)

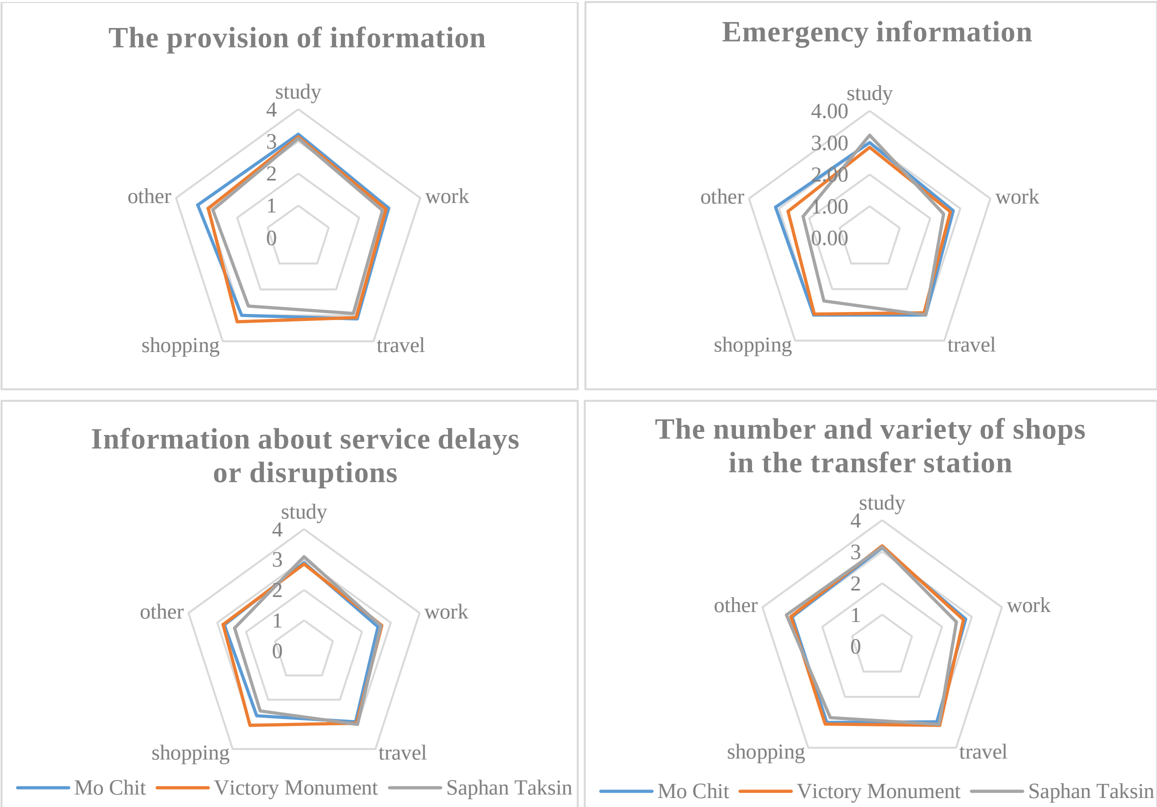


Figure 5.2 Satisfaction level of trip purpose with service (B)

In term of service availability (night time and early morning) of Saphan Taksin station found there were difference between transit purposes in statistical significant of 0.000 and 0.013, the purpose for study have high satisfaction than other group during night time, and purpose for study was highest for availability in early morning. In case of Victory Monument station and Saphan Taksin station, easiness of transportation service use, ticket fare, and comfort information in the station showed significant difference between the groups at 0.004, 0.029 and 0.018 (Victory Monument station) and 0.012, 0.033 and 0.020 (Saphan Taksin station), respectively.

The provision of information during the journey and emergency information of Saphan Taksin station were found higher satisfaction between the groups on significant difference at 0.033 and 0.002. Meanwhile, the number and variety of shops in the transfer station of Victory Monument station was found the significant difference between the groups at 0.000.

For overall satisfied with service, Mo Chit station and Saphan Taksin station found there were difference between the trip purpose in statistical significant of 0.000 and 0.000, the respondents who purposed for study given high score of satisfaction than other groups.

5.3 Analysis of Gender with Mass Transit Node's Safety Satisfaction

The result of table 5.8 discussed the significant relationship between the difference in gender and variables of safety aspect of mass transit node's satisfaction in Mo Chit station, Victor Monument station and Saphan Taksin station. The analysis found there was no difference between the groups of 'the safety of stairs connection to the transfer station', 'the reliability in safety systems of the transfer station' and 'night time security from crime', but 'safety in and out the transfer station' showed significant difference between the groups at 0.018 of Saphan Taksin station; male passengers were higher satisfied that female. The number of security guards of Victory Monument station showed significant difference between the groups at 0.026 by male was satisfied than female. Whereas, the safety of the areas surrounding the transfer station was found female passenger given high score of satisfaction than male at statistical significant of 0.011. The overall satisfaction with safety was found satisfaction between the groups on significant difference at 0.006 of Mo Chit station by male was higher satisfied than female for both stations.

Figure 5.3 Satisfaction level of gender with safety

Table 5.8 Comparative the relationship between gender and safety satisfaction

safety satisfaction	Station	Mo Chit				Victory Monument				Saphan Taksin			
	Gender	X	SD	f	P-value	X	SD	f	P-value	X	SD	f	P-value
Safety in and out the transfer station	Male	3.16	0.807	-1.990	0.075	3.32	0.824	-0.450	0.062	3.30	0.750	3.921	**0.018***
	Female	2.93	0.704			3.28	0.683			2.94	0.990		
The safety of stairs connection to the transfer station	Male	3.27	0.750	-1.110	0.866	3.34	0.747	0.481	0.344	3.28	0.838	-0.052	0.910
	Female	3.14	0.780			3.30	0.830			3.28	0.962		
The number of security guards	Male	3.20	0.846	-0.567	0.584	3.28	0.774	0.011	**0.026***	3.30	0.930	0.859	0.191
	Female	3.13	0.792			3.27	0.652			3.22	0.833		
The reliability in safety systems of the transfer station	Male	3.15	0.899	-0.889	0.172	3.31	0.717	1.419	0.220	3.17	0.922	-0.054	0.404
	Female	3.03	0.792			3.19	0.725			3.18	0.819		
The safety of the areas surrounding the transfer station	Male	3.12	0.836	-2.161	0.907	3.24	0.740	-0.894	0.832	2.95	0.742	-3.064	**0.011***
	Female	2.83	0.845			3.16	0.775			3.20	0.802		
Night time security from crime	Male	3.00	0.887	-2.379	0.314	3.11	0.770	-2.246	0.836	3.13	0.957	0.660	0.262
	Female	2.68	0.841			2.92	0.799			3.06	0.906		
Overall satisfied with safety	Male	3.29	0.849	-2.617	**0.006***	3.34	0.738	-0.986	0.362	3.33	0.962	0.703	0.245
	Female	2.97	0.736			3.26	0.702			3.26	0.745		

* Significant at the 0.05 level/ and there is relationship at least between two groups

**Satisfied level: 1.00 – 1.50 = Highly Dissatisfied, 1.51- 2.50 = Dissatisfied, 2.51- 3.50 = Fair satisfied, 3.51 – 4.50 = Satisfied, 4.51 -5.00 = Highly satisfied

5.4 Analysis of The Number of Transfer in One Trip with Mass Transit Node's Accessibility Satisfaction

Table 5.9 and figure 5.4 shows the significant relationship between variables of 'the number of transfer' and variables of accessibility aspects of mass transit node's satisfaction. Only four variables have shown significant difference between the groups, 'the connection with other public transport systems' and 'rush hour inside the transfer station' of Saphan Taksin station were found different between the groups at statistical significant of 0.018 and 0.023, transfer 2 and 3 times show higher satisfaction of each variable at 3.37 and 3.20, respectively. Meanwhile, the number of escalators of Victory Monument station showed significant difference between the groups at 0.004. The number of stairs was found different between the group at statistical significant of 0.017 of Victory Monument station and 0.005 of Saphan Taksin station; transfer 4 times were higher satisfied than the others of Victory Monument station, and transfer 3 times shows higher satisfied at 3.50 of Saphan Taksin station.

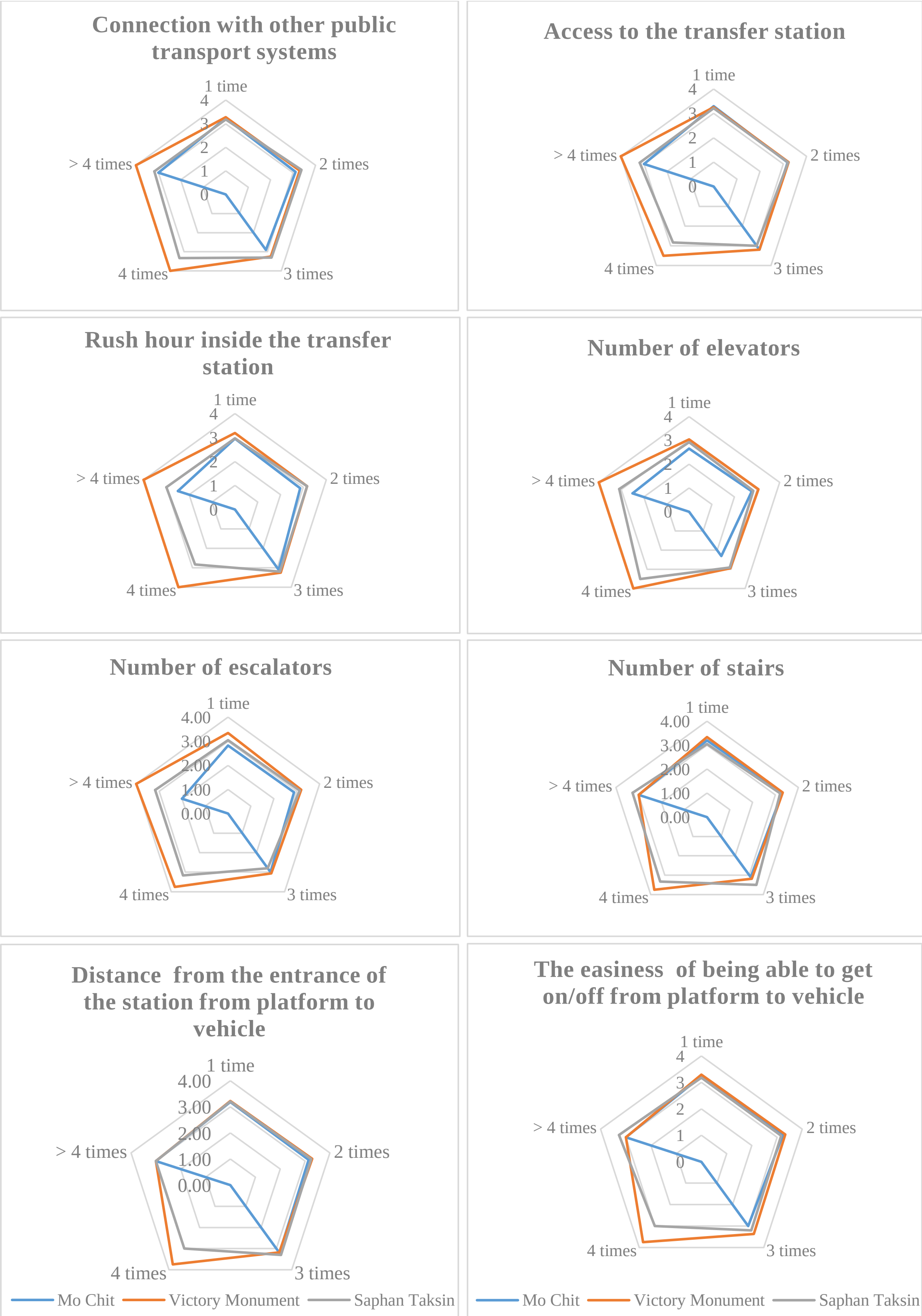


Figure 5.4 Satisfaction level of the number of transfer with accessibility

Table 5.9 Comparative the relationship between the number of transfer and accessibility satisfaction

Accessibility satisfaction	No. of Transfer	Mo Chit station				Victory Monument station				Saphan Taksin station			
		X	SD	f	P-value	X	SD	f	P-value	X	SD	f	P-value
Connection with other public transport systems	1 time	3.23	0.893			3.28	0.773			3.18	0.960		
	2 times	3.11	0.913			3.29	0.766			3.37	0.861		
	3 times	2.90	1.197	-0.114	0.105	3.25	0.762	-0.014	0.735	3.30	0.912	-1.631	**0.018***
	4 times	-	-			4.00	0.756			3.33	0.761		
	> 4 times	3.00	0.000			4.00	0.000			3.18	0.582		
Access to the transfer station	1 time	3.29	0.833			3.25	0.644			3.21	0.914		
	2 times	3.19	0.808			3.23	0.727			3.21	0.917		
	3 times	3.20	1.033	0.736	0.383	3.19	0.821	0.205	0.25	3.00	0.784	-0.027	0.627
	4 times	-	-			3.50	0.926			2.83	0.702		
	> 4 times	3.00	0.000			4.00	0.000			3.18	0.582		
Rush hour inside the transfer station	1 time	2.95	0.933			3.19	0.753			2.97	0.950		
	2 times	2.86	0.974			3.16	0.795			3.16	1.033		
	3 times	3.10	0.738	0.587	0.309	3.25	0.762	0.305	0.939	3.20	0.758	-1.479	**0.023***
	4 times	-	-			4.00	0.756			2.83	1.090		
	> 4 times	2.50	0.707			4.00	0.000			3.00	0.747		
Number of elevators	1 time	2.65	0.994			3.04	0.761			2.92	0.974		
	2 times	2.77	0.924			3.06	0.743			2.83	0.948		
	3 times	2.30	0.948	-0.795	0.178	2.94	0.913	-0.2	0.791	2.90	0.841	0.718	0.938
	4 times	-	-			4.00	0.756			3.50	0.511		
	> 4 times	2.50	0.707			4.00	0.000			3.09	0.802		
Number of escalators	1 time	2.83	0.860			3.35	0.720			3.05	0.907		
	2 times	2.88	0.900			3.19	0.689			3.12	0.837		
	3 times	3.00	0.667	-0.344	0.572	3.06	0.759	2.072	**0.004***	2.80	0.758	-0.645	0.735
	4 times	-	-			3.75	0.886			3.17	0.702		
	> 4 times	2	0			4.00	0.000			3.18	0.724		
Number of stairs	1 time	3.20	0.833			3.34	0.704			3.05	0.752		
	2 times	3.30	0.656			3.32	0.673			3.21	0.766		
	3 times	3.10	0.568	0.184	0.066	3.18	0.535	-1.718	**0.017***	3.50	0.817	-1.598	**0.005***
	4 times	-	-			3.75	0.886			3.33	0.482		
	> 4 times	3.00	1.414			3.00	0.000			3.27	0.758		
Number of moving walkways	1 time	2.87	0.868			3.32	0.713			3.13	0.995		
	2 times	2.84	0.948			3.17	0.638			3.00	1.046		
	3 times	2.80	0.919	0.180	0.367	3.06	0.669	-2.436	0.126	3.20	0.405	0.974	0.848
	4 times	-	-			3.75	0.886			3.33	0.761		
	> 4 times	2.50	0.707			4.00	0.000			2.91	0.910		
Distance from the entrance of the station to the platforms	1 time	3.19	0.741			3.23	0.683			3.21	0.942		
	2 times	3.15	0.846			3.29	0.664			3.25	0.883		
	3 times	3.20	0.632	0.325	0.224	3.18	0.821	-0.839	0.989	3.30	0.911	-0.376	0.500
	4 times	-	-			3.75	0.886			3.00	0.834		
	> 4 times	3.00	0.000			3.00	0.000			3.00	0.747		
The easiness of being able to get on/off from platform to vehicle	1 time	3.23	0.840			3.29	0.705			3.18	1.013		
	2 times	3.23	0.819			3.33	0.697			3.17	0.854		
	3 times	3.00	0.816	0.000	0.828	3.37	0.707	-0.572	0.769	3.20	0.608	0.108	0.089
	4 times	-	-			3.75	0.463			3.00	0.834		
	> 4 times	3.00	0.000			3.00	0.000			3.27	0.450		
Overall satisfied with accessibility	1 time	3.27	0.784			3.32	0.698			3.23	1.052		
	2 times	3.17	0.815			3.32	0.715			3.13	0.886		
	3 times	3.30	0.675	0.817	0.777	3.44	0.504	0.01	0.984	3.50	0.506	0.822	0.056
	4 times	-	-			3.50	0.534			3.17	0.917		
	> 4 times	3.50	0.707			3.00	0.000			3.36	0.487		

* Significant at the 0.05 level/ and there is relationship at least between two groups

**Satisfied level: 1.00 – 1.50 = Highly Dissatisfied, 1.51- 2.50 = Dissatisfied, 2.51- 3.50 = Fair satisfied, 3.51 – 4.50 = Satisfied, 4.51 -5.00 = Highly satisfied

5.5 Investigating the Influence of Variables on Overall Satisfaction

This section discusses the model to figure out the significant relationship between the variables of personal information of respondents and variables of six aspects of mass transit node's satisfaction (service, safety, environment, accessibility, operation and facilities) in Mo Chit station, Victory Monument station and Saphan Taksin station. 46 variables of 6 aspects in the questionnaire survey were involved in logistic regression analysis.

Determining satisfaction is very subjective since it is dependent on emotions and personal experiences, it can be a positive or negative feeling [Hinkle, Wiersma, & Jurs 1998]. The level of expectations could be within a normal range, or surprisingly positive and delightful [Oliver, 1989]. High and low satisfactions were classified as dichotomous data (dummy variables). From a 5 point Likert scale, 3 – 5 represents high satisfaction and 1 – 2 represents low satisfaction based on a binominal scale for logistic regression. The levels of satisfaction from a 5 point Likert scale in this study have been formulated by grouping them into dummy variables as shown in Table 5.10. Demographics, socio-economic and trip pattern were recorded as dichotomous data including gender, age, occupation, income, vehicle in household, trip purpose, frequency of transfer in one trip, trip duration, transfer duration. All variables were categorized into nominal scale. Binary logistic regression was applied to analyze the relationship between general information and the 46 variables in the six aspects of overall satisfaction as show in Table 5.11.

Logistic regression determines the impact of multiple independent variables presented simultaneously to predict membership of one or other of the two dependent variable categories. To predict positive impact on overall satisfaction in mass transit node stations the logistic regression equation can be used as the following equation;

$$\text{Prob (satisfied)} = \frac{1^{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p}}}{1+e^{-\left(\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_p x_p\right)}}$$

Where, Prob = the probability that a case is in a particular category

e = the base of natural logarithms (approx. 2.718)

β_0 = the constant of the equation and

β_1 = the coefficient of the predictor variables

Or $\text{Prob (satisfied)} = \frac{1}{1+e^{-z}}$

Where, $z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p$

Table 5.10 Independent variables demographics, socio-economic and trip pattern

Items	Sub-variables	Dummy value
Gender	- Male	Yes = 1
	- Female	Otherwise = 0
Age	- Years	Number
Occupation	- Private company/Government	Yes = 1 Otherwise = 0
	- Self employed	Yes = 1 Otherwise = 0
	- Unemployment	Yes = 1 Otherwise = 0
Monthly Income	- <15,000	Yes = 1
	- >15,000	Otherwise = 0
Vehicle in household	- Yes	Yes = 1
	- No	Otherwise = 0
Frequency of transfer in one trip	- < 2 times	Yes = 1
	- > 2 times	Otherwise = 0
Trip duration	- < 30 minutes	Yes = 1
	- > 30 minutes	Otherwise = 0
Transfer duration	- < 15 minutes	Yes = 1
	- > 15 minutes	Otherwise = 0
Trip purpose	- Work	Yes = 1
	- Not work	Otherwise = 0

Table 5.11 The 46 variables in classified group of six aspects

Service scale (12 variables)	
Code	**Satisfaction variables**
Sc_1	The punctuality of the vehicle time
Sc_2	What about the service time?
Sc_3	The frequency of the trains on your trip
Sc_4	Availability during night time
Sc_5	Availability in early morning
Sc_6	Easiness of transportation service use
Sc_7	What about the ticket fare?
Sc_8	Comfort of information in the station
Sc_9	The provision of information during the journey
Sc_10	Emergency information
Sc_11	Information about service delays or disruptions
Sc_12	The number and variety of shops in the transfer station

Safety scale (6 variables)	
Code	**Satisfaction variables**
Ts_1	Safety in and out the transfer station
Ts_2	The safety of stairs connection to the transfer station
Ts_3	The number of security guards
Ts_4	The reliability in safety systems of the transfer station
Ts_5	The safety of the areas surrounding the transfer station
Ts_6	Night time security from crime
Environment scale (6 variables)	
Code	**Satisfaction variables**
Es_1	Air quality and pollution in the area surrounding the transfer station
Es_2	Air quality and pollution in the transfer station
Es_3	Interior design of the transfer station
Es_4	Exterior design of the transfer station
Es_5	Cleanliness of the transfer station
Es_6	The temperature inside the transfer station
Accessibility scale (9 variables)	
Code	**Satisfaction variables**
As_1	Connection with other public transport systems
As_2	Access to the transfer station
As_3	Rush hour inside the transfer station
As_4	Number of elevators
As_5	Number of escalators
As_6	Number of stairs
As_7	Number of moving walkways
As_8	Distance from the entrance of the station to the platforms
As_9	The easiness of being able to get on/off from platform to vehicle
Operation scale (8 variables)	
Code	**Satisfaction variables**
Os_1	The maintenance of the station building
Os_2	The maintenance of the station platforms
Os_3	The maintenance of the train
Os_4	The maintenance of the bus
Os_5	The maintenance of the boat
Os_6	The passenger managing system in the transfer station
Os_7	The attitudes and helpfulness of the staff
Os_8	How well transportation company deals with delays
Facilities scale (5 variables)	
Code	**Satisfaction variables**
Fs_1	Facilities for car parking
Fs_2	Ticket buying facilities
Fs_3	The provision of shelter facilities
Fs_4	Availability of seats in the waiting area
Fs_5	The toilet facilities

5.5.1 Results of the influence of personal profile variables on overall satisfaction

To understand how the personal background, socio-economic and trip pattern factors of the respondents could affect satisfaction a number of factors were analysed. A logistic regression model provided coefficients for all six aspects of three stations at <0.05. This indicated that the predictor variables significantly affected the dependent variables. Significant variables of personal profiles were analysed as follow;

Service satisfaction

Occupation 1 (private company/government officer) was a significant variable predicting service satisfaction of Mo Chit station with p-value of 0.025 with a negative value of -0.093. Meanwhile, Victory Monument station, trip duration was found to have significant influence with p-value of 0.019, however this variable indicated less satisfaction with negative value at -0.148. For Saphan Taksin station, gender, occupation (1) and trip duration were found to have significant influence with p-value of 0.001, 0.009, and 0.002 with positive value at 0.170, 0.148, and 0.198. Whereas, trip purpose was significant variable predicting with p-value of 0.000 with negative value of -0.220 for Saphan Taksin station. From Table 5.12 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(2.724-0.093(Occupation1))}}$
2. Victory Monument Station; Prob (event) = $\frac{1}{1+e^{-(3.721-0.148(Trip\ duration))}}$
3. Saphan Taksin Station;

$$\text{Prob (event)} = \frac{1}{1+e^{-(2.852+0.170(Gender)+0.148(Occupation1)+0.198(Trip\ duration)-0.220(Trip\ purpose))}}$$

Table 5.12 Influence of personal profiles on service satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	0.027	0.837	1.602	-0.080	0.129	0.520	**0.170**	**0.001**	**1.342**
Age	0.072	0.374	1.262	-0.083	0.185	0.328	-0.028	0.599	0.526
Occupation(1)	**-0.093**	**0.025**	**0.892**	-0.123	0.579	0.504	**0.148**	**0.009**	**2.626**
Occupation(2)	-0.043	0.464	0.722	-0.112	0.558	0.381	0.070	0.175	1.359
Income	0.344	0.520	1.981	0.921	0.219	1.005	0.246	0.590	1.583
Vehicle in household	0.120	0.097	1.668	0.190	0.099	1.652	-0.150	0.785	0.273
Frequency of transfer	0.111	0.224	1.220	-0.027	0.641	0.467	0.107	0.071	1.810
Trip duration	-0.029	0.688	0.809	**-0.148**	**0.019**	**0.743**	**0.198**	**0.002**	**3.146**
Transfer duration	0.007	0.914	1.642	0.049	0.397	1.487	0.112	0.083	1.737
Trip purpose	0.055	0.086	1.797	0.081	0.753	1.315	**-0.220**	**0.000**	**0.463**
Constant	**2.724**	**0.002**	**7.240**	**3.721**	**0.005**	**11.613**	**2.852**	**0.007**	**11.880**
Prediction percentage correct		89.50%			91.10%			91.20%	

Safety satisfaction

Gender and trip duration were considered significant variables for Mo Chit station with p-values of 0.010 and 0.018. Gender was the only positive value which increased overall satisfaction with safety aspect. Meanwhile, age and vehicle in household were significant variable predicting service satisfaction of Victory Monument station with p-value of 0.040 and 0.015; however, only age was the positive value at 0.128. For Saphan Taksin station, age and frequency of transfer were found significant with p-values <0.05 at 0.021 and 0.024 with positive value at 0.141 for frequency of transfer. From Table 5.13 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(3.126+0.195(Gender)-0.203(Trip\ duration))}}$
2. Victory Monument Station; Prob (event) = $\frac{1}{1+e^{-(2.934+0.128(Age)-0.132(Vehicle\ in\ household))}}$
3. Saphan Taksin Station; Prob (event) = $\frac{1}{1+e^{-(3.799-0.132(Age)\_0.141(Frequency\ of\ transfer))}}$

Table 5.13 Influence of personal profiles on safety satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	**0.195**	**0.010**	**1.614**	0.065	0.216	1.240	-0.330	0.532	0.626
Age	-0.136	0.100	0.857	**0.128**	**0.040**	**1.065**	**-0.132**	**0.021**	**0.823**
Occupation(1)	0.138	0.099	1.658	0.056	0.355	1.296	-0.490	0.410	0.824
Occupation(2)	0.123	0.083	1.685	0.050	0.359	1.198	-0.771	0.193	0.503
Income	0.087	0.069	0.940	-0.581	0.279	0.814	-0.210	0.083	0.896
Vehicle in household	-0.127	0.094	0.369	**-0.132**	**0.015**	**0.514**	0.750	0.186	1.324
Frequency of transfer	0.104	0.177	1.355	0.848	0.397	1.048	**0.141**	**0.024**	**2.262**
Trip duration	**-0.203**	**0.018**	**0.773**	0.068	0.274	1.096	-0.412	0.860	0.771
Transfer duration	0.122	0.149	1.972	0.036	0.536	1.169	-0.211	0.073	0.796
Trip purpose	-0.080	0.333	0.970	0.037	0.506	1.666	0.100	0.079	1.759
Constant	**3.126**	**0.003**	**8.683**	**2.934**	**0.013**	**13.774**	**3.799**	**0.011**	**12.018**
Prediction percentage correct		92.30%			90.70%			90.80%	

Environment satisfaction

Gender and trip duration were significant variables predicting environment satisfaction of Mo Chit station with p-value of 0.008 and 0.011 with a positive value of 0.206 for gender and negative value of -0.222 for trip duration. Meanwhile, gender and trip purpose were found to have significant influence with p-values of 0.011 and 0.038 with positive values at 0.133 and 0.166, respectively. Trip duration and transfer duration were significant affecting environment satisfaction for Saphan Taksin station with p-value of 0.000 and 0.025 and negative value beta indicating low satisfaction for transfer duration while trip duration was positive value at 0.306. From Table 5.14 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(2.978+0.206(Gender)-0.222(Trip\ duration))}}$
2. Victory Monument Station; Prob (event) = $\frac{1}{1+e^{-(2.860+0.133(Gender)+0.116(Trip\ purpose))}}$
3. Saphan Taksin Station; Prob (event) = $\frac{1}{1+e^{-(3.834+0.306(Trip\ duration)-0.151(Transfer\ duration))}}$

Table 5.14 Influence of personal profiles on environment satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	**0.206**	**0.008**	**1.684**	**0.133**	**0.011**	**1.155**	-0.130	0.256	0.798
Age	-0.012	0.890	0.391	0.068	0.271	1.102	0.630	0.260	1.128
Occupation(1)	0.108	0.205	1.271	0.071	0.121	1.049	-0.039	0.506	0.665
Occupation(2)	0.052	0.841	1.292	0.031	0.237	1.083	-0.381	0.210	0.576
Income	-0.169	0.214	0.675	-0.175	0.101	0.732	-0.931	0.301	0.684
Vehicle in household	-0.026	0.735	0.339	-0.083	0.122	0.552	0.284	0.881	1.005
Frequency of transfer	0.048	0.537	0.618	0.078	0.170	1.374	-0.308	0.532	0.625
Trip duration	**-0.222**	**0.011**	**0.571**	0.044	0.481	1.067	**0.306**	**0.000**	**1.469**
Transfer duration	0.030	0.732	1.343	0.110	0.186	1.285	**-0.151**	**0.025**	**0.852**
Trip purpose	-0.032	0.702	0.383	**0.116**	**0.038**	**1.083**	-0.290	0.601	0.523
Constant	**2.978**	**0.005**	**8.539**	**2.860**	**0.002**	**10.277**	**3.834**	**0.009**	**8.831**
Prediction percentage correct		90.80%			89.90%			91.70%	

Accessibility satisfaction

Gender and frequency of transfer were considered significant variable for Mo Chit station with p-values of 0.002 and 0.005 by positive values which increased overall satisfaction with accessibility at 0.234 and 0.946, respectively. Trip duration was the only significant variable affecting accessibility satisfaction for Saphan Taksin station with p-value of 0.000 and positive value of beta indicating high satisfaction. Whereas, Victory Monument station was found no significant variable.

From Table 5.15 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(3.355+0.234(Gender)+0.946(Frequency\ of\ transfer))}}$
2. Victory Monument Station; Prob (event) = $\frac{1}{1+e^{-(3.202)}}$
3. Saphan Taksin Station; Prob (event) = $\frac{1}{1+e^{-(3.608+0.317(Trip\ duration))}}$

Table 5.15 Influence of personal profiles on accessibility satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	**0.234**	**0.002**	**2.103**	0.078	0.142	1.470	0.902	0.966	1.042
Age	-0.010	0.901	0.125	0.084	0.185	1.327	-0.107	0.054	0.935
Occupation(1)	0.048	0.571	1.182	-0.027	0.655	0.488	-0.031	0.592	0.536
Occupation(2)	-0.093	0.075	0.371	-0.018	0.890	0.380	0.716	0.172	1.367
Income	0.119	0.067	1.062	-0.064	0.234	0.861	-0.246	0.074	0.936
Vehicle in household	-0.090	0.239	0.568	-0.088	0.110	0.604	-0.542	0.327	0.982
Frequency of transfer	**0.946**	**0.005**	**1.068**	0.023	0.694	1.394	0.101	0.855	1.182
Trip duration	-0.107	0.211	0.552	-0.092	0.296	0.612	**0.317**	**0.000**	**1.907**
Transfer duration	-0.541	0.073	0.804	0.051	0.387	1.688	-0.079	0.233	0.913
Trip purpose	-0.880	0.569	0.293	-0.038	0.502	0.673	0.540	0.589	1.030
Constant	**3.355**	**0.000**	**9.587**	**3.202**	**0.006**	**10.576**	**3.608**	**0.012**	**11.649**
Prediction percentage correct		94.40%			92.00%			90.10%	

Operation satisfaction

Trip duration was significant variables prediction operation satisfaction of Mo Chit station with p-value 0.031 with a negative of -0.189. Meanwhile, age was found to have significant influence with p-value of 0.003 with positive value at 0.187. For Saphan Taksin station, gender and income were significant affecting operation satisfaction with p-values of 0.045 and 0.018 and negative value beta indicating low satisfaction at -0.107 and -0.138, respectively. From Table 5.16 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(3.286-0.189(Trip\ duration))}}$
2. Victory Monument Station; Prob (event) = $\frac{1}{1+e^{-(3.056+0.187(Age))}}$
3. Saphan Taksin Station; Prob (event) = $\frac{1}{1+e^{-(3.655-0.107(Gender)-0.138(Income))}}$

Table 5.16 Influence of personal profiles on operation satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	0.165	0.033	2.149	0.075	0.150	1.444	**-0.107**	**0.045**	**0.21**
Age	-0.051	0.548	0.602	**0.187**	**0.003**	**1.034**	0.803	0.156	1.423
Occupation(1)	0.089	0.301	1.037	-0.116	0.055	0.926	-0.034	0.577	0.559
Occupation(2)	-0.039	0.514	0.613	0.096	0.091	1.693	-0.269	0.106	0.62
Income	0.254	0.118	1.074	0.066	0.231	1.200	**-0.138**	**0.018**	**0.831**
Vehicle in household	0.670	0.925	1.094	-0.049	0.362	0.913	-0.588	0.890	0.93
Frequency of transfer	-0.025	0.751	0.318	0.096	0.091	1.693	0.442	0.532	1.262
Trip duration	**-0.189**	**0.031**	**0.732**	-0.092	0.140	0.479	0.511	0.455	1.477
Transfer duration	-0.055	0.636	0.526	0.037	0.520	1.643	0.391	0.782	1.277
Trip purpose	-0.067	0.427	0.797	-0.056	0.310	0.999	-0.143	0.455	0.748
Constant	**3.286**	**0.003**	**7.489**	**3.056**	**0.002**	**11.674**	**3.655**	**0.009**	**9.632**
Prediction percentage correct		96.00%			93.70%			92.30%	

Facilities satisfaction

Gender was only one significant variable predicting facilities satisfaction of Mo Chit station with p-vale of 0.026 with positive value of 0.171. For Victory Monument station, four predictor variables were found significant with p-vales <0.05. These included age = 0.019, income = 0.013, trip duration = 0.028 and transfer duration = 0.016. Age and trip duration were positively significant variable that contributes to satisfaction. Meanwhile, income and trip duration were considered significant variables for Saphan Taksin station with p-values of 0.008, 0.001; however income indicated less satisfaction with negative value at -0.143.

From Table 5.17 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Mo Chit Station; Prob (event) = $\frac{1}{1+e^{-(3.358+0.171(Gender))}}$
2. Victory Monument Station;

   Prob (event) = $\frac{1}{1+e^{-(2.889+0.144(Age)-0.097(Income)+0.135(Trip\ duration)-0.137(Transfer\ duration))}}$
3. Saphan Taksin Station; Prob (event) = $\frac{1}{1+e^{-(3.006-0.143(Income)+0.224(Trip\ duration))}}$

Table 5.17 Influence of personal profiles on facilities satisfaction

Station	Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Gender	**0.171**	**0.026**	**2.244**	0.075	0.145	1.459	-0.24	0.638	0.74
Age	-0.052	0.593	0.615	**0.144**	**0.019**	**1.359**	0.201	0.713	1.368
Occupation(1)	0.541	0.589	1.046	0.043	0.466	1.073	-0.809	0.130	0.519
Occupation(2)	-0.204	0.086	0.901	0.134	0.709	1.013	-0.043	0.446	0.763
Income	0.345	0.102	1.129	**-0.097**	**0.013**	**0.709**	**-0.143**	**0.008**	**0.661**
Vehicle in household	-0.460	0.555	0.591	-0.125	0.081	0.730	-0.133	0.081	0.734
Frequency of transfer	-0.146	0.063	0.875	-0.013	0.813	0.327	-0.241	0.490	0.691
Trip duration	-0.104	0.229	0.802	**0.135**	**0.028**	**1.207**	**0.224**	**0.001**	**1.412**
Transfer duration	-0.401	0.814	0.632	**-0.137**	**0.016**	**0.423**	0.104	0.121	1.555
Trip purpose	-0.165	0.052	0.962	0.127	0.052	1.230	-0.042	0.461	0.738
Constant	**3.358**	**0.012**	**7.458**	**2.889**	**0.007**	**12.893**	**3.006**	**0.009**	**10.471**
Prediction percentage correct		91.30%			96.20%			93.40%	

5.5.2 Results of sub-variable satisfaction on overall satisfaction

The significant variables driving performances in the six aspects were presented in Table 5.18 – 5.23. The models of three stations were statistically significant at p-value of <0.05. R values indicated a percentage improvement for the model with sub-variables (predictors) compared with the null model.

