THE DIMENSIONS INFLUENCING RAIL MASS TRANSIT RIDERSHIP IN THE BANGKOK METROPOLITAN AREA

Sopat Voravivatana

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Development Administration)

School of Public Administration
National Institute of Development Administration

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ABSTRACT

Title of Dissertation	The Dimensions Influencing Rail Mass Transit Ridership in the Bangkok Metropolitan Area
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The purpose of this dissertation is to investigate the dimensions influencing Rail Mass Transit (RMT) ridership in the Bangkok metropolitan area. The study asks three primary questions: What are commuter characteristics for selected modes of transportation? What factors do commuters consider important for switching over to Rail Mass Transit systems? And, what demographic and location variables are associated with commuters' attitudes on the dimensions influencing Rail Mass Transit ridership? In order to answer these questions, the dissertation encompasses the following: a review of the major advantages of RMT-based development; an examination of commute characteristics and reasons for using RMT systems in the Bangkok metropolitan area; identification of major factors in commuters' decisions to switch to RMT systems; determination of the rankings of the dimensions influencing RMT ridership; and an analysis of the demographic and location effects on the dimensions influencing RMT ridership.

An extensive review of the literature yielded seven dimensions influencing RMT ridership, namely, Price/Promotions, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality concepts. Accordingly, the research study focused on measuring commuter attitudes on these six dimensions.

The sample for the study consisted of 1,715 RMT commuters in Bangkok. Data collection using questionnaires was carried out at 41 RMT stations during October and November 2007.

The research findings concerning commute characteristics indicate that the majority of RMT users (65.3 percent) are occasional users, and only 22.5 percent are frequent users. In terms of demographics, RMT riders tend to be under 41 years of age (75.8 percent), single (63.1 percent), and predominantly female (59.6 percent). They also tend to have higher education levels (71.4 percent have at least a bachelor's degree) and higher incomes. Roughly one-fifth of commuters are students, 23.1 percent are public sector employees, and 38.8 percent are private sector employees. The two most cited reasons for using RMT systems are routine and work (or study) related, while the next two reasons are recreational.

With respect to the dimensions influencing RMT ridership, commuters rank the Price/Promotions and Safety/Security dimensions as the two most important factors. Gender, education, income and occupation are significantly associated with differences in attitudes on these two dimensions.

Analysis consisting of agglomerative hierarchical clustering using Ward's variance method yielded seven subgroups within the two primary groups. A K-means nonhierarchical cluster analysis was performed to for the two primary cluster groups with relatively homogeneous attitudes on the dimensions influencing RMT ridership. The first cluster group had lower scores on all dimensions influencing ridership, while the second cluster group had higher scores. The first group consists mainly of women, students, and persons with lower education and income levels, while the second group tends to be comprised of males, government officials, and persons with higher education and income levels.

The findings from cluster analysis suggest that RMT policymakers and system operators should consider providing customized measures to target commuter cluster groups based on the relative importance assigned by each group to the dimensions influencing RMT ridership. Findings from the study can be utilized by policymakers to formulate agendas and development plans to encourage motorized vehicle users to switch over to RMT systems, thereby creating financial feasibility for additional RMT development and formulation of policies where RMT systems are utilized for sustainable transportation development.

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Sopat Voravivatana
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TABLE OF CONTENTS

LIST OF TABLES

Tables **Page**

LIST OF FIGURES

ABBREVIATIONS

Abbreviations	Equivalence
$	Dollars
>	Greater Than
<	Less Than
ADB	Asian Development Bank
ANOVA	Analysis of Variance
APTA	American Public Transportation Association
ATM	Automatic Teller Machine
BART	Bay Area Rapid Transit
BMA	Bangkok Metropolitan Administration
BMCL	Bangkok Metro Public Company Limited
BMTA	Bangkok Mass Transit Authority
BRT	Bus Rapid Transit
BTS	Bangkok Transit System
BTSC	Bangkok Mass Transit System Public Company Limited
CDF	Comprehensive Development Framework
CFC_S	Chloroflurocarbons
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSI	Cambridge Systematics Incorporated
CTR	Commute Trip Reduction Program
DOT	United States Department of Transportation
ECTR	European Commission on Transportation Research
EDRG	Economic Development Research Group
EDS	Electronic Data Systems Corporation
ETA	Expressway and Rapid Transit Authority of Thailand
F	F Ratio

FHWA	Federal Highway Administration, Department of Transportation
FTA	Federal Transit Administration
HC	Hydrocarbons
IATSS	International Association of Traffic and Safety Sciences
ITS	Intelligent Transport Systems
L.A.	Los Angeles
M21	Mobility for the 21st Century
MOT	Ministry of Transportation
MRT	Mass Rapid Transit
MRTA	Mass Rapid Transit Authority of Thailand
NESDB	National Economic and Social Development Board
NO_X	Nitrogen Oxides
N_2O	Nitrous Oxide
n/a	Not Available
OCMLT	Office of the Commission for the Management of Land Traffic
OTP	Office of Transport and Traffic Policy
p	F Probability
PM	Particulate Matter
ppd	Passengers per day
PTT	PTT Public Company Limited
QSNCC	Queen Sirikit National Convention Center
RMT	Rail Mass Transit
s.d.	Standard Deviation
SEPTA	Southeastern Pennsylvania Transportation Authority
SO_X	Sulfur Oxides
SPSS	Statistical Package for the Social Sciences
SRT	State Railway of Thailand
TCRP	Transit Cooperative Research Program, Federal Transit Administration
TDRI	Thailand Development Research Institute

TEA 21	Transportation Equity Act for the 21st Century
THB	Thai Baht
TNA	Thai News Agency
TRB	Transportation Research Board
U.K.	United Kingdom
U.S.	The United States of America
USEPA	United States Environmental Protection Agency
UTP	Urban Transport Planning
$\bar{X}$	Mean

CHAPTER 1

INTRODUCTION

1.1 Overview

1.1.1 Background

Traffic congestion is one of the major drawbacks of living in a city. The city is faced with innumerable problems, caused by traffic congestion, that are detrimental to the environment, ecology, economy, and society. Traffic in Bangkok, in comparison with other major cities in the world, has proven to be a very serious problem to the extent that major candidates for national and local offices almost always include a traffic solution as one of the main campaign issues. The notorious traffic congestion in Bangkok has led scholars and academicians to label Bangkok a "traffic disaster" (Yordphol Tanaboriboon, 1993; Chamlong Poboon and Kenworthy, 1995; Barter and Kenworthy, 1997; Barter and Raad, 2000). Air pollution and its hazardous effects have seen Bangkok relabeled the "Los Angeles of the East", from the once famous "Venice of the East" (Kenworthy, 2005). Urban areas heading towards "traffic saturated" areas dependent on bus and motorcycles are diagnosed with the "Bangkok syndrome" (Barter and Kenworthy, 1997; Barter, 1998). The city's "unrestrained motorization" is in contrast with other better-developed countries in the Asia region, where the role of public transportation is more significant (Barter, 1999).

The seriousness of traffic problems has been acknowledged by Thai leaders for quite a period of time. However, most policies have called for an increase of road surface and provision of mass infrastructure to increase traffic speed as the focal strategy to reduce traffic congestion. The Thai government's perception of the problem has been that there are not enough roads to accommodate the automobiles (Kenworthy, 2005). The government's actions based on this assumption have in consequence led to the majority of infrastructure investment being allocated towards large-scale transportation projects (Chamlong Poboon and Kenworthy, 1995). The government has placed development priority on the support of roads and expressway infrastructure leading to car dependence among Bangkok commuters. This is a direct American influence on the development of public transportation in Thailand. An American team, Lichtfield and Associates, produced the Greater Bangkok Plan of 1990 in 1960. The plan called for a "Los Angelizing" of Bangkok, building roads over canals (Bello et al, 1998). However, most of the master-plan was never formally adopted, but American funding still filled many khlongs (canals) with roads. The Ring road and Corridor road systems of connecting regional cities were implemented, and Bangkok has been an automobile city ever since (Manop Bongsadadt, 1990 quoted in Bello et al., 1998). Heavy spending on expressway systems and road expansion were the results of past National Transportation Development Plans, while initiation of Rail Mass Transit (RMT) systems were slow in the planning. At the turn of the new millennium, the Thai government has completed some public RMT systems but the development of road infrastructure for motorized transportation is still undisputedly the country's main traffic solution policy. Although alleviating the problem, Bangkok's urban RMT systems are poorly developed as compared with other neighboring Asian countries (Barter and Kenworthy, 1997).

As Bangkok heads into the 21st century, the consensus in the National Transportation Development Plans is shifting towards the development of RMT systems as the key mechanism for solving Bangkok's troublesome traffic congestion issues. A new RMT system linking the inner city with the new Bangkok International Airport is almost complete, and seven proposed RMT systems are in the planning stages of development. The gradual conversion, from subsidizing infrastructure and road surface to accommodate the never-ending increase of motor vehicles, to advocating RMT systems as the solution for the traffic problems, is clearly the product of an increasing awareness of the problems.

The development of motorized transportation infrastructure to solve increasing and ongoing traffic problems is still the current paradigm practiced in most of the countries in the world. The historical development of motor vehicles has led to car dependence, suburban sprawl, more traffic, and other problems that affect the economy, environment, ecology, and society. Motor transportation produces air pollution from the emissions of the vehicles leading to the escalation of global warming problems (Black, 2000; Barter and Raad, 2000; Laird, 2000; Sheehan, 2002; Yevdokimov and Mao, 2002). The limitations of motorized transportation and the encouragement of sustainable transportation development should be the primary focus of future transportation development plans. However, the realization that sustainable transportation development is impossible with the continued growth of motor vehicles as the foundation for everyday commuter mobility is redirecting the transportation planners towards development involving different modes of transportation. Academically supported by an increasing number of scholars, academicians, researchers, managers, and leaders, the reinvention of the public transportation paradigm for a sustainable future of the world will not focus primarily on motorized transport. Ideas such as transit-based development, transit development corridors, and mixed land use, which lead to sustainable transportation and revitalized livable communities, are being proposed as the future of the public transportation industry.

1.1.2 Public Transportation Planning

In order to understand the process to formulate transportation development plans, one needs to understand the basis supporting the direction of development. The current conventional trend for transportation planning in Thailand, as well as most of the cities in the world, is the utilization of the Urban Transport Planning (UTP) process as the basis for transportation development planning. The approach is a series of technical procedures developed originally by the Mitchell and Rapkin study in 1954 called "Urban Traffic – A Function of Land Use" (Mitchell and Rapkin, 1954). The substance of the UTP process estimates future traffic levels, and plans the transportation infrastructure development based on the estimate figures (Chamlong Poboon, 1997). Most of the development plans call for more road surface area to accommodate the increasing traffic volume expected in the future. The approach creates a strong supply side development of motorized transportation superstructure, which leads to an abundance of sustainability problems in cities all over the world (Kenworthy, 1990). Furthermore, the methodology favors automobile growth, thus creating an "Automobile Dependent" city. As of date, there have been many critics of the conventional UTP process as the basis for transportation development plans, which call for a sustainable transportation development scheme.

1.1.3 Sustainable Transportation

Sustainable transportation is a challenging area of study with its aim to provide a holistic approach to public transportation development. However, sustainable transportation development schemes require a consensus from many parties, in which the government should be the leader and the center of coordination of all activities. Urban development planning should aim for sustainability. Yet, the expansion of transportation infrastructure resulting from the rapid growth of population, cities, free trade and movement of people and goods has come at the expense of economic, environmental, ecological, and social costs (Yevdokimov and Mao, 2002).

Sustainable transportation needs to be implemented in development to provide protection from such costs. There is discussion surrounding the definitive explanation and meaning of sustainable transportation, involving various versions and ideas. The Centre for Sustainable Transportation (1997, 2002) gives a summarized definition of sustainable transportation as a system that can provide people with access to all their transportation needs, with choices of modes of transportation which are efficient, economical, environmental and ecologically sound. The concept calls for an aggressive push for less movement of people by providing mixed land use, a decrease in motorized forms of transportation with alternative fuels as a replacement, and the utilization of technology to reduce the need for travel by the year 2030. Transport Canada (1999) defines sustainable transportation as ensuring that environmental, social, and economic considerations are factored into decisions affecting transportation activity. Richardson (1999) defines sustainable transportation as a system in which fuel consumption, vehicle emissions, safety, congestion, and social and economic access are of such levels that they can be sustained into the indefinite future without causing great or irreparable harm to future generations of people throughout the world.

The definitions for sustainable transportation are vague and idealistic, including concepts and theoretical requirements to protect the transportation development effects on the economy, environment, society, and ecology. A comprehensive and definitive definition of sustainable transportation would be highly debatable and difficult to establish due to the generality of the term sustainable transportation itself. However, the overall concept of sustainable transportation can be used to set goals and targets for transportation development, in which each country can set up practical applications depending on the limitations for each country.

1.1.4 Rail Mass Transit Systems

The current movement to provide a comprehensive transportation development program for transportation sustainability involves the study of the Transit Based Development or Transit Oriented Development approach. This approach is designed to attain sustainable transportation, in which Rail Mass Transit must play the major role in providing all individual commuters with the mobility to move and access anywhere as desired. Transit-based development along with land usage policy makes the need for motorized transport decline substantially. With less travel distance to the locations mixed in and around the transit stations, the community can travel by walking or cycling to their destinations. Transit-based development proposes the community be centered around the transit stations creating pedestrian-scaled communities. These communities, which are linked by regional transit systems, will help the locality develop in a sustainable fashion. The future of transportation will involve sustainable community-oriented growth with mobility acquired by transit development (Mobility for the 21st Century (M21) Task Force and Olsen, 1996).

To attain a sustainable future, the government and the entire general public must be aware of and understand the benefits of the RMT system. Since the environment is one of the main concerns, environmental indicators should be established as a reporting system to direct sustainable development (Ellwanger and Lindeke, 1998). Constant improvement in the direction of sustainable transportation, along with the full support of the government and the general public can help release commuters from automobile dependence. The current paradigm with cities independent of motorized transport and the associated infrastructure development will be progressively shifted to sustainable transit-based development utilizing the RMT system as the core of the system.