The influencing variables of three stations are summarized as follows;

Mo Chit Station

Sub-variables that influenced overall service satisfaction of the station with positive values were; the frequency of the train, ticker fare, and emergency information with p-values of <0.05. The influencing factors showing the highest beta coefficient were; the frequency of the trains (B = 1.592), followed by ticket fare (B = 0.207), and emergency information (B = 0.197). For overall safety satisfaction the influencing variables were; safety in and out transfer station, the reliability in safety systems of the transfer station, and night time security from crime, all showing significant influence with p-values of <0.05. In considering beta values, safety in and out transfer station (B = 0.401), the reliability in safety systems of the transfer station (B = 0.205), and night time security from crime (B = 0.352) play a role for contributing to satisfaction with positive coefficient values. In term of overall environment satisfaction, air quality and pollution in the area surrounding the transfer station, interior design of the transfer station, and the temperature inside the transfer station had significant influence with p-values of <0.05. The air quality and pollution in the area surrounding the transfer station created a high beta value (B = 0.238) which contributed to satisfaction with Mo Chit station. Rush hour inside the transfer station and the easiness of being able to get on/off from platform to vehicle were found to have significant influence on accessibility satisfaction with a p-values of <0.05, and both variables had positive beta values (B = 0.185 and 0.284, respectively). Regarding overall operation satisfaction, the maintenance of the train, and how well Transportation Company deals with delays were found to be significant with positive coefficient values (B = 0.129 and 0.295, respectively) leading to satisfaction. Four independents variables were found to have significant influence with a p-value of <0.05 on facilities satisfaction, these were facilities for car parking, ticket buying facilities, availability of seats in the waiting area, and the toilet facilities. All showed positive coefficient values at B = 0.233, 0.332, 0.227 and 0.167, respectively. From the Table 5.18 – 5.23 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Service aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.567+0.334(Sc3)+0.207(Sc7)+0.197(Sc10))}}$$

2. Safety aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.520+0.401(Ts1)+0.205(Ts4)+0.352(Ts6))}}$$

3. Environment aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.832+0.238(Es1)+0.205(Es3)+0.229(Es6))}}$$

4. Accessibility aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.567+0.185(As3)+0.284(As9))}}$$

5. Operation aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.965+0.219(Os3)+0.295(Os8))}}$$

6. Facilities aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.083+(Fs1)+0.332(Fs2)+0.227(Fs4)+0.167(Fs5))}}$$

Victory Monument Station

The punctuality of the vehicle time, availability during night time, comfort of information in the station, and the number and variety of shops in the transfer station were found to have significant influence on service satisfaction with a p-value of <0.05, and all variables had positive beta values (B = 0.345, 0.144, 0.316 and 0.202, respectively). Meanwhile, the frequency of the trains and ticket fare were found to have significant influence on satisfaction and it was predicted to lead to less satisfaction as a result of a negative beta values. Two independents variables were found to have significant influence with p-value of <0.05 on safety satisfaction, these were safety in and out the transfer station, and night time security from crime. For environment satisfaction the influencing variables were; exterior design of the transfer station, and the temperature inside the transfer station, both show significant influence with p-values of <0.05. In considering beta values, both play a role for contributing to satisfaction with positive coefficient values. In term of overall accessibility satisfaction, connection with other public transport systems and the easiness of being able to get on/off from platform to vehicle had significant influence with p-values of <0.05 with positive beta value (B = 0.230 and 0.435) which contributed to satisfaction with Victory Monument station. Regarding overall operation satisfaction, the maintenance of the bus, the attitudes and helpfulness of the staff, and how well Transportation Company deals with delays were found to be significant with positive coefficient values (B = 0.351, 0.220, and 0.196, respectively) leading to satisfaction. Four independents variables were found to have significant influence with a p-value of <0.05 on overall facilities satisfaction, these were facilities for car parking, ticket buying facilities, the provision of shelter facilities, and the toilet facilities, all showed positive coefficient values. Toilet facilities was an important influencing factor with beta values of 0.343 that encouraged satisfaction. From the Table 5.18 – 5.23 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Service aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(1.569+0.345(Sc1)-0.141(Sc3)+0.144(Sc4)-0.106(Sc7)+0.316(Sc8)+0.202(Sc12))}}$$

2. Safety aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.965+0.225(Ts1)+0.273(Ts6))}}$$

3. Environment aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(1.230+0.128(Es4)+0.357(Es6))}}$$

4. Accessibility aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.848+0.230(As1)+0.435(As9))}}$$

5. Operation aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(1.236+0.351(Os4)+0.220(Os7)+0.196(Os8))}}$$

6. Facilities aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.861+0.107(Fs1)+0.244(Fs2)+0.141(Fs3)+0.343(Fs5))}}$$

Saphan Taksin Station

For overall service satisfaction the influencing variables were; the punctuality of the vehicle time, the frequency of the trains on your trip, availability during night time, and Comfort of information in the station with p-values of <0.05. In considering beta values, all variables play a role for contributing to satisfaction with positive coefficient values at B = 0.313, 0.148, 0.241, and 0.180, respectively. Sub-variables that influenced overall safety satisfaction of Saphan Taksin station with positive values were; safety in and out the transfer station, the reliability in safety systems of the transfer station, the safety of the areas surrounding the transfer station, and night time security from crime with p-values of <0.05. The influencing factors showing the highest beta coefficient were; safety in and out the transfer station (B = 0.259), followed by the reliability in safety systems of the transfer station (B = 0.147), the safety of the areas surrounding the transfer station (B = 0.136), and night time security from crime (B = 0.133). Three independents variables were found to have significant influence with a p-value of <0.05 on environment satisfaction, these were air quality and pollution in the area surrounding the transfer station, air quality and pollution in the transfer station, and cleanliness of the transfer station. All showed positive coefficient values, however, air quality and pollution in the transfer station was an important influencing factor with beta values of 0.352 that encouraged satisfaction. Number of elevators, number of stairs, distance from the entrance of the station to the platforms, and the easiness of being able to get on/off from platform to vehicle were found to have significant influence on accessibility satisfaction with a p-value of <0.05, and all variables had positive beta values (B = 0.186, 0.104, 0.108, and 0.548, respectively). Meanwhile, number of escalators was found to have significant influence on satisfaction and it was predicted to lead to less satisfaction as a result of a negative beta value. In term of overall operation satisfaction, the maintenance of the station building, the maintenance of the bus, the passenger managing system in the transfer station, the attitudes and helpfulness of the staff, and how well transportation company deals with delays had significant influence with p-values of <0.05. How well transportation company deals with delays created a highest beta value B = 0.277) which contributed to satisfaction with Saphan Taksin station. Regarding overall facilities satisfaction, facilities for car parking, and the toilet facilities were found to be significant, both variables showed positive coefficient values (B = 0.303 and 0.375) leading to satisfaction. From the Table 5.18 – 5.23 shows a logistic coefficient (β) that can create a predictive equation formula as below;

1. Service aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.811+0.313(Sc1)+0.148(Sc3)+0.241(Sc4)+0.180(Sc8))}}$$

2. Safety aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.720+0.259(Ts1)+0.147(Ts4)+0.136(Ts5)+0.133(Ts6))}}$$

3. Environment aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(1.063+0.282(Es1)+0.352(Es2)+0.141(Es5))}}$$

4. Accessibility aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.372+0.186(As4)-0.156(As5)+0.104(As6)+0.108(As8)+0.548(As9))}}$$

5. Operation aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.090+0.227(Os1)+0.178(Os4)+0.181(Os6)+0.191(Os7)+0.277(Os8))}}$$

6. Facilities aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(0.175+0.303(Fs1)+0.375(Fs5))}}$$

A predictive equation formula for all station

1. Service aspect — Prediction percentage correct

$$\text{Prob (event)} = \frac{1}{1+e^{-(constant\beta\ +\ \beta(the\ frequency\ of\ the\ trains))}}$$ 92.23%

2. Safety aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(constant\beta\ +\ \beta(Safety\ in/out\ the\ station)+\beta(Night\ time\ security))}}$$ 91.47%

3. Accessibility aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(constant\beta+\beta(the\ easiness\ of\ being\ able\ to\ get\ on/off\ the\ vehicle))}}$$ 91.77%

4. Operation aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(constant\beta+\beta(transportation\ company\ deals\ with\ delays))}}$$ 96.37%

5. Facilities aspect

$$\text{Prob (event)} = \frac{1}{1+e^{-(constant\beta\ +\ \beta(facilities\ for\ car\ parking)+\beta(toilet\ facilities))}}$$ 95.50%

Table 5.18 Influence of sub-variable on overall satisfaction in service aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
	Service features									
Sc_1	The punctuality of the vehicle time	0.096	0.214	1.247	**0.345**	**0.000**	**5.533**	**0.313**	**0.000**	**5.279**
Sc_2	What about the service time?	0.047	0.606	0.517	0.038	0.587	0.544	0.000	0.994	0.007
Sc_3	The frequency of the trains on your trip	**0.334**	**0.000**	**1.098**	**-0.141**	**0.020**	**2.331**	**0.148**	**0.006**	**2.773**
Sc_4	Availability during night time	-0.066	0.399	0.846	**0.144**	**0.014**	**2.460**	**0.241**	**0.000**	**4.000**
Sc_5	Availability in early morning	0.072	0.358	0.922	-0.020	0.745	0.325	-0.025	0.620	0.497
Sc_6	Easiness of transportation service use	-0.070	0.931	0.807	-0.065	0.297	1.045	-0.028	0.624	0.491
Sc_7	What about the ticket fare?	**0.207**	**0.002**	**1.075**	**-0.106**	**0.047**	**1.995**	-0.009	0.850	0.189
Sc_8	Comfort of information in the station	-0.013	0.887	0.412	**0.316**	**0.000**	**4.456**	**0.180**	**0.007**	**2.730**
Sc_9	The provision of information during the journey	0.121	0.181	1.342	-0.043	0.518	0.647	0.022	0.726	0.351
Sc_10	Emergency information	**0.197**	**0.025**	**2.262**	-0.019	0.796	0.259	0.059	0.367	0.903
Sc_11	Information about service delays or disruptions	-0.040	0.957	0.504	0.024	0.736	0.338	0.050	0.391	0.860
Sc_12	The number and variety of shops in the transfer station	-0.091	0.896	0.313	**0.202**	**0.000**	**3.650**	-0.089	0.062	1.872
Constant		**0.567**	**0.024**	**2.287**	**1.569**	**0.000**	**10.108**	**0.811**	**0.000**	**5.603**
Nagellkerke R^2		0.504 (50.4%)			0.382 (38.2%)			0.586 (58.6%)		
Prediction percentage correct		92.10%			89.70%			94.90%		

Table 5.19 Influence of sub-variable on overall satisfaction in safety aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
	Safety features									
Ts_1	Safety in and out the transfer station	**0.401**	**0.000**	**5.156**	**0.225**	**0.000**	**3.977**	**0.259**	**0.000**	**4.303**
Ts_2	The safety of stairs connection to the transfer station	-0.023	0.744	0.328	0.067	0.246	1.162	0.116	0.054	1.936
Ts_3	The number of security guards	-0.023	0.737	0.336	0.081	0.184	1.332	0.057	0.299	1.041
Ts_4	The reliability in safety systems of the transfer station	**0.205**	**0.005**	**2.876**	0.048	0.415	0.817	**0.147**	**0.012**	**2.539**
Ts_5	The safety of the areas surrounding the transfer station	-0.018	0.835	0.209	0.081	0.157	1.419	**0.136**	**0.024**	**2.262**
Ts_6	Night time security from crime	**0.352**	**0.000**	**4.179**	**0.273**	**0.000**	**4.709**	**0.133**	**0.021**	**2.327**
Constant		**0.520**	**0.007**	**2.758**	**0.965**	**0.000**	**5.975**	**0.720**	**0.000**	**4.842**
Nagellkerke R^2		0.635 (63.5%)			0.402 (40.2%)			0.488 (48.8%)		
Prediction percentage correct		90.70%			92.50%			91.20%		

Table 5.20 Influence of sub-variable on overall satisfaction in environment aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
	Environment features									
Es_1	Air quality and pollution in the area surrounding the transfer station	**0.238**	**0.012**	**2.540**	0.107	0.064	1.860	**0.282**	**0.000**	**4.727**
Es_2	Air quality and pollution in the transfer station	0.010	0.920	0.101	0.131	0.062	1.872	**0.352**	**0.000**	**6.026**
Es_3	Interior design of the transfer station	**0.205**	**0.04**	**2.075**	-0.053	0.391	-0.858	-0.083	0.154	1.430
Es_4	Exterior design of the transfer station	0.01	0.908	0.115	**0.128**	**0.026**	**2.228**	0.070	0.219	1.232
Es_5	Cleanliness of the transfer station	0.117	0.153	1.1435	0.096	0.091	1.696	**0.141**	**0.003**	**2.987**
Es_6	The temperature inside the transfer station	**0.229**	**0.013**	**2.514**	**0.357**	**0.000**	**6.376**	0.085	0.100	1.647
Constant		**0.832**	**0.000**	**3.685**	**1.230**	**0.000**	**8.025**	**1.063**	**0.000**	**7.527**
Nagellkerke R^2		0.452 (45.2%)			0.394 (39.4%)			0.525 (52.5%)		
Prediction percentage correct		94.30%			90.90%			94.70%		

Table 5.21 Influence of sub-variable on overall satisfaction in accessibility aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
	Accessibility features									
As_1	Connection with other public transport systems	0.127	0.205	1.273	**0.230**	**0.000**	**4.164**	-0.014	0.789	0.268
As_2	Access to the transfer station	0.002	0.984	0.020	-0.051	0.352	0.931	0.033	0.586	0.545
As_3	Rush hour inside the transfer station	**0.185**	**0.021**	**2.338**	0.077	0.159	1.411	-0.027	0.673	0.422
As_4	Number of elevators	0.173	0.059	1.899	0.05	0.334	0.968	**0.186**	**0.001**	**3.315**
As_5	Number of escalators	0.030	0.753	0.315	-0.090	0.142	1.472	**-0.156**	**0.014**	**2.470**
As_6	Number of stairs	-0.040	0.573	0.564	0.070	0.231	1.201	**0.104**	**0.027**	**2.219**
As_7	Number of moving walkways	0.077	0.393	0.857	0.049	0.442	0.769	0.105	0.089	1.704
As_8	Distance from the entrance of the station to the platforms	0.147	0.077	1.780	0.029	0.624	0.491	**0.108**	**0.036**	**2.105**
As_9	The easiness of being able to get on/off from platform to vehicle	**0.284**	**0.000**	**3.991**	**0.435**	**0.000**	**8.171**	**0.548**	**0.000**	**12.218**
Constant		**0.567**	**0.013**	**2.526**	**0.848**	**0.000**	**5.038**	**0.372**	**0.026**	**2.243**
Nagellkerke R^2		0.569 (56.9%)			0.434 (43.4%)			0.557 (55.7%)		
Prediction percentage correct		92.80%			91.30%			91.20%		

Table 5.22 Influence of sub-variable on overall satisfaction in operation aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Operation features										
Os_1	The maintenance of the station building	0.103	0.320	0.998	0.086	0.202	1.277	**0.227**	**0.000**	**5.442**
Os_2	The maintenance of the station platforms	-0.122	0.221	1.229	0.005	0.931	0.086	-0.008	0.847	0.193
Os_3	The maintenance of the train	**0.219**	**0.012**	**2.555**	-0.002	0.970	0.038	0.014	0.674	0.421
Os_4	The maintenance of the bus	0.156	0.126	1.538	**0.351**	**0.000**	**5.062**	**0.178**	**0.000**	**4.598**
Os_5	The maintenance of the boat	0.090	0.385	0.871	-0.136	0.129	2.199	0.030	0.478	0.711
Os_6	The passenger managing system in the transfer station	0.090	0.302	1.036	0.035	0.579	0.555	**0.181**	**0.000**	**4.142**
Os_7	The attitudes and helpfulness of the staff	0.050	0.489	0.693	**0.220**	**0.000**	**3.840**	**0.191**	**0.000**	**4.891**
Os_8	How well transportation company deals with delays	**0.295**	**0.001**	**3.498**	**0.196**	**0.003**	**2.950**	**0.277**	**0.000**	**6.648**
Constant		**0.965**	**0.000**	**4.405**	**1.236**	**0.000**	**7.551**	**0.09**	**0.329**	**0.977**
Nagellkerke R^2		0.542 (54.2%)			0.424 (42.4%)			0.832 (83.2%)		
Prediction percentage correct		95.10%			96.70%			97.30%		

Table 5.23 Influence of sub-variable on overall satisfaction in facilities aspect

Station		Mo Chit			Victory Monument			Saphan Taksin		
Independents Variables		**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**	**β**	**Sig.**	**Exp (β)**
Facilities features										
Fs_1	Facilities for car parking	**0.233**	**0.000**	**4.026**	**0.107**	**0.027**	**2.216**	**0.303**	**0.000**	**5.559**
Fs_2	Ticket buying facilities	**0.332**	**0.000**	**5.214**	**0.244**	**0.000**	**4.627**	0.083	0.068	1.831
Fs_3	The provision of shelter facilities	0.056	0.387	0.868	**0.141**	**0.023**	**2.275**	0.07	0.244	1.167
Fs_4	Availability of seats in the waiting area	**0.227**	**0.001**	**3.542**	-0.008	0.898	0.128	0.023	0.732	0.343
Fs_5	The toilet facilities	**0.167**	**0.013**	**2.501**	**0.343**	**0.000**	**5.875**	**0.375**	**0.000**	**6.036**
Constant		**0.083**	**0.566**	**0.575**	**0.861**	**0.000**	**5.585**	**0.175**	**0.249**	**1.154**
Nagellkerke R^2		0.744 (74.4%)			0.440 (44%)			0.555 (55.5%)		
Prediction percentage correct		93.80%			97.30%			95.40%		

5.6 Conclusion

Mo Chit station, Victory Monument station, and Saphan Taksin station were represented Mass Transit Node Station in Bangkok. 450 questionnaires were distributed to three stations to understand satisfaction by passenger evaluation theory. The result of questionnaire based on 46 variables forum that most of mean score satisfactions based on six aspects of Victory Monument station was higher than Mo Chit station and Saphan Taksin station. Measuring subjective satisfaction is depend on individual perception and their socio-economic status and trip pattern, the study uses T-test and One-Way ANOVA to examine a difference satisfaction between group of gender, age, occupation, income, vehicle in household, frequency of transfer in one trip, trip duration, transfer duration, and trip purpose. These variables have showed a significant attribute that it could be focused on specific group of passengers to enhance their satisfaction. In the process logistic regression has let us knows the influence variable which are the highest beta coefficient value for prediction high satisfaction of three stations. Therefore, considering these variables into mass transit node station improvement would be contributing high satisfaction level of people that requires close attention.

Measuring passengers' satisfaction with specific aspects of three station was conducted to provide a comprehensive data set, from which it is possible to make recommendations for future improvements to mass transit station quality. The six main recommendation are;

1. *Improvement of Service Features*
   For service of mass transit node station, three stations scored fair satisfaction levels. The passengers traveling in Saphan Taksin station have lower satisfaction than those in Mo Chit station and Victory Monuement station. Service time, the frequency of the trains, and information about service delays or disruptions are significant factor as shown in Table 5.7 that directly affects the satisfaction with service related to trip purpose. Improvement programmes of the company agencies should consider the requirements of all passengers. For example, service time and information about service delays should be assessed. This can inform the passengers to manage their trip with effective to predict their traveling time and enhance the quality of transit between difference transit modes.
2. *Improvement of Safety Features*
   The research revealed that Saphan Taksin station had lower satisfaction scores compared to Mo Chit station and Victory Monument station. To improve all the elements may not be possible due to safety is also based on external factor which difficult to control, so it is necessary to consider priority based on satisfaction levels. The influencing variable affecting satisfaction level in Table 5.13 is safety in and out the transfer station, which should be more affect to passengers' feeling. Because the area surrounding the station has

many risk-prone areas with crime. Automobile accidents, theft, and crimes are problems related to this station.

3. *Improvement of Environment Features*

   Satisfaction with the environment of three stations was at a fair level. Air quality and pollution in the transfer station plays an important factor that influenced satisfaction, as indicated by coefficient beta values. Three projects are located in transit node areas which the center of transportation of each part of Bangkok, this cause to high pollution inside and around the stations. Providing the air quality controlling should be considered so as to increase satisfaction of environment.

4. *Improvement of Accessibility Features*

   For accessibility of transfer station three stations scored fair satisfaction levels. The passengers who traveling in Mo Chit station have lower satisfaction than those in Victory Monument station and Saphan Taksin station. Based on satisfaction level and indicated by coefficient beta value, to improve the easiness of being able to get on/off from platform to vehicle is the most influencing factor of three stations that could be improve the level of satisfaction.

5. *Improvement of Operation Features*

   According to the research results, Mo Chit station had lower satisfaction scores compared to Victory Monument station and Saphan Taksin station. Monitoring and managing the service delay plays and important factor that influenced satisfaction, this factor also can contribute to satisfaction in case of Victory Monument station and Saphan Taksin station. However, the most influencing facto of Victory Monument station is the maintenance of the bus, this factor also can contribute to satisfaction in case of Saphan Taksin station.

6. *Improvement of Facilities Features*

   Satisfaction with the facilities of three stations was at a fair level, except for satisfaction with toilet facilities of Saphan Taksin station was dissatisfied. Facilities of car parking and the toilet facilities play an important factor that influenced satisfaction, as indicated by coefficient beta values for three stations. Provide the parking space and toilet facilities are strongly required from the passengers that the company agencies should considered.

To conclude, the results of this research into the level of passengers' satisfaction with the three transfer stations may assist the authorities of public transit to prioritize specific actions. These actions, based on evidence should aim to improve the level of passengers' satisfaction.

Chapter 6

Investigation of Bangkok Mass Transit Nodes' Service

6.1 Service Time at Transit Stations

The BTS is undoubtedly the swiftest way to get around, and can whisk the passenger right where they want to be in no time at all. It is not cheapest transit but it smooth, cool, clean, fast and scenic way to travel in Bangkok. Major shopping mall, all Sukhumvit Road's attractions, and even the riverside are accessible by Skytrain.

While the Silom line runs west to south, the Sukhumvit line runs for north to east of Bangkok. The service run between 05:15 to 00:50, Sukhumvit Line; the first train departs from Mo Chit bound for Samrong and depart from Samrong to Mo Chit at 05:15 am. And the last train from Mo Chit station to Samrong station departs at 00:14 am, while, from Samrong station to Mo Chit station departs at 00:00 am as shown in the Table 6.1. For Silom Line; the first train runs from National Stationdium at 05:30 am bound for Bang Wa, and from Bang Wa to National stadium departs at 00:00 am as shown in the Table 6.2. The trains can be packed during peak hours (07:00 – 09:00 and 16:00 – 19:00). The frequency of the trains are difference depend on service hours, service days, and service lines; the approximate time between trains during peak hours on weekday are every 02:50 min and 04:50 min for Sukhumvit line and Silom line in the morning, respectively, and every 03:00 min and 04:50 min for Sukhumvit line and Silom line in the evening as shown in Table 6.3. For Saturday, Sunday and public holiday, the frequency of trains for Sukhumvit line is every 04:40 – 08:00 min, and every 05:40 – 08:00 for Silom line as shown in Table 6.4. How, the above information is the service interval between trains during 'normal operations'.

Table 6.1 BTS Skytrain's service time information of Sukhumvit Line

Sukhumvit Line	To Samrong		To Mo Chit	
From Station	First Train (hrs.)	Last Train (hrs.)	First Train (hrs.)	Last Train (hrs.)
Mo Chit	5:15	0:14	-	-
Saphan Khwai	5:16	0:15	5:55	0:41
Ari	5:19	0:18	5:53	0:39
Sanam Pao	5:20	0:19	5:51	0:37
Victory Monument	5:23	0:22	5:48	0:34
Phaya Thai	5:25	0:24	5:47	0:33
Ratchathewi	5:26	0:25	5:45	0:31
Siam	5:29	0:28	5:43	0:28
Chit Lom	5:31	0:31	5:40	0:25
Phloen Chit	5:32	0:32	5:39	0:24
Nana	5:34	0:34	5:37	0:22
Asok	5:36	0:36	5:36	0:21
Phrom Phong	5:38	0:38	5:34	0:19
Thong Lo	5:40	0:40	5:32	0:17
Ekkamai	5:41	0:41	5:30	0:15
Phra Khanong	5:43	0:43	5:28	0:13
On Nut	5:45	0:45	5:26	0:11
Bang Chak	5:47	0:47	5:24	0:09
Punnawithi	5:49	0:49	5:23	0:08
Udom Suk	5:50	0:50	5:21	0:06
Bang Na	5:53	0:53	5:18	0:03
Bearing	5:55	0:55	5:17	0:02
Samrong	-	-	5:15	0:00

Table 6.2 BTS Skytrain's service time information of Silom Line

Silom Line	To Bang Wa		National Stadium	
From Station	First Train (hrs.)	Last Train (hrs.)	First Train (hrs.)	Last Train (hrs.)
National Stadium	5:30	0:24	-	-
Siam	5:31	0:28	5:53	0:28
Ratchadamri	5:34	0:31	5:50	0:22
Sala Daeng	5:36	0:32	5:47	0:19
Chong Nonsi	5:38	0:36	5:45	0:17
Surasak	5:41	0:38	5:43	0:14
Saphan Taksin	5:43	0:40	5:41	0:12
Thon Buri	5:45	0:42	5:39	0:10
Wongwian Yai	5:47	0:44	5:37	0:08
Pho Nimit	5:48	0:46	5:35	0:06
Talat Phlu	5:50	0:48	5:34	0:04
Wutthakat	5:52	0:50	5:32	0:02
Bang Wa	-	-	5:30	0:00

Table 6.3 BTS Skytrain's service intervals for weekday (Monday – Friday)

Service Hours (hrs.)	Approximate Time Between Trains (min.sec)	
	Sukhumvit Line	Silom Line
06:00 - 07:00	5.00	6.00
07:00 - 09:00	2.40 5.20 (Samrong)	3.45
09:00 - 09:30	3.35	6.00
09:30 - 16:00	6.3	6.00
16:00 - 16:30	4.25	6.00
16:30 - 17:00	2.40 5.20 (Samrong)	6.00
17:00 - 20:00	2.40 5.20 (Samrong)	3.45
20:00 - 21:00	4.25	6.00
21:00 - 22:00	6.00	6.00
22:00 - 24:00	8.00	8.00

Table 6.4 BTS Skytrain's service intervals for Saturday – Sunday and Public Holiday

Service Hours (hrs.)	Approximate Time Between Trains (min.sec)	
	Sukhumvit Line	Silom Line
06:00 - 08:00	7.00	7.00
08:00 - 09:00	5.55	7.00
09:00 - 11:00	5.55	5.40
11:00 - 21:00	4.30 6.00 (Samrong)	5.40
21:00 - 22:00	7.00	7.00
22:00 - 24:00	8.00	8.00

6.2 Transit Modes Available at Transit Nodes' Stations

Modes of transit interchange with Rapid trains may include metros, trams, buses, river transport, maritime services, air services, private and hire cars, taxis, and private and hire motorcycles. In most cases the connecting services will be owned by another company, or by private individuals.

‘Connections’ are a frequent source of conflict between passengers (who value ‘assured’ connections) and the staffs (for whom connecting services are burdensome, especially when delays occur). Passengers are particularly annoyed when a connecting service departs just as they are alighting from another transport mode, for example from the far side of the connection route. On a busy metro system this may be unavoidable.

The various feeder modes available at transit station attracts more passenger travelling by public transit. However, Travel time is an important factor in a potential user’s decision to use transit on a regular basis, as well as for the existing transit users. Travel time for transit users consists of different components, including walking time from the passenger’s origin to the first stop and from the last stop to the final destination, in-vehicle travel time, initial waiting time and any transfer time from one service to another, if required.

Passenger transfers between lines occur where two or more transit lines intersect or terminate at one point. Transfers may also happen between the lines which are relatively close to each other and can be accessed via short walking. The phenomenon of transferring from one transit service to another imposes transfer waiting times to the passengers. Each transfer adds a transfer time to one’s travel time because of the wait required for the next service. Transfers also may lead to a missed connection when the passenger misses the related service, which leads to longer waiting time.

6.2.1 Mo Chit Station

Figure 6.1 illustrates transit mode available location at Mo Chit station include bus, van, and MRT Chatuchak park subway station. Four bus stops are located on 4 entrance/exit of the BTS station, the 33 bus routes serve for the bus stop exit 1 and 3, the 27 bus routes service at the bus stop exit 2, and 31 bus routes serve for the bus stop exit 4. Moreover, Mo Chit station provides motorcycle taxi which locate near 4 station’s entrance/exit. The station also provides van transit that serve the passenger between BTS Mo Chit – Thammasat University Rangsit campus, and Mo Chit station – Pak Nam. The service time of buses and vans are service from early morning until late night, however some bus routes serve for 24 hours as shows in Figure 6.2.

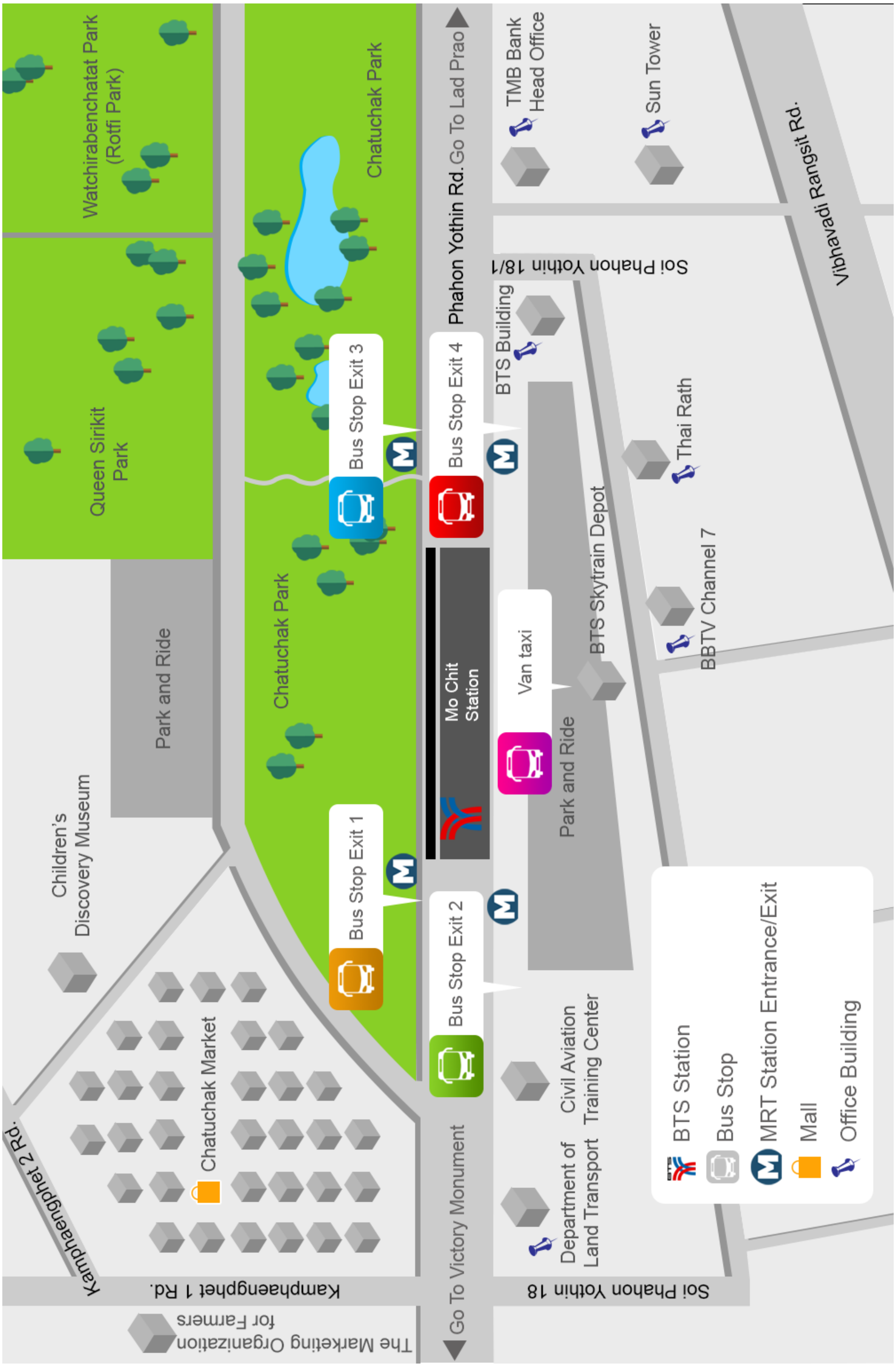


Figure 6.1 Transit modes location at Mo Chit Station

Bus Stop Exit 1 **Bus Stop Exit 3**

BUS No.	Routes	Service Time
3	Mo Chit - Klong San	24 Hours
8	Happy Land - Phra Phuttha Yodfa Bridge	04:00 - 00:00
15	The Mall Thapra - Sanam Luang	04:00 - 22:00
24	Prachaniwet 3 - Victory Monument	04:30 - 22:00
26	Meanburi - Victory Monument	24 Hours
27	Meanburi - Victory Monument	05:00 - 22:00
28	Mo Chit 2 - Talingchan Bus Terminal	05:00 - 22:00
29	Thammasat University Rangsit - Hua Lamphong	24 Hours
29A	Rangsit - Hua Lam Phong	05:00 - 22:00
34	Rangsit - Hua Lamphong	24 Hours
38	Ramkhamhaeng 2 - Chandrakasem Rajabhat University	05:00 - 23:00
39	Talaad Thai - Victory Monument	04:00 - 21:30
44	Happy Land - Tha Tien	05:00 - 22:00
52	Pak Kred - Bang Sue Railway station	05:00 - 22:00
59	Rangsit - Sanam Luang	24 Hours
63	Nonthaburi - Victory Monument	24 Hours
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
90	Thanam Bang Poon - Phahon Yothin	05:00 - 23:00
96	Meanburi - Mo Chit BTS station	04:00 - 22:00
104	Pak Kred - Tiwanon Rd.	05:00 - 23:00
108	The Mall Thapra - Ratcha Yothin	05:00 - 23:00
122	Hua Kwang - Lad Phrao MRT station	05:00 - 22:00
134	Bang Bua Thong Village - Mo Chit 2	24 Hours
136	Klong Teoy - Mo Chit	03:00 - 22:00
157	Aom Yai - Mo Chit 2	05:00 - 22:00
177	Wong Klom Bang Bua Thong - Victory Monument	05:00 - 22:00
182	Withayaket Ram - Happy Land	05:00 - 22:00
502	Suan Siam - Victory Monument	05:15 - 20:20
503	Rangsit - Sanam Luang	04:00 - 00:00
509	Phutthamonton 2 - Mo Chit 2	04:00 - 22:00
510	Thammasat University Rangsit - Victory Monument	04:00 - 22:00
517	Therd Thai market - Mo Chit 2	05:00 - 20:00
524	Lak Si - Sanam Luang	05:00 - 22:00

Bus Stop Exit 2

BUS No.	Routes	Service Time
3	Mo Chit - Klong San	24 Hours
8	Happy Land - Phra Phuttha Yodfa Bridge	04:00 - 00:00
15	The Mall Thapra - Sanam Luang	04:00 - 22:00
26	Meanburi - Victory Monument	24 Hours
27	Meanburi - Victory Monument	05:00 - 22:00
28	Mo Chit 2 - Talingchan Bus Terminal	05:00 - 22:00
29A	Rangsit - Hua Lam Phong	05:00 - 22:00
29	Thammasat University Rangsit - Hua Lamphong	24 Hours
34	Rangsit - Hua Lamphong	24 Hours
38	Ramkhamhaeng 2 - Chandrakasem Rajabhat University	05:00 - 23:00
39	Talaad Thai - Victory Monument	04:00 - 21:30
44	Happy Land - Tha Tien	05:00 - 22:00
52	Pak Kred - Bang Sue Railway station	05:00 - 22:00
59	Rangsit - Sanam Luang	24 Hours
63	Nonthaburi - Victory Monument	24 Hours
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
90	Thanam Bang Poon - Phahon Yothin	05:00 - 23:00
108	The Mall Thapra - Ratcha Yothin	05:00 - 23:00
157	Aom Yai - Mo Chit 2	05:00 - 22:00
159	Phutthamonton 2 - Mo Chit 2	05:00 - 22:00
177	Wong Klom Bang Bua Thong - Victory Monument	05:00 - 22:00
182	Withayaket Ram - Happy Land	05:00 - 22:00
502	Suan Siam - Victory Monument	05:15 - 20:20
503	Rangsit - Sanam Luang	04:00 - 00:00
509	Phutthamonton 2 - Mo Chit 2	04:00 - 22:00
510	Thammasat University Rangsit - Victory Monument	04:00 - 22:00
524	Lak Si - Sanam Luang	05:00 - 22:00

Van taxi

VAN No.	Routes	Service Time
118	BTS Mo Chit - Thammasat University Rangsit Campus	06:00 - 22:00
120	BTS Mo Chit - Pak Nam (Express)	06:00 - 22:00

Bus Stop Exit 4

BUS No.	Routes	Service Time
3	Mo Chit - Klong San	24 Hours
8	Happy Land - Phra Phuttha Yodfa Bridge	04:00 - 00:00
15	The Mall Thapra - Sanam Luang	04:00 - 22:00
26	Meanburi - Victory Monument	24 Hours
27	Meanburi - Victory Monument	05:00 - 22:00
28	Mo Chit 2 - Talingchan Bus Terminal	05:00 - 22:00
29A	Rangsit - Hua Lam Phong	05:00 - 22:00
29	Thammasat University Rangsit - Hua Lamphong	24 Hours
34	Rangsit - Hua Lamphong	24 Hours
38	Ramkhamhaeng 2 - Chandrakasem Rajabhat University	05:00 - 23:00
39	Talaad Thai - Victory Monument	04:00 - 21:30
44	Happy Land - Tha Tien	05:00 - 22:00
52	Pak Kred - Bang Sue Railway station	05:00 - 22:00
59	Rangsit - Sanam Luang	24 Hours
63	Nonthaburi - Victory Monument	24 Hours
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00

BUS No.	Routes	Service Time
90	Thanam Bang Poon - Phahon Yothin	05:00 - 23:00
96	Meanburi - Mo Chit BTS station	04:00 - 22:00
104	Pak Kred - Tiwanon Rd.	05:00 - 23:00
108	The Mall Thapra - Ratcha Yothin	05:00 - 23:00
122	Hua Kwang - Lad Phrao MRT station	05:00 - 22:00
136	Klong Teoy - Mo Chit	03:00 - 22:00
157	Aom Yai - Mo Chit 2	05:00 - 22:00
159	Phutthamonton 2 - Mo Chit 2	05:00 - 22:00
177	Wong Klom Bang Bua Thong - Victory Monument	05:00 - 22:00
182	Withayaket Ram - Happy Land	05:00 - 22:00
502	Suan Siam - Victory Monument	05:15 - 20:20
503	Rangsit - Sanam Luang	04:00 - 00:00
509	Phutthamonton 2 - Mo Chit 2	04:00 - 22:00
510	Thammasat University Rangsit - Victory Monument	04:00 - 22:00
524	Lak Si - Sanam Luang	05:00 - 22:00

Figure 6.2 Service time of Buses and Van taxis at Mo Chit Station

6.2.2 Victory Monument Station

Transit modes location at Victory Monument station shows in Figure 6.3, four bus stops are located at 4 island around Victory monument namely Ratchawithi island, Phahon Yothin island, Din Daeng island and Phaya Thai island. Ratchawithi island bus stop is located in front of Rajavithi hospital, this bus stop serves 17 bus routes and motorcycle taxis. Phahon Yothin island bus stop is on the left side of Ratchawithi island which provides 25 bus routes, 17 van routes, and motorcycle taxis. The 21 bus routes, 9 van routs and motorcycle taxis serve at Phaya Thai island bus stop, this bus stop is located in commercial area of Victory Monument which surrounds by shopping malls and restaurants. The last is Din Daeng island bus stop that located opposite Phahon Yothin island, provides 14 bus routes, 17 van routes and also motorcycle taxi. All bus number, routes and service time illustrated in Figure 6.4.