As the transportation planners see the success of more and more RMT projects develop and observe the great benefits that the RMT system can provide in line with the recommendations of transportation consultants, more RMT developmental plans will be incorporated into the National Transportation Development Plans. In Bangkok, the Thai government is aiming for an intensive RMT system, in which approximately 300 more kilometers of RMT systems will be constructed[1] (Chartchai Praditpong, 2006). This ambitious transportation development scheme aims to be the initiative that solves the terrible traffic congestion in Bangkok.

1.1.5 Rail Mass Transit Ridership

It is now commonly accepted that RMT systems will be the new focal point for transportation development. However, the plans to introduce the RMT systems in Bangkok have faced major obstacles in the planning and implementation stages. One of the major problems associated with RMT development projects is the amount of ridership projected does not correspond with that actually obtained upon commencement of the system operations. Establishing an RMT system is very costly (Weyrich and Lind, 1999; Budin, 2002). In turn, this high expenditure leads to expensive ridership fare (Gwilliam, 1997; Skinner, 2000). Many people feel that rail development cannot be cost effective by generating enough ridership to justify the investment (Horowitz and Beimborn, 1995; Halcrow Fox, 2000b). In the project's developmental stages, the ridership projections play an important role in the determination of the financial feasibility studies of the project. Massive RMT developmental projects require substantial amounts of funds to proceed with the construction, commissioning, and operations, which usually means unfavorable financial feasibility recommendations being made to the decision maker. The ridership projection of the developmental project will have to generate sufficient

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[1] Since 2006, when the plans for 300 more kilometers of RMT routes in Bangkok were in process, new plans for the RMT mega-projects have been constantly altered with the appointment of each new government leader. However, each RMT development plan still proposes at least five new RMT systems and at least 200 more kilometers of routes.

income source to accommodate the expenses projected for the project. In many cases, the ridership projections are rather optimistic to allow for the approval of implementation of the project, thus resulting in financial difficulties during the operation stages. In Bangkok, as seen in the initial Mass Rapid Transit Authority's M.R.T. Chaloem Ratchamongkhon Line[2], the forecast of 250,000 passengers per day was not met, with the system accommodating 180,000 passengers per day during actual operation[3] (Chartchai Praditpong, 2006). The Bangkok Transit System[4] originally forecasted 400,000 passengers per day but the actual numbers were approximately 220,000 passengers per day (Charoen Kittikanya, 2001; 2Bangkok, 2008d). With the enormous financial strain that the RMT development projects carry, the government usually plays an important leading role in carrying out the projects. Few private developers have the capability to oversee and implement an entire RMT development project due to the financial risks.

The study of the factors that significantly affect the ridership of an RMT development project will enhance understanding in terms of ridership projections during the planning stages, or operational improvements and adjustments during the operational stages. More accurate projection of ridership will ensure a more secure financial investment for the developmental project, thereby giving the decision makers better information with which to make their decisions on the implementation of each project. In the long run, a better prediction of the ridership of a system will help provide a more precise estimate and better opportunity to generate sufficient income during the operational stages of the project.

Increased RMT patronage will create more and more sustainability in the transportation industry (Jones, 1995; Centre for Sustainable Transportation, 1997; Chamlong Poboon, 1997; Daft et al., 1998; Barter and Raad, 2000; NESDB, 2001;

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[2] The first MRTA RMT subway line is officially named "the M.R.T. Chaloem Ratchamongkhon Line" and is often referred to as the "Blue Line" or the "Initial Subway System"

[3] The MRTA Subway system inaugurated on 3 July 2004, and the data presented is as of late 2005. To demonstrate the inconsistent ridership projections, 2Bangkok (2008c) reports initial forecasts for 2002-2003 at 404,880 passengers/ day, while in December 2000 OCMLT forecasts 300,000 passengers/ day, and in May 2001 Prachachart Turakij forecasts 270,000- 280,000 passengers/ day (Charoen Kittikanya, 2001).

[4] The Bangkok Transit System is often known as the "Skytrain".

Wheeler, 2001). With the increased ridership on the RMT systems, the amount of motorized transportation will generally decline as well, thus leading to a more sustainable transportation system. Therefore, the study of the commuters' characteristics can make way for important policy implications that might convert motorized transport users to selecting the RMT system as their primary mode of transportation.

1.2 Significance of the Research Problem

Public transportation in the form of Rail Mass Transit can provide numerous beneficial outcomes for a city. In order to acquire the full benefits from the implementation of RMT systems, the project initiators must truly and fully understand the different factors associated with mass transit systems. Indeed, without the proper knowledge, RMT systems and other public transportation systems can prove to be equally detrimental. The complexity and uniqueness of each mass transit system project can create huge varying margins between each system. Therefore, mass transportation systems around the world must be studied in order to draw general conclusions on the various aspects that are beneficial for the country to develop their mass transportation system.

The various modes of transportation must be integrated in a systematic format. The holistic consideration of all the various modes of transportation will be the backbone for a new paradigm in the transportation industry (Daft et al., 1998). The holistic view is to find a suitable role for the transportation industry to coexist within the sustainable requirements of the economy, environment, and society (Centre for Sustainable Transportation, 1997). The provision of transportation within the boundaries of a sustainable economy, environment, and society will lead to a sustainable transportation direction for the future of the world.

The impact from RMT ridership can be seen in the various stages of transportation development planning. The completed RMT projects in Bangkok had lower ridership numbers than predicted during the feasibility study of the projects. The same holds true for many RMT projects all over the world. With a better understanding of the dimensions that influence the ridership on the RMT systems, the better assumptions can be made in feasibility studies on the planned projects. This is important because most of the RMT projects are not deemed viable due to unfavorable financial feasibility studies. Improvements along the lines of the various dimensions that influence ridership in the RMT systems will increase the revenue generated by the system. Thus, it is more likely that financial feasibility studies for future projects will be favorable and their implementation justified.

More importantly, an increase in the RMT ridership signifies the conversion of motorized transportation users to the RMT systems. This change in the mode of transportation is essential in lowering the unsustainable consequences of motorized transportation usage as the RMT systems provide a more sustainable means of transportation.

Therefore, understanding the various aspects of RMT ridership and the factors that influence ridership will prove to be beneficial to the plans for future RMT developments and improvements to the existing RMT systems. With worsening traffic congestion in Bangkok and huge transportation development plans concerning both motorized transportation infrastructure and RMT developments, the dissertation will provide additional knowledge on the two RMT systems for the decision makers of Thailand, and hopefully will be persuasive and informative in supporting transportation development in the form of RMT systems.

1.3 Research Questions

The dissertation is an analytical process which utilizes the empirical evidence obtained from survey data collection in providing an explanation to the following research questions.

1) What are commuter characteristics for selected modes of transportations?

2) What factors do commuters consider important for switching over to the Rail Mass Transit systems?

3) Do demographic and location variables affect commuters' attitudes on the dimensions influencing Rail Mass Transit ridership?

The first question concentrates on the commuters' current mode of transportation selection. Based on the commute characteristics, information can be extracted on the various groups of transportation users to determine the travel behavior for each group of users for the various modes of transportation. The second question focuses on the endeavor to encourage an increasing amount of RMT users. The information on the commute characteristics can provide an empirical base for better-suited policies to promote RMT usage. The third question determines the various perspectives of the commuters on the dimensions that influence RMT ridership. Investigation of demographic and location variations and the respective impact on the dimensions influencing RMT ridership will provide better understanding for a customer based approach, as an alternative for the policy makers and system operators to improve the development plans and services in the future.

1.4 Research Objectives

The objectives for this dissertation will provide intermediate guidelines for the researcher to ultimately determine the answers of the three research questions. The objectives for this research are as follows:

1) The dissertation will review the major advantages of the Rail Mass Transit Based Development approach in comparison to the conventional Urban Transport Planning (UTP) process.

2) The dissertation will examine the commute characteristics of the commuters, to determine the various groups and the respective travel behavior, and identify the major factors for the switch to utilize RMT systems.

3) The dissertation will indicate the commuters' actual reasons for using the RMT system in Bangkok to provide general knowledge on the travel characteristics of Bangkok RMT commuters.

4) The dissertation will determine and rank the importance of each dimension influencing RMT ridership, based on the Bangkok RMT commuters' attitudes.

5) The dissertation will demonstrate and provide statistical evidence on the significant demographic and location variations on the dimensions influencing RMT ridership.

6) The dissertation will provide guidelines based on the study's findings for the Royal Thai Government to utilize in achieving sustainable transportation in

Thailand and suggest the key aspects for policy formulation and implementation for sustainable transportation development in Thailand.

1.5 Research Usefulness

The dissertation will provide information for the relevant policy makers, system operators, and those concerned on the different influences on Rail Mass Transit ridership. The dissertation will provide a customer-based approach perspective as another alternative to making specific decisions concerning system ridership. Most RMT development projects rely on available information from the transportation planners, system operators, concessionaires, and consultants. A customer-based study can be useful giving different viewpoints and inputs for the system. The quantitative analysis based on the commuters' attitudes will illustrate the passengers' perceived views on the important aspects that need improvement. This information can be incorporated with the known data to generate better solutions to the various aspects of RMT development.

The government, system operator, or concessionaire can create diversified strategies and policies to increase RMT usage, and encourage motorized transportation commuters to utilize the RMT systems. The conversion of motorized transportation to RMT usage for the commute helps move the city forward towards more sustainable development.

The information obtained can also be used to improve newly planned projects, making their implementation more feasible due to the increase in ridership on the existing RMT systems. This can be useful in increasing RMT development projects and thus provide a better chance for a more sustainable mode of transportation.

The study will also provide information and knowledge to create public awareness of the unsustainable transportation development patterns and encourage actions to achieve sustainable transportation systems in Thailand. With the current escalation in oil prices and the increasing public awareness of global warming, the government can find it easier to justify sustainable transportation systems. The information and knowledge provided could then be used by the Royal Thai Government decision-makers in formulating fundamental strategic policies reducing the high automobile dependence of commuters and providing transportation development that enhances sustainable transportation and livable communities.

1.6 Scope and Limitations of the Dissertation

The dissertation's main purpose is to evaluate the dimensions that influence the Rail Mass Transit ridership in the Bangkok Metropolitan area. The quantitative study will focus on the commuters' point of view, giving customer-based attitudes on the influencing dimensions of the RMT ridership. The study limits the focus to customers' attitudes towards the dimensions as collected from the survey questionnaires providing a basic social science empirical study to instigate advancement in terms of social improvements in the transportation sector of Bangkok. The customer-based opinions will present a different perspective to the issue than the various policy makers, system operators, and concessionaire owners, and can be used for incorporation into the current development and improvement plans. The research paper does not provide an inclusive analysis with respect to political science considerations, although an analysis based purely on a political science perspective will prove to be very interesting since most of the problems for the RMT systems in Thailand are formulated from the rich history of policy conflicts and delays (Unger, 1998). The perspectives of the policy and decision makers, influential groups, system operators, and concessionaire operators at the planning, implementation, and operation stages are not considered in the dissertation processes.

The factors, which will be considered as influential dimensions upon the RMT ridership numbers, are also concepts with regards to the generality of the commuters' knowledge. Influence factors as a consequence of advanced political influences or profound economical policies are beyond the limitations for the study. Visible governmental influences such as policies with direct impact on the transportation sector, and external factors such as the oil prices and traffic congestion are included in the study since such dimensions are comprehensible from a normal commuter's perspective.

The dissertation limits the empirical data collection to the commuters of the two RMT systems in Bangkok, namely the Bangkok Transit System and the Mass Rapid Transit Authority system. Although the actual planned RMT system will be extensively greater than that what is currently available, the available systems at the moment are limited to two. Therefore, the data collection for the dissertation will endeavor to represent RMT users from every station of the 41 RMT stations in Bangkok. The sampling distribution will be organized according to the size and importance of each different station. The categories for the distinction of stations are "Large", "End", "Connecting", and "Between" stations.

Public mass transportation covers various modes and systems, such as automobiles, expressways, buses, airplanes, and rail. This paper focuses on the RMT projects and development plans in Thailand, which are seen in various forms such as the underground subway and the elevated sky train. The RMT development approach is key to the sustainable "Transit-Based Development" or "Transit-Oriented Development" approach. The current focus on the development of motorized transportation infrastructure such as the expressways can be shifted to RMT-based development with the appropriate information and knowledge provided to the policy makers.

Data collection was carried out in October and November 2007. Since November 2007 the oil prices have escalated[5], causing commuters to use less motor vehicles with RMT usage increasing as a consequence. The research findings for the study are limited to the empirical data collected in October and November 2007.

1.7 Organization of the Dissertation

Many studies, based on statistical transportation data and the researcher's experience, have focused on the factors influencing Rail Mass Transit ridership. However, the decision to utilize the RMT system is ultimately made by the commuter. This dissertation will study the factors based on the commuters' attitudes towards RMT systems, which will provide a customer's perspective of ridership. The study will also evaluate commute characteristics to determine and indicate the commuter groups for the different modes of transportation, in order to propose policy

[5] PTT (2008) website reports commercial prices for Gasoline Unleaded 95 increased from 31.69 Baht on 14 November 2007 to 43.89 Baht on 7 July 2008 (38.5 percent increase); commercial prices for Diesel increased from 28.64 Baht on 14 November 2007 to 44.24 Baht on 7 July 2008 (54.5 percent increase).

implications that may convert the groups of commuters to use RMT systems instead of motorized forms of transportation.

The dissertation is organized into six chapters. This introductory chapter provides the initial context in the form of a background to the study, the significance of the research problem, the research questions, and the objectives of the study, the usefulness of the study, and its scope and limitations.

Chapter 2 reviews the literature on public transportation development, illustrating the current development paths popular for transportation planners and the related sustainable and unsustainable consequences of the plans. The study then focuses on the public transportation development in Thailand and the various transportation projects, plans, and policies. Next, sustainable transportation and the role of RMT systems are discussed. The information provided will show the benefits of having RMT systems in comparative terms to motor forms of transportation. The next part of the chapter then focuses on a review of literature of RMT ridership. The various dimensions influencing RMT ridership and the relationships among the variables are identified.

Chapter 3 introduces the research methodology. The chapter discusses the key measures derived for each of the dimensions influencing RMT ridership, questionnaire construction, and sampling design.

Chapter 4 describes commuter characteristics for the RMT and motorized transportation systems and examines relationships between the usage of each mode of transportation and the general demographical and location area details corresponding to the commuters' choice. The information obtained from the actual commuters' selection of mode of transport can be evaluated to explain the frequent and occasional use of each system by each group of commuters. Occasional RMT users and frequent motorized transportation users are the focal point of the analyses, and identification of the factors significant to the group to increase RMT usage is a key element. Based on the general behavior of the various groups of commuters identified, policy implications can be made for each group of commuters and attempt to convert the users of motorized transportation to utilize the RMT systems. The findings from this chapter will be of importance to policymakers in proposing and activating plans to assist the commuter conversion of motorized transportation to RMT systems as the daily mode of transportation.

Chapter 5 presents further data analysis on demographic subgroups and segmentation of commuters by their attitudes toward RMT ridership.

Chapter 6 consists of a conclusion and recommendations. In the context provided, the overall process of the research will be reviewed and the major aspects of the entire dissertation discussed to provide a conclusion to the dissertation. Policy implications and recommendations derived from the findings of the research will be emphasized in order to point out and present the substance of the dissertation's findings in response to the primary research questions. Lastly, recommendations for future studies will be presented to provide guidelines for future research in the area.

CHAPTER 2

LITERATURE REVIEW

2.1 Public Transportation Development

2.1.1 Transportation Development Patterns

In the beginning, all cities start with walking as the primary mode of transport from one place to another. Figure 2.1 shows the pattern of a "traditional walking city". As cities grew and the need for travel increased dramatically, different forms of travel commute were established. However, there are only two succinct routes or patterns of transportation development that a city can be directed towards. Some cities grow into a "modern transit city" (see Figure 2.2), while others become an "automobile city" (see Figure 2.3). The development path of each country differs spontaneously from one to the other depending on the transportation development philosophy. However, the development pattern of each country still tends to be in between one extreme, a pure automobile city and, on the other, a transit city. All cities are somewhere in between the two spectrums, depending on the choice of the development path the city management desires (Chamlong Poboon, 1997; Barter, 1998). Both of the transportation development schemes certainly have their advantages and disadvantages. The important decision for the management is to decide the proportions between the motorized "automobile cities" and Rail Mass Transit "transit cities" development directions.

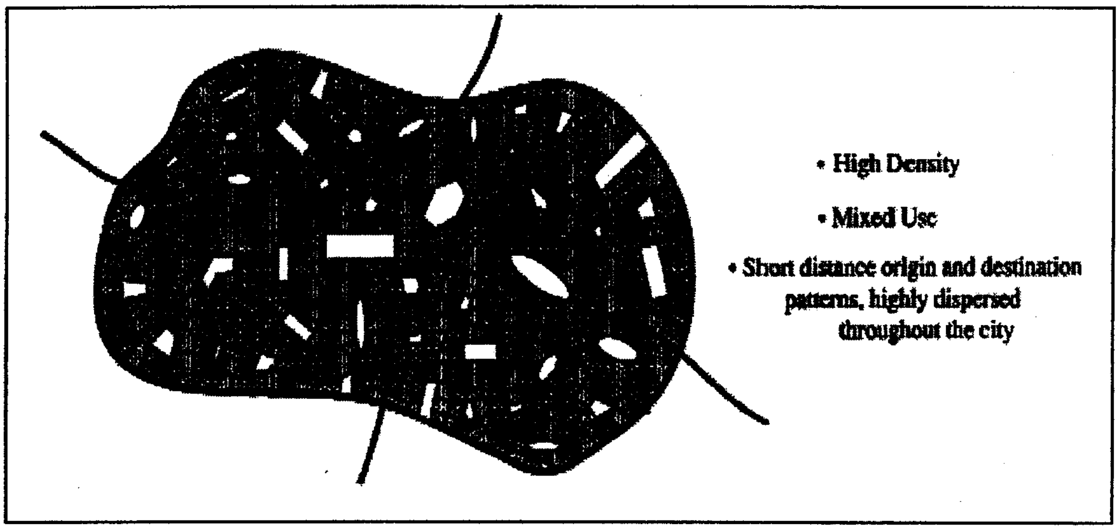

Figure 2.1 Traditional Walking City

Source: Chamlong Poboon, 1997 and Barter, 1999 adapted from Newman, 1995.

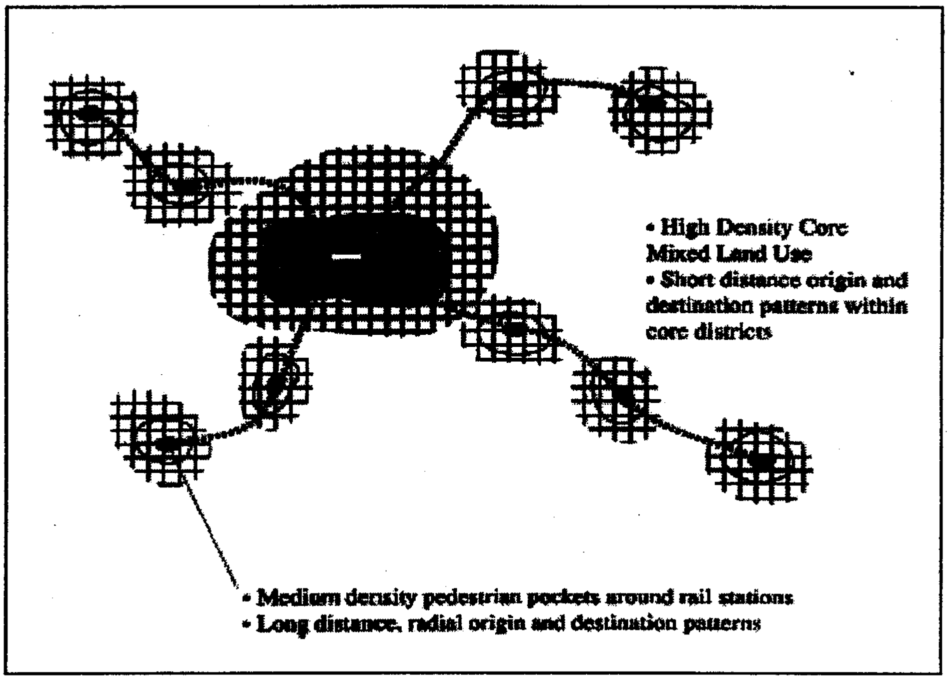

Figure 2.2 Modern Transit City

Source: Chamlong Poboon, 1997 and Barter, 1999 adapted from Newman, 1995.

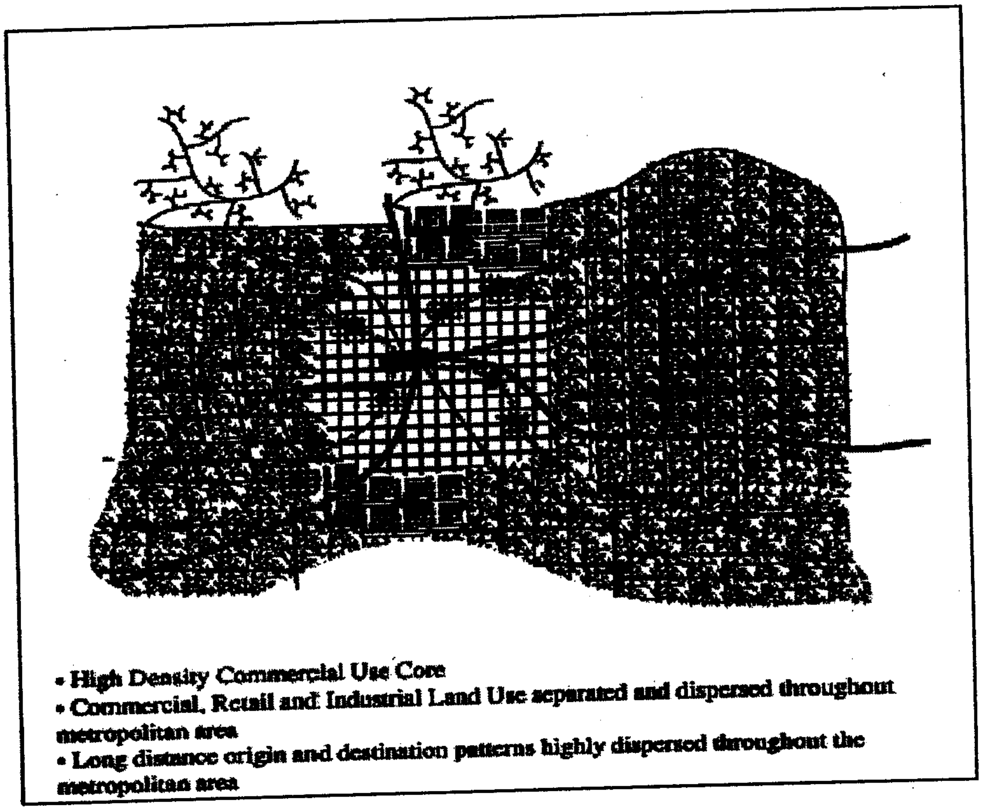

Figure 2.3 Automobile City
Source: Chamlong Poboon, 1997 and Barter, 1999 adapted from Newman, 1995.

2.1.2 Motorized Transportation Systems

After World War II, the vision of the future was one of the expansion of cities into the urban surrounding areas. Sprawling or suburbanizing was associated with home ownership, modern schools, responsive local government, uncrowded environment, and green lawns. The dispersion of development was controlled by motorized transportation through modern high-capacity highways (see Figure 2.4). This vision filled people with hope until previously unanticipated problems began to arise. These problems included escalating operational costs, expensive infrastructure construction costs, deteriorating quality of life due to the sprawls, crowded inner city business districts, the lack of mobility of the inner city poor due to everything being automobile dependent, automobile injuries, automobile congestion, the urban sprawls entering environmentally and ecological sensitive areas, the loss of agricultural land and communities, the resulting health problems from urban air pollution, excessive oil consumption, deteriorating community life, and undesirable land use (Mobility for the

21st Century (M21) Task Force and Olsen 1996). Facing these many problems, scholars and researchers began to wonder if the vision of motorized transportation as the backbone of future transportation development is justified or whether there could be other methods with better future transportation implications.

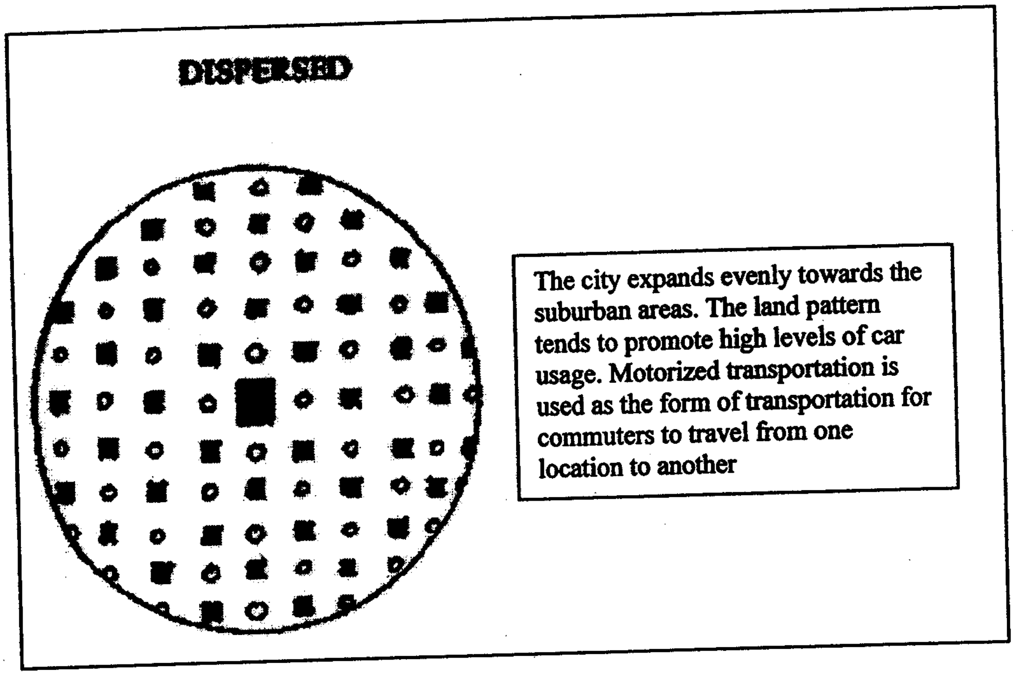

Figure 2.4 Dispersed Development Pattern
Source: Barter and Raad, 2000 adapted from Newman and Kenworthy, 1999.

The solution to traffic congestion proposed by motorized transport advocates is to build more roads to accommodate the traffic volume. "Highway planners are caught up in a vicious cycle," says Martin Wachs of the University of California Transportation Center, "You can never build enough roads to keep up with congestion. Traffic always rises to exceed capacity." (Gibbs, 1997). Congestion is inevitably a "paradox". "Build it and they will come" refers to the expansion of roads which will be congested after the road surface is opened for usage (Barter and Raad, 2000). This situation is what transportation planners call "suppressed demand" or "traffic saturation". New expanded roadways attract more cars to the point where they become congested themselves. The traffic then accumulates in a vicious circle where there is a never-ending solution (Chamlong Poboon, 1997). Many studies such as Hansen (1995), Lewis and Williams (1999), and Chu (2000) have proven this effect (Weyrich and Lind, 2001).

The perceived solution for motorized transportation advocates to build sufficient road capacity to serve the excess amount of motor vehicles is not the answer to the traffic problems. The solution runs the possible future risk of a congestion problem that has a larger impact occurring. The solution is not sustainable.

2.1.3 Problems Associated with Motorized Transportation Systems

Development in most countries takes on the form of a dispersal pattern towards the surrounding rural areas and outskirts of the urban areas. The uncontrolled expansion of the city leads to heavy dependence on motorized transport (Skinner, 2000). The continuous increase of motorized vehicles in turn leads to traffic congestion and pollution in the inner city. Developers then endeavor to solve the traffic problem by providing more road surface to cope with the increasing travel and road demand. However, this development pattern leads to traffic saturation where there cannot be enough roads provided to match the travel demands. The inner city space becomes unavailable and there is no more room left for further development of road surface. The traditional city with its unstructured planning creates a problem of obtaining the right of way for newer transportation projects (World Bank, 1999; Skinner, 2000). In short, the traffic volume is still increasing while there is no more capability to provide more road surface.