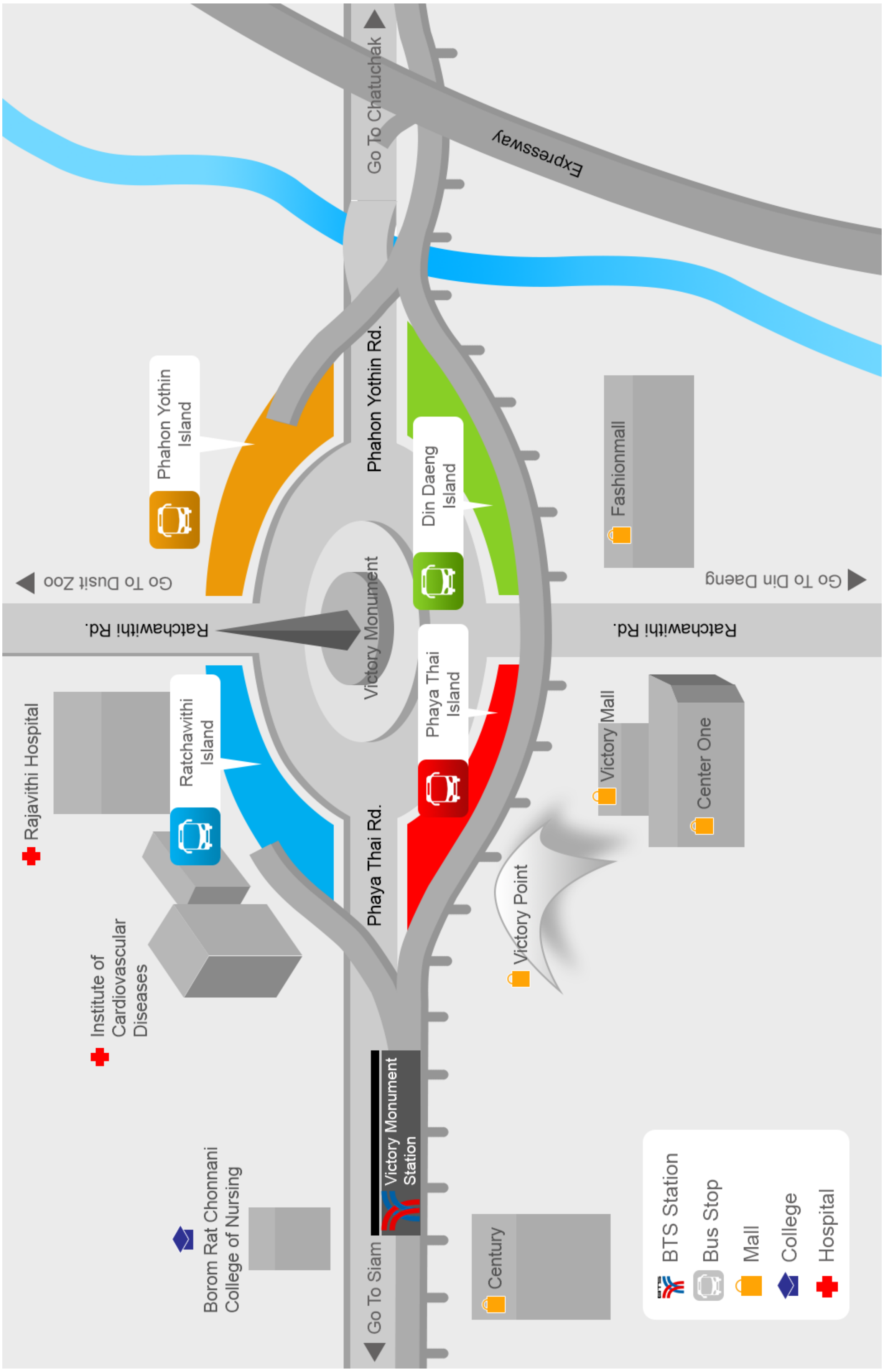


Figure 6.3 Transit modes location at Victory Monument Station

Ratchawithi Island

BUS	Routes	Service Time
8	Happy Land - Phra Phuttha Yodfa Bridge	04:00 - 00:00
Air 8	National Housing Authority Rom Klao - Phra Phuttha Yodfa Bridge	04:00 - 00:00
12	Hua Kwang - Victory Monument	04:10 - 22:30
14	Sri Yan - Suan Lumphini	04:30 - 22:30
18	Tha It - Victory Monument	04:15 - 22:00
28	Sai Tai Mai - Mo Chit 2	05:00 - 22:00
97	Priest Hospital - Ministry of Public Health	24 Hours
108	The Mall Thapra - Ratcha Yothin	05:00 - 23:00
125	Mahidol University Salaya Campus - Victory Monument	05:00 - 22:00
157	Aom Yai - Mo Chit 2	05:00 - 22:00
171	National Housing Authority Thonburi - Nakkila Village	05:00 - 22:00
509	Phutthamonton 2 - Mo Chit 2	04:00 - 22:00
515	Phutthamonton 5 - Victory Monument	05:00 - 22:00
Exprees 536	Crocodile Farm and Zoo - Mo Chit 2	04:00 - 21:30
Trollway 538	Klong 6 - Priest Hospital	05:00 - 22:00
539	Aom Noi - Victory Monument	05:00 - 22:00
542	Wong Klom Sai Tai Mai - Wong Wain Yai	05:00 - 22:00

Phahon Yothin Island

BUS	Routes	Service Time
8	Happy Land - Phra Phuttha Yodfa Bridge	04:00 - 00:00
Air 8	Phra Phuttha Yodfa Bridge - Rom Klao	04:00 - 00:00
26	Meanburi - Victory Monument	24 Hours
27	Meanburi - Victory Monument	05:00 - 22:00
29	Thammasat University Rangsit - Hua Lamphong	24 Hours
34	Rangsit - Hua Lamphong	24 Hours
38	Ramkhamhaeng 2 - Chandrakasem Rajabhat University	05:00 - 23:00
39	Talaad Thai - Victory Monument	04:00 - 21:30
54	Wong Klom Rob Maung - Hua Kwang	24 Hours
63	Nonthaburi - Victory Monument	24 Hours
74	Klong Teoy - Hua Kwang	05:00 - 22:00
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
97	Nonthaburi - Priest Hospital	24 Hours
108	The Mall Thapra - Ratcha Yothin	05:00 - 23:00
157	Aom Yai - Mo Chit 2	05:00 - 22:00
166	Impact Arena - Victory Monument	04:20 - 22:00
Expressway 166	Government Complex - Victory Monument	04:20 - 22:00
177	Wong Klom Bang Bua Thong - Victory Monument	05:00 - 22:00
204	Hua Kwang - Ratchawong	04:15 - 22:00
502	Suan Siam - Victory Monument	05:15 - 20:20
503	Ransit - Sanam Luang	05:00 - 00:00
509	Phutthamonton 2 - Mo Chit 2	04:00 - 22:00
510	Thammasat University Rangsit - Victory Monument	04:00 - 22:00
522	Ransit - Victory Monument	04:30 - 21:30
VAN		
6	Bang Kae	06:00 - 22:00
64	Pak Kred (Expressway)	06:00 - 22:00
69	Phraram 3 Rd. (Expressway)	05:00 - 22:00
71A	National Housing Authority Thonburi (Expressway)	06:00 - 22:00
82	Saphan Mai Market	06:00 - 22:00
85	Bangkok University - Thammasat University Rangsit Campus	06:00 - 22:00
84B	Saphan Mai-Future Park Rangsit	06:00 - 22:00
86	Maung Thong Village (Expressway)	06:00 - 22:00
86	The Mall Ngamwongwan - Dhurakit Pundit University (Expressway)	06:00 - 22:00
87	Bangkuuwad Temple (Expressway)	06:00 - 22:00
88	Bang Bua Thong (Expressway)	06:00 - 22:00
88A	Tiwanon Rd. - Thanam Nonthaburi	06:00 - 22:00
88B	Bang Yai (Expressway)	06:00 - 22:00
91-92	Meanburi (Expressway)	06:00 - 22:00
104	Bang Pa Kok (Expressway)	06:00 - 22:00
127A	Samut Sakhon (Expressway)	06:00 - 22:00
143B	Aom Noi	06:00 - 22:00

Phaya Thai Island

BUS	Routes	Service Time
14	Sri Yan - Suan Lumphini	04:30 - 22:30
17	Tha Kham - Victory Monument	05:00 - 22:00
29	Rangsit - Hua Lam Phong	05:00 - 22:00
34	Rangsit - Hua Lam Phong	24 Hours
36	Hua Kwang - Sii Phraya	04:30 - 22:00
38	Ramkhamhaeng 2 - Chandrakasem Rajabhat University	05:00 - 23:00
54	Rob Maung - Hua Kwang	24 Hours
59	Rangsit - Sanam Luang	24 Hours
62	Sathu Pradit - Victory Monument	04:30 - 22:00
74	Klong Teoy - Hua Kwang	05:00 - 22:00
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
Expressway 139	Ramkhamhaeng 2 - Victory Monument	05:00 - 22:00
140	Samae Dum - Victory Monument	04:20 - 22:00
172	National Housing Authority Thonburi - Nakkila Village	05:00 - 22:00
177	Wong Klom Bang Khun Tien - Victory Monument	05:00 - 22:00
183	Aom Yai - Victory Monument	05:00 - 23:00
187	Klong Sam - Sii Phraya	05:00 - 22:00
204	Hua Kwang - Thanam Ratchawong	04:15 - 22:00
503	Rangsit - Sanam Luang	05:00 - 00:00
529	Samae Dum - Mo Chit	05:00 - 22:00
Expressway 535	Crocodile Farm and Zoo - Mo Chit 2	05:00 - 22:00
542	Wong Klom Sai Tai Mai - Wong Wain Yai	05:00 - 22:00
VAN		
69	Sathu Pradit Praram 3	06:00 - 22:00
83	Future Park Rangsit (Trollway)	06:00 - 22:00
84	Klong 4 (Trollway)	06:00 - 22:00
84	Sai Klong	06:00 - 22:00
85	Bangkok University - Thammasat University Rangsit (Trollway)	06:00 - 22:00
515	Mahidol University Salaya Campus	06:00 - 22:00
153	Lam Luk Ka	06:00 - 22:00
155	Nawa Nakorn (Trollway)	06:00 - 22:00
156	Hua Takae	06:00 - 22:00

Din Daeng Island

BUS	Routes	Service Time
12	Hua Kwang - Pak Klong Talad	04:10 - 22:30
24	Prachaniwet 3 - Victory Monument	04:30 - 22:00
36	Hua Kwang - Sii Phraya	04:30 - 22:00
36A	Suan Siam - Victory Monument	05:00 - 22:00
58	MeanBuri - Pra Tu Nam	05:00 - 22:00
69	Tha It - Victory Monument	05:00 - 23:00
Air 92	National Housing Authority Rom Klao - Victory Monument	05:00 - 22:00
168	Suan Siam - Victory Monument	05:00 - 22:00
171	Nakkila Village - National Housing Authority Thonburi	05:00 - 22:00
172	National Housing Authority Thonburi - Nakkila Village	05:00 - 22:00
187	Klong Sam - Sii Phraya	05:00 - 22:00
528	Sai Noi - Victory Monument	05:00 - 22:00
529	Samae Dum - Mo Chit 2	05:00 - 22:00
Trollway 538	Klong 6 - Priest Hospital	05:00 - 22:00
VAN		
70	Ramkhamhaeng 22 (Expressway)	06:00 - 22:00
91-92	Meanburi (Expressway)	06:00 - 22:00
93	Meanburi	06:00 - 22:00
93	Meanburi (Expressway)	06:00 - 22:00
129	Bang Bo (Expressway)	06:00 - 22:00
153	Rajamangala University of Technology Thanyaburi (Trollway)	06:00 - 22:00
156	King Mongkut's Institute of Technology Ladkrabang	06:00 - 22:00
156B	Seacon Square - Rodfi Market (Expressway)	06:00 - 22:00

Figure 6.4 Service time of Buses and Van taxis at Victory Monument Station

6.2.3 Saphan Taksin Station

Figure 6.5 illustrates transit mode available at Saphan Taksin station include buses and central pier. Ten bus routes serve for three bus stops near the station. This station provides Songtaew or minitruck for passenger who travel around Charoen Krung road and Sathon areas. Moreover, one of main feeder mode for this station is river transit which 4 types of boat that make this station different from the other as shown in Figure 6.6.

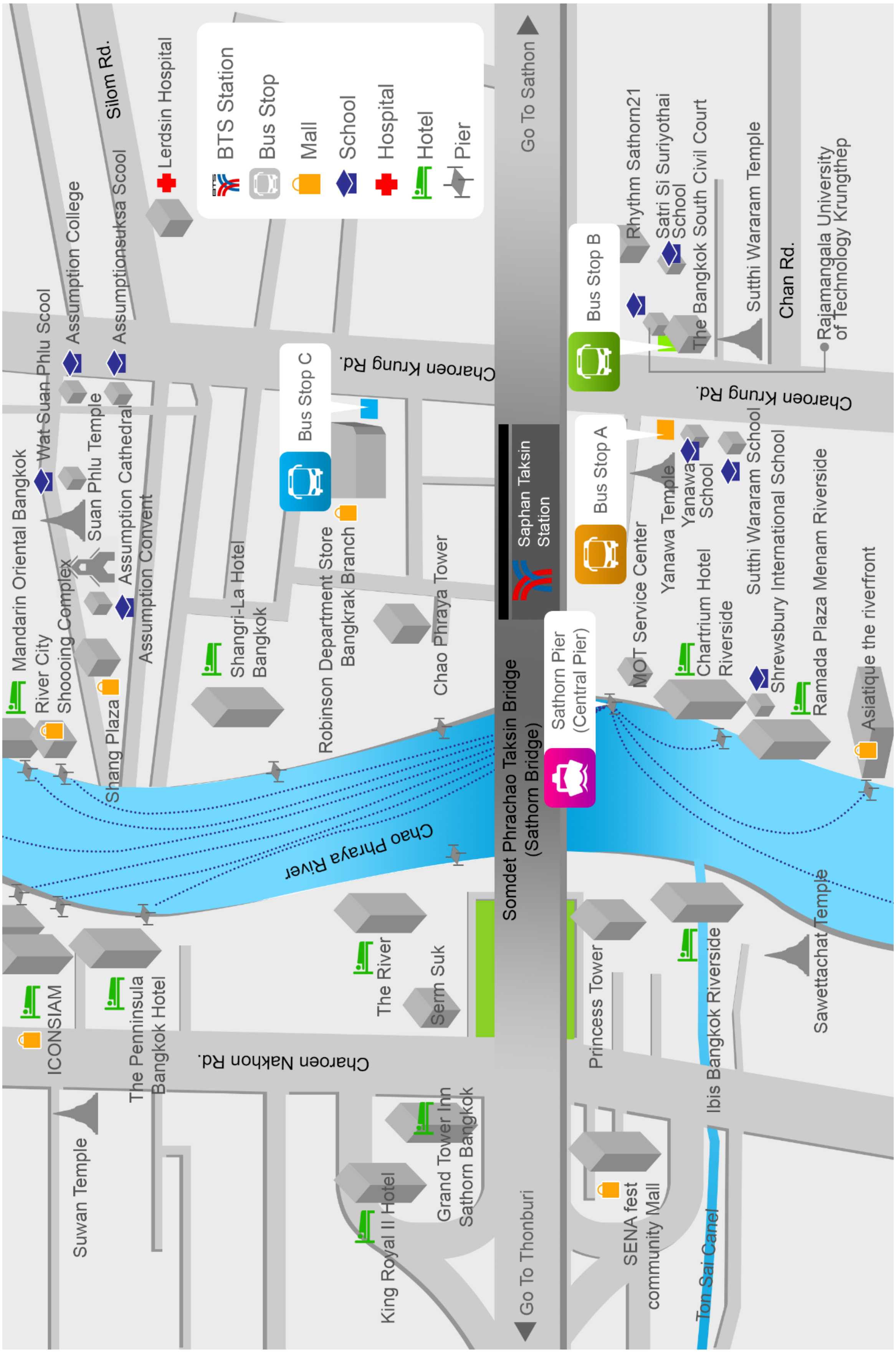


Figure 6.5 Transit modes location at Saphan Taksin station

Bus Stop A   Bus Stop C

BUS No.	Routes	Service Time
1	Tok Rd. - Tha Tien	04:30 - 23:00
15	The Mall Thapra - Sanam Luang	04:00 - 22:00
35	Talingchan Bus Terminal - Wan Son	05:00 - 23:00
75	Bhudthabucha Temple - Hua Lamphong	04:00 - 23:00
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
115	Suan Siam - Silom Rd.	05:00 - 23:00
163	Phra Ram 9 - Phutthamonton 4	05:00 - 23:00
504	Rangsit - Krung Thep Bridge	05:00 - 22:00
544	Phra Ram 2 - Tee Din Thai	05:00 - 22:00
547	Rajamangala Institute of Technology University Rattanakosin - Mo Chit 2	05:00 - 22:00

Bus Stop B

BUS No.	Routes	Service Time
1	Tok Rd. - Tha Tien	04:30 - 23:00
15	The Mall Thapra - Sanam Luang	04:00 - 22:00
35	Talingchan Bus Terminal - Wan Son	05:00 - 23:00
75	Bhudthabucha Temple - Hua Lamphong	04:00 - 23:00
77	Central Plaza Phra Ram 3 - Mo Chit 2	03:00 - 22:00
115	Suan Siam - Silom Rd.	05:00 - 23:00
163	Phra Ram 9 - Phutthamonton 4	05:00 - 23:00
504	Rangsit - Krung Thep Bridge	05:00 - 22:00
544	Phra Ram 2 - Tee Din Thai	05:00 - 22:00
547	Rajamangala Institute of Technology University Rattanakosin - Mo Chit 2	05:00 - 22:00

Sathorn Pier (Central Pier)

Route	Departure	Finished	Service	Time	Frequency/minute
No Flag Nonthaburi - Rajsingkorn Temple	Nonthaburi	Rajsingkorn Temple	Mon - Fri	06:45 - 07:45	20
				16:00 - 16:30	25
Pakkret - Sathorn	Pakkret	Sathorn	Mon - Fri	06:00 - 08:10	15
	Sathorn	Pakkret	Mon - Fri	15:45 - 18:05	20
Nonthaburi - Sathorn	Nonthaburi	Sathorn	Mon - Fri	06:15 - 07:00	8
				07:00 - 08:00	5
				08:00 - 08:20	10
	Sathorn	Nonthaburi	Mon - Fri	16:00 - 19:00	20
				19:00 - 20:00	20
Nonthaburi - Rajsingkorn Temple	Nonthaburi	Rajsingkorn Temple	Mon - Fri	05:50 - 07:00	10
				07:00 - 08:00	5
				08:00 - 09:00	15
				09:00 - 15:00	20
				15:00 - 18:00	15
				18:00 - 19:00	20
	Nonthaburi	Rajsingkorn Temple	Sat - Sun - Holidays	06:00 - 19:00	20
	Rajsingkorn Temple	Nonthaburi	Mon - Fri	06:00 - 07:00	15
				07:00 - 08:00	12
				08:00 - 15:00	20
				15:00 - 16:00	15
				16:00 - 19:00	10
	Rajsingkorn Temple	Nonthaburi	Sat - Sun - Holidays	06:00 - 19:00	20
Sathorn - Phra Arthit	Sathorn	Phra Arthit	Mon - Fri	09:00 - 17:30	30

Figure 6.6 Service time of Buses and Boats at Saphan Taksin Station

6.3 Ticket Fares

6.3.1 BTS

BTS Fare is not the cheapest mass transit cost but if considering about less time-consuming compare to traveling on the super traffic jam of Bangkok, the higher price seems to be no problem for most people in this city.

BTS Fare starts from 16 baht to maximum 59 baht depends on the distance of beginning station and destination. Table 6.6 shows BTS single journey ticket fares that effective from 1st October 2017. However, ticker fare also varies depend on the ticket types, BTS provide 2 ticket types; single journey ticket and Rabbit card as shown in Figure 6.7.

Single journey ticket

This ticket is valid for a single journey, with fare according to chosen destination and valid for travel on date of purchase only. The ticket will be retained at an Automatic gate upon exit, and the tickets can be purchase at any Ticket issuing machine.

Rabbit card

Adult Rabbit

This card divides in to three types; A: Add store value, B: Add 30-day trips, and C: Add store value and 30-day trips. For type A, the fare collection system will deduct fare according to the Figure x. While, type B, trips can be used for unlimited travel distance for the number of trip specified, the trip fare depends on the number of trips as shown in the table below.

Table 6.5 Rabbit Card 30 day trips fare

Trips	Adult (Baht)	Student (Baht)
15	465 Average 31Baht/trip	360 Average 24Baht/trip
25	725 Average 29Baht/trip	550 Average 22Baht/trip
40	1,080 Average 27Baht/trip	800 Average 20Baht/trip
50	1,300 Average 26Baht/trip	950 Average 19Baht/trip

Student Rabbit

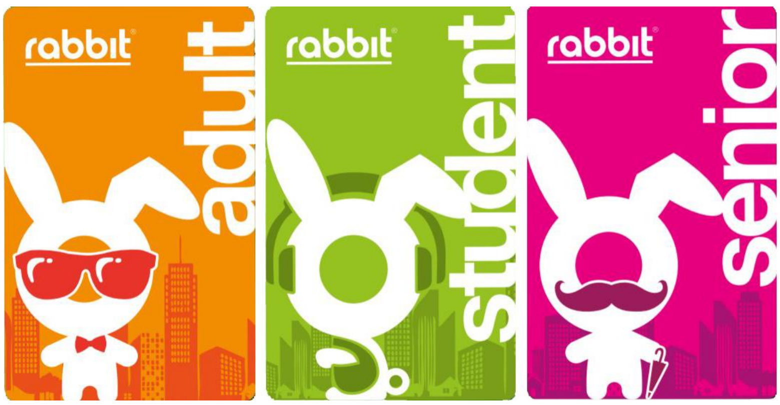
Student Rabbit card may only be used by current fulltime students, aged not over 23 years, according to date of birth on Citizen ID and currently studying at an academic institution in Thailand, or studying in a foreign country at an institution recognized by the Ministry of Education. Student ID and Citizen ID must be presented upon request by BTS Staff. Student Rabbit card also divides into three type as the Adult Rabbit ticket. The ticker fare for type A also same as Single journey ticket and Adult Rabbit ticket, but the fare for 30-trips are cheaper than the other

However, for 30-trips type, trips on a Rabbit card are valid for 30 days from date of first use. Cards should be used within 45 days from date of issue or trips last refilled, after which any remaining trips will be automatically cancelled and trips are non-refundable.

Senior Rabbit

Senior Rabbit card Senior Rabbit card may only be used by Thai Senior Citizens aged 60 years and over, according to date of birth as shown on Citizen ID, which must be presented upon request be BTS Staff. Thai senior citizens aged 60 years and over, pay only half fare when using a Senior Rabbit card for travel on the BTS skytrain.

Single Journey Ticket



Rabbit Card

Figure 6.7 BTS Ticket [85]

Table 6.6 Effective fare in the BTS Skytrain System

From \ Destination		N8	N7	N6	N5	N4	N3	N2	N1	CEN	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	W1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Mo Chit	N8	16	16	23	26	30	33	37	40	44	44	44	44	44	44	44	44	44	44	59	59	59	59	59	59	44	44	44	44	44	44	44	44	44	59	59	59	59
Saphan Khwai	N7	16	16	16	23	26	30	33	37	40	44	44	44	44	44	44	44	44	44	59	59	59	59	59	59	44	44	44	44	44	44	44	44	44	59	59	59	59
Sena Ruam	N6	23	16	16	16	23	26	30	33	37	40	44	44	44	44	44	44	44	44	59	59	59	59	59	59	40	40	44	44	44	44	44	44	44	59	59	59	59
Ari	N5	26	23	16	16	16	23	26	30	33	37	40	44	44	44	44	44	44	44	59	59	59	59	59	59	37	37	40	44	44	44	44	44	44	59	59	59	59
Sanam Pao	N4	30	26	23	16	16	16	23	26	30	33	37	40	44	44	44	44	44	44	59	59	59	59	59	59	33	33	37	40	44	44	44	44	44	59	59	59	59
Victory Monument	N3	33	30	26	23	16	16	16	23	26	30	33	37	40	44	44	44	44	44	59	59	59	59	59	59	30	30	33	37	40	44	44	44	44	59	59	59	59
Phaya Thai	N2	37	33	30	26	23	16	16	16	23	26	30	33	37	40	44	44	44	44	59	59	59	59	59	59	26	26	30	33	37	40	44	44	44	59	59	59	59
Ratchathewi	N1	40	37	33	30	26	23	16	16	16	23	26	30	33	37	40	44	44	44	59	59	59	59	59	59	23	23	26	30	33	37	40	44	44	59	59	59	59
Siam	CEN	44	40	37	33	30	26	23	16	16	16	23	26	30	33	37	40	44	44	59	59	59	59	59	59	16	16	23	26	30	33	37	40	44	59	59	59	59
Chit Lom	E1	44	44	40	37	33	30	26	23	16	16	16	23	26	30	33	37	40	44	59	59	59	59	59	59	23	23	26	30	33	37	40	44	44	59	59	59	59
Phloen Chit	E2	44	44	44	40	37	33	30	26	23	16	16	16	23	26	30	33	37	40	55	55	55	55	55	55	26	26	30	33	37	40	44	44	44	59	59	59	59
Nana	E3	44	44	44	44	40	37	33	30	26	23	16	16	16	23	26	30	33	37	52	52	52	52	52	52	30	30	33	37	40	44	44	44	44	59	59	59	59
Asok	E4	44	44	44	44	44	40	37	33	30	26	23	16	16	16	23	26	30	33	48	48	48	48	48	48	33	33	37	40	44	44	44	44	44	59	59	59	59
Phrom Phong	E5	44	44	44	44	44	44	40	37	33	30	26	23	16	16	16	23	26	30	45	45	45	45	45	45	37	37	40	44	44	44	44	44	44	59	59	59	59
Thong Lo	E6	44	44	44	44	44	44	44	40	37	33	30	26	23	16	16	16	23	26	41	41	41	41	41	41	40	40	44	44	44	44	44	44	44	59	59	59	59
Ekkamai	E7	44	44	44	44	44	44	44	44	40	37	33	30	26	23	16	16	16	23	38	38	38	38	38	38	44	44	44	44	44	44	44	44	44	59	59	59	59
Phra Khanong	E8	44	44	44	44	44	44	44	44	44	40	37	33	30	26	23	16	16	16	31	31	31	31	31	31	44	44	44	44	44	44	44	44	44	59	59	59	59
On Nut	E9	44	44	44	44	44	44	44	44	44	44	40	37	33	30	26	23	16	16	15	15	15	15	15	15	44	44	44	44	44	44	44	44	44	59	59	59	59
Bang Chak	E10	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	15	15	59	59	59	59	59	59	59	59	59	59	59	59	59
Punnawithi	E11	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	15	15	59	59	59	59	59	59	59	59	59	59	59	59	59
Udom Suk	E12	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	15	15	59	59	59	59	59	59	59	59	59	59	59	59	59
Bang Na	E13	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	15	15	59	59	59	59	59	59	59	59	59	59	59	59	59
Bearing	E14	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	15	0	59	59	59	59	59	59	59	59	59	59	59	59	59
Samrong	E15	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	38	31	15	15	15	15	15	0	0	59	59	59	59	59	59	59	59	59	59	59	59	59
National Stadium	W1	44	44	40	37	33	30	26	23	16	23	26	30	33	37	40	44	44	44	59	59	59	59	59	59	16	23	26	30	33	37	40	44	44	59	59	59	59
Ratchadamri	S1	44	44	40	37	33	30	26	23	16	23	26	30	33	37	40	44	44	44	59	59	59	59	59	59	23	16	16	23	26	30	33	37	40	55	55	55	55
Sala Daeng	S2	44	44	44	40	37	33	30	26	23	26	30	33	37	40	44	44	44	44	59	59	59	59	59	59	26	16	16	16	23	26	30	33	37	52	52	52	52
Chong Nonsi	S3	44	44	44	44	40	37	33	30	26	30	33	37	40	44	44	44	44	44	59	59	59	59	59	59	30	23	16	16	16	23	26	30	33	48	48	48	48
Suksa Witthaya	S4	44	44	44	44	44	40	37	33	30	33	37	40	44	44	44	44	44	44	59	59	59	59	59	59	33	26	23	16	16	16	23	26	30	45	45	45	45
Surasak	S5	44	44	44	44	44	44	40	37	33	37	40	44	44	44	44	44	44	44	59	59	59	59	59	59	37	30	26	23	16	16	16	23	36	41	41	41	41
Saphan Taksin	S6	44	44	44	44	44	44	44	40	37	40	44	44	44	44	44	44	44	44	59	59	59	59	59	59	40	33	30	26	23	16	16	16	16	31	31	31	31
Thon Buri	S7	44	44	44	44	44	44	44	44	40	44	44	44	44	44	44	44	44	44	59	59	59	59	59	59	44	37	33	30	26	23	16	16	16	31	31	31	31
Wongwian Yai	S8	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	59	59	59	59	59	59	44	40	37	33	30	26	16	16	16	15	15	15	15
Pho Nimit	S9	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	31	31	15	15	15	15	15
Talat Phlu	S10	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	31	31	15	15	15	15	15
Wutthakat	S11	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	31	31	15	15	15	15	15
Bang Wa	S12	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	55	52	48	45	41	31	31	15	15	15	15	15

6.3.2 Bus

Bus system in Bangkok operates by Bangkok Mass Transit Authority (BMTA). In 2017, BMTA provided bus services for the public, both BMTA - operated buses and private joint buses. As of 31 October 2017, the services included a total of 14,104 buses, as follows: BMTA buses - 2,554(including 117 PBC buses), divided as Regular buses 1,543 buses, Air-conditioned buses 1,011 buses, Private joint buses (big buses) 3,444, divided as Regular buses 2,061 buses, Air-conditioned buses 1,383 buses, Private joint buses (small buses) 7,989, divided as Minibuses 931 buses, Shuttle in sois 2,119 buses, Microbuses 4,810 buses, Microbuses CNG 129 buses. Bus service rates are depending on the vehicle categories and the distance as shown in Table 6.7.

Table 6.7 Vehicle categories and Service rate of bus system

Categories	Color	Fare Rate	Service Period (Hrs.)
Regular bus	Cream - Red	6.50 baht	05:00 - 23:00
Regular bus	White - Blue	7.50 baht	05:00 - 23:00
Regular Express Way	Cream - Red	8.50 baht	05:00 - 23:00
Regular Overnight Way	Cream - Red	8 baht	23:00 - 05:00
Air Condition	Cream - Blue	10, 12, 14, 16, 18 baht depending on the distance	05:00 - 23:00
Air Condition (Euro2)	Yellow - Orange	11, 13, 15, 17, 19, 21, 23 baht depending on the distance	05:00 - 23:00

6.3.3 Boat

Travel on the boat is not expensive and most of the boats on time service. Pricing depends on distance and type of services, service fares start from 10 – 14 baht for the local line, from 13 – 32 baht for the express lines, and 50 and 180 baht for Tourist boat as shown in table 6.8.

Table 6.8 Vehicle categories and Service rate of bus system

Boat	Route	Duration (Min.)	Fares (Baht)
No Flag Local Line	Nonthaburi - Rajsingkorn Temple	80	10/12/14
Green Express Line	Pakkret - Sathorn	75	13/20/32
Yellow Express Line	Nonthaburi - Sathorn	50/60	20
Orange Express Line	Nonthaburi - Rajsingkorn Temple	65	15
Chao Phraya Tourist Boat	Sathorn - Phra Arthit	30	50/180

6.4 Influences of Feeder Modes at Transit Nodes' Station

Mass transit have been recommend for the future urban transportation plans in many cities. Nevertheless, most of the strategies are mainly focuses on expanding the mass transits' network coverage, but improving connectivity, both passenger accessibility and connection to the station, has been usually put low priority. To expand the mass transit networks is very difficult and requires long time considering many obstructions. The variety of feeder modes at transit station provides easy connectivity to mass transit system, also utilizes existing resources. Not only the public transits, paratransit is one of popular transit in developing country. Paratransit shows their capability as both complementary mode and feeder mode to other public transits, especially in the areas left by the public transits [86-88].

This part aims to investigate the potential of feeder modes at transit nodes' station, and to explore the effects of passengers' satisfaction on the different types of feeder mode to attitudes concerning mass transit connectivity among passenger's income levels. Structural Equation Model (SEM) is introduced to investigate the mentioned objectives.

6.4.1 Survey and Data Collection

The areas within the distance up to 2 kilometers from mass transit node stations along BTS lines were selected. The surveys focused on connectivity including access trip from home to transit node stations and egress trip to destinations. The attitudes and perceptions as well as present travel pattern of all passenger were also collected. All passengers were asked to explain their access and egress trips especially for access trip to transit node stations in order to gather the current connectivity patterns. The target group are the passengers who regularly travel for work and study.

Access and egress trips were classified into three main parts as illustrated in Figure 6.8. Part 1 is going from home/destination to find feeder services, Part 2 relates to the uses of feeder services i.e. bus, taxi, Songtaew etc., and Part 3 is a section to the mass transit node stations (BTS station) after getting off the feeder (Chapter 4 and 5). Passengers were requested to express their satisfaction levels related to each part.

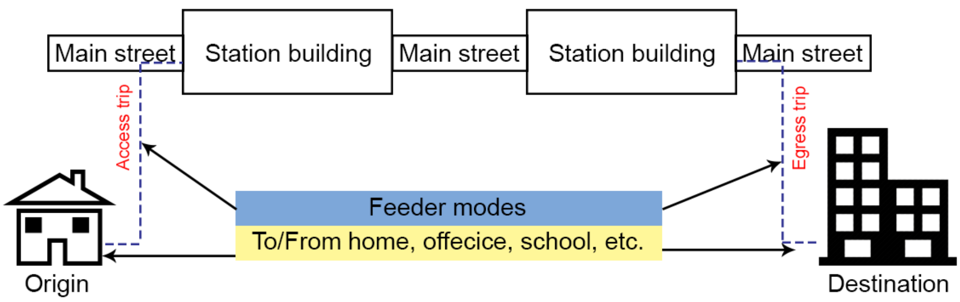


Figure 6.8 Connectivity Definition

The direct interview and drop-off surveys were performed by on-site survey. The survey was conducted around the station areas in every day in the afternoon – evening (14:00 – 20:00) during their return trips in order to earn ease of participation and gather the passengers living in specific areas. The questionnaire contained 4 sections, namely general section, trip pattern, transit stations access modes, and attitudes to use feeder modes.

6.4.2 Survey Findings

6.4.2.1 Respondent Characteristics

A personal socio-economic characteristic as a basic information to understand the passengers' characteristics including gender, age, occupation, income, and vehicle in household as shows in Table 6.9 below.

Table 6.9 Respondent characteristics

Individual characteristics	**Category range**	**Respondents**	
		No.	**%**
Gender	Male	194	43.11
	Female	256	56.89
Nationality	Thai	440	97.78
	Foreign	10	2.22
Age	<20 years old	70	15.56
	21 - 30 years old	290	64.44
	31 - 40 years old	72	16.00
	41 - 50 years old	8	1.78
	51- 60 years old	6	1.33
	>60 years old	4	0.89
Occupation	Student	79	17.56
	Company employed	273	60.67
	Government officer	21	4.67
	Self - employed	46	10.22
	Not employed	8	1.78
	Other	23	5.11
Monthly income (Baht)	<15,000	108	24.00
	15,000 - 30,000	326	72.44
	>30,000	16	3.56
Vehicles in household			
Car	Yes	252	56.00
	No	198	44.00
Motorcycle	Yes	77	17.11
	No	373	82.89

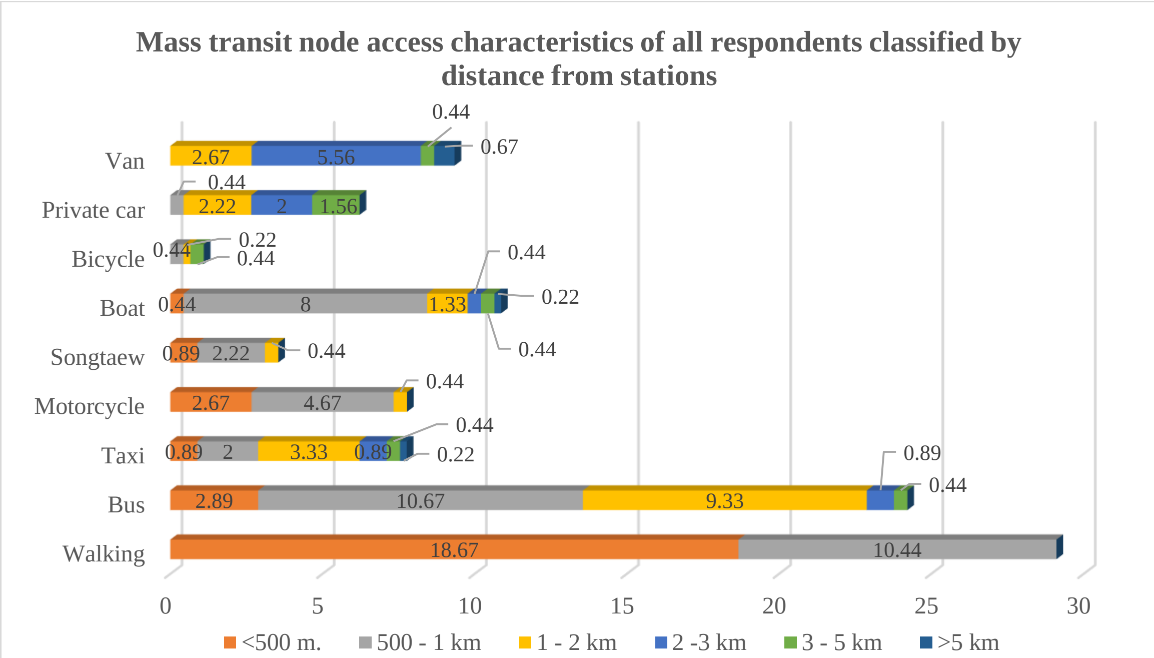
Table 6.10 Passengers' Trip pattern characteristic

Individual characteristics	Category range	Respondents	
		No.	%
Frequency of use the transit station	1 - 2 times/week	188	41.78
	3 - 4 times/week	62	13.78
	5 - 6 times/week	30	6.67
	everyday	36	8.00
	only weekday	36	8.00
	only weekend	98	21.78
Frequency of transfer in one trip	1 time	197	43.78
	2 times	185	41.11
	3 times	42	9.33
	4 times	11	2.44
	>4 times	15	3.33
Trip purpose	study	38	8.44
	work	221	49.11
	travel	103	22.89
	shopping	64	14.22
	other	24	5.33
Trip duration	<15 minutes	106	23.56
	15 - 30 minutes	197	43.78
	30 - 60 minutes	95	21.11
	1 - 2 hours	39	8.67
	>2 hours	13	2.89
Transfer time duration	<5 minutes	136	30.22
	5 - 15 minutes	180	40.00
	15 - 30 minutes	77	17.11
	30 - 45 minutes	39	8.67
	45 - 60 minutes	8	1.78
	>60 minutes	10	2.22

6.4.2.2 Access trip characteristics

Among the respondent, there are four most popular access modes that are walking, bus, boat, and van as illustrated in table 6.11. Walking have the highest share especially for the passengers who live within the distance of 1 kilometer from transit stations. It can be concluded that passengers prefer to go to the nearest mass transit stations. The second mode is bus that the most famous mode in the distance of 2 kilometers. Boat is the popular feeder at Saphan Taksin station, meanwhile van taxi is the one of popular feeder mode that were selected by the passenger who transit at Victory Monument station. Most of people use only 1 access mode within the distance 2 kilometers, but share of 2 and 3-access mode users become significant in the longer distance. Table 6.11 shows the shares numbers of mode used to access mass transit node stations of the respondent.

This study classified passengers into main groups based on availability of data that are (1) low income – who earn less than 15,000 baht per month, (2) middle income – whose income is 15,000 – 30,000 baht, and (3) high income – who obtained monthly of more than 30,000 baht. Table 6.11 revealed that lower income passengers use bus, boat, van and Songtaew more than higher income groups. Bus, van and Songtaew are dominant modes for low income among passengers. The reasons are low income people tend to live in the longer distance, and these three services offer lower expenses. The average distances to the transit node stations are 1.34, 2.56, and 2.28 kilometers for high, middle and low income passengers, respectively. For the passenger in middle level, bus, taxi and boat own larger shares. High income people prefer walking, taxi, and private car. However, walking and taxi own the largest portion for the high income comparing with the others. High income group prefers using taxi to other motorized access modes because it offers faster travel time, easy to change the route and the fare is acceptable for them. Based on the survey results, feeder modes show their potential to serve as an access mode to the mass transit node stations.



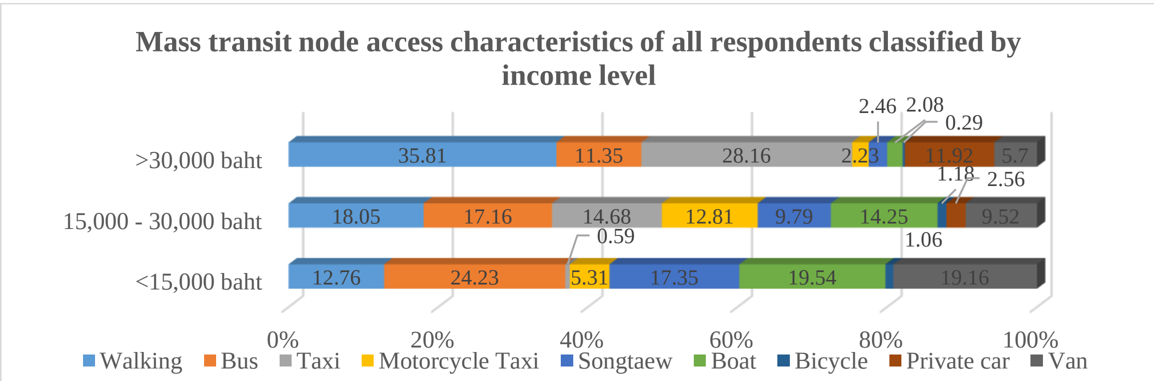


Figure 6.9 Access trip characteristics

Table 6.11 Mass transit node access characteristics of all respondents classified by distance from stations and income level

User characteristics	Walking	Bus	Taxi	Motorcycle Taxi	Songtaew	Boat	Bicycle	Private car	Van	No. of access mode		
										1	2	3
<500 m.	18.67%	2.89%	0.89%	2.67%	0.89%	0.44%	-	-	-	84.56%	10.22%	5.22%
500 - 1 km	10.44%	10.67%	2.00%	4.67%	2.22%	8.00%	0.44%	0.44%	-	82.44%	12.67%	4.89%
1 - 2 km	-	9.33%	3.33%	0.44%	0.44%	1.33%	0.22%	2.22%	2.67%	74.89%	15.22%	9.89%
2 -3 km	-	0.89%	0.89%	-	-	0.44%	-	2.00%	5.56%	68.22%	21.11%	10.67%
3 - 5 km	-	0.44%	0.44%	-	-	0.44%	0.44%	1.56%	0.44%	61.44%	22.56%	16.00%
>5 km	-	-	0.22%	-	-	0.22%	-	-	0.67%	60.22%	24.89%	14.89%
Overall Passenger	29.11%	24.44%	7.56%	7.78%	3.56%	10.89%	1.11%	6.22%	9.33%	59.11%	28.44%	12.45%
<15,000 baht	12.76%	24.23%	0.00%	5.90%	17.35%	19.54%	1.06%	0.00%	19.16%	78.35%	15.81%	5.84%
15,000 - 30,000 baht	18.05%	17.16%	14.68%	12.81%	9.79%	14.25%	1.18%	2.56%	9.52%	80.79%	16.57%	2.64%
>30,000 baht	35.81%	11.35%	28.16%	2.23%	2.46%	2.08%	0.29%	11.92%	5.70%	93.50%	5.46%	1.04%

6.4.2.3 Passenger attitudes and satisfactions

This study observed two main attitudes that are (1) attitudes regarding feeder modes, and (2) attitudes concerning access trip to mass transit node stations. All respondents were asked to express their perceptions on 6 attributes regarding mass transit node connectivity, and 7 attributes with regard to service quality of feeder modes. So, the total 13 attributes was observed to each respondent with the satisfaction level ranging as 1 is ‘very dissatisfied’, 2 is ‘dissatisfied’, 3 is ‘moderately satisfied’, 4 is ‘satisfied’, and 5 is ‘very satisfied’.

Mass transit connectivity attitudes and satisfactions

Table 6.12 shows the average satisfaction scores of 6 attributes of mass transit node station’s connectivity. Passenger seem satisfied with their access trip to mass transit node stations in present; but not so satisfied with walking time. Only high income states that they satisfied with access time, meanwhile low income passenger not so satisfied with feeder mode available as well as middle income respondents who access by the modes other than walking and private car related modes. However, all passengers dissatisfied on the feeder mode available in the present. Moreover, high income passengers expressed the higher level of satisfaction to mass transit node stations based on access time, waiting time and walking time comparing with the others. The potential reasons are most of them live closer to the stations, as discussed in the average distances to the stations in previous section, and access to the stations by using only one mode such as walking, taxi, and motorcycle taxi.

Table 6.12 The average satisfaction scores of 6 mass transit node station’s connectivity attributes

Parameter	Access time	Waiting time	Walking time	Transfer Difficulties	Access cost	Feeder mode available
Overall	2.98	3.01	2.88	2.92	2.53	2.68
Low income	2.84/3.04	2.81/3.15	2.84/2.82	2.92/2.87	2.70/2.81	2.69/2.77
Middle income	2.79/2.96	2.98/3.08	2.80/2.71	2.96/2.84	2.97/2.85	2.53/2.89
High income	3.10/3.17	3.01/3.04	3.09/3.02	2.92/3.00	2.93/2.91	2.50/2.68

Remark; A/B : A = walking, bicycle, and private car; B = bus, boat, and others

Feeder service attitudes and satisfactions

The average satisfaction scores of 7 feeder mode’s service attributed in table 6.13. All feeder modes were assessed by three income groups of the respondents. Except for boat, all passenger dissatisfied with all feeder modes on riding quality. On the other hand, taxi is satisfactory preferred to the other modes in term of on demand service, the number of stops and flexibility route. High income respondents expressed high satisfaction level for taxi and motorcycle taxi especially for flexibility, less stop, and on demand service. Passengers seem dissatisfied with Songtaew and bus service especially for high income respondents. In addition, respondents dissatisfied with service schedule and fare information, but has higher dissatisfied over other modes. It is because bus schedule seldom on time service especially during rush hours. All respondents dissatisfied on the service time during early morning and late night of boat.

Table 6.13 The average satisfaction scores of feeder modes based on respondents' economic status

Feeder Modes Service Quality Attributes	Bus	Taxi	Motorcycle Taxi	Songtaew	Boat	Van
Low income						
1. Waiting time for using service	2.34	2.82	3.02	2.29	2.25	3.50
2. Number of stops along the way	2.55	3.14	3.17	2.16	2.96	2.66
3. Adequate service and on demand service	3.05	3.01	2.98	2.42	2.67	3.02
4. Availability in night time/early morning	2.81	2.96	3.01	2.44	2.01	2.37
5. Flexibility to change route	2.88	3.24	3.45	2.17	2.34	2.44
6. Riding/driving quality	1.76	2.05	2.09	2.47	2.88	1.95
7. Service schedule/fare information	2.20	2.17	2.37	2.25	2.90	2.13
Middle income						
1. Waiting time for using service	2.31	2.85	2.98	2.13	2.22	3.11
2. Number of stops along the way	2.47	3.25	3.32	1.85	2.94	2.95
3. Adequate service and on demand service	2.97	3.06	2.79	2.34	2.50	3.05
4. Availability in night time/early morning	3.01	2.95	3.11	2.31	1.97	2.77
5. Flexibility to change route	2.73	3.18	3.42	2.19	2.01	2.59
6. Riding/driving quality	1.52	1.94	2.06	2.21	2.77	2.13
7. Service schedule/fare information	2.04	2.44	2.55	2.35	3.02	2.35
High income						
1. Waiting time for using service	1.28	3.04	2.88	2.08	2.16	2.33
2. Number of stops along the way	2.30	3.30	3.36	1.93	2.33	2.49
3. Adequate service and on demand service	2.75	3.26	2.97	2.27	2.15	2.41
4. Availability in night time/early morning	2.55	3.11	3.03	2.39	1.95	2.15
5. Flexibility to change route	1.93	3.23	3.45	1.87	1.69	1.85
6. Riding/driving quality	0.94	1.84	1.25	2.01	2.22	1.02
7. Service schedule/fare information	1.18	2.45	2.68	2.15	3.05	1.25

6.4.2.4 Feeder mode's service influences investigation

Mass transit access and feeder mode service measurement

This section aims to categorize both mass transit connectivity and feeder mode service attributes in term of service measurement. It is not only classify into main service measurements, but also facilitate the model development and accuracy. Factor analysis was applied to perform in the categorizing process by the analysis of moment structures, AMOS5.0 [Arbuckle, et al]. This structure analyzed the total of 13 attributes of feeder mode service and mass transit access attitudes by using confirmatory factor analysis procedure (CFA) based on the significant criteria of 5% significance. The model was assessed by multiple fit indices including chi-square (X^2), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), root mean square residual (RMR), and root mean square error of approximation (RMSEA).

The X^2/df value for this model is 2.483, which is less than 3. The fit indices of the established model can be explained by the RMR, 0.04, and RMSEA, 0.08, that satisfy assess criteria of less than 0.10 and 0.08, respectively. The GFI and AGFI values were 0.79 and 0.75 respectively that means more than 75% of the co-variation in the data could be represented by the given model. The recommended values of GFI and AGFI are 0.90 and 0.80. The indices obtained from CFA could not reach the recommended values. While considering the effects from a small number of respondents and the level of model representation, the model can be implied as acceptable. The 4 main factors, consist of 42 significant attributes, are made based upon the variables that loads on the factor, and classified in to Mass transit node access, and feeder modes service measurement as shown in Table 6.14.

Table 6.14 Mass transit access and Feeder modes service measurements

Mass transit node access Measurement	Feeder Modes Service Measurement
1. Total access time 2. Total waiting time 3. Total access cost 4. Transfer difficulty	1. Waiting time for using service 2. Number of stops along the way 3. Adequate service and on demand service 4. Availability in night time/early morning 5. Flexibility to change route 6. Riding/driving quality 7. Service schedule/fare information

Influence investigation model specification

The primary objective here is to interrelate attitude concerning services of feeder modes to the perception regarding mass transit node connectivity. Moreover, the related objective is to determine how passengers consider each service attributes of paratransit service quality and mass transit connectivity. Structure equation model is applied to examine the influences of feeder modes services. Total of 21 separate sets of models were developed based on 7 feeder mode service measurement, and each measurement are classified into three groups of income level, low, middle, and high income.

Each of the model contains one endogenous latent variable for mass transit node connectivity attitude (ξ), and two latent exogenous variables for attitudes of bus (η_1), taxi (η_2), motorcycle taxi (η_3), Songtaew (η_4), boat (η_5), and van (η_6) as illustrated in Figure 6.10. The observed variables for each latent variables are listed in the table 6.15. The observed variables of mass transit node connectivity attitude are applied for all feeder mode service measurement's model. The models of each measurement can be defined in terms of structural equations model:

$$\xi_k = \beta_{1k}\eta_{1k} + \beta_{2k}\eta_{2k} + \beta_{3k}\eta_{3k} + \beta_{4k}\eta_{4k} + \beta_{5k}\eta_{5k} + \beta_{6k}\eta_{6k} + \varepsilon_k$$

Where; ξ_k = mass transit node connectivity attitude of feeder mode service measurement k

η_{1k} = bus attitude of feeder mode service measurement k

η_{2k} = taxi attitude of feeder mode service measurement k

η_{3k} = motorcycle taxi attitude of feeder mode service measurement k

η_{4k} = Songtaew attitude of feeder mode service measurement k

η_{5k} = boat attitude of feeder mode service measurement k

η_{6k} = van attitude of feeder mode service measurement k

β_{1k} = parameter of bus attitude of feeder mode service measurement k

β_{2k} = parameter of taxi attitude of feeder mode service measurement k

β_{3k} = parameter of motorcycle taxi attitude of feeder mode service measurement k

β_{4k} = parameter of Songtaew attitude of feeder mode service measurement k

β_{5k} = parameter of boat attitude of feeder mode service measurement k

β_{6k} = parameter of van attitude of feeder mode service measurement k

ε_k = error term of feeder mode service measurement k

T_{ik} = i^{th} observed bus's variable of feeder mode service measurement k

U_{ik} = i^{th} observed taxi's variable of feeder mode service measurement k

V_{ik} = i^{th} observed motorcycle taxi's variable of feeder mode service measurement k

W_{ik} = i^{th} observed Songtaew's variable of feeder mode service measurement k

X_{ik} = i^{th} observed boat's variable of feeder mode service measurement k

Y_{ik} = i^{th} observed van's variable of feeder mode service measurement k

Z_k = observed mass transit connectivity's variable of feeder mode service measurement k

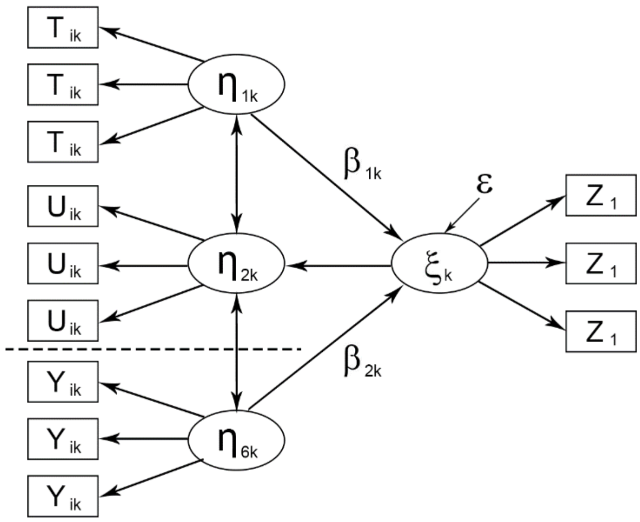


Figure 6.10 Structure model diagram

Table 6.15 Mass transit access and Feeder modes service measurements

Mass transit access trip						
Variable						**Description**
Z_1						Total access time
Z_2						Total waiting time
Z_3						Total access cost
Z_4						Transfer difficulty
Feeder mode service [Bus (T); Taxi (U); Motorcycle Taxi (V); Songtaew (W); Boat(X); Van(Y)]						
Variable						**Description**
T_1	U_1	V_1	W_1	X_1	Y_1	Waiting time for using service
T_2	U_2	V_2	W_2	X_2	Y_2	Number of stops along the way
T_3	U_3	V_3	W_3	X_3	Y_3	Adequate service and on demand service
T_4	U_4	V_4	W_4	X_4	Y_4	Availability in night time/early morning
T_5	U_5	V_5	W_5	X_5	Y_5	Flexibility to change route
T_6	U_6	V_6	W_6	X_6	Y_6	Riding/driving quality
T_7	U_7	V_7	W_7	X_7	Y_7	Service schedule/fare information

Model results

Models for 'waiting time for using service' of feeder mode;

All income level models were significant at 95% level of confidence as explained by p-values, and contained the x^2/df value of 1.294, 1.325 and 1.369, which is far behind 3, for low, middle and high income respectively. The RMR and RMSEA of most models were close to recommended values of less than 0.10 and loss than 0.08 respectively. In contrast, the goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values were not reach the recommended values of at least

0.90 and 0.80. However, their values as shown in table x closed to the thresholds. These fairly fit values are probably caused from the low number of samples. However, it can be implied that all models have a reasonably good fit.

Van has positive effects to mass transit node access satisfaction for the low income and middle income with the parameter (β_6) of 0.235 and 0.153 at the level of confidence more than 90%, respectively. But, it is not significant for the high income. The potential of these effects is low and middle income seem to aware on their access cost as expressed the higher weigh in table 6.16, and they ride van mode than high income people. Also motorcycle has positively affects only on low income group with the parameter (β_3) of 0.048. It implies that low income people also pay attention to waiting time as expressed by the coefficients of V_1 in table 6.17.

Models for 'Number of stops along the way' of feeder mode;

All groups were significant at 95% level of confidence with taxi and motorcycle taxi. For the three significant models, their x^2/df values were far behind 3 as shown in table 6.16. The RMR of three models reached to the recommended values, but RMSEA models were not reach to the recommended; however, it was acceptable for middle and high income group. The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values shown in table 6.17 were also not reach the recommended values of at least 0.90 and 0.80; however, they were again acceptable and can be implied as reasonably good fit models.

Among the estimated coefficients, taxi and motorcycle taxi have positive effects to mass transit node access satisfaction for all groups; low, middle and high income with the parameter $\beta_2 = 0.162$, 0.117, 0.129 and $\beta_3 = 0.199$, 0.182, and 0.199, respectively. Moreover, from high value of U_2 and V_2 in table x, middle income pay more attention to the number of stops of the vehicle comparing with the other groups.

Models for 'Adequate service and on demand service' of feeder mode;

All income level models were significant at 95% level of confidence as explained by p-values, and contained the x^2/df value of 1.277, 1.296 and 1.309, which is far behind 3, for low, middle and high income respectively. The RMR of three models reached to the recommended values, the RMSEA also reached to the recommended value except for middle income group; however it was acceptable. In contrast, the goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values were not reach the recommended values of at least 0.90 and 0.80. However, their values as shown in table x closed to the thresholds. These fairly fit values are probably caused from the low number of samples. However, it can be implied that all models have a reasonably good fit.

It is again that only β_2 has significant at 95% of significant for all income level. The interrelation shows that taxi positively influences on the satisfaction level of mass transit node access for all income level passengers with the parameter of 0.041, 0.057 and 0.0176, respectively. Van also has positive effects to mass transit node access satisfaction for the low income and middle income with the parameter (β_6) of 0.048, 0.052 at the level of confidence more than 90% respectively, but it is not significant for the high income. Moreover, bus also has positive effects for the low income which mean low income pay more attention to on demand service of bus comparing with the other groups as expressed the higher weigh in table 6.17.

<u>Models for 'Availability in night time/early morning' of feeder mode;</u>

All group were significant 95% level of confidence with motorcycle taxi. For the three significant models, their x^2/df values were far behind 3 as shown in table 4.16. The RMR and RMSEA of three models reached to the recommend values except the RMSEA of the low income model; however, it was acceptable. The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values shown in table 6.17 were also not reach the recommended values of at least 0.90 and 0.80; however, they were again acceptable and can be implied as reasonably good fit models.

Motorcycle taxi has positive effects to mass transit node access satisfaction for all levels; low income, middle income and high income with the parameter (β_3) of 0.047, 0.051 and 0.046 at the level of confidence more than 90%, respectively. It implies that all groups pay more attention to the service time as expressed by the coefficients of V_4 in table 6.17. Taxi has positive effect for only high income passengers with the parameter (β_2) of 0.054 at the level of confidence more than 90%.

<u>Models for 'Flexibility to change route' of feeder mode;</u>

All income groups were significant 95% level of confidence with taxi and motorcycle taxi. For the three significant models, their x^2/df values were far behind 3 as shown in table 6.16. The RMR and RMSEA of three models reached to the recommend values except the RMSEA of the low income model; however, it was acceptable. The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values shown in table 6.17 were also not reach the recommended values of at least 0.90 and 0.80 except for high income group, The GFI of high income passengers reached to the recommend values of at least 0.90; however, they were again acceptable and can be implied as reasonably good fit models.

Among the estimated coefficients, taxi and motorcycle taxi have positive effects to mass transit node access satisfaction for all groups; low, middle and high income with the parameter $\beta_2 = 0.172$, 0.122 and 0.166 and $\beta_3 = 0.328$, 0.245 and 0.269, respectively. It implies that all respondents pay more attention to flexibility of taxi and motorcycle taxi comparing with other feeder modes as expressed by coefficients of U_5 and V_5 in table 6.17.

Models for ‘Riding/driving quality’ of feeder mode;

All passenger groups have negative satisfaction for all feeder modes, especially for high income passengers which the most dissatisfied on driving quality of bus and van. For the three significant models, their x^2/df values were far behind 3 as shown in table 6.16. The RMR and RMSEA of three models reached to the recommend values. The goodness of fit index (GIF) and adjusted goodness of fit index (AGFI) values shown in table x were also reached the recommended values of at least 0.90 and 0.80 except for low income people, the AGFI of low income passengers was not reach the recommended value; however, it was acceptable.

Models for ‘Service schedule/fare information’ of feeder mode;

Middle income and high income models were significant at 95% level of confidence for boat service, but low income’s model was not significant. For the two significant models, their x^2/df values were far behind 3 as shown in table 6.16. The RMR of three models reached to the recommended values, but RMSEA models were not reach to the recommended; however, it was acceptable for middle and high income models. In contrast, the goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) values were not reach the recommended values of at least 0.90 and 0.80. However, their values as shown in table x closed to the thresholds. These fairly fit values are probably caused from the low number of samples. However, it can be implied that all models have a reasonably good fit.

Boat has positive effects to mass transit node access satisfaction for middle income and high income models with the parameter β_5 = 0.048 and 0.051, respectively. It implies that middle income and high income passengers pay more attention to the service time as expressed by the coefficients of X_7 in table 6.17.

Table 6.16 Parameter estimates and fitness indices of SEM models

Parameter		β1	β2	β3	β4	β5	β6	X^2	df	X^2/df	p	GFI	AGFI	RMR	RMSEA
1. Waiting time for using service	Low	-0.123 (p=0.617)	-0.094 (p=0.255)	0.048 (p=0.753)	-0.159 (p=0.392	-0.162 (p=0.384)	0.235 (p=0.121)	98.379	76	1.294	0.006	0.862	0.740	0.048	0.085
	Middle	-0.104 (p=0.633)	-0.095 (p=0.208)	-0.088 (p=0.729)	-0.182 (p=0.515)	-0.077 (p=0.492)	0.153 (p=0.225)	95.407	72	1.325	0.015	0.832	0.744	0.043	0.081
	High	-0.266 (p=0.351)	0.042 (p=0.653)	-0.095 (p=0.208)	-0.210 (p=355)	-0.179 (p=212)	-0.121 (p=584)	95.857	70	1.369	0.012	0.821	0.746	0.039	0.076
2. Number of stops along the way	Low	-0.144 (p=0.587)	0.162 (p=0.179)	0.199 (p=0.113)	-0.179 (p=0.253)	-0.081 (p=0.556)	-0.123 (p=0.284)	99.364	74	1.343	0.042	0.831	0.761	0.052	0.102
	Middle	-0.153 (p=0.601)	0.117 (p=0.203)	0.182 (p=0.121)	-0.235 (p=0.383)	-0.012 (p=0.446)	-0.010 (p=0.429)	98.109	72	1.363	0.048	0.853	0.764	0.051	0.084
	High	-0.123 (p=0.605)	0.129 (p=0.735)	0.199 (p=0.204)	-0.213 (p=0.352)	-0.122 (p=0.517)	-0.149 (p=0.204)	98.004	68	1.441	0.060	0.854	0.765	0.047	0.081
3. Adequate service and on demand service	Low	0.052 (p=0.774)	0.041 (p=0.428)	-0.088 (p=0.321)	-0.149 (p=0.613)	-0.127 (p=0.295)	0.048 (p=0.164)	98.338	77	1.277	0.048	0.866	0.788	0.045	0.082
	Middle	-0.080 (p=0.402)	0.057 (p=0.814)	-0.080 (p=0.381)	-0.123 (p=0.583)	-0.140 (p=0.551)	0.052 (p=0.874)	97.219	75	1.296	0.41	0.868	0.792	0.041	0.078
	High	-0.111 (p=0.307)	0.176 (p=0.084)	-0.080 (p=0.123)	-0.169 (p=0.366)	-0.177 (p=0.293)	-0.149 (p=0.601)	96.882	74	1.309	0.57	0.871	0.793	0.038	0.084
4. Availability in night time/early morning	Low	-0.091 (p=0.252)	-0.076 (p=0.163)	0.047 (p=0.669)	-0.153 (p=0.641)	-0.206 (p=355)	-0.119 (p=0.147)	57.175	31	1.844	0.014	0.873	0.768	0.045	0.082
	Middle	0.039 (p=0.791)	-0.078 (p=0.533)	0.051 (p=0.019)	-0.151 (p=0.595)	-0.227 (p=0.235)	-0.117 (p=0.294)	55.854	32	1.745	0.035	0.882	0.786	0.037	0.079
	High	-0.144 (p=0.523)	0.054 (p=0.139)	0.046 (p=0.753)	-0.131 (p=0.667)	-0.221 (p=0.329)	-0.174 (p=0.252)	55.123	29	1.901	0.041	0.889	0.788	0.035	0.073
5. Flexibility to change route	Low	-0.074 (p=0.259)	0.172 (p=0.008)	0.328 (p=0.204)	-0.179 (p=0.388)	-0.123 (p=0.602)	-0.112 (p=0.349)	100.242	69	1.453	0.008	0.894	0.743	0.043	0.088
	Middle	-0.111 (p=0.427)	0.122 (p=0.193)	0.245 (p=0.007)	-0.179 (p=0.252)	-0.227 (p=845)	-0.159 (p=0.421)	100.407	65	1.545	0.005	0.898	0.747	0.040	0.076
	High	-0.213 (p=0.122)	0.166 (p=0.672)	0.269 (p=0.083)	-0.247 (p=0.491)	-0.277 (p=0.384)	-0.241 (p=0.313)	100.579	62	1.622	0.013	0.902	0.749	0.037	0.071
6. Riding/driving quality	Low	-0.259 (p=0.408)	-0.145 (p=0.623)	-0.141 (p=0.551)	-0.153 (p=587)	-0.095 (p=0.239)	-0.210 (p=0.699)	34.212	29	1.180	0.136	0.915	0.798	0.041	0.069
	Middle	-0.285 (p=332)	-0.215 (p=0.384)	-0.231 (p=845)	-0.172 (p=0.205)	-0.106 (p=0.318)	-0.179 (p=274)	31.864	27	1.180	0.039	0.927	0.807	0.045	0.057
	High	-0.324 (p=0.772)	-0.251 (p=0.416)	-0.269 (p=0.431)	-0.212 (p=339)	-0.077 (p=0.264)	-0.302 (p=0.683)	30.146	27	1.117	0.053	0.973	0.862	0.049	0.042
7. Service schedule/fare information	Low	-0.183 (p=201)	-1.189 (p=0.684)	-0.117 (p=0.372)	-0.077 (p=0.484)	-0.077 (p=0.591)	-0.179 (p=0.272)	47.237	32	1.476	0.291	0.883	0.765	0.044	0.095
	Middle	-0.148 (p=0.243)	-0.153 (p=0.381)	-0.153 (p=0.612)	-0.122 (p=0.327)	0.048 (p=0.593)	-0.121 (p=0.297)	45.388	31	1.464	0.022	0.888	0.773	0.047	0.089
	High	-0.211 (p=0.025)	-0.151 (p=0.308)	-0.125 (p=0.425)	-0.177 [illegible]	0.051 (p=0.587)	-0.269 (p=0.736)	45.106	31	1.455	0.014	0.895	0.779	0.050	0.082

Recommended fitness indices: $X^2/df \leq 3.0$, $GFI \geq 0.90$, $AGFI \geq 0.80$, $RMR \leq 0.10$ and $RMSEA \leq 0.08$

Table 6.17 Standardized regression estimates of measurement equations from SEM models

Relation			Low	Mid	High	Relation			Low	Mid	High
Z_1	<--	ξ	0.494	0.802	0.635	W_1	<--	η_4	0.776	0.703	0.711
Z_2	<--	ξ	0.647	0.785	0.830	W_2	<--	η_4	0.749	0.673	0.669
Z_3	<--	ξ	0.749	0.648	0.516	W_3	<--	η_4	0.694	0.677	0.630
Z_4	<--	ξ	0.598	0.822	0.593	W_4	<--	η_4	0.732	0.712	0.729
T_1	<--	η_1	0.703	0.504	0.660	W_5	<--	η_4	0.630	0.617	0.584
T_2	<--	η_1	0.425	0.543	0.527	W_6	<--	η_4	0.779	0.735	0.740
T_3	<--	η_1	0.757	0.774	0.759	W_7	<--	η_4	0.744	0.732	0.721
T_4	<--	η_1	0.622	0.776	0.731	X_1	<--	η_5	0.722	0.690	0.612
T_5	<--	η_1	0.630	0.729	0.725	X_2	<--	η_5	0.749	0.792	0.694
T_6	<--	η_1	0.792	0.736	0.749	X_3	<--	η_5	0.802	0.712	0.733
T_7	<--	η_1	0.777	0.725	0.612	X_4	<--	η_5	0.627	0.734	0.629
U_1	<--	η_2	0.850	0.862	0.914	X_5	<--	η_5	0.683	0.782	0.571
U_2	<--	η_2	0.837	0.859	0.827	X_6	<--	η_5	0.791	0.721	0.733
U_3	<--	η_2	0.775	0.702	0.604	X_7	<--	η_5	0.795	0.805	0.801
U_4	<--	η_2	0.780	0.747	0.659	Y_1	<--	η_6	0.915	0.883	0.599
U_5	<--	η_2	0.911	0.877	0.814	Y_2	<--	η_6	0.788	0.802	0.733
U_6	<--	η_2	0.796	0.734	0.745	Y_3	<--	η_6	0.876	0.871	0.717
U_7	<--	η_2	0.734	0.749	0.753	Y_4	<--	η_6	0.733	0.790	0.672
V_1	<--	η_3	0.786	0.772	0.765	Y_5	<--	η_6	0.761	0.755	0.599
V_2	<--	η_3	0.815	0.891	0.824	Y_6	<--	η_6	0.544	0.677	0.384
V_3	<--	η_3	0.781	0.736	0.711	Y_7	<--	η_6	0.692	0.730	0.475
V_4	<--	η_3	0.947	0.899	0.862						
V_5	<--	η_3	0.889	0.872	0.894						
V_6	<--	η_3	0.788	0.739	0.717						
V_7	<--	η_3	0.722	0.731	0.822						

Note: All estimated values are significant at 95% level of confidence

6.5 Summary and Conclusion

Based on the reviews and findings, feeder modes shows their service capability to be implemented as a feeder system with mass transit node stations. However, each feeder mode's performance depends on its levels of service perceived by travelers. Passengers' attitudes are the powerful tools that helpfully assess quality of service and reveal problems that need to be considered for all feeder modes and mass transit node connectivity. Structural models were developed to gather the influences of feeder mode services to attitude concerning mass transit node connectivity based on passengers' perceptions. Seven important service measurements – waiting time for using service, number of stops along the way, adequate service and on demand service, availability in night time/early morning, flexibility to change route, riding/driving quality, and service schedule/fare information – were evaluated according to passenger's income segments. The developed models demonstrate that passengers' satisfactions on service quality of feeder modes have positive effects to mass transit node access trip.