2.1.3.1 Unsustainable Development

Motorized transportation is not a sustainable mode of transportation because the system uses fossil fuels. The fossil fuel in turn creates local air problems and contributes significantly to global warming (Black, 2000; Barter and Raad, 2000; Laird, 2000; Sheehan, 2002). The overall motorized transportation system produces excessive fatalities and injuries, and contributes strongly to traffic congestion (Black, 2000). Alternative modes of transportation to replace the combustion of low-cost oil by motorized vehicles must be sought over the long term. The future transportation system must be economical, environmental, ecological, and socially sustainable. The requirements of a sustainable future are not possible with the further development of motorized transportation as the major system. Given the many detrimental attributes of motorized transportation, the overall system of motorized transportation is a barrier to sustainable development (Centre for Sustainable Transportation, 1997, 2002).

2.1.3.2 Traffic Congestion

Traffic congestion can prove to be very detrimental to the economy, environment, and society and is not a sustainable development scheme (Camph, 1997; Centre for Sustainable Transportation, 1997, 2002; Wheeler, 2001). The traffic congestion problem must be decreased or limited effectively to provide the opportunity for a sustainable future for the future generations. Unless there are measures to restrain motorized traffic growth, traffic congestion (at least in the rush hours) will be embedded permanently within almost all cities in the world (Barter and Raad, 2000).

Congestion caused on the urban road surface is a cost and therefore a problem for the public (Chamlong Poboon, 1997). Congestion costs occur when there is inefficient use of the valuable road space or too little is charged for the valuable road space (Roth and Villoria, 2001). This situation allows too many motorized vehicles on the limited road space creating disastrous traffic congestion. The excess of users must be charged a certain road fee to balance the congestion costs, resulting in an appropriate number of motorized vehicles in accordance with the capacity of the road space.

In addition to the effect of the traffic congestion costs on the economy, the environment, ecology, and society are also affected in terms of pollution, health, wasted time, and other problems. Global warming, one of the world's major concerns, is another direct consequence from traffic emissions.

RMT systems are seen to be a source of traffic congestion relief (Horowitz and Beimborn, 1995). The paradigm of motorized transportation development should be shifted towards transit based development using RMT systems and land use policies to create a sustainable future.

2.1.3.3 Environment and Ecology

Motorized vehicles are a major source of environmental pollution, endangering the well-being of those exposed. Diesel engines utilized in most buses generate dangerous pollutants such as Particulate Matter (PM), Nitrogen Oxide (NO_X), Carbon Dioxide (CO_2), Sulfur emission, Carbon Monoxide (CO), and

Hydrocarbons (HC). Overall, diesel contains 40 substances regarded as toxic and 15 regarded as carcinogenic (Chamlong Poboon, 1997; Ellwanger and Lindeke, 1998; Barter and Raad, 2000; Sayeg et al., 2002). The overall situation in Asian cities is unacceptable with these places facing severe air pollution problems (Barter and Raad, 2000). Table 2.1 shows the environmental effects of vehicle emissions. In addition, noise is also another environmental problem associated with motorized transportation (Corrales et al., 1996; Ellwanger and Lindeke, 1998). The health effects of vehicle emissions are shown in Table 2.2.

Table 2.1 Environmental Effects of Vehicle Emissions

Substance	Source	Environmental Effect
Carbon Dioxide (CO_2)	Fossil fuel combustion	Global warming: shifting climate patterns, rising seas, extreme weather, agricultural and ecosystem disruption
Nitrous Oxides (N_2O)	Fossil fuels; old and faulty catalytic converters	Global warming: 270 times the warming potential of CO_2, though released in smaller quantities
Nitrogen Oxides (NO_x)	Fossil fuels; old and faulty catalytic converters	Acid rain, ground level ozone constituent, suppressed of plant growth, degrading of buildings
Volatile organic compounds	Incomplete combustions; fuel vapours	Contributes to global warming through formation of ground level ozone
Smog (ground level ozone)	Reaction of NO_x and hydrocarbons	Damages plants and crops, reduces structural integrity of materials, contributes to global warming
Lead	Petrol additive	Enters food chain through soil and water. Extremely toxic. Inhibits neural development, particularly in children
Particulate matter ($PM_{2.5}$ and PM_{10})	Fossil fuel combustion, particular diesel	Haze, changed precipitation patterns.
Chlorofluorcarbons (CFCs)	Operation and leaking of car air conditioners	Depletion of ozone layer, increases ultraviolet radiation, inhibits photosynthesis, contributes to global warming
Carbon Monoxide (CO)	Fossil fuel combustion	May contribute to global warming at 2.2 times the warming potential of CO2 through atmospheric reactions.

Source: Adapted from Barter and Raad, 2000.

Table 2.2 Health Effects of Vehicle Emissions

Substance	Source	Health Effect
Carbon Dioxide (CO_2)	Fossil fuel combustion	Secondary effects associated with global warming; potential of increased disease
Nitrogen Oxides (NO_x)	Fossil fuels; old/faulty catalytic converters	Increased susceptibility to viral infections, lung irritant causing bronchitis and pneumonia, premature mortality
Volatile organic compounds (eg. benzene)	Incomplete combustions; fuel vapours	Drowsiness, eye irritation, cancer- causing, neurotoxic effects
Smog (ground level ozone)	Reaction of NO_x and hydrocarbons	Temporary breathing difficulty, long term lung damage, reduced immunity, increased hospitalisations
Lead	Petrol additive	Inhibits neural development, causes brain damage, particularly in the young
Particulate matter ($PM_{2.5}$ and PM_{10})	Fossil fuel combustion, particular diesel	Cardivascular disease, respiratory disease, particularly in the young and elder
Sulfur Oxides (SO_x)	Operation and leaking of car air conditioners	Helps form acidic aerosol sulfates which penetrate deep into lungs and cause damage
Carbon Monoxide (CO)	Fossil fuel combustion	Hampers ability of blood to carry oxygen, exacerbates heart disease, drowsiness, compromises brain function and foetal development

Source: Adapted from Barter and Raad, 2000.

The deterioration in air quality and health is only one of the many problems associated with motor vehicles. Ecological sustainability is also affected. Motor vehicle travel uses more energy than the RMT systems (Shapiro et al., 2002). The conservation of valuable energy is another important aspect that needs to be discussed in order to preserve sustainable future development. Motorization demands fossil fuels as the energy power. However, an ecological future should prevent the overuse of important energy sources such as these very fossil fuels (Barter and Raad, 2000).

In addition to the impacts produced by vehicle travel, other indirect factors associated with motorized transportation are also detrimental to environment sustainability. Infrastructure construction, vehicle and parts manufacturing, vehicle maintenance and support, and disposal of used vehicles and parts play a major role in contributing to environmental and social problems (Corrales et al., 1996).

Motorized transport continuously generates hazardous pollution in the environment. As a consequence, this pollution causes climate change, acid rain, and adds to the global warming effect, which is detrimental for sustainable development (Barter and Raad, 2000; Yevdokinov and Mao, 2002). The environment and ecological costs of motorized transportation are unacceptable and must be considered a major problem (Corrales et al., 1996; Camph, 1997; Centre for Sustainable Transportation, 1997, 2002; Ellwanger and Lindeke, 1998; Halcrow Fox, 2000; Sayeg et al., 2002; Sheehan, 2002). Future transportation should provide a system with little or no environmental and ecological impacts for the better health of the people within that particular urbanized area (Horowitz and Beimborn, 1995; Centre for Sustainable Transportation, 1997, 2002). A system that is environmentally friendly and feasible should be developed. This need for sustainable development encourages the promotion of RMT development instead of the old paradigm of promoting motorization as the main mode of transportation (Horowitz and Beimborn, 1995; Barter and Kenworthy, 1997; Chamlong Poboon, 1997; Barter, 1998).

2.1.3.4 Problems in Bangkok

Comparative studies with other major cities in the world[6] show that the level of noise pollution in Bangkok is severely damaging to the human body (Chamlong Poboon, 1997). The air and noise pollution is hazardous not only to the environment but also the people. Eight hours in Bangkok traffic is equivalent to smoking nine cigarettes (Chamlong Poboon, 1997).

Bangkok consumes an enormous amount of energy. Indeed it is the highest in Asia, only slightly behind the United States and Australia, which are well-known car dependent countries (Chamlong Poboon, 1997).

The quality of life of a working person is also affected by the Bangkok traffic. The Expressway and Rapid Transit Authority of Thailand estimates that one-quarter of the average working time is spent on the commute (Therakomen, 2001). This time spent in traffic results in both social and economical losses.

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[6] Chamlong Poboon (1997) and Kenworthy (2005) provide extensive comparative study data for Bangkok with other major cities in the world.

An analysis of Bangkok land use patterns reveals that its good land use mix and high-density population mean that walking, cycling or mass transit are the most appropriate means of transport. However, the extremely hot conditions, the lack of cycling routes, and obstacles along the sidewalks combined with the attitudes favouring automobile dependence among Thai commuters make walking and cycling in Bangkok extremely troublesome.

The degree of car dependence in Bangkok is slightly less than developed cities in America and Australia.[7] The corresponding energy consumption also makes Bangkok the highest energy consumer at levels slightly lower than American and Australian cities (Kenworthy, 1995; Chamlong Poboon, 1997). Excessive energy consumption is a detrimental trend for the future ecology. Energy must be conserved for our future generations. If the city cannot solve the traffic problem then there will continue to be over-excessive consumption of the valuable energy in the world. In Bangkok the traffic solution has been to build more road capacity to accommodate the increasing traffic demands. Bangkok has experienced the worst possible consequences of such decisions with the development of road networks and expressways still failing to solve the city's fundamental traffic problem (ADB, 2000).

Transportation development in Thailand is moving in an unsustainable direction. A comparative study shows that Bangkok has extremely low road networks, transportation infrastructure and RMT systems while the vehicle ownership rate is high (Kenworthy, 1995; Chamlong Poboon, 1997). There is a severe problem in the capital's urban development theme – this must be addressed immediately and transformed into one of sustainable development.

The trends in other developed cities are still towards the support of unsustainable motorized transport development as is the case in Bangkok. In the United States, the population's average age is getting higher and the percentage of the elderly is increasing. However, these groups of people do not want to be stationed at home, rather they want to enjoy life and travel for leisure. This will be a major cause behind an increase in travel mainly by motorized vehicles (Skinner, 2000). Motorized

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[7] Kenworthy (2005) provides an extensive comparative analysis for Bangkok with other major cities in the world.

the rural areas. The effect is the formation of heavily suburbanized areas dependent on motor vehicles (Kenworthy, 1995; World Bank, 1999; Skinner, 2000; Wheeler, 2001). This unsustainable trend will lead to greater traffic congestion because the existing systems cannot accommodate the increasing demand for transportation (Gibbs, 1997; Skinner, 2000). The bottom line for the American population is that they want more mobility, a better environment, and more personal space (Skinner, 2000). More flexible mobility such as traveling to leisure locations or traveling to suburban areas to obtain more personal space requires the usage of motorized vehicles. However, the quest for a better environment has to be solved by limiting the motorized transportation mode and encouraging the RMT systems.

2.1.4 The Future of Public Transportation

Given the negative effects and consequences of the motorized private and public transportation, scholars are reluctant to support the rapid growth of motorized cities. The "restraints of motorized forms of transportation" encourage cities to stem the rapid growth of motorization and encourage the utilization of high-capacity public transportation in development policies (Kenworthy, 1995; Ellwanger and Lindeke, 1998; Barter, 1999; Barter and Raad, 2000; Wheeler, 2001). This is the core argument of sustainability advocates as the solution to the unorganized development of cities. The developing cities need a public transport system such as the RMT system to be the core of a transit-based development scheme that leads to sustainable development.

The role given to the RMT industry is that of an energy-efficient, environmental-friendly competitor to motorized transportation (Schultz, 1994). Transit-based development emphasizing land use planning to reduce the travel needs should be promoted as a better solution for transportation development (FTA, 1994; Barter and Kenworthy, 1997; Centre for Sustainable Transportation, 1997, 2002; Chamlong Poboon, 1997; Barter and Raad, 2000, Campion et al., 2000; Lefaver et al., 2001). Land use planning leads to a good mix of establishments within close proximity making long travel unnecessary. The containment and interaction of people in the transit area provides a revitalized community leading to livable communities (FTA, 1994; Schultz, 1994; Mobility for the 21st Century (M21) Task Force and

Olsen, 1996; Chamlong Poboon, 1997; Crosby, 1999; Barter and Raad, 2000; Skinner, 2000; Lefaver et al., 2001; Sheehan, 2002).

The RMT industry needs to be given full backing by the government. A shift from motor transport-based development to RMT-based development is not an easy task to be done successfully. The task to convince the general public to see, use, and accept the RMT system is an important one that has to be accomplished. Transit-based development programs and the supporting mix land use policies must be accepted by the people of the city. The expensive investment costs of all the RMT systems must be justified according to their feasibility and acceptance gained from the general public. The citizens must be informed that the government needs to install and adopt a more sustainable transportation development scheme. Also, the transportation industry must be reinvented to encourage sustainable development in the future (Schultz, 1994; Ellwanger and Lindeke, 1998).

2.1.4.1 Holistic Approach to Public Transportation Development

The need for a holistic view of the problem is essential to integrating the whole transportation section in order to provide optimal sustainability for the urban areas (Mitric, 1998; Gwilliam, 2000; Halcrow Fox, 2000a; Weyrich and Lind, 2001). The integrated approach should equally consider the economy, environment, ecology, and society (Barter and Raad, 2000). A Comprehensive Development Framework[8] (CDF) should be holistically formulated by adopting the information and ideas of all the concerned parties to provide conformity for development (World Bank, 1999).

The holistic policies must be able to identify the hidden aspects of the RMT industry, such as future expected problems, external benefits that the project offers, and new technology that will emerge (Horowitz and Beimborn, 1995; Skinner, 2000). All the embedded details can act as an important factor in altering the existing policies. The decision-maker must be visionary and see the total public transportation sector holistically to gain enough vital information and knowledge for planning and making future policies.