People in low income and middle income level put more awareness to the waiting time for their access trips to the station which transit by van. In addition, middle income group stated higher consideration on the transfer difficulties. This implies that time is very important for middle people. The expense of access trip as well as waiting time are very important for both low and middle income respondents.

Bus and Songtaew, offering lower fare, it has negative effects to mass transit node connectivity satisfaction for all income passengers. However, bus has the big share of feeder modes at 24.44% of respondents. It should be noted that bus service dissatisfied and posed slightly negative impact for all passenger groups regarding to all service aspects, especially for waiting time and riding/driving quality.

Taxi's waiting time and flexibility aspect presents positive influence for the high income people who always prefer faster and convenient mode than cheaper mode. They evaluated feeder mode services mainly on easiness of finding and quick responsiveness. Therefore, flexible of taxi and motorcycle taxi are the suitable mode that effectively offer high demand responsive and maneuver ability. From the advantage of fast and flexible, it also shows positive result to middle income. It should be noted that all feeder modes dissatisfied and posed slightly negative impact for all passenger groups regarding the riding and driving quality attitude, although the parameters are not so significant.

Boat presents positive influence for low income and middle income passengers who often use its services. They evaluated feeder mode services mainly on clearness of service schedule and fare information. Meanwhile, van service has positive effects to mass transit node connectivity satisfaction for low income and middle income passenger who always prefer faster and convenient mode to safer mode.

To implement feeder modes for mass transit node, it is important to understand how each feeder mode influence the passengers and mass transit node connectivity. As in the case study of Bangkok, people especially in middle and high income level prefer fast and flexible of access to transit node stations. All passengers dissatisfied to bus and Songtaew; nevertheless, it shows positive influences to mass transit connectivity satisfaction for all service measurements. As a result, flexibility aspect should not be overlooked. The shortcomings on unavailability in night time/early morning and unreliable waiting time must be minimized. Moreover, the improvements regarding safety and security are required not only driving quality of all feeder modes, as it shows the negative effect to the connectivity, but also the vehicle condition and safety equipment of all feeder modes. The service schedule and fare information is also important especially service schedule because they relate direct to waiting time, travel time that all passengers stated important. The study presented here attempts to grasp hoe attitudes toward utilizing feeder modes and mass transit node connectivity differ across the population, and renders one of important insights for the efforts to attract more patronages of mass transit systems.

Chapter 7

Analysis of Bangkok Mass Transit Node's Accessibility

7.1 Introduction of Mass Transit Node's Accessibility

Accessibility refers to the ease of access to services, activities, and destinations, known as the "potential of opportunities" [16]. An accessible transportation system can be defined as one that enables individuals to reach their destinations. An accessibility-based analysis can lead to better solutions to transportation problems by providing benefits and congestion reduction in cost-effective ways [17]. Access to mass transit stations has become a major issue in many cities in recent years [89]. Accessibility concerns both non-disabled and disabled people, so all users benefit when the main routes through stations are made accessible. Access to stations includes issues relating to safety, especially for pedestrians, as well as the need to make access attractive to passengers [90].

The accessibility of a transit system or one of its stations includes the standard of the connections between different modes of transportation [91]. High-quality public transit nodes improve the transfer experience and attract more passengers [92]. In Bangkok's mass transit system, there are many problems posed by inconvenient transit setups, ranging from the connection area and the environment around the transit nodes to safety, security, and accessibility.

This chapter aimed to evaluate and compare accessibility performance across Bangkok's mass transit nodes station and to interpret transit mode connection behavior according to the road systems on an urban scale and the design space in the architectural aspect. The findings will contribute a better understanding of the accessibility of transit stations and their relationship with their surrounding environments; the results can also be useful for improving transit stations or ongoing transit projects and for similar transit systems in other cities.

7.2 Accessibility Analysis

7.2.1 Analysis of accessibility around the stations

The specificity data of the connectivity transfer the road space into axial lines and were used to calculate the integration value. The results analysis uses integration value (Int.V) and global integration value (Global Int.V) to represent the tightness of the contact between one node and all the nodes throughout the system, and partial integration value, which usually takes the activity goal center and has three topology steps, is the tightness between one node and its surrounding nodes in the system [18]. It disperses the degree to which one unit space connects with all other parts in the same system. A high integration value means a more convenient space.

Minimum Global Int.V is the minimum integration value of accessibility. A place with the Minimum Global Int.V is remote and hard to get to. Maximum Global Int.V is the maximum integration value of accessibility. A place with the Maximum Global Int.V is very convenient to get to and has a high degree of utilization. Mean Global Int.V is the mean integration value of accessibility. It describes an average degree of accessibility. The last value, local integration value (Local Int.V), is the partial integration value of accessibility. It describes the relationship between one space and its surroundings. Table 7.1 shows the integration values of accessibility around the three selected stations.

Table 7.1 The Integration value of accessibility around the stations

Stations	**Global Int.V**			**Local Int.V**		
	Minimum	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**
Mo Chit	0.128	0.286	0.422	0.105	0.311	0.670
Victory Monument	0.142	0.304	0.442	0.129	0.530	0.715
Saphan Taksin	0.133	0.289	0.426	0.117	0.598	0.726

Color graphics are often used to distinguish the relevant variable values. Figures 7.2, 7.4, and 7.6 use a series of color gradation, which changes from warmer to cooler colors, such as red, yellow, green, and blue. It is generally used to express the distribution of the variable values from high to low. Here, the differently colored lines represent the integration value.

7.2.1.1 Mo Chit Station

The connectivity around the stations includes the bus stops that service the buses in the capital area and van taxis. Motorcycle taxi is also a popular mode of transit at Mo Chit Station for the passengers who have destinations within 5 kilometers of the station. The connectivity nodes at Mo Chit Station are shown in Figure 7.1.

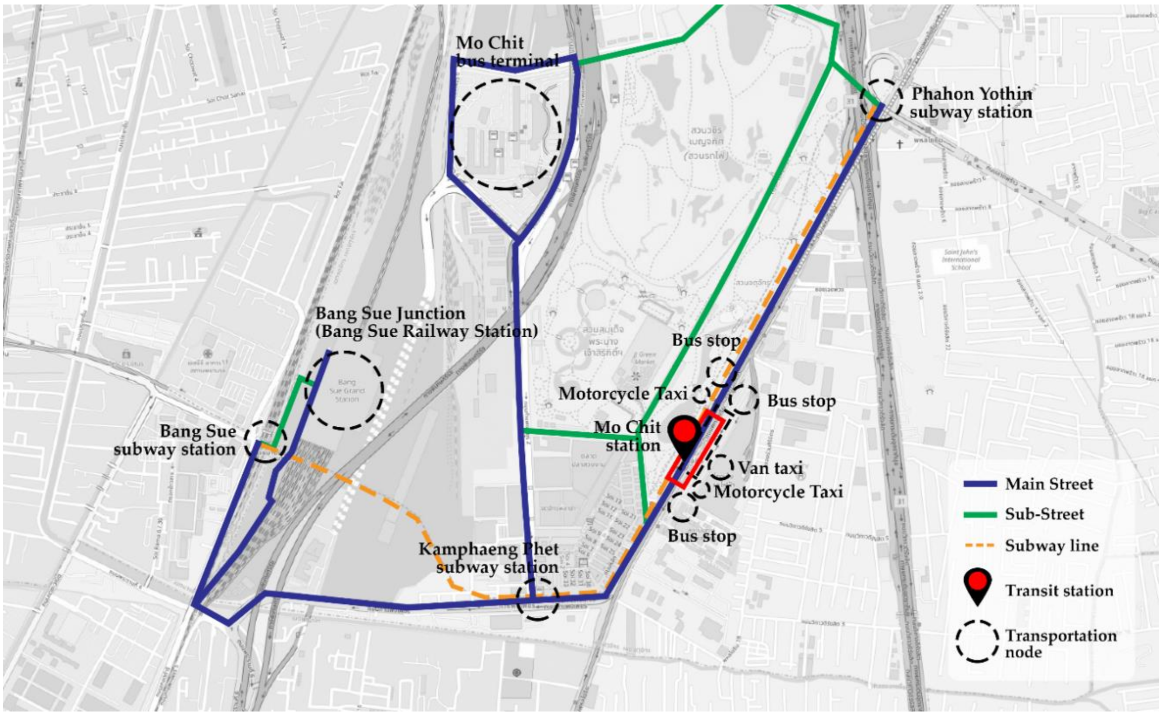


Figure 7.1 The connectivity at Mo Chit Station with the different transit modes

The minimum Global Int.V at Mo Chit Station is 0.128, its mean Global Int.V is 0.286, and its maximum Global Int.V is 0.422. Its minimum Local Int.V is 0.105, its mean is 0.311, and its maximum is 0.670, as shown in Figure 7.2. The main road that directly connects to the station has a Global Int.V of 0.277, which means a normal accessibility but is lower than the mean Global Int.V. The space surrounded by this road is not really convenient to reach, including the station building. Access to the station is inconvenient for passengers, especially during rush hour. Considering that the roads around the station that are connected to the main road also have low Global Int.V, their positions are relatively remote and lack activity.

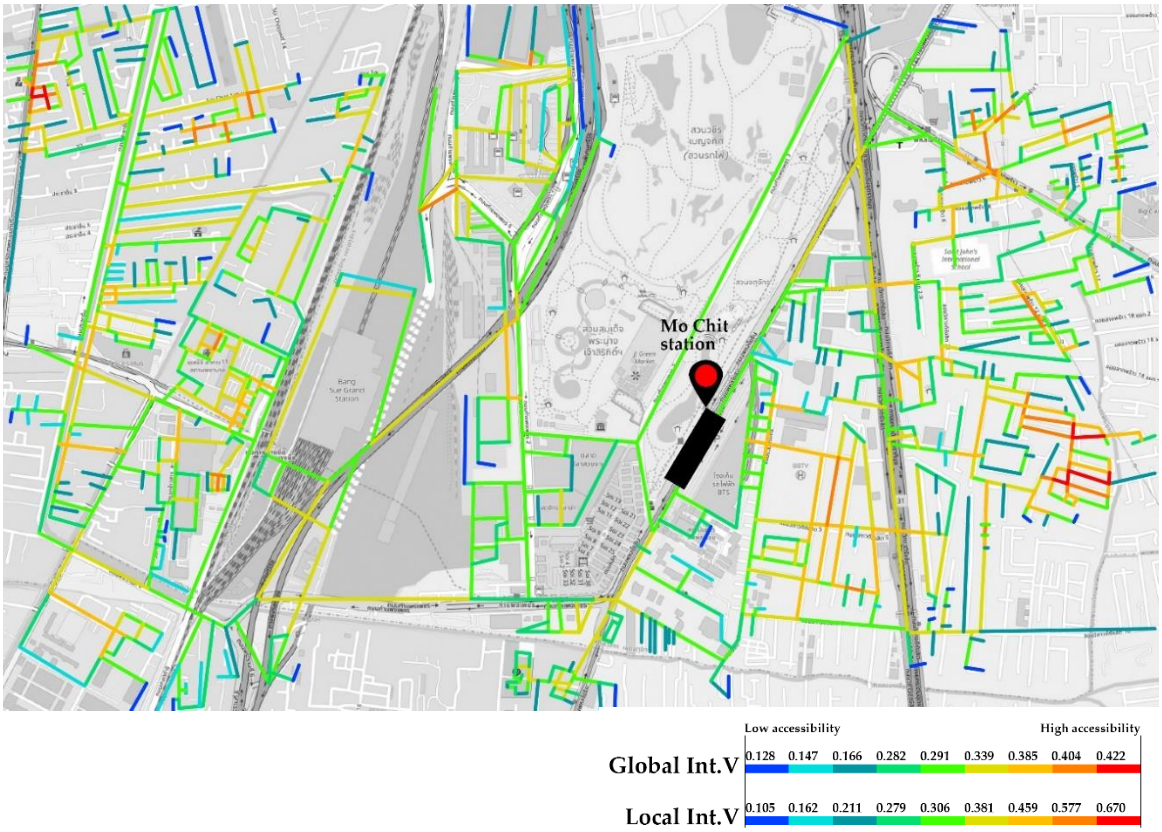


Figure 7.2 The integration value analysis of Mo Chit Station

7.2.1.2 Victory Monument Station

The connectivity around the station includes motorcycle taxis located near the bus stops. The passengers can connect to all bus stops via a skywalk that is linked to all four exits of the traffic circle. The skywalk from the station is also connected to shopping malls around the Victory Monument, so passengers can access the station building directly from the shopping malls. Figure 7.3 shows the connectivity nodes at Victory Monument Station.

As Figure 6.4 shows, the minimum Global Int.V is 0.142, the mean Global Int.V is 0.304, and the maximum Global Int.V is 0.442. Its minimum Local Int.V is 0.129, its mean is 0.530, and its maximum is 0.715. In the center of the Victory Monument, there is one road that has the highest value and four roads that have high values, which make for high accessibility and the most dynamic places. The space surrounded by these roads of high integration value is more convenient to reach. Meanwhile, the main road that directly accesses the station has a Global Int.V of 0.30, which is nearly the mean Global Int.V, indicating average accessibility. However, the ring road around the center of the Victory Monument can support the main road to access the station.

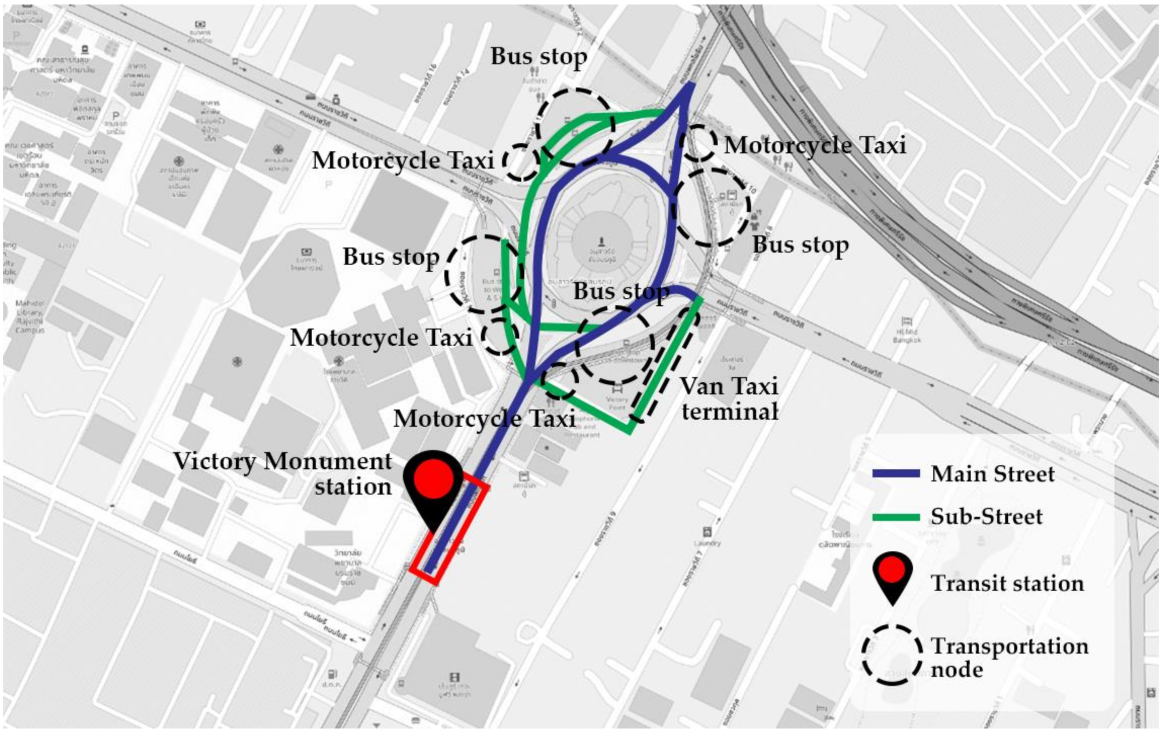


Figure 7.3 The connectivity at Victory Monument Station with the different transit modes

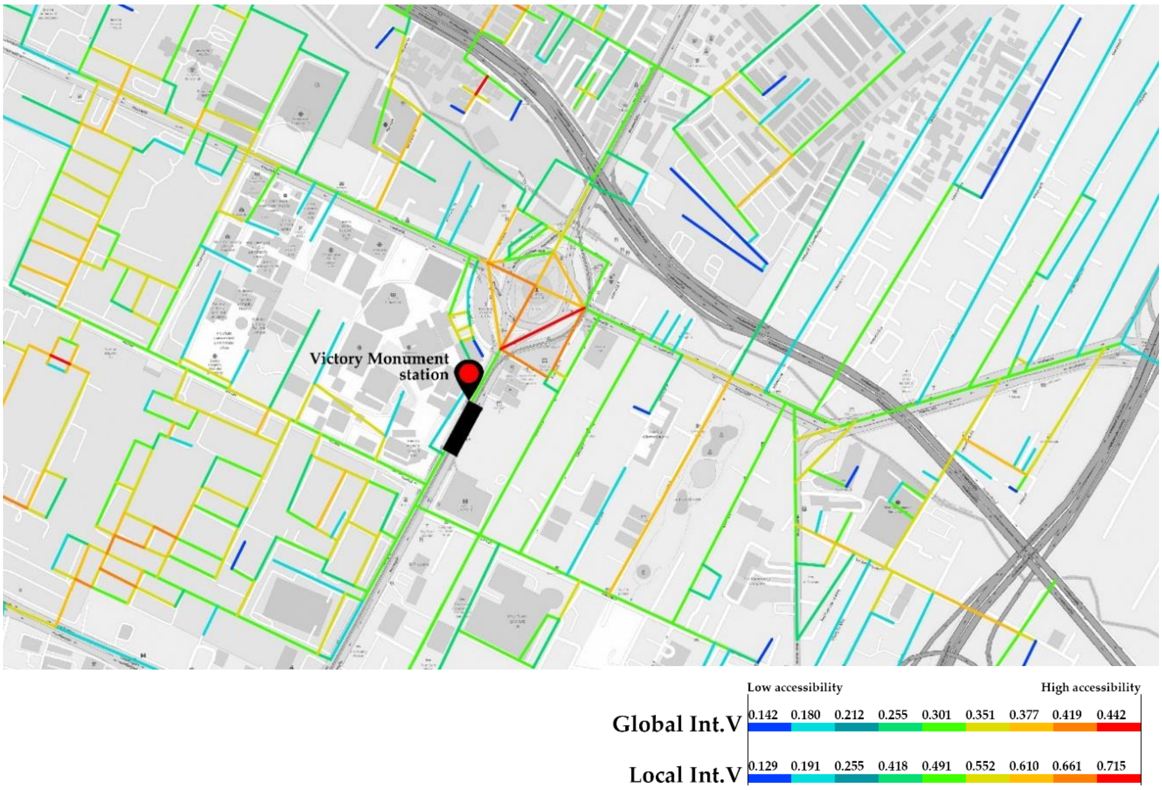


Figure 7.4 The integration value analysis of Victory Monument Station

7.2.1.3 Saphan Taksin Station

Saphan Taksin Station is a station on the BTS Silom line in Sathon District. It is located at the entry ramp of Taksin Bridge, below Sathon Road and east of the Chao Phraya River. Saphan Taksin Station is the only rapid transit station in Bangkok whose passengers can transfer to a river pier for the ferry to Thonburi and the Chao Phraya Express Boat service. That makes the station popular for both daily passengers and tourists sightseeing on river boats in the historical area around the Chao Phraya River.

The connectivity around the station also includes bus stops, motorcycle taxis, and Songtaew (minibuses) that serve Sathon District. The connectivity nodes at Saphan Taksin Station are shown in Figure 7.5.

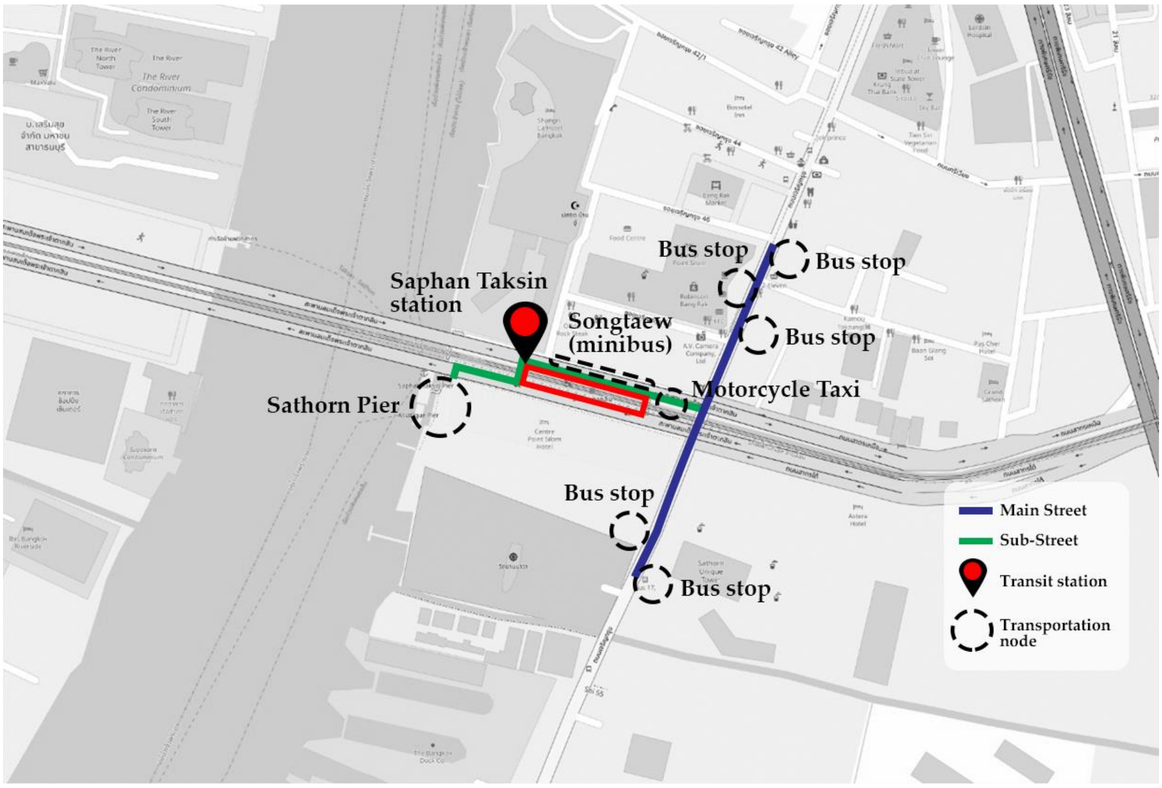


Figure 7.5 The connectivity at Saphan Taksin Station with the different transit modes

The minimum Global Int.V at Saphan Taksin Station is 0.133, the mean Global Int.V is 0.289, and the maximum Global Int.V is 0.426. Its minimum Local Int.V is 0.117, its mean is 0.598, and its maximum is 0.726, as shown in Figure 7.6. The main road that directly connects to the station has a high value of 0.303, which makes for high accessibility and the most dynamic places. Access to the station is therefore more convenient. Moreover, the two routes of river transport that access the station have the highest value, which means that Saphan Taksin Station also has high accessibility via river transport. The three roads that connect to the main road also have Global Int.V more than

0.32, which means that these roads also have high accessibility. These support the accessibility at the main road and improve the accessibility around the station.

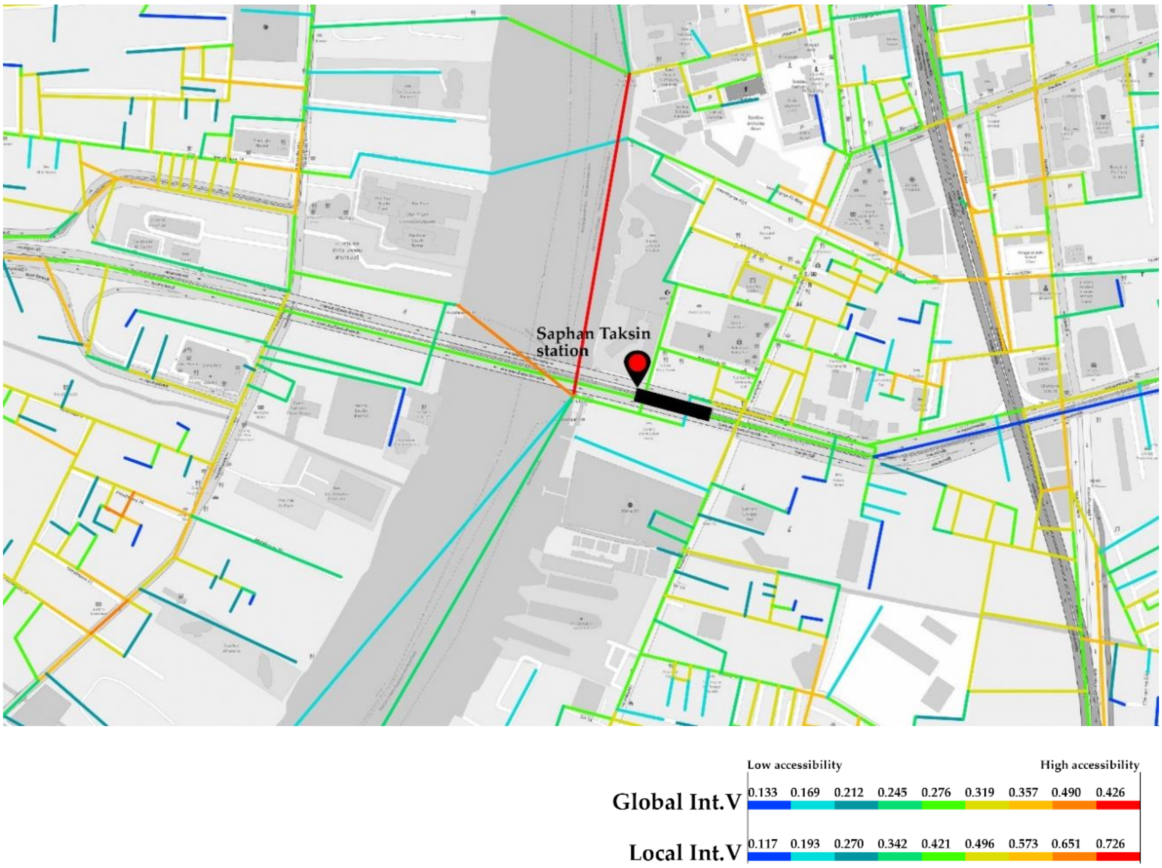


Figure 7.6 The integration value analysis of Saphan Taksin Station

7.2.2 Accessibility analysis inside the station building

In the analysis results, color graphics are used to describe the variable values. The red in the analysis results indicates that a space has the highest integration value, indicating that it has the most potential destinations, shallowest spatial depth, and highest accessibility. The cooler colors indicate that a space has a lower degree of integration, and the deeper the depth of the space, the less accessibility it has.

A station building with the minimum Int.V is remote and hard to get into, while one with the maximum Int.V is very convenient to access and has high utilization, and one with the mean Int.V has an average degree of convenience. Table 7.2 shows the integration values of accessibility in the stations.

Table 7.2 The Integration values of accessibility in the stations

Stations	Minimum	Mean	Maximum
Mo Chit	0.591	1.104	2.318
Victory Monument	0.722	1.212	2.413
Saphan Taksin	0.480	1.347	2.901

7.2.2.1 Mo Chit Station

Figure 7.7 illustrates Mo Chit Station’s floorplan. The station building can be accessed via four entrances. Entrances/exits 1 and 3 are located at the west of the station—entrance/exit 1 is connected to Chatuchak Market, while entrance/exit 3 is connected to Queen Sirikit Park. Entrances/exits 2 and 4 are located at the east of the station and connect to a van taxi terminal and a parking area. The station provides staircases and escalators to access the station building as well as an elevator for disabled users. The ticketing machines are located at the north and south of the station, near the station’s entrance gate. In the station area, staircases and escalators are also provided for access to the platform on the upper floor.

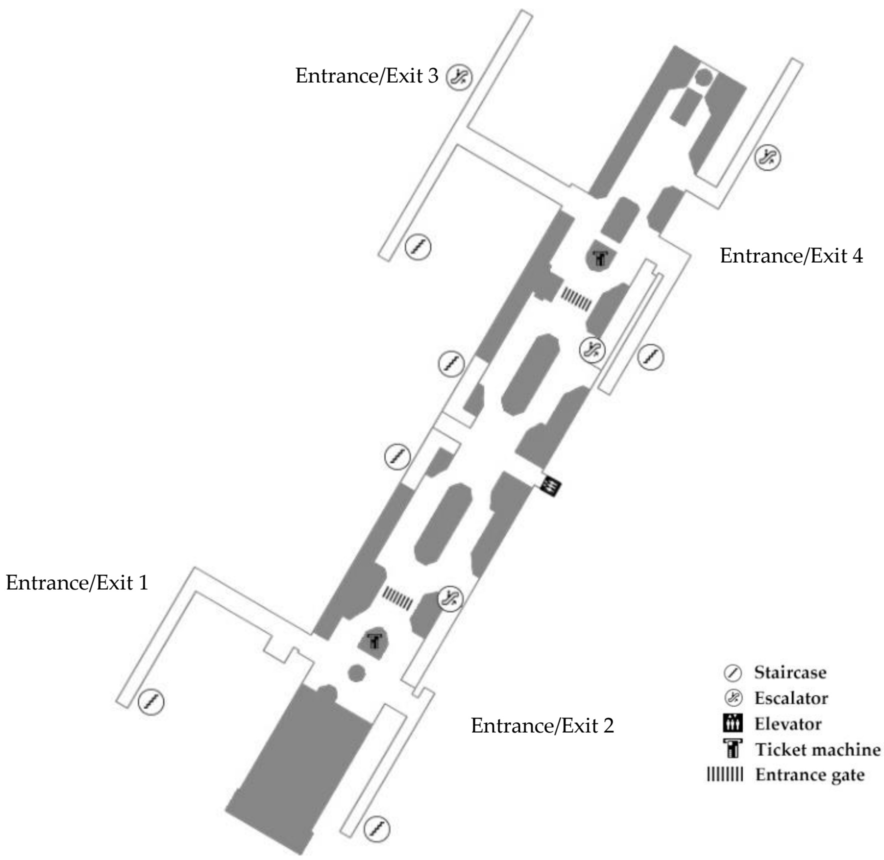


Figure 7.7 Mo Chit Station’s floorplan

As shown in Figure 7.8, the maximum Int.V is 2.318, which belongs to a corridor space at the center of the station, near the stairs that access the platform. The minimum Int.V is 0.591, belonging to the circulation space that connects the station building and surrounding area. The mean Int.V is 1.104. The integration values of the station's two entrances are quite similar, and both have high accessibility. Except for the corridor that connects inside and outside the station, the corridor and circulation spaces of Mo Chit Station have good accessibility and high dynamicity.

The spaces inside the entrance gates have high accessibility along two lines in the corridor space, especially the spaces in front of the staircases that connect to the platform on the upper floor. These spaces have high values of accessibility, so they are very convenient to access and have high utilization. Meanwhile, the accessibility at the entrance/exit areas is of low value, so it is hard to access these areas.

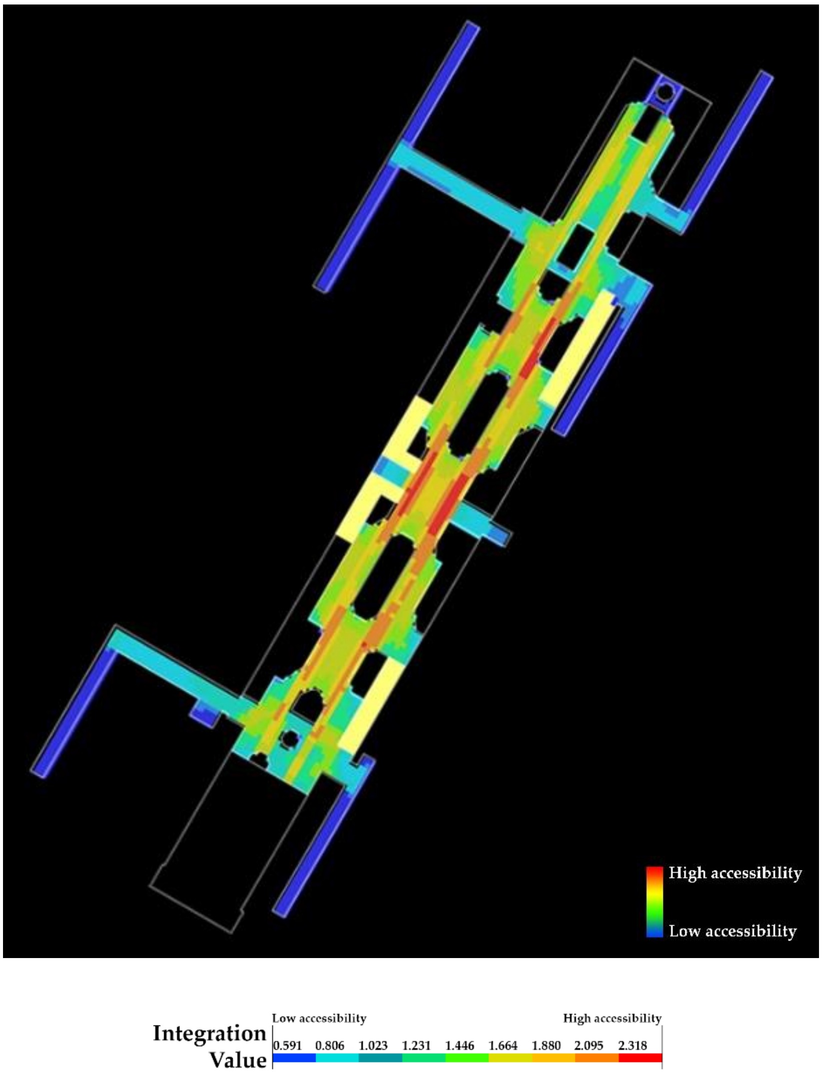


Figure 7.8 Accessibility analysis in Mo Chit Station's building

7.2.2.2 Victory Monument Station

Victory Monument Station can be accessed through five entrances. Entrances/exits 1 and 3 are located at the west of the station—entrance/exit 1 is connected to Boromarajonani College of Nursing, while entrance/exit 3 is connected to Rajavithi Hospital. Entrances/exits 2 and 4 are located at the east of the station—entrance/exit 2 is directly connected to the Century Movie Plaza via the skywalk, and entrance/exit 4 is connected to the Siam International building. Entrance/exit 5 is directly connected by the skywalk to other buildings other transit modes around the Victory Monument. The entrance gates are located at the north and south of the station building next to the ticket machines.

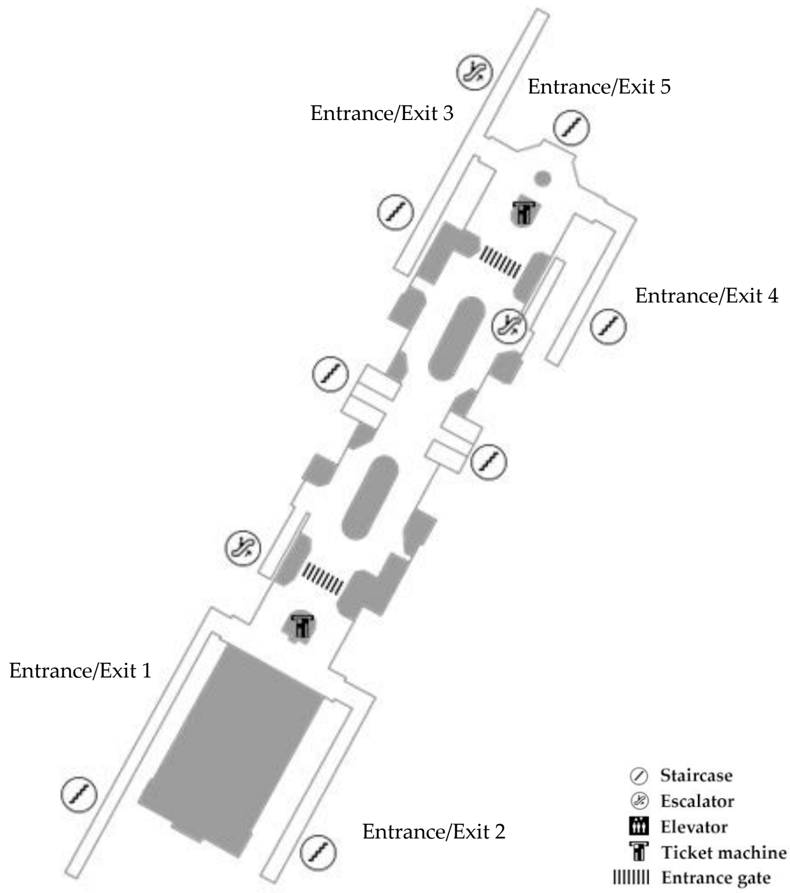


Figure 7.9 Victory Monument Station's floorplan

The minimum Int.V is 0.722, which belongs to the stairs and escalators that connect the station building and the surrounding area. The mean Int.V is 1.212. As Figure 7.10 shows, the maximum Int.V of Victory Monument Station of 2.413 belongs to the spaces on both sides of the station near the entrances. This means that these spaces have the highest accessibility and the most dynamic space and are the most convenient to reach. The integration values of most of the station spaces are nearly the mean Int.V, which means most of the spaces in this station have good accessibility and are convenient to access. Figure 7.10 also illustrates the quality of accessibility at Victory Monument Station. The highest accessibility belongs to the ticketing machine areas at the north and south of the station building (red zones); these spaces are convenient to access and have good connectivity with other spaces. The space in the station building between the two entrance gates also has good accessibility to the passengers inside the station areas, whereas the entrance/exit areas have the lowest accessibility.

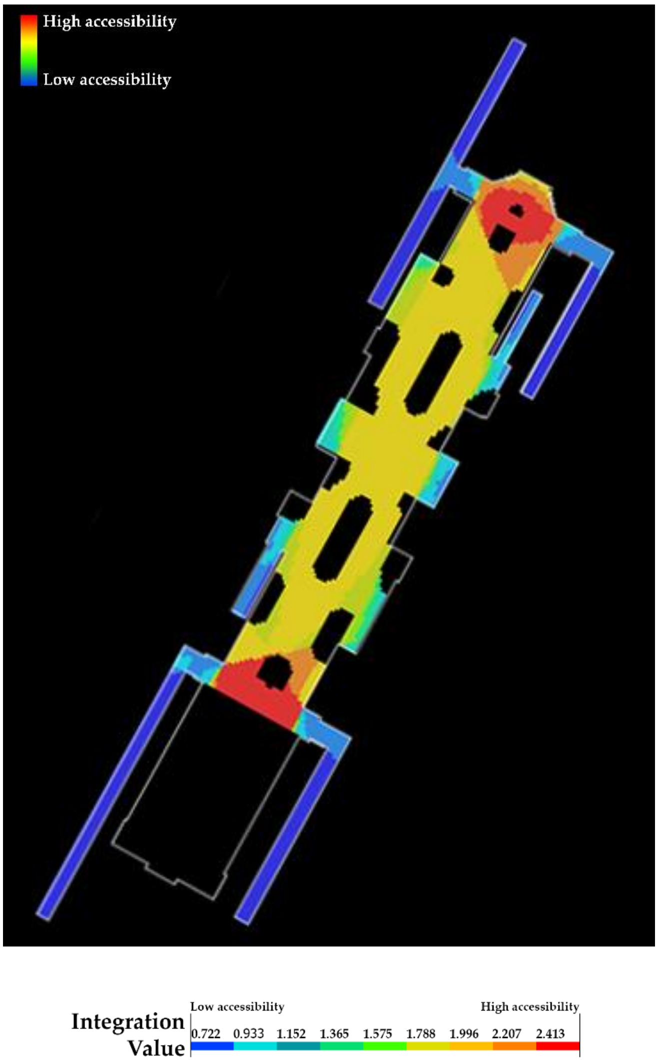


Figure 7.10 Accessibility analysis in Victory Monument Station's building

7.2.2.3 Saphan Taksin Station

This station building is located at the entry ramp of Taksin Bridge. Entrances/exits 1 and 2 are located at the west of the station and connect to the Sathorn Pier, while entrances/exits 3 and 4 are connected to Charoen Krung road at the east of the station. The ticketing machines and entrance gates are in the east wing and the west wing of the station building. To access the platform on the upper floor, passengers must use the staircases at the south side of the station.

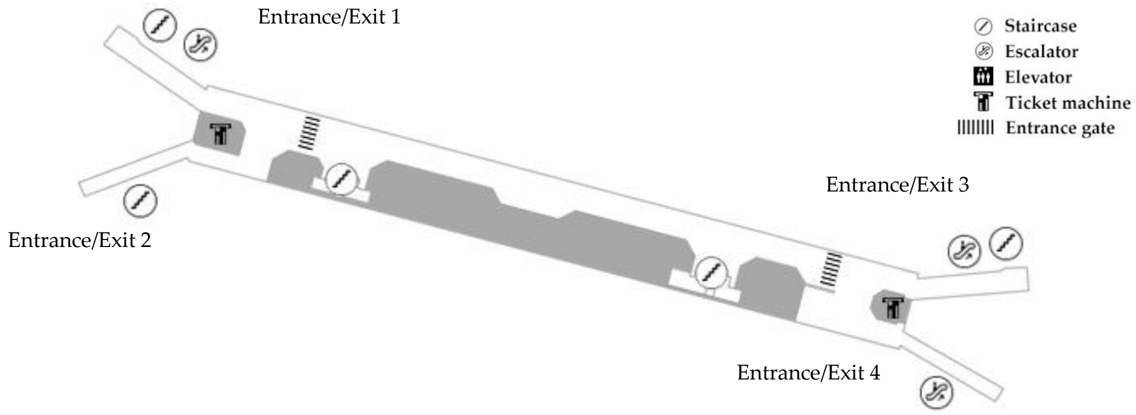


Figure 7.11 Saphan Taksin Station's floorplan

As Figure 7.12 shows, the minimum Int.V of Saphan Taksin Station is 0.480, which means the space is remote and hard to get into. The long corridor and the circulation space in the station building have the highest accessibility and are the most dynamic, with the maximum Int.V of 2.901. However, the spaces near the stairs connected to the platform have an Int.V that is nearly the minimum, meaning that these spaces have low accessibility and are inconvenient to access. As a result, the linear corridor has the highest accessibility from entrances/exits 1 and 3. This space could lead the passengers with its convenience and highly dynamic activity. However, entrance/exit 2 has very poor accessibility, and entrance/exit 4 has poor accessibility, making it inconvenient for passengers who access the station from both of these entrances.

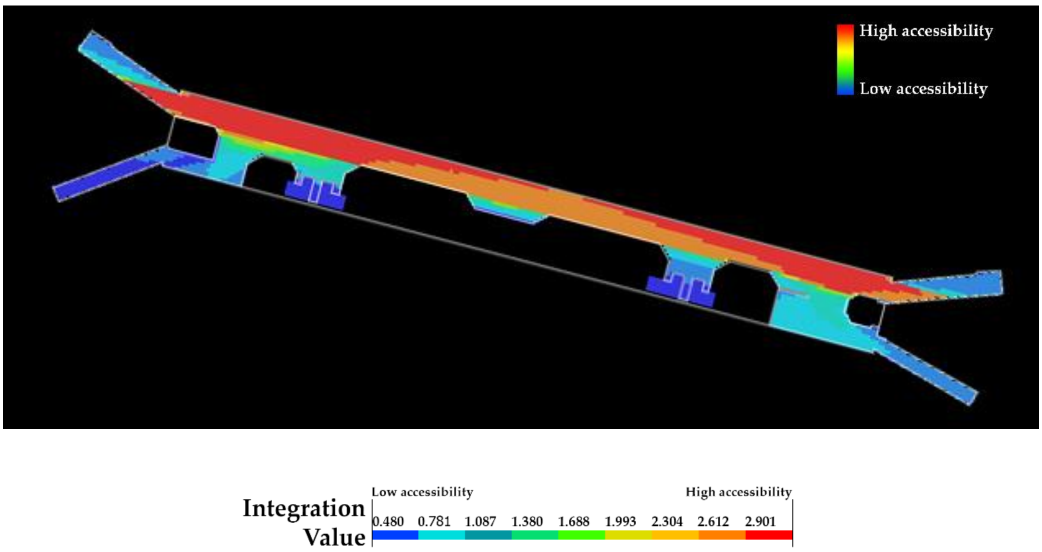


Figure 7.12 Accessibility analysis in Saphan Taksin Station's building

7.2.3 Analysis of the nearest connection route in the station building

By calculating the shortest path between origins and destinations within the assigned network, the normalization of the betweenness index is defined as formula in Chapter 3. The study counted the number of activities located around the nearest connection route between the entrance/exit gates and the staircases connected to the platform on the upper floor by representing them as an observer point function in the UNA tool. The observer points were counted as the number of trips that passed by each observer point. Then, the study used observer points to represent the location of each activity in the station area, which is illustrated in Figure 7.13, 7.14, and 7.15, in order to interpret how activities along the corridor area impact the potential connection routes.

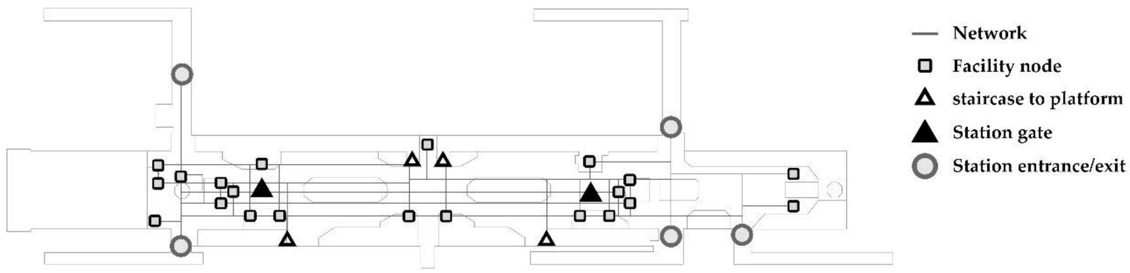


Figure 7.13 Location of facility nodes interpreted as observer points of Mo Chit Station

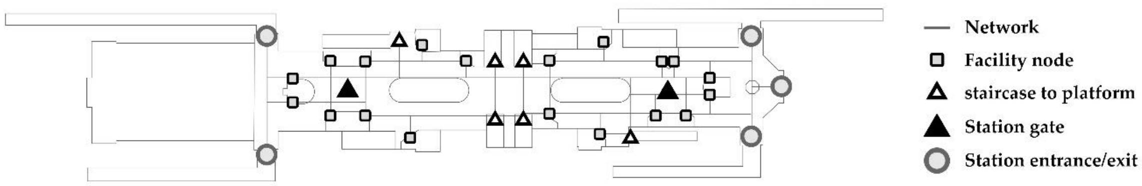


Figure 7.14 Location of facility nodes interpreted as observer points of Victory Monument Station

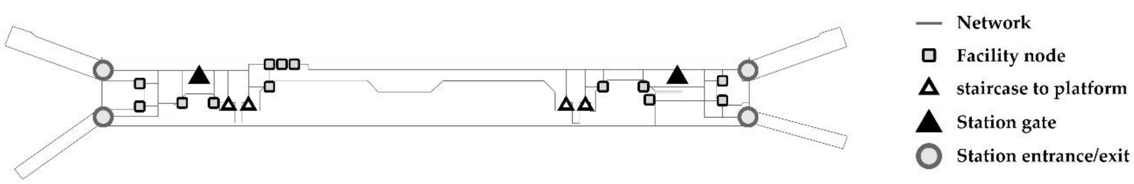


Figure 7.15 Location of facility nodes interpreted as observer points of Saphan Taksin Station

Moreover, the detour ratio variable was analyzed in this study through the interpretation of alternative route analysis on pedestrian accessibility. The study area that was investigated covered 30% of the detour ratio from the shortest paths of transit modes' connection paths, according to pedestrian behavior, which usually deviated around 10–20% above the shortest route. The investigation did not limit the search radius to rule out the additional time spent on access that might occur due to other factors and to concentrate on the distance factor via the nearest route, and the detour ratio already included the limitation of time of accessibility.

Considering the relationship between facility nodes in the corridor space and the connection route in the station, corridor spaces were investigated to identify the relationship between activity arrangements and effective transit station connecting routes in transit station buildings. The circulation of connection routes was surrounded by facility nodes. The spatial circulations were interpreted by analyzing the most common connection routes between stations' entrances/exits and platforms by the betweenness index's value, which shows the number of trips that occur with the shortest distance among nodes. This study assigned a detour ratio of up to 30% from the shortest route whereby the station entrances/exits could access the staircase to the platform.

As a result, the facility nodes were connected with transit connection paths differently based on the priority of space and activity arrangement in the Mo Chit Station area. Figure 7.16 illustrates the facility nodes' involvement in major connection routes, which follows the percentage of detour ratios that were assigned in the simulation process. The nearest routes occasionally passed the facility nodes, which means that the main accessibility route could not be easily reached by the passengers via the main facilities such as ticketing machines. However, if these connection routes were followed by passengers during rush hour, access to the platform and station area would not be obstructed by other activity, which could improve the efficiency of transit accessibility.

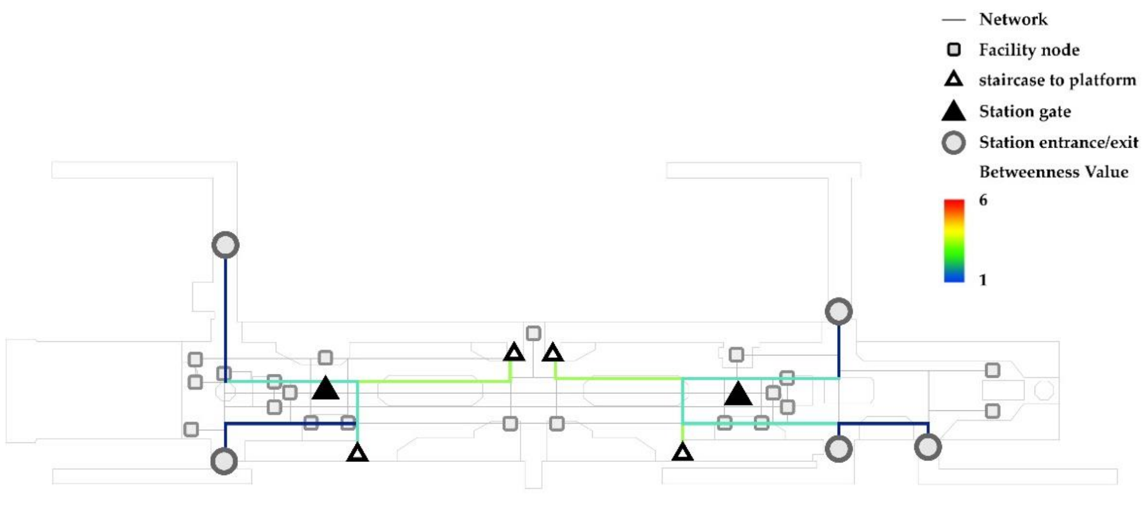


Figure 7.16 The nearest connection routes between every station entrance/exit and the staircases that connect to the platform on the upper floor of Mo Chit Station

Figure 7.17 illustrates the interaction among transit connection paths in the major connection route within a 30% detour between every station entrance/exit and the platform through the value of the trajectory paths passed by the facility nodes in Victory Monument Station. The nearest routes in this station also occasionally led the passengers past the facility nodes.

However, most of the connection routes led the passengers through the ticketing facility, giving the passengers easy access to the main facility of the station. Conversely, with the large number of passengers, the activity at the facility nodes could obstruct accessibility, especially during rush hour.

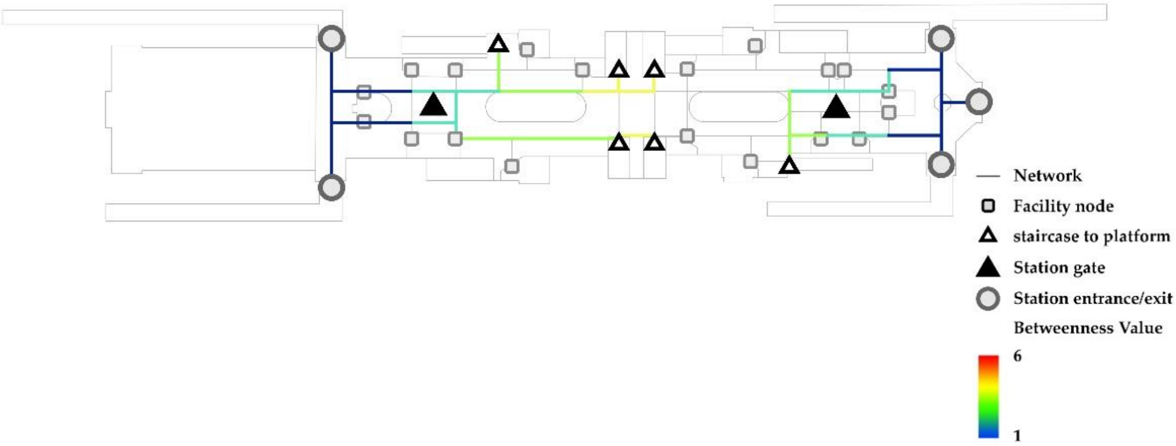


Figure 7.17 The nearest connection routes between every station entrance/exit and the staircases that connect to the platform on the upper floor of Victory Monument Station

Saphan Taksin Station has a different design compared to other stations due to its location at the entry ramp of Taksin Bridge, which limited its construction. The station building has only one platform, which connects the west and east wings of the station via a long linear corridor. Figure 7.18 shows the nearest connection route between station entrances/exits and the platform; the nearest connection routes have the shortest distance compared with the other stations. However, the circulation that connected the west and east wings of the station had a long distance and lacked a facility node, so this corridor lacks activity and is inaccessible to passengers.

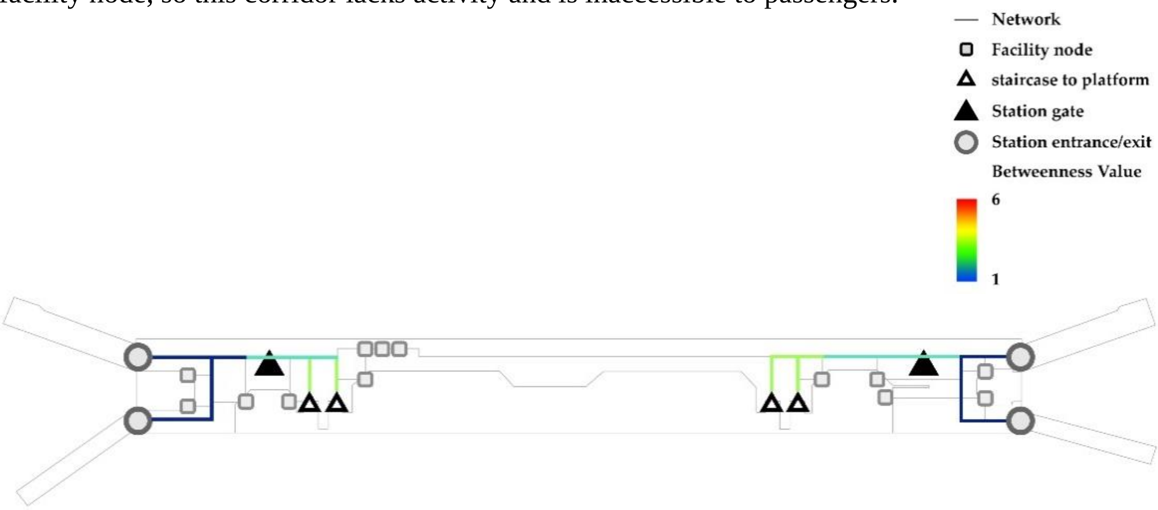


Figure 7.18 The nearest connection routes between every station entrance/exit and the staircases that connect to the platform on the upper floor of Saphan Taksin Station

7.3 Comparative analysis of connectivity around the stations

Figure 7.19 shows the results of the integration value analysis of each station. The blue lines are the Global Int.V of all the stations, and the orange lines are the Local Int.V of all the stations. Among the three transit stations, the lowest minimum Global Int.V 0.128 was at Mo Chit Station. Meanwhile, the lowest maximum Global Int.V 0.422 was also at Mo Chit Station. The connectivity lines in this station must have some spaces with the lowest accessibility, and it may be hard to transfer from this part to anywhere else around the station.

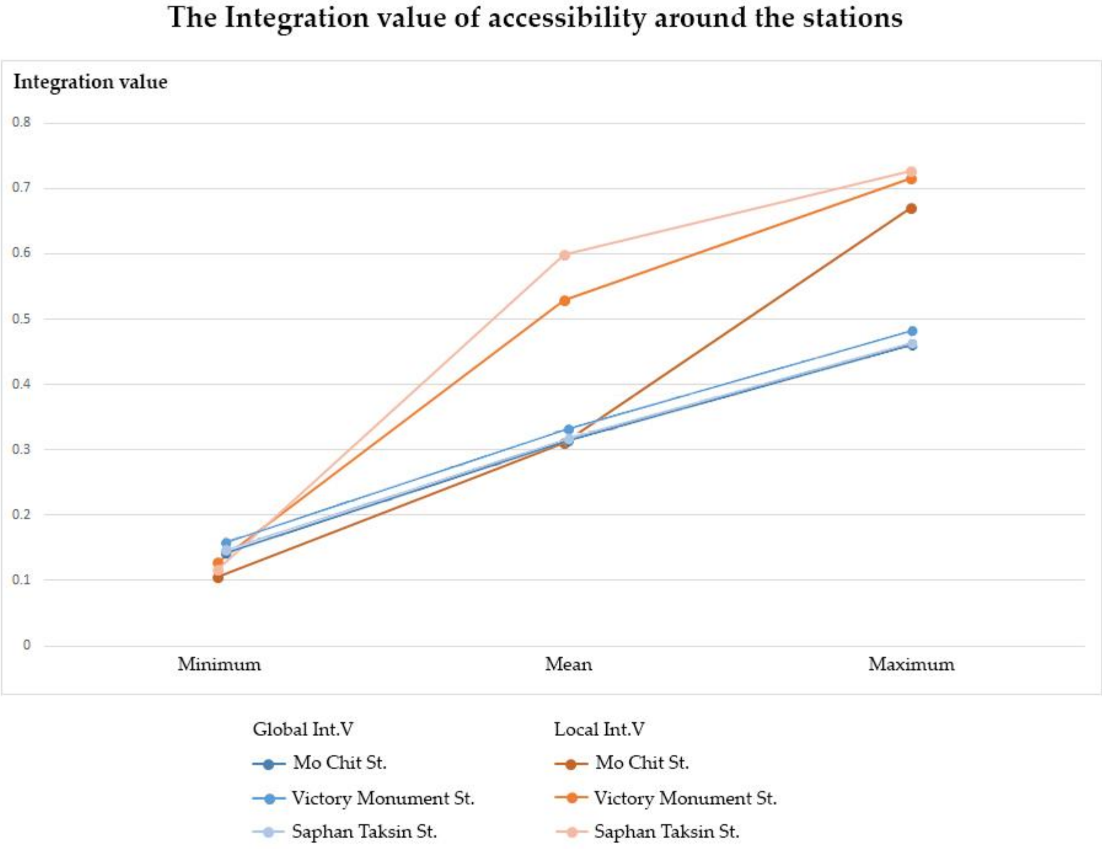


Figure 7.19 The comparative analysis of connectivity around the stations

On the other hand, the highest maximum Int.V of 0.442 was at Victory Monument. This must be due to its being on a road that has the best accessibility and its connection to several other high-accessibility roads. The passengers can transfer conveniently. Mo Chit Station also had the lowest minimum Local Int.V, 0.105, and the lowest Local Int.V, 0.670. The highest maximum Local Int.V 0.726 was at Saphan Taksin Station, where it is convenient to transfer to the surrounding area.

There are several types of connectivity within different road systems. As shown in Figure 7.20, the ring road system and the tandem road system are the two most common ways to organize a road network [39]. Both of these road systems are used for station accessibility; in this study, the main roads through the stations are ring roads, which combine with branch roads to form a road network system. Based on the analysis results, the ring road system has a high accessibility value at all stations. Considering the roads within a radius of 500 meters of the station (Table 7.3), Victory Monument Station is more efficient to reach than the other stations, especially via the ring road around the monument, which means that passengers can conveniently transfer between different transit modes around the monument and the station. At Saphan Taksin Station, the road network within a radius of 500 meters has moderate efficiency. However, access to the station areas by river transport has the highest accessibility value. In fact, access to Saphan Taksin Station by river transport is more convenient and effective due to there being no traffic conditions such as traffic jams, especially during rush hour. At Mo Chit Station, the road networks around the station have a fair accessibility value. Within a radius of 500 meters, access to the station from the west, especially from the northwest, is inconvenient because the route that connects to the station is a large ring road because these areas are a big market and big park; therefore, accessibility from these areas is limited.

According to the analysis results, a ring road network has more efficient accessibility than a tandem road network. To improve the efficiency of accessibility, planners should design the road network with ring roads, especially small ring roads that could spread out passengers' access to the station building from different directions. This could give passengers convenient access to the station building and station area.

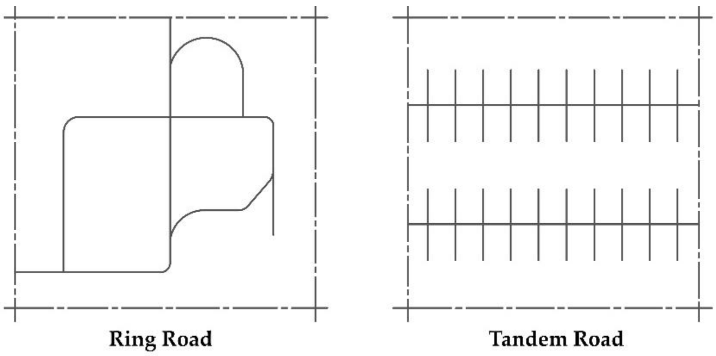
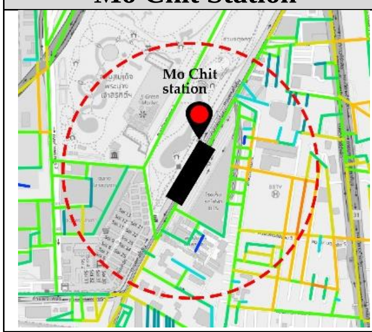
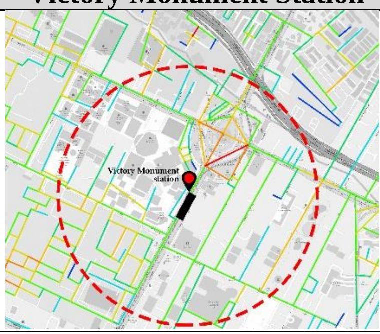
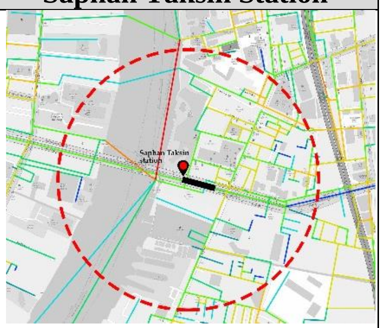


Figure 7.20 The connectivity types of different road systems

Table 7.3 The road systems connected to the stations within a radius of 500 meters

Mo Chit Station	Victory Monument Station	Saphan Taksin Station
		

7.4 Comparative analysis of accessibility at station buildings and activities involvement along station building connection routes

The integration value analysis of the stations' accessibility is shown in Figure 6.21. The blue line is the integration value of Mo Chit Station, the orange line is the integration value of Victory Monument Station, and the gray line is the integration value of Saphan Taksin Station. Among the three transit stations, the lowest minimum Int.V is 0.480, at Saphan Taksin Station. This means that some spaces in this station have low accessibility, making it inconvenient to transfer from that space to other spaces. Meanwhile, the highest maximum Int.V, 2.901, is also at Saphan Taksin Station. This means that there is a space in Saphan Taksin Station that has the best accessibility, from which it is very convenient to reach other spaces.

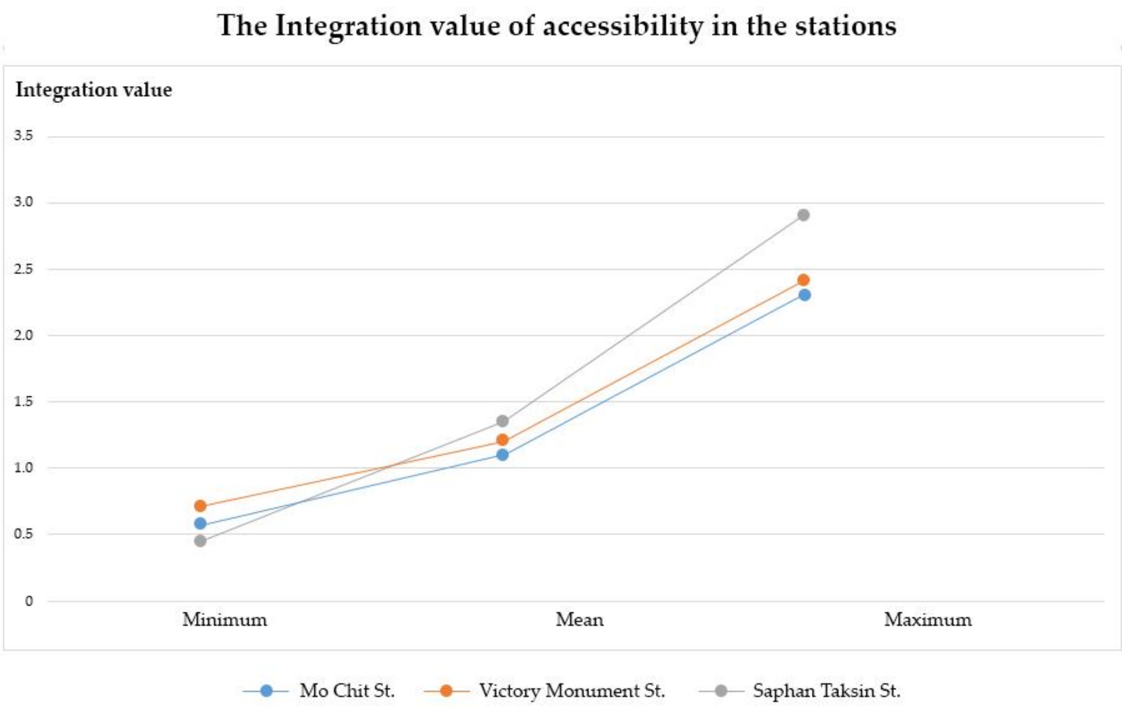


Figure 7.21 The comparative analysis of accessibility at the station buildings

The corridors interacted with the stations' major connection paths strongly, as illustrated by the betweenness index values of the facility nodes, which indicated the major connection routes within a 30% detour between every station entrance/exit and the staircase connecting to the platform on the upper floor through the value of trajectory paths that passed by the station facilities in transit station buildings. Figure 7.22 interprets the percentage of facility nodes that were involved along the main connecting route. Facility activities involved at Mo Chit Station were at 3.60% along the nearest connecting route, which expanded to 7.56%, 10.35%, and 12.85% when assigned detour ratios of 10%, 20%, and 30%, respectively.

Meanwhile, Victory Monument Station had a higher level of 4.73% of such facilities located along the nearest route between entrances/exits and platform, which rose to 8.21%, 10.35%, and 12.85% when the assigned detour ratio was 10%, 20%, and 30% respectively.

Although Saphan Taksin Station also expanded when assigned a higher detour ratio, the activities involved along the main connection route were on the lower level at 0.24%, which increased to 0.77%, 1.03%, and 1.24% when the assigned detour ratio was 10%, 20%, and 30% respectively.