The importance of decision-making data is an important factor. Different groups of people have different perspectives and views towards a particular

[8] The Comprehensive Development Framework (CDF) is a holistic program of the World Bank used as the current paradigm for the development activities of the Bank.

area of interest. For transportation development, the engineer thinks of the solutions. On the other hand, the economist thinks of low cost measures while planners think of the implementation possibilities (Ferguson, 2001). Therefore, the decision-maker must look at transportation development from a holistic view to consider the various perspectives and ideas in order to select the best optimal path for the development of transportation. The overall transportation strategy is a political decision process that should be executed in a transparent manner and in which the general public must play a part in the decisions (Barter and Raad, 2000). The holistic approach in planning will enable the transportation sector to have sustainable development that benefits the overall well-being of the citizens (ADB, 2000; Billiar and Weissenborn, 2000).

An important base for deriving policies is the community. The transportation development plan is directly responsible for maintaining the well-being of the community. The government should gather vital information regarding the real needs of the community to be able to develop the most beneficial policies for the people. Public participation from the community in the policy-planning process will prove to be important and vital for good development (Barter and Raad, 2000; Billiar and Weissenborn, 2000; Lefaver et al., 2001; Sheehan, 2002). The government must make the community a strategic partner in developing holistic viewpoints from the providers and the consumers of the RMT systems. This cooperation will prove to lead to public policies with local community support that revitalize communities and develop livable cities (TRB, 1997).

2.1.4.2 Government Role in Public Transportation Systems

In order to move towards a sustainable development of transportation, the government must take the responsibility in leading and making the transformation happen. The government cannot just follow the trends and market signals, but it must be strong and lead the way (Barter and Raad, 2000; Halcrow Fox, 2000a). Political level influences will have to yield to the importance of the strong and full government support for transportation development projects (BB&J Consult, 2000). Transportation has to be an essential element for sound national policies (Shapiro et al., 2002). Government policies are the most important indicator of sustainable transportation development. Indeed, the major barrier to sustainability is the unsustainable policies of the government (Centre for Sustainable Transportation, 1997, 2002). Policymakers are usually politicians or bureaucrats that might be concerned with political acceptability instead of the actual benefits of the economy, environment, and society (Ferguson, 2001). Another potential detrimental factor highly affecting policymaking is the influence of the various stakeholders. Along with this, government policymakers can make decisions based on their own values, opinions, or moral judgments (Ferguson, 2001).

2.1.5 Different Modes of Public Transportation in Bangkok

The various modes of transportation in Bangkok include a variety of systems for the commuter to select from. Massive transportation infrastructures in the forms of expressways, RMT systems are important mechanisms supporting the commuter, while waterways and public buses are also available for the commuter to select as modes of transportation.

2.1.5.1 The Expressway System

Bangkok motorists rely heavily on the expressway system for commuting especially during rush hours. The expressway systems in Bangkok are quite extensive, but not sufficient for the increasing demands of transportation. The rush-hour commuter often encounters bumper-to-bumper traffic on the various expressway systems with some routes in gridlock. Table 2.3 shows the existing list of expressways in Bangkok.

Table 2.3 Bangkok Expressway Systems

	Bangkok Expressway Systems
1	The First Stage Expressway System
2	The Second Stage Expressway System
3	Don Muang Tollway
4	Ramintra-At Narong Expressway
5	The Bang Na- Chon Buri Expressway
6	The Bang Pa In- Chaeng Wattana Expressway

2.1.5.2 The Bangkok Transit Syatem

The Bangkok Transit System was the first RMT system introduced in Thailand, starting operations in December 1999. The system utilizes electrically-powered trains running on an elevated structure. The system runs 24 kilometers with 23 stations. The estimated cost of construction of the system was $ 1.7 billion.

2.1.5.3 The M.R.T. Chaloem Ratchamongkhon Line

The MRTA's M.R.T. Chaloem Ratchamongkhon Line in Bangkok has a total of 18 stations running 20 kilometers from Bang Sue to Hua Lamphong. Similar to the BTS Skytrain system, the MRTA's system utilizes RMT electrically-powered trains to carry the passengers along the system. The estimated cost of construction of this project was approximately $ 3.2 billion.

2.1.5.4 The BMTA Bus System

The BMTA bus system is the main transportation mode for average commuters in Bangkok. The BMTA divides the bus services into eight divisions covering 122 routes. The BMTA provides 1,670 non air-conditioned buses and 1,935 air-conditioned buses, while private concessionaires under the BMTA provide a total of 3,319 buses. In addition to the eight bus operation divisions, the BMTA provides supplementary services in the form of concessionaires and self operations. One of such additional services is the expressway bus system with 14 routes, which utilizes the expressway system as routes for transportation. Other concessionaires are the minibuses with 56 routes and 1,174 buses on the main streets, and 125 routes and 2,085 buses in the sub streets. Lastly, there are the minivans, which cover 143 routes and 5,547 vans. The total overall services provided by the BMTA and their concessionaires total 426 routes and 15,730 vehicles.

2.1.5.5 The Public Water Transport System

In Bangkok, water transport is another type of motorized transport system. However, boats are obviously used instead of automobiles and buses. The waterways of inner Bangkok have developed into a vital mode of transportation for commuters since the boat trips are less time consuming and more convenient in the respective areas of service.

2.2 Rail Mass Transit Development

Rail Mass Transit systems are essential for transportation development. The role of RMT systems is central to the future of sustainable cities (Halcrow Fox, 2000a). In the long run, RMT systems will be the backbone of the public transportation industry. The transit network is the sustainable future of Asia's large cities (Allport, 1995).

From the previous information presented concerning the development patterns, one can see that the transportation development direction of a country can be directed along different paths depending on the philosophy used as the basis for the plans. Therefore, the decision-making of the policy-makers plays an important role in determining the future direction and development path for public transportation of a country. In order to ensure the optimal development pattern for the country, the decision-makers must be thoroughly informed about the advantages and disadvantages of each public transportation development methodology and public transportation mode, in order to make the best available decision for the development plans within the limitations at that current time.

2.2.1 Transit- Based Development

Transit-based development utilizes the RMT system as central to the development of the transportation system and the community around the transit line. Transit-based development provides sustainable transportation that should be the new paradigm in transportation development replacing that towards motorized transportation (FTA, 1999; Barter and Kenworthy, 1997; Centre for Sustainable Transportation, 1997, 2002; Chamlong Poboon, 1997; Campion et al., 2000; Lefaver et al., 2001). The city structure and land use is formulated so that workplaces, shops, business establishments, community event centers, entertainment and leisure locations and other amenities are conveniently located in the vicinity of the transit station. The closeness of each location means that there is a favorable opportunity for walking and cycling to be used as the modes of transportation. A consequence is the enormous reduction in travel demands. The community member has no need to travel long distances. The major mode of transportation is walking and cycling while any necessary, longer trips can be provided by the RMT regional link (Mobility for the 21st Century (M21) Task Force and Olsen, 1996). The future development of the city is contained in the development corridors. The urban development in the form of "development corridors" moves along the transit line, therefore retaining the same characteristics of near proximity to the transit stations, mixed land use, and being community-centered (Kenworthy, 1995; Horowitz and Beimborn, 1995; Chamlong Poboon, 1997; TRB, 1997; Barter and Raad, 2000; Laird, 2000). Figure 2.4 shows the development corridor concept.

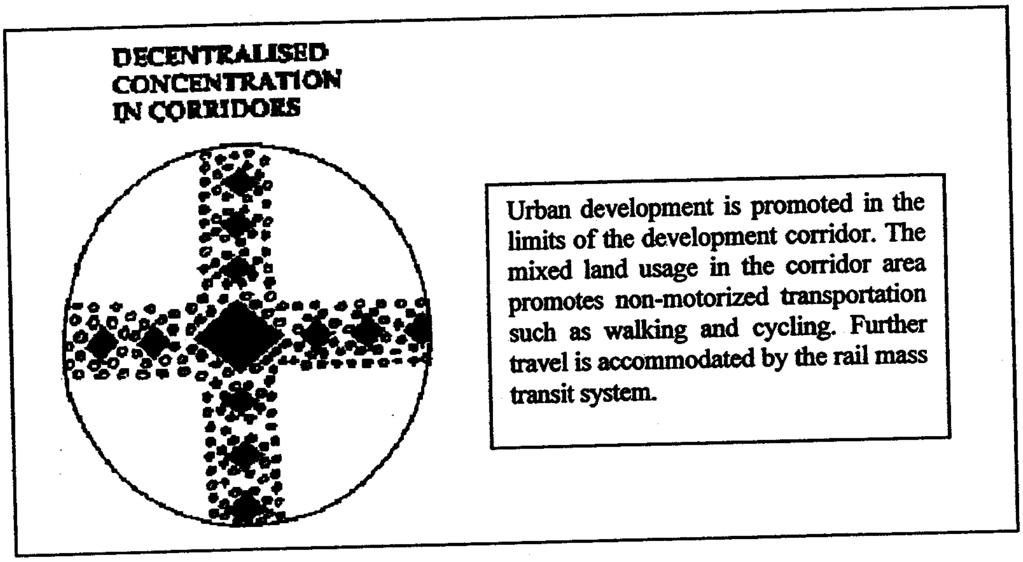

Figure 2.5 Decentralized Concentration in Corridors
Source: Barter and Raad, 2000 adapted from Newman and Kenworthy, 1999.

Since the plan focuses on creating a strong community through mixed land use, public participation by community members in the development plan is vital for a successful planning stage and sustainable development of the community (TRB, 1997). The policies used to ensure the proper transit-based development in corridors must be holistically planned and implemented. The integration of other transportation modes and systems in the supportive role provides assistance to the RMT system.

2.2.2 Problems Associated with Rail Mass Transit Development

The development of RMT systems is not an easy task to be achieved. Depending on the development project, a series of obstacles have to be overcome throughout the whole process of establishing an RMT system. This section discusses some of the many problems that might occur during the development process.

2.2.2.1 Justification of Rail Mass Transit Projects

Motorized transportation advocates confer that the RMT system does not convert private motorized users to switch to traveling on the transit system. The motorized transport advocates cite the RMT system as getting passengers from the bus transit systems (Semmens, 1998). Therefore, the creation of an RMT system to reduce the effects of private motorized vehicles degrading the environment is not justified. The RMT system is deliberately undermined by a group of motorized transport supporters who are directly affected if a RMT system is built. The motorized transportation advocates use special cases to make generalizations on the whole RMT industry. The case that supports the claim that RMT users are former bus mass transit users is also made for the Los Angeles area system. The Los Angeles area Blue Line serves a transit-dependent population. This case is an exception, not a typical rule to be generalized (Weyrich and Lind, 2001). RMT supporters must face the various criticisms from motorized transport supporters, who are also substantial stakeholders in the motor business.

2.2.2.2 Comparison with the Bus System

The RMT system is also often compared with the bus system and the busways. Bus systems are still the major choice of mode of public transportation (Sayeg et al., 2002). However, the bus transit systems are oversubsidized by the government even though the systems are not economically viable (Semmens, 1998). In the long run, the operational costs involved in running a bus system are more than those for an RMT system (Weyrich and Lind, 2001). In addition, RMT is a more sustainable transportation system than the bus system. Table 2.4 below compares the Rail Transit system with the bus system.

Table 2.4 Comparison of Bus Transit and Rail Transit Systems

Bus Transit	Rail Transit
Flexibility. Bus routes can change and expand when needed. For example, routes can be changed if a roadway is closed, or if destinations or demand changes	Greater demand. Rail tends to attract more discretionary riders than buses
Requires no special facilities. Buses can use existing roadways, and general traffic lanes can be converted into busways	Greater comfort, including larger seats with more legroom, more space per passenger, and smoother and quieter ride
More suitable for dispersed land use, and so can serve a greater rider catchment area	More voter support for rail than for bus improvements
Several routes can converge onto one busway, reducing the need for transfers. For example, buses that start at several suburban communities can all use a busway to a city center	Greater maximum capacity. Rail requires less space and is more cost effective o high volume routes
Lower capital costs	Greater travel speed and reliability, where rail transit is grade-separated
Is used more by people who are transit-dependent, so bus service improvements provide greater equity benefits	More positive land use impacts. Rail tends to be a catalyst for more accessible development patterns
	Increased property values near transit stations
	Less air and noise pollution, particularly when electrically-powered
	Rail stations tend to be more pleasant than bus stations, so rail is more appropriate where many transit vehicles congregate

Source: Litman, 2004.

2.2.2.3 Commute Mobility with Rail Mass Transit Usage

The flexibility of the RMT system is another area which critics use to undermine the system. Motorized vehicles can provide mobility for commuters to move and travel to any location according to their wishes. RMT systems are fixed lines where the destinations are fixed also. As cities gradually sprawl and grow larger, the less flexible RMT systems cannot compete with the flexibility of the private and public motor vehicles for mobility. The sufficient land in the suburbs eliminates the problem of land acquisition for parking of the motor vehicles (Jones, 1995; Skinner, 2000). This development pattern of using the open suburban land is synonymous with the unsustainable development patterns of many cities in the world. The development can be controlled by using transit-based development and creating a livable community within the inner city. The farmlands and agricultural lands will not be disturbed and car dependence will be decreased (FTA, 1994; Wheeler, 2001).

2.2.2.4 Investment Costs[9]

The costs of establishing an RMT system are very costly (Weyrich and Lind, 1999; Budin, 2002). The major problem for RMT systems starts from the high expenditure involved in their initial establishment, which leads to expensive ridership fare (Gwilliam, 1997; Skinner, 2000). Many people feel that the rail development cannot be cost effective by generating enough ridership to justify the investment (Horowitz and Beimborn, 1995; Halcrow Fox, 2000a). A quantitative research of European rail operators indicates that the most significant key factor for the rail industry is cost sensitivity (Nijkamp and Pepping, 1998). This proves that the cost is still one of the most important factors in the decision to develop a rail-based mass transportation system. Excessive cost is one of the major problems, used by rail transit critics, to undermine the promotion of the system. Since the decision-makers often are economists, who really concentrate on low-cost solutions, the economic cost justification of RMT systems is vital (Ferguson, 2001).

Public transportation systems require substantial amounts of capital for investment in the system depending on the particular details of the system. The cost is dependent on the configuration of the system components such as underground tunnels, elevated superstructure, rolling stock, and other amenities. Since each project must be tailored to the urban area, there are no standard configurations and no standard approach (Budin, 2002). This leads to high costs of investment in the RMT programs.