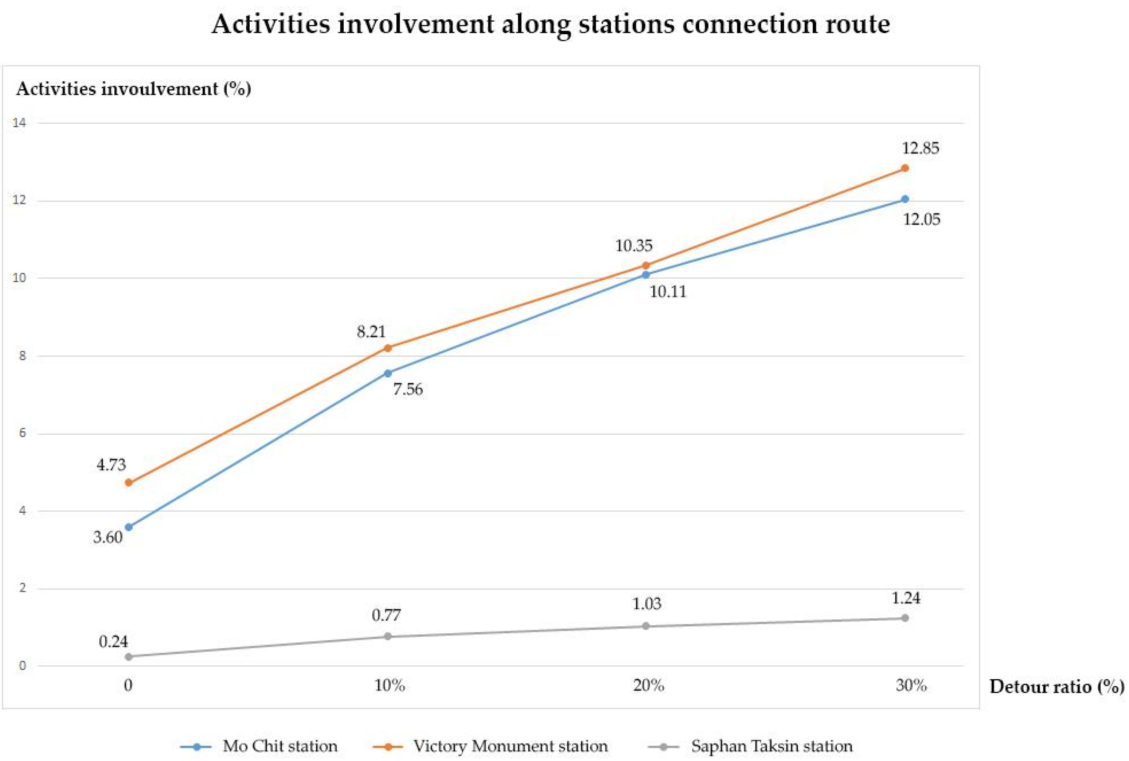
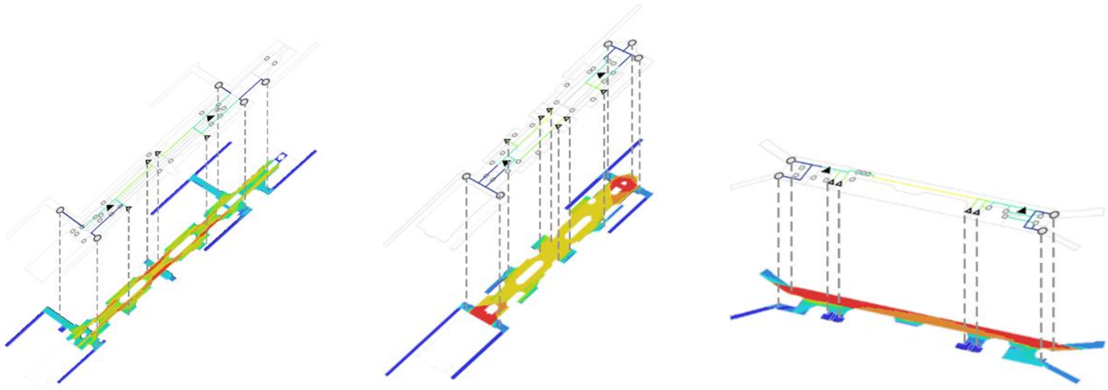


Figure 7.22 Activities involvement within a 30% detour of the nearest connection route from every station entrance/exit to the platforms of Bangkok transit station buildings

According to the analysis results, Saphan Taksin station has more efficient accessibility than the others which the long corridor that connected between the east gate and the west gate. Saphan Taksin station has difference floor plan compare to other stations, and it has only one platform while the other stations have two platform as shown in Figure 7.23. This reason make Saphan Taksin station has the difference spaces and difference circulations inside the station building. However, the long corridor has no function and activity because all the station facilities are located only in east gate and south gate arears. The circulations and activities in this station do not reach passengers through this corridor. It make the spaces around the facilities nodes crowed with the large number of passenger during rush hour that obstruct the accessibility inside the station area. Whereas, the facilities nodes at Mo Chit station and Victory Monument station spread in the station that could spread out the passengers' access to the station facilities and easier to flow the large number of passengers.

To improve the efficiency of accessibility and manageable the passenger, designer should spread the station facilities to reach the passenger through the different circulation that could decrease the concentration of the passengers. This could give passenger convenient access to the station facilities and services in the station area.



(a). Mo Chit Station (b). Victory Monument Station (c). Saphan Taksin Station

Figure 7.23 The accessibility values of space in the station building and accessibility values of the shortest routes between station entrance and the staircases that connect to the platform

7.5 Conclusion

Based on the above analysis of Bangkok transit stations by integration degree, depth value calculation, and analysis of the surrounding areas and building spaces of the transit stations, the accessibility of Bangkok transit stations was analyzed and compared based on the theory of space syntax and Depthmap software. Some basic information, including the available facilities and connectivity modes, was collected for comparative analysis. It was found that facilities and feeder modes may support accessibility. For example, Victory Monument provides more facilities and transfer modes, which improves the convenience of accessibility.

However, the accessibility inside the station buildings, especially the corridor spaces that connect the station buildings and surrounding areas, had low integration values. Therefore, the total depth of the location space plans needed to be low so they could be quickly reached and quickly evacuated. In the layout, corridors and circulation spaces were located in the core area of integration. The entrance gates were crucial to the accessibility of each space, but the connections with the horizontal corridors that connect to the platform should be increased to make it easier to reach. Thereby, the space depth of the free space can be reduced to use higher-intensity areas to improve the convenience of accessibility.

The performance of corridor spaces in transit station buildings identified the connection characteristics among spaces in transit stations through activities along the corridors. Siewwuttanagul, and et al. [93] discussed that corridor space characteristics are investigated for identifying the relationship between activity arrangements and effective transit modes connection route in transit station. Involvement of corridor spaces can integrate transit mode accessibility development solutions toward better connectivity of space usage in station areas to assist passengers during their trips. Conforming to the spatial planning of transport facilities will encourage potential transit mode connections with high-level accessibility integration. The arrangement of activities in corridor spaces was significantly related to the priority of uninterrupted circulation. Major route connections were considered as high circulation areas for accessing particular modes of transport.

Analysis of transit station's accessibility with the road networks and design space in transit stations was conducted to provide a comprehensive data, from which it is possible to make recommendations for future improvements to mass transit station accessibility. The main recommendations are;

1. *Improvement of connectivity around the station*

For the connectivity around the station, the ring road system has higher efficiency accessibility than tandem road system which could reach the passenger's access to the station from different direction. Planner and designer should design the road system around the station as a ring road system. Regarding three stations in this study, there are many tandem roads around Mo Chit station that make unconnected access from one node to another node. The planner should design the connection of the single dead-end route and change it to be the ring road. It could give more convenient access to the station. For Saphan Taksin station and Victory station, some routes that connected to the stations are also the single dead-end route, Bangkok Metropolitan administration should consider with this point that could reduce the traffic problem especially the traffic jam during rush hour around these three stations.

2. *Improvement of accessibility in the station*

The result revealed that Saphan Taksin station has the highest accessibility at the long corridor, but in reality, this corridor lacked a facility and inaccessible to passengers. The design of this station could not reach passenger through this corridor. The station is usually unmanageable of a large number of passengers in the areas around both the station entrances during peak hour because the activity at the facility nodes are obstructed passengers' accessibility. Compare with Mo Chit station and Victory Monument station, both stations have fair accessibility, however, the station's circulation of both stations could spread passengers' access through the facilities along the corridor. Improvement programmes of the company agencies should consider the location of the station's facility that could spread the passengers' access to the station by difference direction. For example, the ticketing machines in and out the station gate should provide at difference node (move the ticketing machines which located inside the station gate to the long corridor area).

To conclude, the results of this research into the transit station's accessibility with the three transfer stations may assist the company agencies and relevant public transit stakeholders to improve the convenient of station's accessibility. It should aim to improve the accessibility quality and could solve the traffic problem around the transit station not only for transit station in Bangkok but also another transit station that have the same station's characteristic.

Chapter 8

Investigating Facilities in Transit Station and Its Effect to Passengers' Activities of Bangkok Mass Transit Node's

8.1 The Functions of Transit Station and Station's Facilities

One of the primary functions of transit station is the provision of facilities so that transit patrons can access the transit station [Metropolitan Council station and support facility]. All transit stations should provide facilities that support access for pedestrians and for all passengers, station platform, waiting shelters for all public transit routes service the station, and provision for short term pick-up/drop-off of transit patrons by shuttle, taxi, etc. Station may also include facilities for additional functions such as transit center, transit layover. The factors to consider in deciding which additional facilities to provide at each station, if any, are existing and future passenger demand, market needs; transit service plans (transit station and other transit service); capital, operating, and maintenance costs, available right of way; and consistency with surrounding development plans and land use policies.

Station functions

The physical factors are important for transit nodes quality, including integration with the surrounding area, different functions and facilities. Based on the research literature, the functions of transit node were classified into three zones: access zone, facilities zone, and transfer zone.

Access zone

The access zone should provide facilities and services for the different user arriving or leaving the interchange. Figure 8.1 shows the functions of access zone.

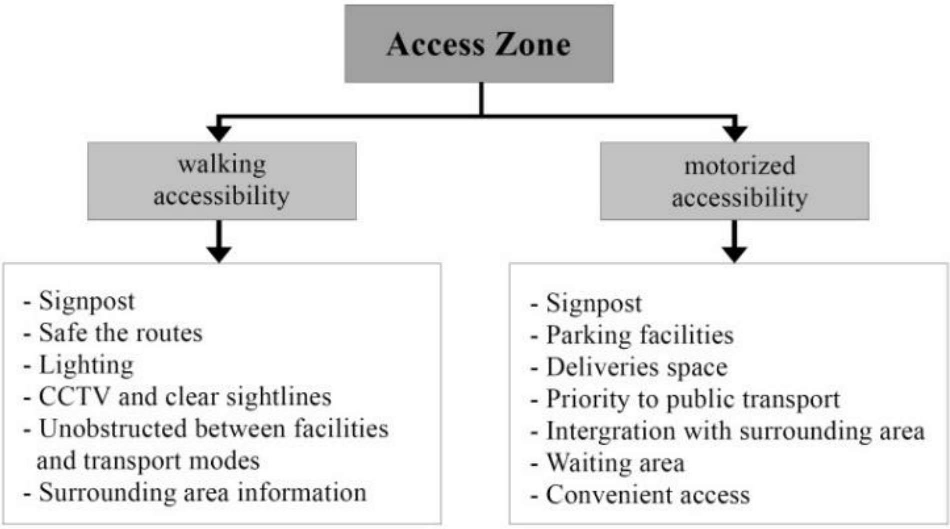


Figure 8.1 The functions of access zone

Facilities zone and transfer zone

The facilities zone is where users who have more time available to spend at the interchange while they wait for their transfer, the facilities should provide in this zone are those that assist safety and security, convenient access, efficient movement, signpost easy for understand and find the way, and also waiting areas should be provided for those waiting for transit modes. Transfer zone is where users will be waiting for transport modes within the transit node, it should be convenient access for all passenger. Figure 8.2 shows the functions of facilities and transfer zone.

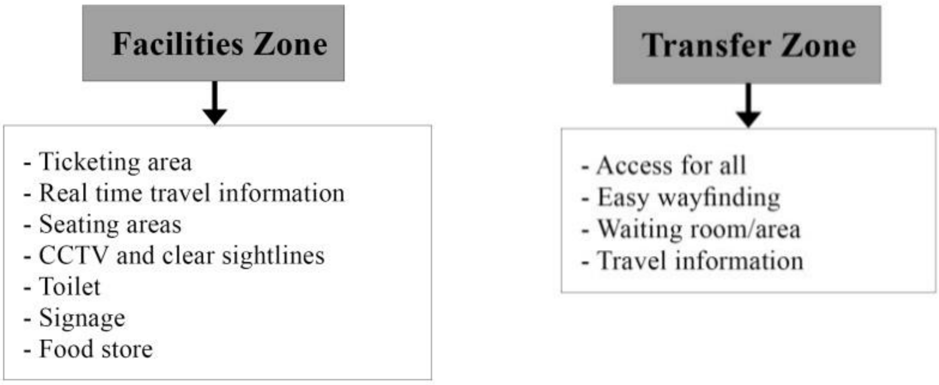


Figure 8.2 The functions of facilities and transfer zone

8.2 The provision of facilities in mass transit nodes

8.2.1 Facilities around the station

Mo Chit station

The areas around Mo Chit station within the distance of 2 kilometer, are the location of Mo Chit Bus Terminal (orange zone) which the biggest bus station in Bangkok connects the North, Central, Eastern, and Northern provinces. Moreover, Bang Sue Railway station, where the largest railway station bound for northern and northeastern Thailand is also located within the distance of 2 kilometer of Mo Chit station as shown in Figure 8.3. The areas around Mo Chit station within the distance of 1 kilometer, Queen Sirikit Park and Wachirabenchatat Park (Figure 8.6) are located at the west north of the station, these are the one of largest park in Bangkok with over 7,000 visitors on weekday and over 17,000 visitors on holiday (May, 2018).

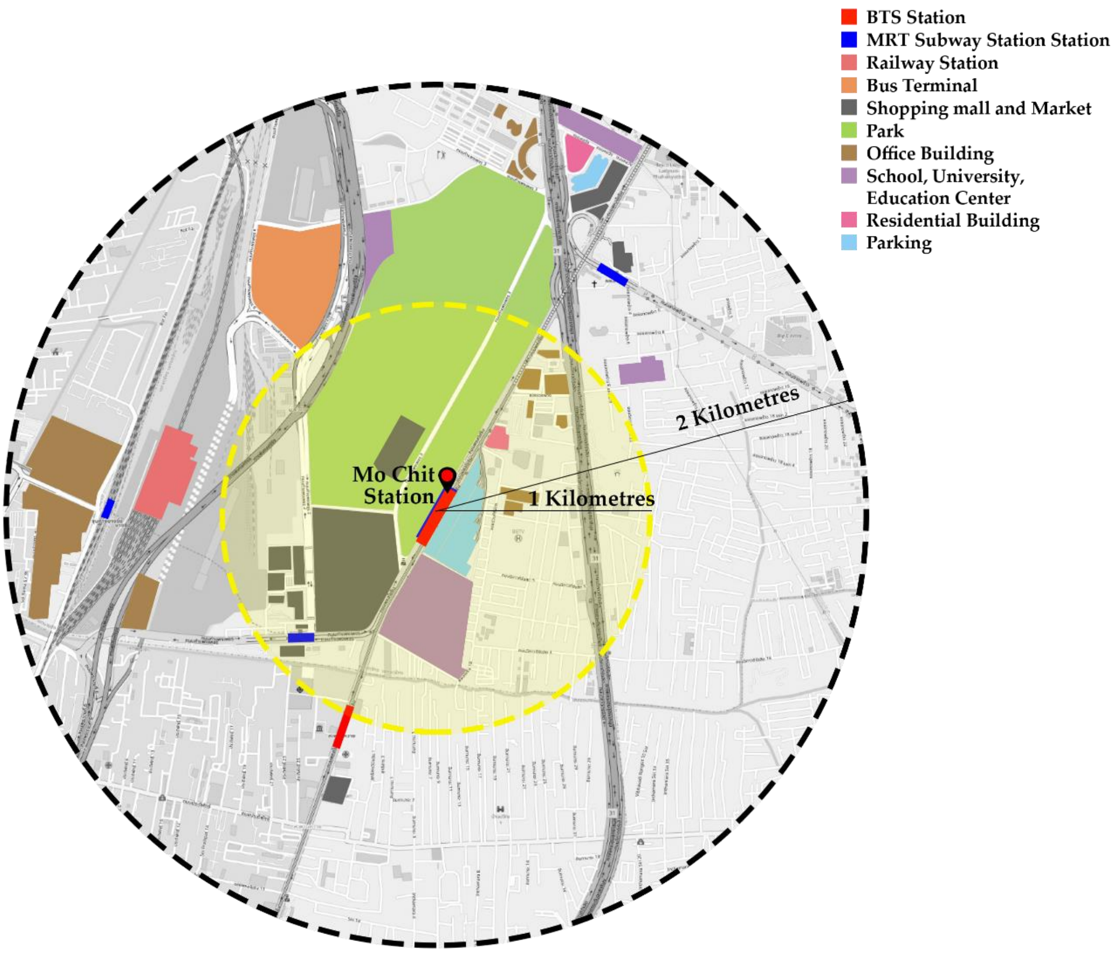


Figure 8.3 Facilities around Mo Chit station within the distance of 2 kilometer

Next to Queen Sirikit Park, Chatuchak Market (Figure 8.4) is located at the south west of the station. It is the largest market in Thailand also known as JJ Market, it has more than 8000 stalls, divided into 27 section. Chatuchak Market sells many different kinds of goods, including plants, antiques, consumer electronics, cosmetics, pets, food and drinks, fresh and dry food, ceramics, furniture and home accessories, clothing, and books. It is the world's largest and most divers weekend market, with over 200,000 – 300,000 visitors on a daily basis [Food and music shops to look out for at Bangkok's Chatuchak Weekend Market". The Straits Times. 23 December 2016]. At the east of station is the location of the large parking area which 1,500 parking lots as shown in Figure 8.5. Many passengers usually park their car at this parking and use the public transit in this station to their destination. The number of the visitors at Queen Sirikit Park, Wachirabenchatat Park, and Chatuchak Market were affect to the number of the passengers at Mo Chit station, most of the visitor are usually use public transit to access these places.

Figure 8.4 Chatuchak Market

Figure 8.5 Parking area at Mo Chit station

Figure 8.6 Activities at Wachirabenchathat Park

Victory Monument station

Victory Monument is the largest interchange of transportation in Bangkok city and suburb areas (Figure 8.9). One of land development in this area is purpose for the commercial uses, many shopping mall and stalls are located around the Victory Monument such as Victory Mall, Center One Shopping Plaza, Century Mall, King Power Complex, The Season Mall, and Fashion Mall (Figure 8.8). The areas around Victory Monument station within the distance of 2 kilometer are surrounded by office building, hospital, apartment and condominium, and hotel. The highlight of this area is the location of 10 leading hospitals include; Bangkok Cancer Specialized Hospital, Phyathai 2 International Hospital, Phramongkutklao Hospital, Queen Sirikit National Institute of Child Health, Rajavithi Hospital, Bhumirajanagarindra Kidney Institute Hospital, Phyathai 1 Hospital, Priest Hospital, Ramathibodi Hospital, and Vichaiyuth Hospital. Moreover, there are also six institutions include; Sri Ayutthaya School, Chitralada School, Wannasorn Tutorial School, Royal Thai Army Nursing College, Phramongkutklao College of Medicine, and The Faculty of Medicine Ramathibodi Hospital of Mahidol University, which more than 4,000 students as shown in Figure 8.7.

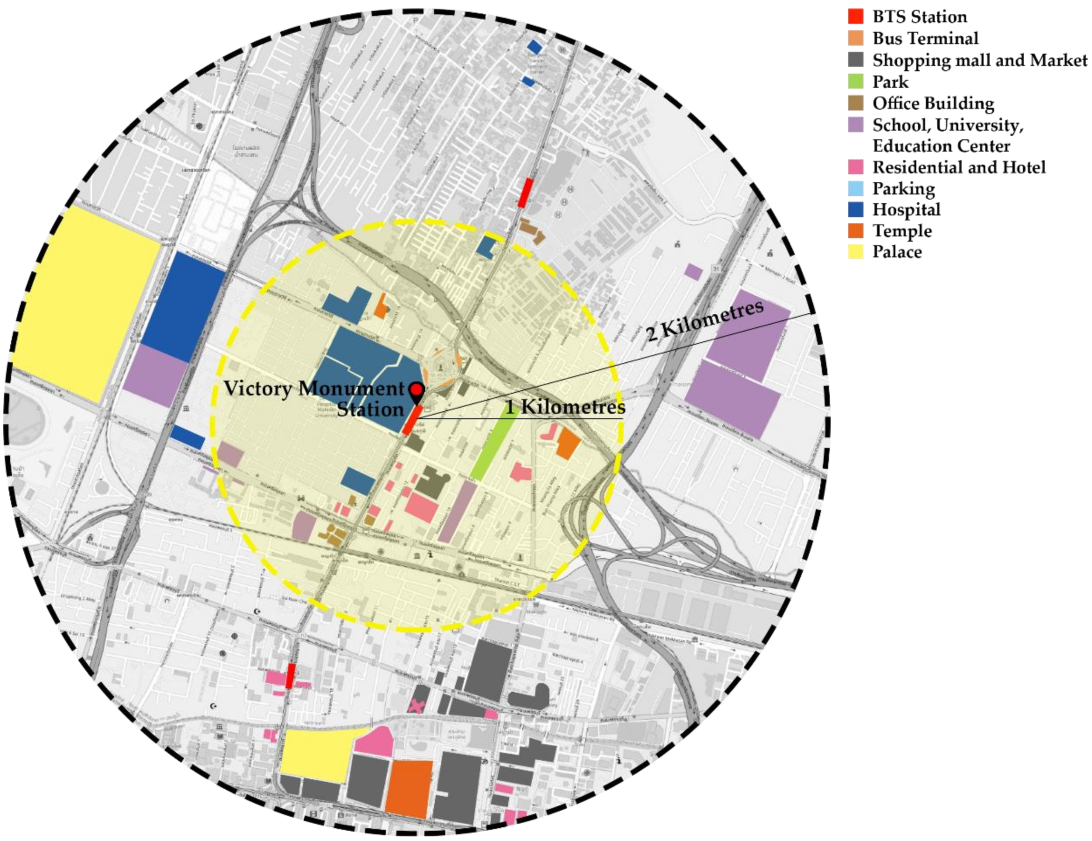


Figure 8.7 Facilities around Victory Monument station within the distance of 2 kilometer

Figure 8.8 Shopping center at Victory Monument

Figure 8.9 Transit condition at Victory Monument

Saphan Taksin station

Many residential buildings, hotels, and institutions are located in the areas around Saphan Taksin station within the distance of 2 kilometer. The station is located in a highly development area with business and commercial uses. Moreover, Sathorn Pier, the central pier in Bangkok is located near Saphan Taksin station which more than 14,000 passengers travelling by river transport transfer at Saphan Taksin station. (Annual report 2016; Statistics related to cargo and passengers' river transport)

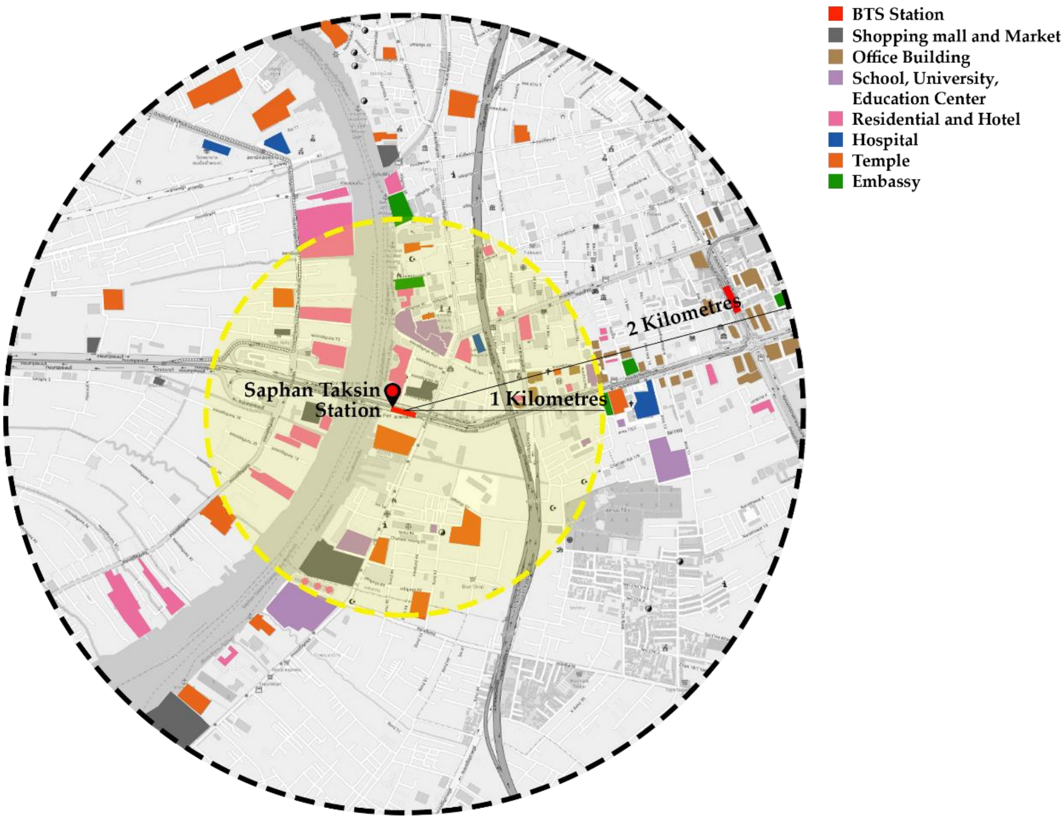


Figure 8.10 Facilities around Saphan Taksin station within the distance of 2 kilometer

Figure 8.11 Sathorn Pier

8.2.2 Facilities and corridor spaces at the station building

Based on data collection and site survey, Mo Chit station was the only one station which provided elevator for disable and wheelchair passengers to access the station building. The survey also found that Saphan Taksin station do not provide the commercial facilities in the station building whereas Mo Chit station and Victory Monument station provide commercial facilities such as the stalls and small retail shops in and out the station gate as shown in Figure 8.12 – 8.14.

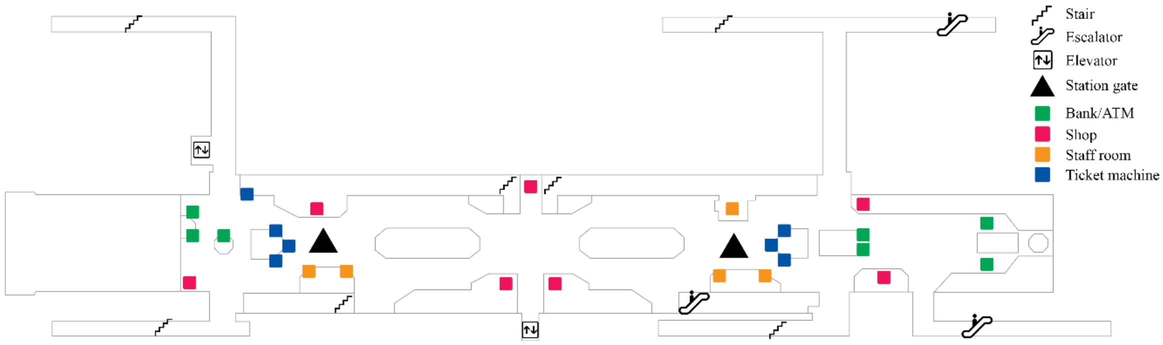


Figure 8.12 The provision of facilities at Mo Chit Station

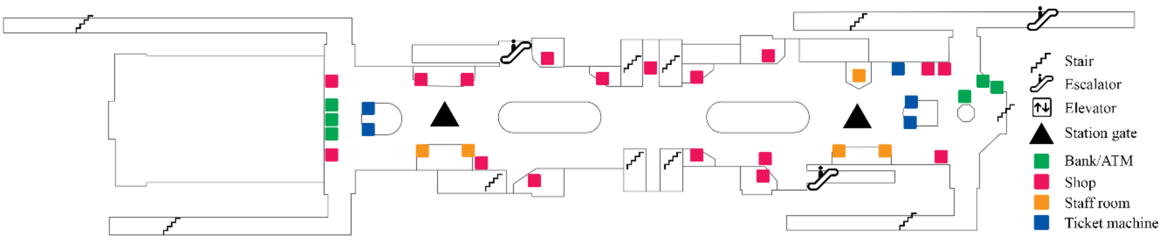


Figure 8.13 The provision of facilities at Victory Monument Station

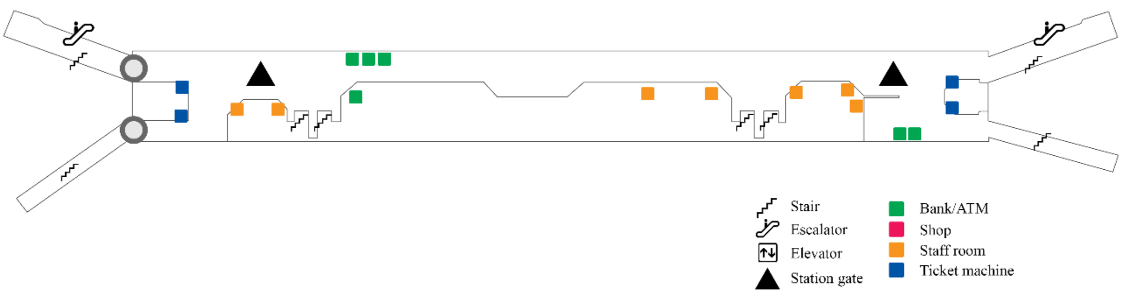


Figure 8.14 The provision of facilities at Saphan Taksin Station

Based on data collection, facilities and activities around transit stations and in the station buildings can divided into three groups by separating the types of corridor space. The corridor spaces in mass transit nodes were identified as three types. An 'area connection corridor' is a walkway connecting between two or more functions. This interprets the connection between transit modes to other areas in the transit station. A ‘commercial corridor’ is a space surrounded by commercial activities, managed to support and attract passengers, and also to make the station a focal point of communities. Some stations copy shopping malls by offering interesting and useful retail outlets as a convenience store, restaurants, cafés, souvenir shops and also Bank/ATM facilities. A ‘facility corridor’ is the primary function of a transit station as the provider of facilities that passengers can access as shown in table 8.1. Station design should naturally lead passengers past a facilities corridor in a logical order and circulation should be obvious and direct.

Table 8.1 The typology of corridor in Bangkok transit station

Corridor Type	Type of activity	Space Type		Circulation type	Station		
		inside	outside		Mo Chit	Victory monument	Saphan Taksin
Area connection corridor	Closed space	√	X	N	√	X	X
	Open space	√	√	N	√	√	√
	Bridge	√	√	N	X	√	X
Commercial corridor	Café/ Souvenir	√	√	W	√	√	X
	Restaurant	√	√	W	√	√	X
	Convenience store/drug store	√	√	W	√	√	X
	Clothes/ Accessories	√	√	W	√	√	X
	Financial (bank/ATM)	√	√	N	√	√	√
Facility corridor	Safety facility	√	√	W	√	√	√
	Ticketing	√		W	√	√	√
	Storage (coin locker)	√	√	N	√	X	X
	Toilets	√	X	W	√	X	X
	Parking	X	√	W	√	X	X

N = non-motorize (human powered transportation includes walking, bicycling, and variants such as small-wheeled)

W = walkway

√ = Available

X = Unavailable

The ratio of space usage in transit nodes are shown in Table 8.2. Transit services at all stations provided basic transportation system facilities such as buses and railways. The ratios of space usage per activity were different. Commercial activity in Mo Chit station offered the highest use of space at 62% followed by transit facilities at 23% and other services occupying 15%. Victory Monument also offered the highest use of space for commercial activities at 55% followed by transit facilities at 41% and other services only 4%. Meanwhile, transit facilities in Saphan Taksin station offered the highest use of space at 56% followed by commercial activities at 31% and other service occupying 13%.

Table 8.2 The ratio of space use in transit nodes within distance of 500 meters

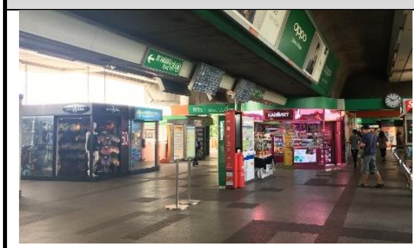
Stations	Ratio of space use in station (Percentage)		
	Commercial	Transit facilities	Other services
Mo Chit	62%	23%	15%
Victory Monument	55%	41%	4%
Saphan Taksin	31%	56%	13%

The types of activity and explanations of architectural space elements as shown on tables 8.3, 8.4, and 8.5. Mo chit station and Victory monument station had variety of commercial activities in the station area attracting more passenger into the commercial corridor.

Commercial corridor

Commercial corridor is the area along the circulation which primarily composed of commercial activities. Victory Monument station has the highest percentage of commercial space used among Bangkok mass transit node’s station. There are several types of commercial activities that being occupy in three station. Table 8.3 identified the use of commercial activities which found in three station areas. The commercial activities classified into five types such as clothes & accessibilities, restaurant, café & souvenir, convenience store, and financial. Passenger movement in the commercial corridor was directly connected to the main circulation. Financial facilities were located in unoccupied more secure areas than other commercial facilities.

Table 8.3 Commercial corridor spaces in Bangkok transit station

Corridor space	Station	Type of activity	Explanation
	Mo chit	Clothes/ Accessories	The space in this corridor is located in the main circulation, sometimes obstruct the movement during peak hours. Activities include shopping for clothes and accessories.

 	Victory Monument	Restaurant	Space in the corridor provides a seating area for restaurant function with activity time longer than other areas. This corridor is located in sub-circulation and does not obstruct movement of the main circulation.
	Mo chit	Café/ Souvenir	Café activity was found in a selected station, also souvenir shop was not found in all station.
	Victory Monument	Convenience store	Convenient stores are usually situated near areas of main circulation with easy passenger access. Activities in convenience store areas take little time. Space design of this corridor allows passengers convenient access to the shops. In larger stations, convenient stores may be located in sub-circulation areas so as not to interfere with the main circulation during rush hours.
	Saphan Taksin	Financial (Bank/ATM)	Unoccupied secure spaces are mostly used for ATM's not located in the main circulation space. Activities in this corridor need more security than others. The ATM corridor is designed to make passengers feel safe and secure.
	Mo chit		

Area connecting corridor

Area connection corridor is where the walkway connects between two or more functions. This interpret the connection between transit modes to other areas in the transit station or between each transit modes. The main access routes to station building and platforms were area connecting corridors which provided convenient access to the station as shown in table 8.4.

Table 8.4 Area connecting corridor spaces in Bangkok transit station

Corridor space	Station	Type of activity	Explanation
	Victory monument	Open space	The open space courtyard can be inside or outside the building. This corridor is usually a gathering place and event location. Circulation in this area are various and uncontrollable, the circulation route depends on passenger availability.
	Mo chit		
	Victory Monument	Bridge	Bridge corridor connects between station entrance and the surrounding areas such as shopping street and other building. Some corridors are connected to main access points of station such as Victory Monument station.
	Saphan Taksin	Connecting/ Close space	This corridor is a pathway that connects different corridors or transit node as a walkway, it can be inside or outside the station. Circulation characteristics are linear and designed to optimize flow.
	Mo chit		

Facilities corridor

Facility corridor in provided necessary amenities for a particular purpose which support passengers during their trip. According to the site survey, facility corridors were located in the main circulation areas and provided three activities that support passenger's trip other than commercial activities such as ticketing facility, storage, and security check which classified the detail in table 8.5.

Table 8.5 Facilities corridor spaces in Bangkok transit station

Corridor space	**Station**	**Type of activity**	**Explanation**
	Victory Monument	Ticketing	Space in the main circulation of station area usually provide ticketing function. Circulation designs naturally lead passengers here and it is often located near the station gate.
	Mo chit		
	Mo chit	Storage	Storage corridors are located in the sub-circulation area or connection corridors. Only a few stations in Bangkok provide storage facility.
	Saphan Taksin	Security check	All the selected stations provide security check located near each station entrance.

From the survey results, the station designs should promote both the free flow of passengers through public areas and reasonable comfort in waiting areas, while promoting a feeling of security. Sufficient space should provided for all activities, without conflict. Space designs should allow an envelope of space around each item of hardware such as a ticket machine, seat or elevator to take a value of passenger circulation.

The commercial corridor spaces design has limitation to create space, activities in this corridor should not conflict with through flows. The commercial corridor spaces are not the main function for the station, but there are the second activities to get profit from the rent of shop. In this respect design of stations differs from that of commercial areas premises, since the aim is not to tempt through flows to slow down and browse (obviously passengers can be tempted to leave the main flow). Commercial areas have basic templates for the concept such as convenience store and restaurant, and they may superimposed on station premises. The design of the retail space needs to lead customers past the sales displays and their way from the main circulation to the booking office. For station convenience stores to introduced successfully, quality retail space must designed into the public area.

The area connection corridor spaces design should provide the large space for carrying a large number of passenger in rush hour or peak time. The activities in this corridor sometimes were event location, but the activities in the event should not interfere the main circulation of the station because sometimes it is an advantage to overcome the problem of users while they using the station. The facility corridor spaces have a limitation in the area space such as toilet, as some big station did not provide enough toilet. It has an effect on the long queues while passenger transfer from one to another transit could not get off from the station area. The toilets are mostly located in the main circulation, the queues are sometimes obstructing the main circulation while having high density in the station area.

Circulation of station designs should naturally lead passengers past facilities such as ticket selling facilities in a logical order. Routes should be obvious and direct, requiring minimal walking distances. Passengers must be able to circulate freely when moving between the different activities points, such as the entrance, ticket machine, and automatic ticket barrier. All the activities should not conflict with through flows in other activities and should not obstruct the main circulation. Also, the relationships with other activities are important to note whether or not the timings overlap, since if not certain areas may be devoted to two or more non-conflicting uses. Using one-way routes cause higher capacities, provided that flows can be managed to use the space efficiently. Where a station is operating close to capacity, it is advisable to separate small opposing flows from the main flow, indicating the adoption of a one-way system - separate entry and exit. Even small routing can disrupt the main flow, so one-way systems should only be introduced where they can managed the passenger flow.

8.3 Examining passenger satisfaction based on group of activities at transit station and the provision of facilities

For this section, six facilities aspect of transit station (the number and variety of shops, car parking, ticket buying, the provision of shelter, availability of seats, and toilet) and six groups by separating the activities of passengers at transit station (wait for transfer, study, shopping, meeting, eating, and other) are conducted to investigate passengers' satisfaction. This analysis based on the assumption that different station and the provision of facilities might show different satisfaction. The six questions from questionnaire survey of 450 samples in Mo Chit station, Victory Monument station, and Saphan Taksin station, which had been used for analysis in Chapter 4 and 5, were applied.

The hypothesis testing was analyzed by Independent-Samples, T-Test, and One-Way ANOVA.

Hypothesis

<u>The provisions of facilities by Independent-Samples T-Test</u>:

H1 : The provision of facilities variables affect on different passenger satisfaction in statistical significant.

H0 : The provision of facilities variables no affect on different passenger satisfaction in statistical significant.

<u>Different groups of activities at transit station by One-Way ANOVA</u>:

H1 : Different group variables affect on different passenger satisfaction in statistical significant.

H0 : Hi : Different group variables no affect on different passenger satisfaction in statistical significant.

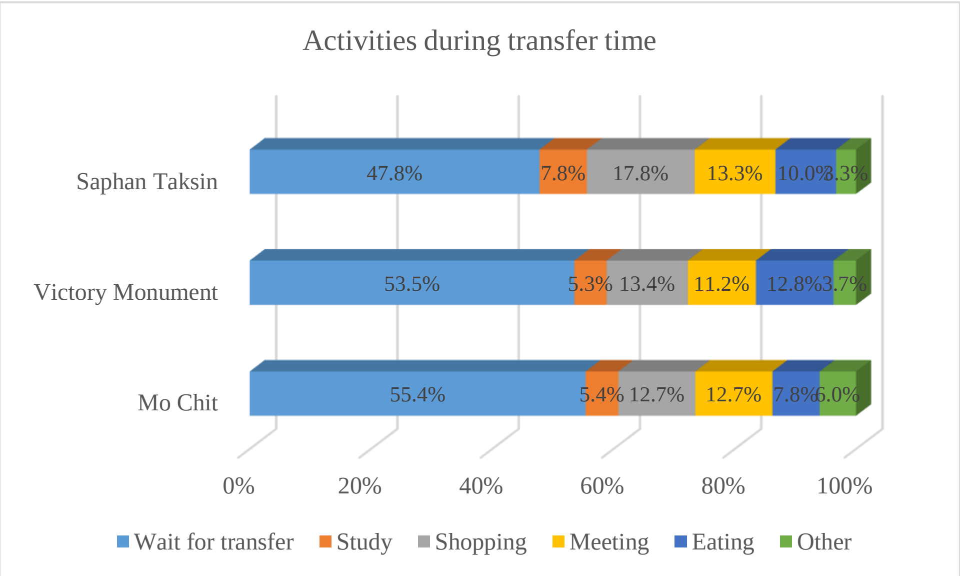


Figure 8.15 Percentage of respondents on activities during their transfer

Table 8.6 Mean score of passengers' satisfaction with different facilities aspects

Accessibility satisfaction	Acti-vity	Mo Chit station				Victory Monument station				Saphan Taksin station			
		$\bar{X}$	SD	f	P-value	$\bar{X}$	SD	f	P-value	$\bar{X}$	SD	f	P-value
The number and variety of shops in the transfer station	A	2.89	0.718	0.868	0.354	3.00	0.802	6.870	0.009*	2.65	0.889	4.971	0.029*
	B	3.00	1.000			2.60	1.046			3.63	0.934		
	C	3.05	0.973			3.32	0.844			2.86	1.268		
	D	3.00	0.632			3.00	0.541			3.00	0.923		
	E	3.23	0.832			3.13	0.926			2.56	0.504		
	F	3.10	0.568			2.86	1.027			3.00	0.853		
Facilities for car parking	A	2.78	0.836	0.001	0.982	2.06	0.734	0.055	0.815	3.00	0.918	0.166	0.684
	B	2.67	0.866			2.80	0.768			3.31	0.852		
	C	2.52	0.981			3.20	0.699			2.86	1.146		
	D	2.95	0.973			3.14	0.647			2.75	1.021		
	E	3.15	1.143			3.17	0.694			3.22	0.422		
	F	1.90	0.738			2.71	0.469			3.33	0.985		
Ticket buying facilities	A	2.83	1.012	0.524	0.471	3.11	0.881	1.621	0.204	2.81	0.924	2.065	0.155
	B	2.56	1.130			3.30	0.470			3.06	0.664		
	C	2.71	0.717			3.20	0.857			2.86	0.848		
	D	3.19	1.030			3.28	0.774			3.25	1.101		
	E	3.15	1.281			3.29	0.988			2.89	0.887		
	F	2.20	1.229			2.71	0.726			3.33	0.985		
The provision of shelter facilities	A	2.90	0.813	3.133	0.080	2.96	0.788	1.446	0.231	2.77	1.011	4.321	0.041*
	B	2.56	1.240			3.10	0.552			3.19	0.639		
	C	2.57	0.870			3.16	0.681			2.86	0.848		
	D	3.00	1.183			3.09	0.692			2.75	1.176		
	E	3.00	1.000			3.25	0.729			3.11	0.747		
	F	2.30	1.059			2.71	0.469			2.33	0.492		
Availability of seats in the waiting area	A	2.64	0.897	1.354	0.247	2.90	0.833	0.001	0.978	2.74	1.105	9.714	0.003*
	B	2.22	1.301			2.90	0.852			3.06	0.664		
	C	2.38	1.071			3.16	0.738			2.71	0.713		
	D	2.71	0.956			2.95	0.909			2.25	1.101		
	E	3.08	0.954			3.13	0.733			2.89	0.747		
	F	2.20	1.135			2.86	0.663			2.67	0.492		
The toilet facilities	A	2.41	1.081	1.886	0.173	2.86	1.032	0.045	0.832	2.56	1.191	9.745	0.000*
	B	2.00	0.866			2.90	1.071			2.69	0.687		
	C	2.14	0.910			3.08	0.804			3.00	1.089		
	D	2.81	1.123			2.95	0.962			2.25	1.101		
	E	2.85	1.281			3.00	0.875			2.78	1.149		
	F	1.40	0.699			2.43	0.756			3.00	0.853		

A: Wait for transfer, B: Study, C: Shopping, D: Meeting, E: Eating, F: Other

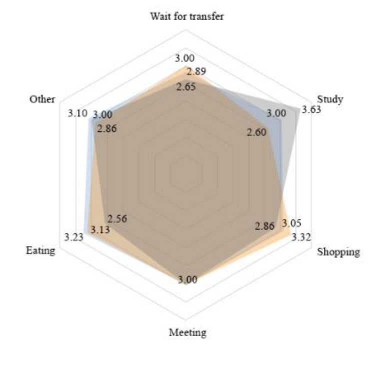
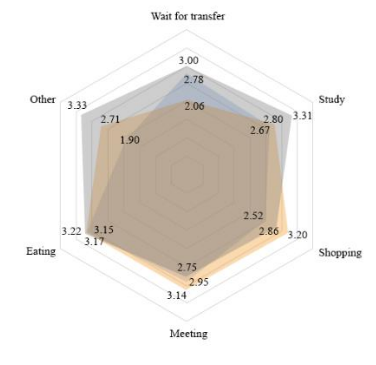
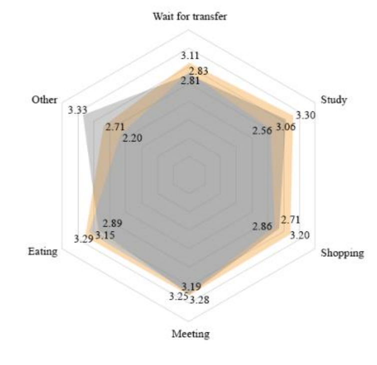
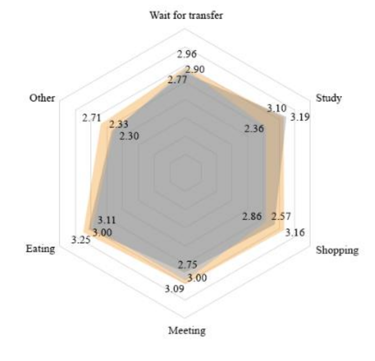
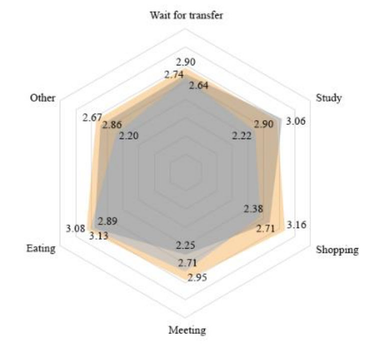
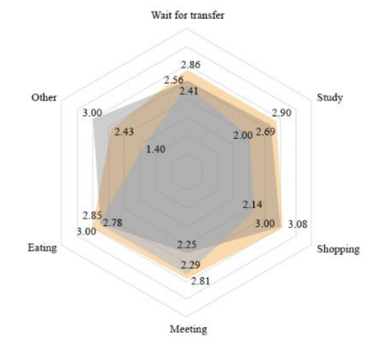
* Significant at the 0.05 level/ and there is relationship at least between groups

**Satisfied level: 1.00 – 1.50 = Highly Dissatisfied, 1.51- 2.50 = Dissatisfied, 2.51- 3.50 = Fair satisfied, 3.51 – 4.50 = Satisfied, 4.51 -5.00 = Highly satisfied

As shown in Figure 8.15, it was revealed that the majority of activities of Mo Chit station, Victory Monument station, and Saphan Taksin station were ‘wait for transfer’ by representing 55.4%, 53.5%, and 47.8%, followed by ‘shopping’ were 12.7%, 13.4%, and 17.8%, respectively. Table 8.6, an independent-samples t-test was conducted passengers’ satisfaction based on type of passengers’ activities of three stations. The results found there was difference between the groups of the number and variety of shops at 0.009 of Victory Monument station and 0.029 of Saphan Taksin station. The provision of shelter facilities, availability of seats in the waiting area, and toilet facilities showed difference between the groups at statistical significant at 0.041, 0.003, and 0.000 of Saphan Taksin station, respectively.

For testing passengers’ satisfaction level among groups of activities during their transfer dividing groups into six independent groups, a One-Way ANOVA is used to understand these variables. The result found that the passenger satisfaction on the toilet facilities was not a significant difference in the scores by F-test > 0.05 as shown in Table 8.6. There were five dependents; the number and variety of shops in the transfer station, facilities for car parking, ticket buying facilities, the provision of shelter facilities, and availability of seats in the waiting area showing statistically significant difference between groups by F-test < 0.05. Then, determining which of these groups differ from each other is important. Using a post-hoc test by Scheffe method found passengers’ satisfaction in the number and variety of shops in the transfer station aspect of Group A was a statistically significant difference between groups at 0.000 and 0.016 by score higher than B and C, also Group B was a statistically significant difference between groups that less than 0.05. The passengers’ satisfaction in facilities for car parking of Group B and E were a statistically significant difference by score higher than Group F. The passengers’ satisfaction in ticket buying facilities of Group A was a statistically significant difference between groups that less than 0.05. The passengers’ satisfaction in the provision of shelter facilities of Group B and E were a statistically significant difference between groups at 0.006 and 0.000 by score higher than F, while Group A was a statistically significant difference by score higher than Group E. For availability of seats in the waiting area, the passengers’ satisfaction of Group D was a statistically significant difference between groups at 0.031 by score higher than group E. These above results can be interpreted that the provision of facilities at transit station in term of the physical conditions which Group A, B, D and E have been done (Table 8.7), the passengers’ satisfaction as well as their preferences was higher than another group.

Table 8.7 Mean score of passengers with six groups of facilities at three station

<table>
<tr><th>The number and variety of shops in the transfer station</th><th>Facilities for car parking</th><th>Ticket buying facilities</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>F-test = 7.041 (Sig .000)</td><td>F-test = 2.955 (Sig .012)</td><td>F-test = 2.729 (Sig .019)</td></tr>
<tr><td>Group A Group B Sig .000
Group C Sig .016
Group B Group E Sig .005</td><td>Group B Group F Sig .022
Group E Group F Sig .015</td><td>Group A Group D Sig .029
Group D Group F Sig .038</td></tr>
<tr><th>The provision of shelter facilities</th><th>Availability of seats in the waiting area</th><th>The toilet facilities</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
<tr><td>F-test = 4.385 (Sig .001)</td><td>F-test = 2.851 (Sig .015)</td><td>F-test = 2.004 (Sig .076)</td></tr>
<tr><td>Group A Group E Sig .030
Group B Group F Sig .006
Group E Group F Sig .000</td><td>Group D Group E Sig .031</td><td>No different between groups</td></tr>
</table>

Mo Chit Station
Victory Monument Station
Saphan Taksin Station

A: Wait for transfer, B: Study, C: Shopping, D: Meeting, E: Eating, F: Other

* Significant at the 0.05 level/ and there is relationship at least between two groups

8.4 Conclusion

Chapter 8 analyzes the facilities around transit station at station building of Mo Chit station, Victory Monument station, and Saphan Taksin station to encourage passengers' satisfaction. The analysis process based on the provision of facilities around the station and in the station building survey, and interview passengers. It found five dependents; the number and variety of shops in the transfer station, facilities for car parking, ticket buying facilities, the provision of shelter facilities, and availability of seats in the waiting showing statistically significant difference between groups. It could be noted that the provision of facilities would be reflect high score of passengers' satisfaction.

Based on survey and measuring passengers' satisfaction with the provision of facilities of three stations were conducted to provide a comprehensive data set, from which it is possible to make recommendations for future improvements to transit station's facilities. The seven main recommendation for facilities are;

1. Improvement of Pedestrian and bicycle access

Special attention should be given to provide convenient and safe access to and through transit station for people walking, in wheelchairs, and on bicycles. Bicycle parking should be provided at transit station. Pedestrian access paths to transit station should be visible from access drives and parking areas, avoid crossing or passing through vehicular access drives. Pedestrian and bicycle paths should be designed to provide the most direct route, paved, clearly marked, lighted, and buffered to improve bicycle and pedestrian experience and discourage people from crossing tracks or roadways in other than designated areas.

2. Improvement of Passenger waiting area with weather shelter

Together with platforms, passenger waiting area function as primary features of a transit station. All transit stations should provide one or more weather shelters for waiting passengers. Shelters and canopies should provide protection for passengers from rain, wind, and sun. Shelters are generally free-standing structures, but may be incorporated into other buildings. Shelter design should consider passenger safety, passenger comfort, functional similarity, and ease of maintenance. Factors to consider in sizing shelters include average peak period passenger usage, length of average wait time, location-specific conditions such as wind, and optimized sight lines. Shelters should be designed to maximize the benefit of overhead radiant heat, where heat is provided. Shelters should not impede passenger circulation and ease of movement to platforms. At transfer points, sheltered waiting areas should be provided for all connection transit passengers at the locations of the connections.

3. Improvement of Seating

Seats allow passengers to wait in more comfort, particularly if waiting times are longer. An adequate number of seats are required on concourses and platforms, sufficient to accommodate the passengers not waiting elsewhere, and a proportion of short-distance travelers.

Seating may be located in front of the large station name signs located on platforms, but should never be placed in front of route maps, timetables, advertisements or other 'information'. Where this guideline is ignored, passengers seeking to read maps or posters are forced to look right across other, seated passengers – behavior that is inconsiderate and sometimes threatening. Seats must always be fixed to the permanent structure of the station. Otherwise vandals will, eventually, throw seats onto the track. The same qualification applies to all 'movable' platform furniture.

4. Improvement of Ticket sales

Tickets may be sold in a different number of ways, both on and off the station. The options include staffed ticket offices or station ticket machines, conductors on board trains, travel agents, shops, telesales and from the internet.

Ticket machines have traditionally been seen as means of either relieving pressure on staffed ticket offices at busy stations or providing a basic sales facility at quieter stations where staffing is not justified for some or all of the traffic day. Machines are generally only able to sell a limited range of tickets in terms of types and destinations. However, ticket machines are not suited to very quiet or remote locations, owing to the logistics of emptying them of cash and the risk of their being broken into by thieves.

5. Improvement of Transit information

One of the most important functions of the transit station is the provision of transit information. Signage should be designed to clearly guide passengers to and through the station and its functions, including passengers who are not familiar with the transit system, with disabilities, who are non-native language speakers, and those who can't read. The placement and general content of signage should be consistent within station areas whenever possible.

Station signage may include some or all types of signage:

- Static; permanent signage of text and graphic map
- Changeable/variable; printed information on routes, service times which may change and be updated by replacing hard copy material within protected display areas
- Real time; electronic information providing current information on next train or bus, rout number and emergency conditions.

6. Improvement of Commercial

Passengers also value the provision of retail facilities, which materially add to the value of journeys by rapid train and train. To an appreciable extent, transportation companies need to be aware what combination of retail most benefits passengers, and therefore enhances the core transport business. Whilst the free market is able to deliver a satisfactory package (in other words, a varied mix that satisfies passengers and generates worthwhile rental income) at larger stations, policy decisions may be required in other areas.

7. Improvement of Toilets Facility

Toilets are a problem area. Although they provide for the regular and unavoidable bodily functions of passengers, they are frequently vandalized, and may be used by drug dealers and addicts. Many railway operators, therefore, regard toilets as a burden.

Passengers, meanwhile, are dissatisfied. Too many toilet are dingy, dirty and vandalized. Too often toilets are closed due to 'lack of staff', or vandalism. The traditional solution (other than simply closing the toilet) is to refurbish using the most robust finishes and fitting possible, typically ceramic tiles and stainless steel throughout. Combined with a proper maintenance and cleaning regime, reasonable success may be obtained at staffed stations.

Toilets should lead from busy, well-lit areas where a staff presence is maintained. This will minimize the potential for misuse of toilets. Obviously CCTV surveillance is not practical within toilets; however, the practice of locking the entrance door open (privacy inside being protected by a suitable screen wall) so that staff outside can hear vandalism taking place inside should be considered.

So, this chapter has provide insight of transit node's station through the provision of facilities which could be useful for provide the facilities in transit station in Bangkok.

Chapter 9

Conclusion and Recommendation

9.1 Summary of Research Study

This section has drawn a summarized result of analysis mass transit node's station improvement based on passenger evaluation. The summary of this research starts with a crucial issue of mass transit system in Thailand. Research methods and importance results of investigation also pointed out a significant factor to be involved in mass transit node improvement. Finally, a future direction for studying on this topic is combined with this part.

Bangkok, the capital of Thailand, is experiencing an imbalance between demand and supply of urban mass transit. Bangkok is facing a transportation problem, especially Bangkok seems to have an urban transit system in which urban and transport planning is not necessarily executed in the interest of the people in terms of public transport that because Bangkok suffers from many standalone projects across the city, which can cause troubles with urban design efficiency. The provision of rapid transit to serve people as mass transit mode could not solve transport issues in Bangkok. Transit node is one of the issues that should be addressed as soon as possible, as it is one of the most important aspects of mass transit system. While mass transit system is in a poor condition, few studies have been conducted only on evaluating the land use development and environment around transit station. It could be mentioned that the mass transit system issue in Thailand is still be seriously condition to deal with quality of transit especially in mass transit nodes, the critical part of mass transit system. From literature review of mass transit development in Thailand and theoretical of passengers evaluation and satisfaction based on the previous studied, this research has extent passengers evaluation as an important identification method for providing key influence factors of mass transit node improvement approaches in six aspects (service, safety, environment, accessibility, operation, and facilities). The purpose of this research was that the results would complement mass transit node research in Thailand and hence contribute to the decision-making and policy formulation of future mass transit policy and improvement initiatives. Mo Chit station, Victory Monument station, and Saphan Taksin station are the case study by collection data through a questionnaire survey of 450 samples as the first step of identifying influenced factor of six aspects. Then, a statistical method by using SPSS program was employed to analysis. Based on 46 variables, the process logistic regression has let us knows the influence variables which are the highest beta coefficient value for predicting high satisfaction of Mo Chit station, Victory Monument station, Saphan Taksin station. Therefore, considering these variables into mass transit node improvement plan would be contributing high satisfaction level of passenger with six approaches. The frequency of the train (B = 0.334), ticket fare (B = 0.207), and emergency information (B = 0.197) contribute high satisfaction of transit service for Mo Chit station. Safety in and out the transfer station (B = 0.401), the reliability in safety systems of the transfer station (B = 0.205), and night time security from crime (B = 0.352) play a role in contributing satisfaction with safety aspect. In term of environment satisfaction, air quality and pollution in the area surrounding the transfer station (B = 0.238), interior design of the transfer station (B = 0.205), and temperature inside the transfer station (B = 0.229) created a high beta value which contributed to satisfaction. Meanwhile, rush hour inside the transfer station (B = 0.185) and get on/off from platform to vehicle (B = 0.284) had positive beta value of accessibility. Regarding operation aspect satisfaction, the maintenance of train and transportation company deals with delays showed positive coefficient value (B = 0.219 and 0.295, respectively). Facilities for car parking, ticket buying facilities, availability of seats in the waiting area, and toilet facilities showed positive coefficient values of 0.233, 0.332, 0.227, and 0.167, respectively. For Victory Monument station, the punctuality of the vehicle time (B = 0.345), availability during night time (B = 0.144), comfort of information in the station (B = 0.316), and the number and variety of shops in the transfer station (B = 0.202) play role in contributing satisfaction with transit service. Meanwhile, safety in and out the transfer station and night time security from crime had positive beta values of safety (B = 0.225 and 0.273, respectively). Regarding environment satisfaction, exterior design of the transfer station and the temperature inside the transfer station showed positive coefficient values (B = 0.128 and 0.357). Connection with other public transport systems (B = 0.230) and get on/off from platform to vehicle (B = 0.435) contribute high satisfaction of accessibility. In term of operation satisfaction, the maintenance of the bus (B = 0.351), the attitudes and helpfulness of the staff (B = 0.220), and transportation company deals with delays (B = 0.196) created a high beta value which contributed to satisfaction. Facilities for car parking, ticket buying facilities, the provision of shelter facilities, and the toilet facilities showed positive coefficient values of 0.107, 0.244, 0.141, and 0.343, respectively. In case of Saphan Taksin station, the punctuality of the vehicle time (B = 0.313), the frequency of the train (B = 0.148), availability during night time (B = 0.241), and comfort of information in the station (B = 0.180) contribute high satisfaction of service. In term of safety satisfaction, safety in and out the transfer station (B = 0.259), the reliability in safety systems of the transfer station (B = 0.147), the safety of the areas surrounding the transfer station (B = 0.136), and night time security from crime (B = 0.133) created a high beta value which contributed to satisfaction. Regarding environment aspect satisfaction, air quality and pollution in the area surrounding the transfer station, air quality and pollution in the transfer station, and cleanliness of the transfer station showed positive coefficient value (B = 0.282, 0.352, and 0.141, respectively). Number of elevators (B = 0.186), number of stairs (B = 0.104), distance from the entrance of the station to the platforms (B = 0.108), and the easiness of being able to get on/off from platform to vehicle (B = 0.548) play role in contributing satisfaction with transit service. Meanwhile, the maintenance of the station building, the maintenance of the bus, the passenger managing system in the transfer station, the attitudes and helpfulness of the staff, and transportation company deals with delays had positive beta values of operation (B = 0.227 and 0.178, 0.181, 0.191, and 0.277, respectively). Facilities for car parking and the toilet facilities showed positive coefficient values of 0.303 and 0.375.

Based on the influenced factor of six aspects, the more investigated analysis was conducted with three influence factors including service, accessibility, and facilities. A basic of mass transit node service and the potential of feeder modes at transit nodes' station were investigated to explore the effects of passengers' satisfaction on the different types of feeder mode to attitudes concerning mass transit connectivity among passenger's income levels. The result indicates that people especially in middle and high income level prefer fast and flexible of access to transit node stations. All passengers dissatisfied to bus and Songtaew; nevertheless, it shows positive influences to mass transit connectivity satisfaction for all service measurements. The improvements regarding safety and security are required not only driving quality of all feeder modes, as it shows the negative effect to the connectivity, but also the vehicle condition and safety equipment of all feeder modes. This result of the study can fulfil the condition of the connectivity at transit node to relevant authorities of public transit to concern their improving transit station that could make a positive impact for the better connectivity at transit node. In term of accessibility, accessibility has been evaluate and compare a performance across Bangkok's mass transit nodes station and to interpret transit mode connection behavior according to the road systems on an urban scale and the design space in the architectural aspect. It was found that facilities and feeder modes may support accessibility. For example, Victory Monument provides more facilities and transfer modes, which improves the convenience of accessibility. However, the accessibility inside the station buildings, especially the corridor spaces that connect the station buildings and surrounding areas, had low integration values which mean low accessibility performance. The connections with the horizontal corridors that connect to the platform should be increased to make it easier to reach. The result should aim to improve the accessibility quality and could solve the traffic problem around the transit node station. Finally, the provision of facilities was analyzed based on the provision of facilities around the station and in the station building survey, and interview passengers. It found five dependents; the number and variety of shops in the transfer station, facilities for car parking, ticket buying facilities, the provision of shelter facilities, and availability of seats in the waiting showing statistically significant difference between groups. It could be noted that the provision of facilities would be reflect high score of passengers' satisfaction.

9.2 Recommendation

According to analysis results and literature review, to improve passenger's satisfaction based on six aspects should focus on the following;

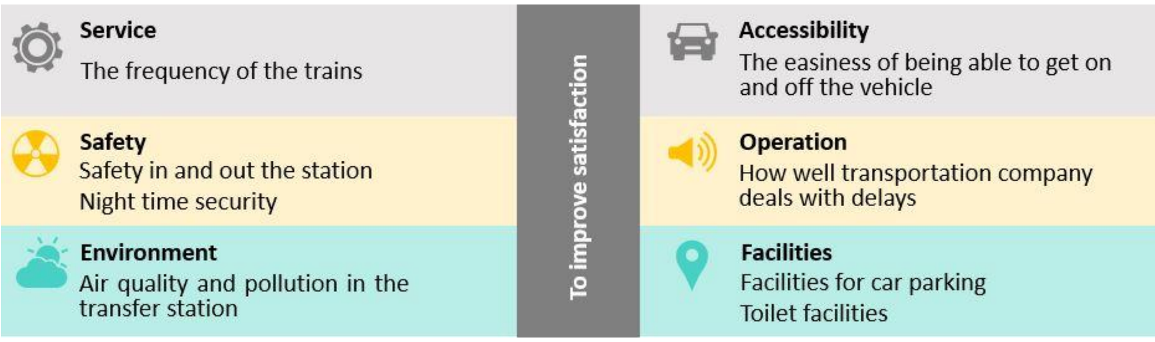


Figure 9.1 The important factors to improve passenger's satisfaction

In term of accessibility, it should be considerate the location of the station's facility. Spread the station facilities to reach the passenger through the different circulation that could decrease the concentration of the passengers. Make the passenger convenient access to the station facilities and services in the station area. The connectivity around the stations should design as the Ring road which high accessibility value that can reach the passenger's access to the station from different direction.

The development of Japanese's transit stations are the good example to improve the quality of transit station thereby improve facilities of terminal station, develop over-track site effectively, integration of multi transit modes, more accessible and convenient terminal, and promote urban mode transportation using railway and expressway bus.

The results of research into the influenced factors of case study may assist the authorities of public transit to prioritize specific actions. This result enables analytical platform of in-depth mass transit node study to identify the way in improving the quality of transit for passengers through convenient access and service condition.

9.3 Further Research

The research that has been undertaken for this thesis has highlighted a key point which further research would be beneficial. The mass transit node stations should be examined in details of six aspects. Especially, the influenced factor that contributes passengers' satisfaction might be different aspect of Mo Chit station, Victory Monument station, and Saphan Taksin station. Feeder modes connectivity and accessibility to transit node's station should be studied how also directly affects property value as impact to a choosing feeder based on the distance between the origin to transit station, and transit station to the destination. Finally, the provision of facilities could be a highlight on a characteristic of each transit node and transit station and compare with mass transit station in developed country that what is differences in term of mass transit node management based on six main aspects.

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Appendix

Questionnaire Survey

Bangkok Urban Mass Transit Node's User Satisfaction Questionnaire

Thank you for your cooperation on this questionnaire.

This questionnaire is designed solely to carry out investigation on the topic of Study on Urban Mass Transit Node's User Satisfaction: The case study of Bangkok, Thailand compared to Tokyo, Japan for PhD Research in Architecture, The University of Kitakyushu, Japan. Your prompt cooperation in responding to the questions appropriately shall be highly appreciated. All information provided will be treated with strict confidentiality.

Please tick ✓ only one box per question, unless directed otherwise.

CONSIDER ONLY THE STATION YOU ARE USING MOST OFTEN

(Which station do you use most often?)

1. **About individual characteristics**

Q1. What is your gender?

Male…………………………………………………………………………………… ☐

Female………………………………………………………………………………… ☐

Q2. What is your nationality?

Thai…………………………………………………………………………………… ☐

Foreign………………………………………………………………………………… ☐

Q3. Age?

< 20 years…………………………………………………………………………… ☐

21-30 years…………………………………………………………………………… ☐

31-40 years…………………………………………………………………………… ☐

41-50 years…………………………………………………………………………… ☐

51-60 years…………………………………………………………………………… ☐

> 60 years…………………………………………………………………………… ☐

Q4. Household net income

< 10,000 Baht………………………………………………………………………… ☐

10,000-15,000 Baht…………………………………………………………………… ☐

15,001-20,000 Baht…………………………………………………………………… ☐

20,001-25,000 Baht…………………………………………………………………… ☐

25,001-30,000 Baht…………………………………………………………………… ☐

> 30,000 Baht………………………………………………………………………… ☐

Q5. Employment status

Student………………………………………………………………………………… ☐

Company employed…………………………………………………………………… ☐

Government officer....…………………………………………………………..…….………… ☐

Self-employed……...…………………………………………………………..…….………… ☐

Not employed.…….……………………………………………………………...……….………… ☐

Other……..…………………………………………………………………..……………… ☐

Q6. The vehicles in your household

Motorcycle Yes……☐ No........☐

Car Yes……☐ No........☐

Q7. How often do you use the transfer station?

1-2 times/week...…………………………………………………………….….……………… ☐

3-4 times/week...…………………………………………………………….….……………… ☐

5-6 times/week...…………………………………………………………….….……………… ☐

Everyday……....…………………………………………………………….….……………… ☐

Only weekday….....…………………………………………………………...……….………… ☐

Only weekend….....…………………………………………………………...……….………… ☐

2. About your trip pattern

Q8. Usually how many times do you transfer at the transfer station in one trip?

1 time……………………………...……………………………………...………….………… ☐

2 times…………………………...……………………………………...………….………… ☐

3 times…………………………...……………………………………...………….………… ☐

4 times…………………………...……………………………………...………….………… ☐

>4 times………………………...……………………………………...………….………… ☐

Q9. Usually when you take public transportation from your house what is your trip purpose?

Study……………………….……………...…………………………………...…….………… ☐

Work……………………….……………...…………………………………...…….………… ☐

Travel……………………….……………...…………………………………...…….………… ☐

Shopping..……………….……………...…………………………………...…….………… ☐

Other……………………….……………...…………………………………...…….………… ☐

Q10. Usually how long do you spend for one trip?

<15 minutes……………….……………...…………………………………...…….………… ☐

15-30 minutes……………….………...…………………………………...…….………… ☐

30-60 minutes……………….………...…………………………………...…….………… ☐

60-120 minutes……………….………...………………………………...…….………… ☐

>120 minutes……………….………...…………………………………...…….………… ☐

Q11. Usually how long do you stay in the transfer station?

<5 minutes…...…………….………...…………………………………...…….………… ☐

5-15 minutes……………….………...…………………………………...…….………… ☐

15-30 minutes……………….………...…………………………………...…….………… ☐

30-45 minutes……………….………...…………………………………...…….………… ☐

45-60 minutes……………….………...…………………………………...…….………… ☐

>60 minutes…...…………….………...…………………………………...…….………… ☐

Q12. Usually what do you do at the transfer station when you have some free time?

Wait for transfer...……………………………………………………………………………… ☐

Study……………………………………………………………………………………………… ☐

Shopping..………………………………………………………………………………………… ☐

Meeting..…………………………………………………………………………………………… ☐

Eating..……………………………………………………………………………………………… ☐

Other………………………………………………………………………………………………… ☐

Q13. Usually how do you go to the transfer station?

Walk………………………………………………………………………………………………… ☐

Bike…………………………………………………………………………………………………… ☐

Bus…………………………………………………………………………………………………… ☐

Taxi…………………………………………………………………………………………………… ☐

Motorcycle…………………………………………………………………………………………… ☐

Songtaew……………………………………………………………………………………………… ☐

Train…………………………………………………………………………………………………… ☐

Other………………………………………………………………………………………………… ☐

Passengers' satisfaction

How satisfied are you with the following?	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied
Service					
The punctuality of the vehicle time					
What about the service time?					
The frequency of the trains on your trip					
Availability during night time					
Availability in early morning					
Easiness of transportation service use					
What about the ticket fare?					
Comfort of information in the station					
The provision of information during the journey					
Emergency information					
Information about service delays or disruptions					
The number and variety of shops in the transfer station					
Overall, how satisfied are you with transfer station service?					
Safety					
Safety in and out the transfer station					
The safety of stairs connection to the transfer station					
The number of security guards					
The reliability in safety systems of the transfer station					
The safety of the areas surrounding the transfer station					
Night time security from crime					
Overall, how satisfied are you with transfer station safety?					

How satisfied are you with the following?	Very dissatisfied	Dissatisfied	Average	Satisfied	Very satisfied
Environment					
Air quality and pollution in the area surrounding the transfer station					
Air quality and pollution in the transfer station					
Interior design of the transfer station					
Exterior design of the transfer station					
Cleanliness of the transfer station					
The temperature inside the transfer station					
Overall, how satisfied are you with transfer station environment?					
Accessibility					
Connection with other public transport systems					
Access to the transfer station					
Rush hour inside the transfer station					
Number of elevators					
Number of escalators					
Number of stairs					
Number of moving walkways					
Distance from the entrance of the station to the platforms					
The easiness of being able to get on/off from platform to vehicle					
Overall, how satisfied are you with transfer station accessibility?					
Operation					
The maintenance of the station building					
The maintenance of the station platforms					
The maintenance of the train					
The maintenance of the bus					
The maintenance of the boat					
The passenger managing system in the transfer station					
The attitudes and helpfulness of the staff					
How well transportation company deals with delays					
Overall, how satisfied are you with transfer station operation?					
Facilities					
Facilities for car parking					
Ticket buying facilities					
The provision of shelter facilities					
Availability of seats in the waiting area					
The toilet facilities					
Overall, how satisfied are you with transfer station facilities?					
Overall satisfied with transit station					

Thank you for completing this questionnaire.