2.2.3 Rail Mass Transportation Benefits

RMT systems provide a variety of beneficial aspects economically, environmentally, and socially. The numerous benefits provided by RMT systems will assure policymakers to include more RMT systems in transportation development plans.

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[9] Railway Technical Web Pages (2005) provides data on investment costs for numerous RMT systems

2.2.3.1 The Environment and Ecology

The environment is one particular area that benefits substantially from the RMT systems (Halcrow Fox, 2000a). The RMT systems reduce the usage of motorized vehicles and traffic congestion that burn fossil fuels polluting the air and contributing to global warming. The well-planned RMT systems reduce the air pollution in urban areas by reducing motor transport needs (FTA, 1994; Halcrow Fox, 2000a; Sayeg et al., 2002; Sheehan, 2002). In addition to the air pollution problem, other pollutions are also reduced. The establishing of an RMT system will reduce noise pollution caused from the motorized means of transportation (FTA, 1994).

The world's natural resources from the ecological system can also be preserved with reductions in motor transport usage. The transit travel uses significantly less energy than motorized vehicle travel. Therefore, the public transportation system conserves energy and reduces damage to the environment caused by fuel emissions (Shapiro et al., 2002). Replacing motorized transportation with the more sustainable RMT system is beneficial for the environment and the ecology. The RMT systems are the future paradigm in the public transportation industry and the sustainable development plans.

2.2.3.2 Reducing Traffic Congestion and Travel Accidents

RMT systems reduce traffic congestion (FTA, 1994; Camph, 1997; Chamlong Poboon, 1997; Halcrow Fox, 2000a). As mentioned previously, the reduction of traffic congestion also reduces negative environmental and ecological effects. However, the reduction of motorized transportation and the promotion of RMT also have more beneficial consequences. RMT systems play an important role in the reduction of motorized transportation usage and traffic accidents (CSI and EDRG, 1999; Campion et al., 2000; Halcrow Fox, 2000a). Accidents are a leading cause of deaths in a city. Fatal accidents certainly have a major social effect on family life and also cause economical damage.

2.2.3.3 Economic Development

The RMT systems provide opportunities for economic development (Camph, 1997; CSI and EDRG, 1999; Halcrow Fox, 2000a). RMT development focuses on the community around the transit line. The micro-focus on land usage and community re-building resulted in improved prospects for the local economy. The development strategy provides a spark for local economic development and the generation of local entrepreneurs (TRB, 1997). The transit system provides great opportunity for local and community development. The system enhances property value, rents and occupancy rates (Camph, 1997). Jobs and increasing sales as well as the accessibility to the job location is another beneficial by-product from RMT systems (Camph, 1997; CSI and EDRG, 1999; Halcrow Fox, 2000a).

Quantitative findings by the Cambridge Systematics Inc. and Economic Development Research Group (1999) illustrated the economic benefits of RMT systems in terms of jobs created, business gains, net savings from motor vehicle costs, and others that cannot be quantified such as quality of life, changes in land use, social welfare, and cost reductions from other modes of transportation.

Many critics of RMT systems assert that the establishment of an RMT system is expensive and not cost-effective. The overall costs of running a RMT system compared with the costs of motorized transport are interesting. The RMT systems, although more expensive initially in their establishment, are more cost-effective than motorized transportation in the long run (Barter and Raad, 2000; Weyrich and Lind, 2001). A sustainable future seen holistically must consider the long-term effects of the transportation system. The long-term costs of RMT systems are more cost-effective than the motorized transportation system as a whole. People often forget that the government must build and maintain the road network for the commuters because the government normally subsidizes this cost. The commuters usually think that the only cost associated with motorized vehicles is the purchase value of the actual vehicle. Therefore, support for motorized vehicles can be obtained relatively easily. When the overall systems of motorized transportation and RMT systems are compared, the RMT system proves to be the better economic choice (Weyrich and Lind, 2001).

2.2.3.4 Urban Development

RMT critics argue that RMT systems are inflexible as they cannot accommodate the dispersed sprawling of transportation needs to the suburbs. The organized urban development patterns enable the containment of urban development to be dispersed into rural areas but in an unsustainable form. This development control prevents the acquisition of agricultural land and open space from urban sprawl (FTA, 1994; Wheeler, 2001). The RMT system works against continuous sprawl and formulates growth in high-density corridors (Kenworthy, 1995; Horowitz and Beimborn, 1995; TRB, 1997; Chamlong Poboon, 1997; Barter and Raad, 2000). RMT systems provide a development corridor extension from the urban city centers. The mass transit lines are secured and permanent infrastructures in which land developers can be assured of their existence. Unlike busways or bus routes, which can easily be changed as the management require, RMT structures provide land developers the security of a permanent public transport source. RMT systems can be considered as fixed, high-value assets guaranteeing high property value, high rents, and more customers (Weyrich and Lind, 2001). Urban development should maintain a good mixture of land usage within the distances of the RMT stations to encourage less motorized transportation demands, generate increased local business, increase land value, revitalize local communities, and enhance the overall quality of life (Centre for Sustainable Transportation, 1997, 2002; Chamlong Poboon, 1997; Barter and Raad, 2000; Halcrow Fox, 2000a; Laird, 2000; Weyrich and Lind, 2001; Sheehan, 2002). Businesses grow around the mass transit stations providing services to the additional commuters of the RMT system. Mixed housing for different levels of income are also within the proximity of the RMT system to create a good community mix without segregation between the low, middle, and high social classes (Wheeler, 2001). This creates the appropriate blend of people to formulate a diversified community life. The mixed land usage around the transit line provides local urban transit-based development or development corridors (Kenworthy, 1995; Horowitz and Beimborn, 1995; Chamlong Poboon, 1997; TRB, 1997; Barter and Raad, 2000). The more efficient community will then be released from the dependence of motorized transportation (Horowitz and Beimborn, 1995).

The RMT system and its surrounding vicinity provide space for people to meet and share a community life. Well-planned and designed transit along with the patterned arrangement of the urban area provides a direction leading to livable communities in the future (FTA, 1994; TRB, 1997; CSI and EDRG, 1999). The strong local community reduces the need to travel far distances, thus promoting the usage of walking and cycling as the sustainable modes of transport (Chamlong Poboon, 1997; Sheehan, 2002).

2.2.3.5 Quality of Life

The generation of roads into communities proves detrimental to the local quality of life. The roads divide the community through barriers between the shops, schools, and businesses of the community. The road occupies space that could be provided for community projects, greenery, parks, and other community recreation activities. These detrimental aspects of motorized transport can deteriorate the quality of life and then lead to the slow extinction of the original heritage and culture (Barter and Raad, 2000). Provision of RMT systems reduces the need for motorized transport, thus providing a better economic, environmental, ecological, and social future for the community and the people within the community.

Many of the factors mentioned previously lead to the improvement of the citizens' quality of life (CSI and EDRG, 1999). The revitalized community as a consequence of transportation planning plays an important part in social development. Reduction of hazardous pollution, decreased energy use, and non-motorized transport usage leads to revitalized communities and a better quality of life (Sheehan, 2002). According to World Bank (1999), the quality of life is enhanced with better social interaction and cohesion. If the RMT system develops into the center of community life, the quality of life for the commuters and the community will also progress in a positive direction.

2.2.3.6 Urban Poverty

Understanding the transportation needs for the poor is an important factor in developing a transportation system that benefits the poor (World Bank, 1996; World Bank, 1999). RMT systems will provide increased mobility for the poor (Barter, 1998). This could be beneficial for the poor to be more competitive in many areas. The poor spend more time making shorter trips than the others making longer trips (Barter and Raad, 2000). This shows that the poor have less mobility than other groups do. Increased mobility using the public mass transportation system can help solve this problem. Prospects for the poor improve in essential areas such as jobs, food, shelter, and others because of the better mobility. In the long run, the improvements will lead to a better quality of life for the poor (World Bank, 1999; Halcrow Fox, 2000a).

Mixed-income housing can provide the shelter for the poor and others. Housing near RMT stations helps the poor travel in less time. Mixed-income housing is also needed to provide a mixture of people to avoid poverty-concentrated areas. Poverty-concentrated areas often generate more crime (Wheeler, 2001). RMT systems can provide social benefits by contributing to poverty alleviation. The RMT network contributes to city efficiency and benefits the poor through the trickle-down effect, integrates poor communities within the city, and generates pro-poor policies on tariffs to benefit the poor Halcrow Fox, 2000a; Budin, 2002).

The RMT systems serve the poor to a certain extent. However, the bus mass transit system is truly the means of transportation for the poor people (Horowitz and Beimborn, 1995). This is an example of the integration of the various modes of transportation to develop the best solution for the people's transport needs. Along with the bus mass transit systems, promotion of non-motorized transportation, such as cycling and walking by making safe pedestrian and bicycle routes, should be considered to promote sustainable transportation (Barter, 1998).

2.2.4 Transportation Development in Thailand

2.2.4.1 Background

The development of Bangkok in the early periods was not planned from a holistic viewpoint. Bangkok faces a severe traffic problem everyday because the inadequate road space cannot accommodate all the travel demands. However, the problem is more complicated than the initial observation. The Bangkok problem is the consequence of a mismatch in the three major components of public transportation. The transportation pattern, urban form, and transport infrastructure are not planned holistically in an integrated manner (Barter and Kenworthy, 1997; Chamlong Poboon, 1997). The urban form of Bangkok is appropriate for walking and transit patronage, but the transportation pattern or public choice is the usage of private cars. The relatively constant hot weather, polluted air environment, and poorly conditioned sidewalks with many obstacles, such as street vendors, make walking and riding bicycles an unattractive mode of transportation. Meanwhile the transport infrastructure lacks roads, mass transit systems, and bus priority lanes (see Figure 2.6).

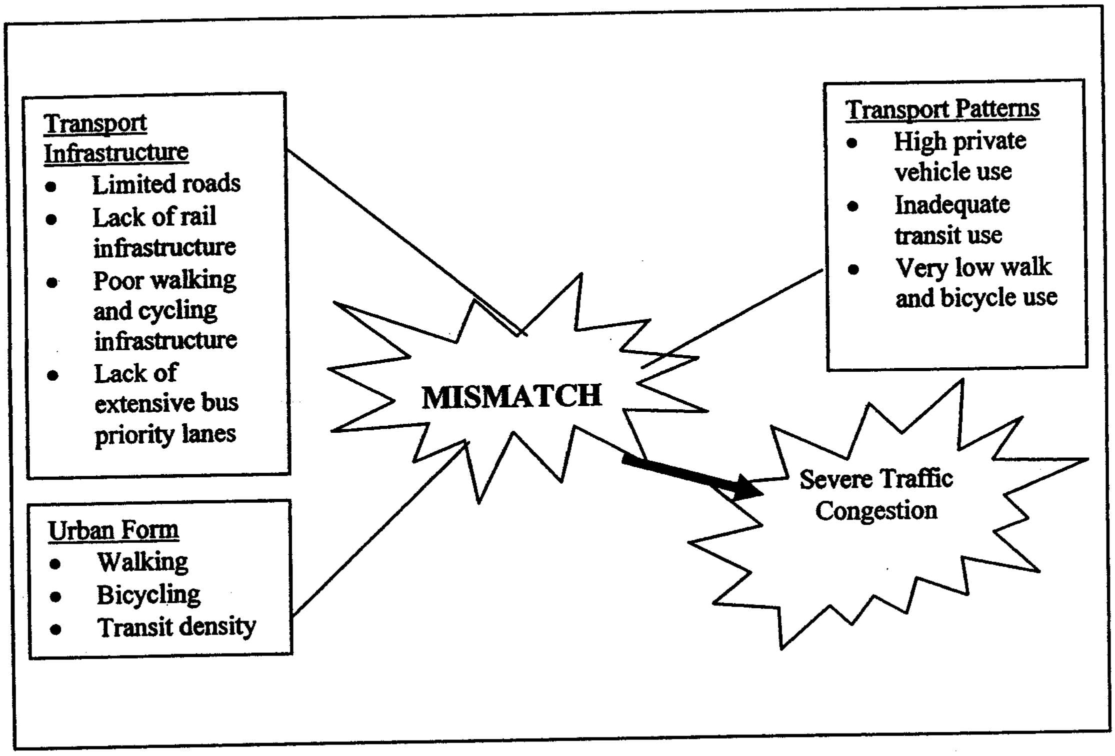

Figure 2.6 Mismatch between Bangkok's Transportation Infrastructure
Source: Chamlong Poboon, 1997.

In the case of Bangkok, the government also chose the building of more roads to reduce the problematic traffic congestion (Bello et al., 1998). In the end, the road networks are not even close to providing sufficient capacity for traffic growth, even with the strong support from the Thai government (Chamlong Poboon, 1997).

2.2.4.2 Transportation Development Planning

In Thailand, a holistic view of the future has not been clearly prepared and generated. The government has already focused on the environmental issues of the development. The environmental concern has been acknowledged and recognized since the 5th National Social and Economic Development Plan, where the issue was included into the context. Since then, the environment has become a vital part of the plans up until the current National Social and Economic Development Plan (Chamlong Poboon, 1997). However, the problem of the Thai development plan lies within the context of the society. Little has been discussed on the consequences and effects of the development on society. A holistic view should include all the aspects of developmental concerns in the plan. The society should be studied and the policies associated with the society will have to be included in the future development plans.

In Thailand, there are major concerns in transportation development that the government will have to rectify immediately. The government agencies responsible for the national transportation plans are fragmented and segregated. Each agency has their own policies and visionary direction, resulting in institutional conflicts and no holistic transportation development plan (Chamlong Poboon, 1997; ADB, 2000). The result of the lack of cohesion in the policy created the planning and implementation chaos identified by the lack of direction, and uncoordinated development projects (Unger, 1998). Table 2.5 shows the various segmented government offices that have a part in the development of transportation in Thailand.[10]

Table 2.5 Government Offices and State Enterprises Responsible for Public Transportation

Government Offices and State Enterprises Responsible for Public Transportation	
Government Offices	
1	Ministry of Transportation
2	The Department of Land Transport, Ministry of Transportation
3	The Department of Maritime Transport and Commerce, Ministry of Transportation
4	The Department of Highways, Ministry of Transportation
5	The Department of Rural Roads, Ministry of Transportation
6	The Office of Transport and Traffic Policy and Planning, Ministry of Transportation
7	The Department of Public Works and Town Planning, Ministry of Interior
8	Bangkok Metropolitan Administration
9	The Traffic and Transportation Department, Bangkok Metropolitan Administration
10	The Department of City Planning, Bangkok Metropolitan Administration
11	The Royal Thai Police
State Enterprises	
1	The State Railway of Thailand
2	The Express Transportation Organization of Thailand
3	The Bangkok Mass Transit Authority
4	The Transport Company Limited
5	The Expressway and Rapid Transit Authority of Thailand
6	Mass Rapid Transit Authority

In order to move towards a sustainable development in transportation systems for Bangkok, the government must be the central force behind making its

[10] On October 2002, the government has realigned the various transportation agencies to reduce segregation and fragmentation in policy making.

various internal groups work together in a cooperative fashion. The government must also seek the cooperation and partnership of the private sector. The cooperation of all parties involved in the transportation business will lead to a holistic form of transportation development. The end result should be the increased consideration of instituting sustainable transportation and livable communities.

The Royal Thai Government has expressed concerns about the segregation of the various governmental ministries, departments, offices, state enterprises, and agencies on transportation and the idea of combining each individual RMT system is being pursued. Negotiations with the BTSC for the purchase of the BTS Skytrain system concessionaire are continually in progress – the latest offer from the Royal Thai Government being a purchase price of 56 billion THB (TNA, 2008). Negotiations with BMCL, the concessionaire for the MRTA subway system were held in 2004, when the BMCL agreed to sell back the system if given the right price (Charoen Kittikanya, 2004a).

2.2.5 Rail Mass Transit Development in Bangkok

In recent years, there has been increasing awareness that the Bangkok transportation problems need to be solved by utilizing RMT systems to move commuters through the city en masse instead of the dependence solely on motor vehicles. Transportation development planners have increasingly proposed more RMT routes in the transportation master plans for Bangkok; however, the actual implementation and development of the RMT systems as planned are time consuming and very limited. Many of the developmental problems discussed previously have been detrimental to the RMT development plans yet the main problems associated with the delays have arisen from the disagreement between the various governmental branches in the planning stages. This section discusses RMT development in Thailand.

2.2.5.1 Rail Mass Transit Development Planning

Development corridors are not a new idea in the transportation sector. Bangkok urban development in the past has been in corridors. The development corridors were along the main road artilleries starting from inner Bangkok to the suburbs (see Figure 2.7). However, the combination of development corridors and motorized transportation has proven to be a mistake leading to car dependence and the unsustainable development of air pollution (Chamlong Poboon, 1997). Bangkok needs to build more development corridors along the RMT routes instead of the highways and high capacity road surfaces. RMT based development corridors will be the key solution to this world-renowned traffic problem and the better sustainable development of Bangkok. Since the RMT development is still in the early stages, the corresponding development of RMT systems, land use policies, transit-based development, and implementation procedures can be executed optimally to be of the utmost benefit to the development of Bangkok. Bangkok can learn from the mistakes of other developing countries and provide a transportation system and urban development pattern that is sustainable.

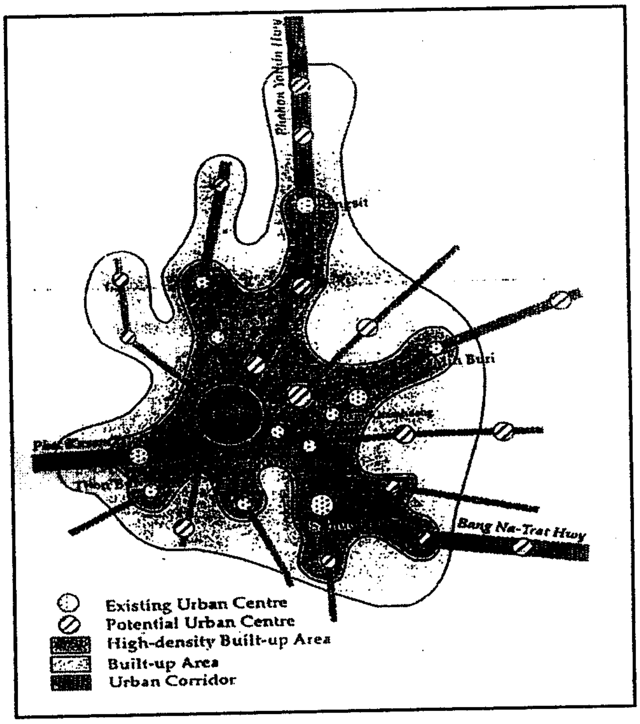

Figure 2.7 Bangkok Development Corridors along Major Roadways

Source: Chamlong Poboon, 1997.

In Thailand, the main transport policies still encourage the generation of roadways for motorized vehicles, while RMT systems are very limited (Chamlong

Poboon, 1997; O'Grady, 2001). The current trend in the Thai policy must be changed and enhanced to improve the transportation sector in a sustainable direction.[11] The development of more RMT systems in Bangkok can assist the transportation development plans taking a sustainable direction in the future.

2.2.5.2 Reduction of Traffic Congestion and Travel Accidents

Bangkok is a city that can benefit immensely from the promotion of RMT systems. When compared to other major cities, Bangkok has substantially high travel-related deaths from motor vehicles (Chamlong Poboon, 1997). The switching of commuters to use the RMT system as the mode of transportation can prevent many travel-related accidents, and reduce the amount of motor vehicle-related deaths. The RMT system must be attractive to offer the motorist the choice of selecting the system instead of using other motor forms of transportation. Therefore, the proper development of RMT systems in Bangkok must be accomplished appropriately for the better future of Bangkok residents.

2.2.5.3 Rail Mass Transit Development Projects

Although development in motor vehicle transportation is mainly proposed as the resolution of Bangkok's traffic problems, RMT projects were also considered in the master plans. There are currently two RMT projects in Bangkok that are in operation, however much more RMT projects are essential for the sustainable development of the transportation system. Figure 2.8 shows the existing RMT systems in Bangkok, which include the BTS system[12] and the MRTA's M.R.T. Chaloem Ratchamongkhon Line[13].

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[11] Since the initiation of the Bangkok Transit System in late 1999, and the Mass Rapid Transit Authority's system in 2004, the Thai government has made major efforts to implement seven more Rail Mass Transit systems covering approximately 300 kilometers.

[12] The BTS system is operated by BTSC under a concessionaire agreement with the BMA

[13] The MRTA's system is operated by BMCL under a concessionaire agreement with the MRTA

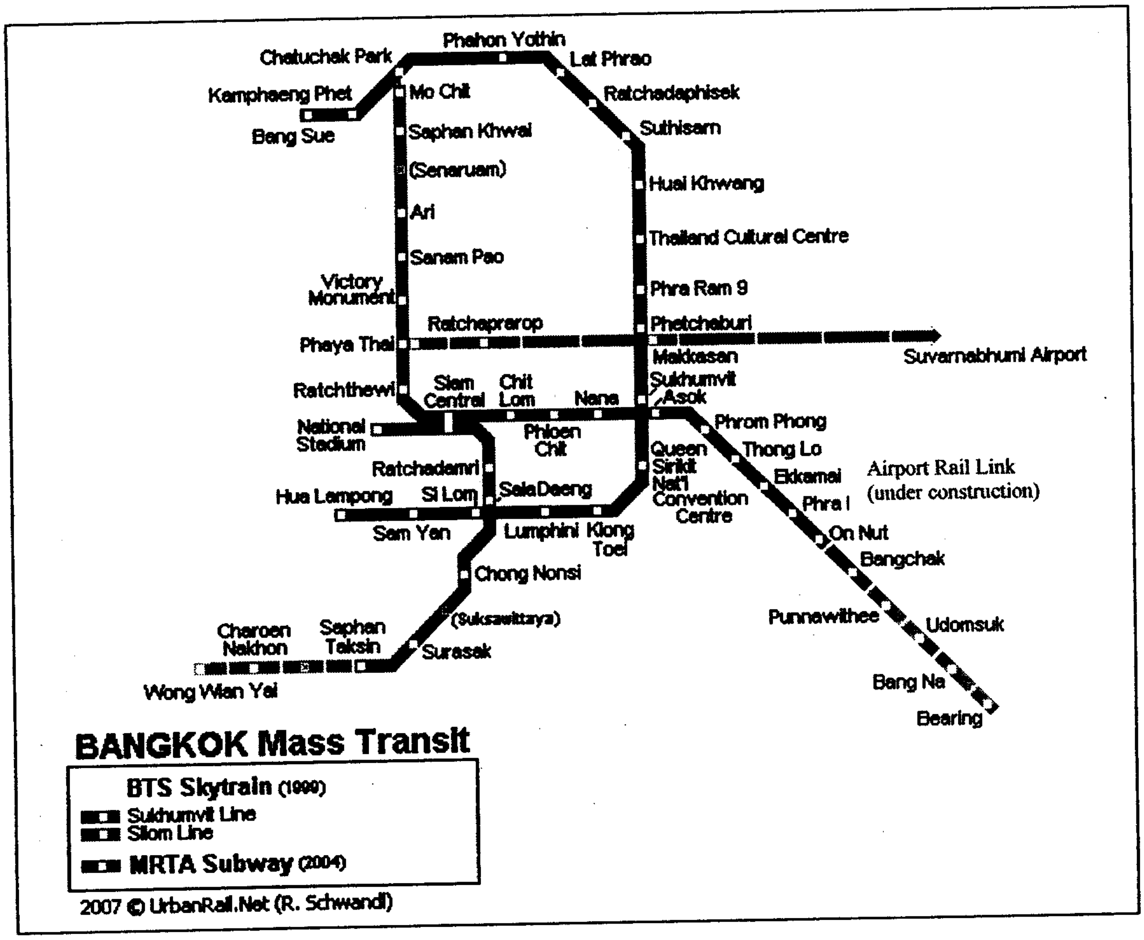

Figure 2.8 Rail Mass Transit Systems in Bangkok
Source: Adapted from UrbanRail.Net, 2008.

The trend in Thailand concerning mass transportation is that policymakers have started to seriously consider and include RMT systems in the master plans. However, the proposed projects have not been executed due to the many obstacles for implementing such projects. The proposed RMT extensions to be implemented by the Mass Rapid Transit Authority are shown in Figure 2.9. The RMT development projects undertaken by the Bangkok Metropolitan Administration are presented in Figure 2.10 The initial RMT plan (2004 to 2009) produced by the Office of Transport and Traffic Policy, Ministry of Transportation is shown in Figure 2.11, and the overall proposed RMT master plan is shown in Figure 2.12. Figure 2.13 shows the Airport Rail Link project, which has almost been completed and will be the third RMT system in Bangkok utilizing the old Hopewell route and structure to provide an RMT system to the new Suvanabhumi Airport. The Airport Rail Link project is being developed by the State Railway of Thailand.

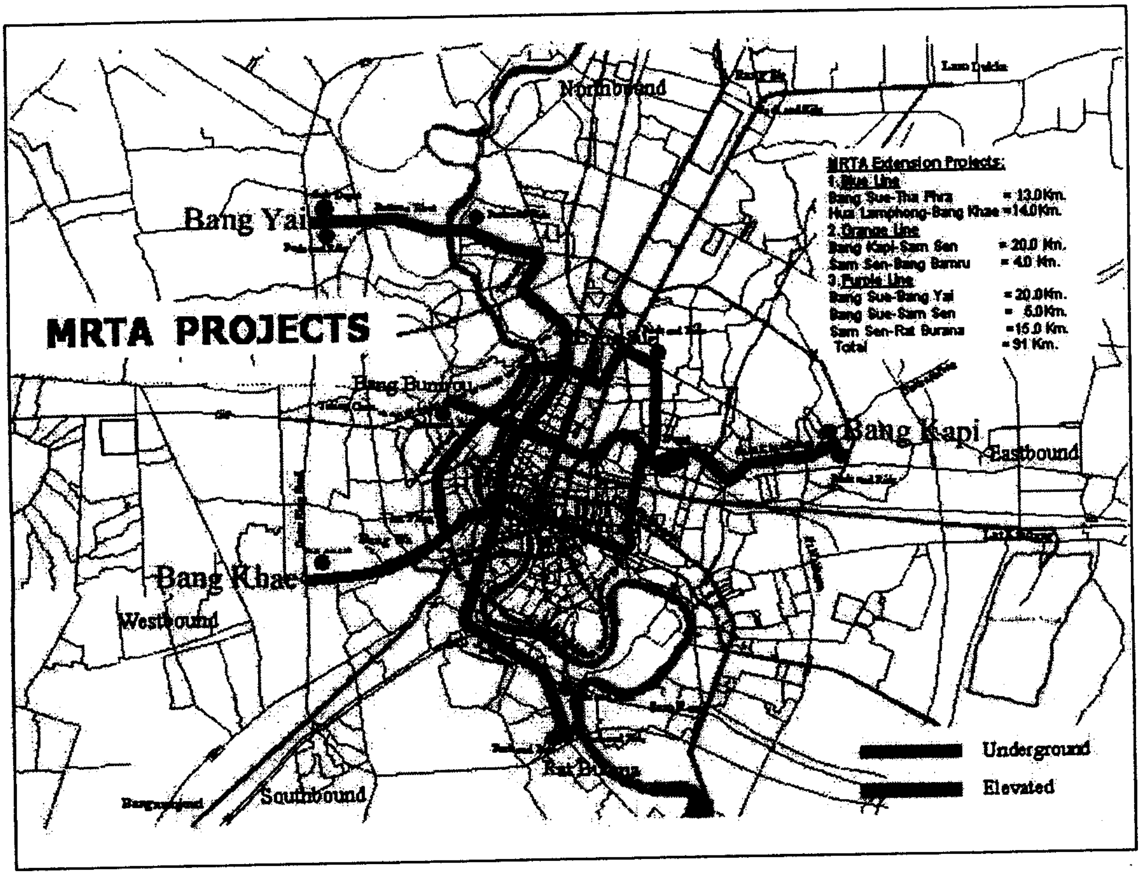

Figure 2.9 Proposed Rail Mass Transit System Extensions by MRTA

Source: MRTA, 2008.

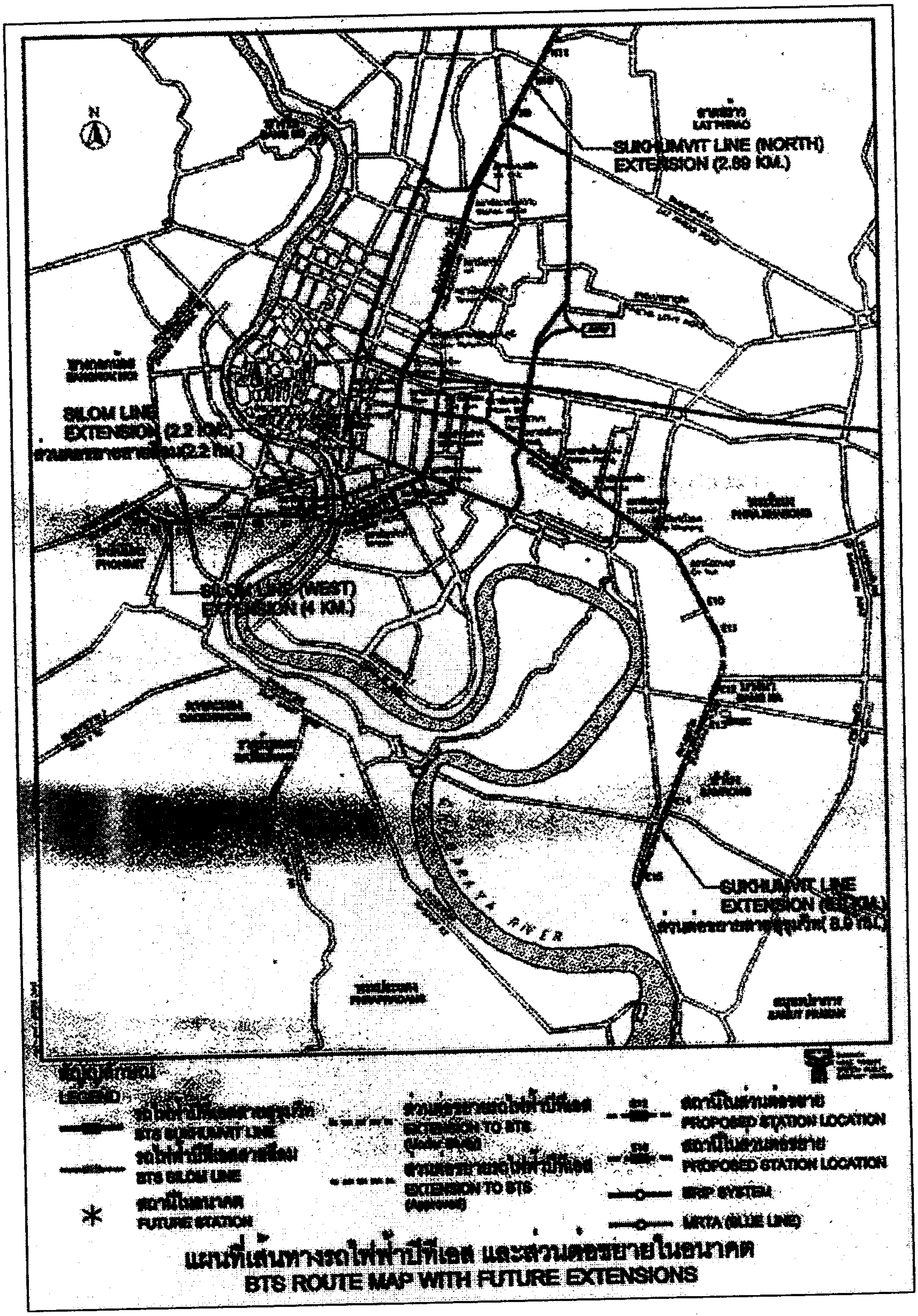

Figure 2.10 Proposed Rail Mass Transit System Extensions by BMA

Source: 2Bangkok, 2008a.

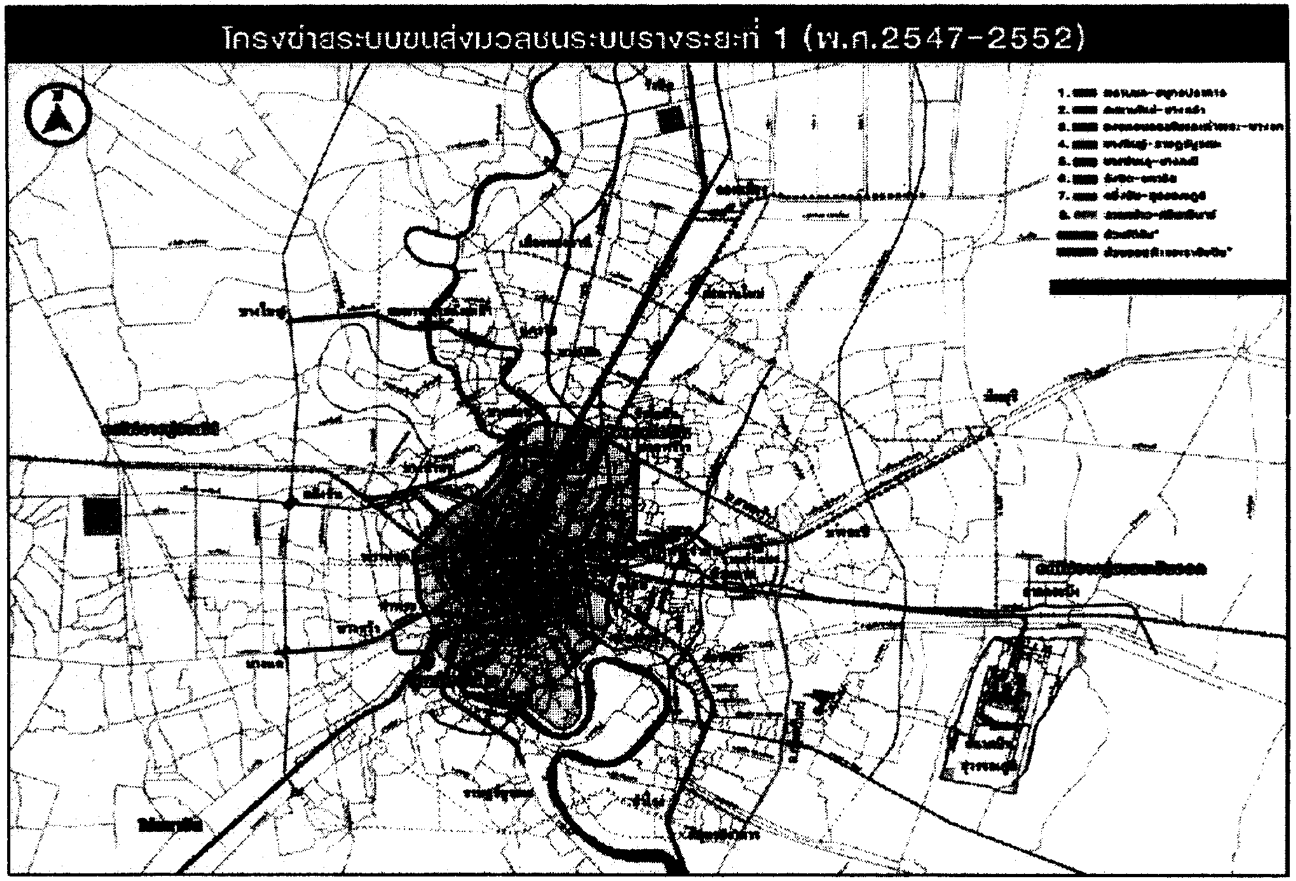

Figure 2.11 Initial Rail Mass Transit Plan (2004 to 2009)

Source: Chamroon Tangpaisalkit, 2007.

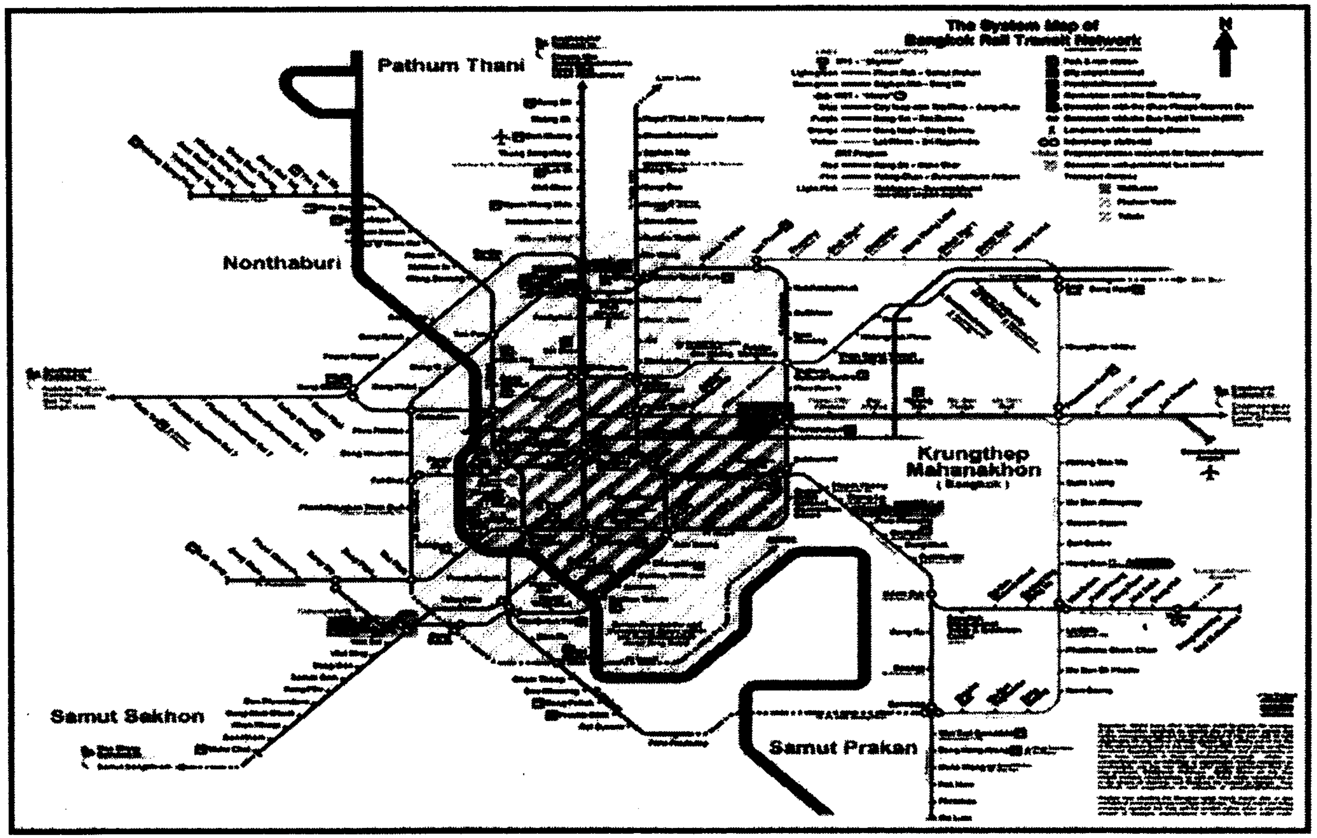

Figure 2.12 Proposed Rail Mass Transit System Master Plan

Source: 2Bangkok, 2008b.

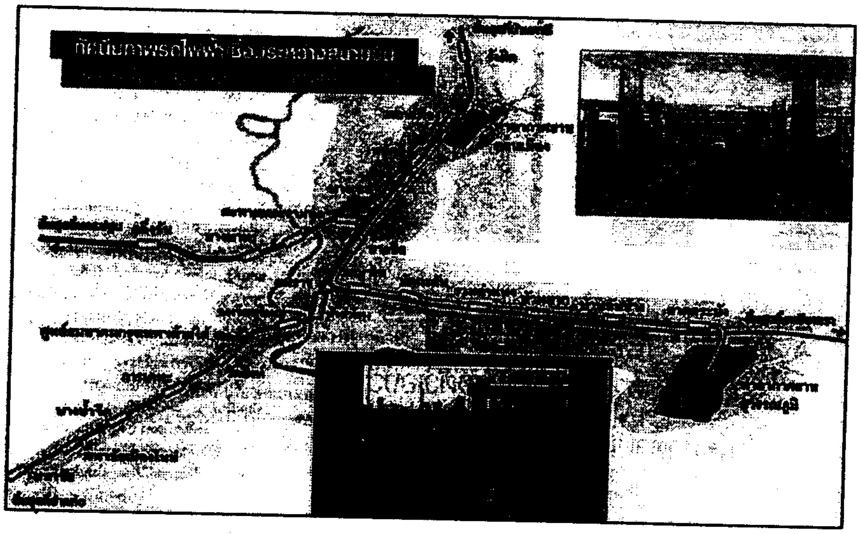

Figure 2.13 Airport Rail Link Project
Source: Prachachart Turakij, 2004.

2.3 Rail Mass Transit Ridership

As previously discussed, Rail Mass Transit ridership plays an important role in the successful establishment of the RMT system. Given the environmental and social benefits of mass transit systems, the ridership increase is a very beneficial phenomenon. There is a lot of room for RMT ridership increase because, currently, the RMT systems carry only one percent of the total transportation trips made (Weyrich and Lind, 1999). Increased ridership proves to create more economic revenue, thus making public transportation attractive to private investors and concessionaires. Ridership increase means commuters choose to use mass transit systems over personal automobiles, thus ensuring less motor vehicle transport. RMT ridership is evaluated by performance and acts as a substitute for automobile travel, which consequentially reduces congestion, parking costs, and accidents (Litman, 2004). Therefore, RMT ridership encouragement strategies should be generously implemented and carried out to appeal to and attract motor vehicle commuters and other commuters to use the RMT systems.

However, RMT ridership can be affected by many factors. In Japan, the farebox only covers the operational costs; however, the railways are very efficient and the cleanliness and reliability are of a high standard resulting from the sacrifice of the increased costs subsidized by the government (Railway Technical Web Pages, 2005). With the high costs associated with the development of the RMT systems, financial feasibility is often difficult to justify. Often, the government accepts future financial risks by producing aggressive ridership forecasts to bear the costs and justify implementation of a project (Fjellstrom, 2003).

The key to most RMT systems often occurs in the planning stages of the transit project. Financial justification is directly influenced by the projected ridership and revenues used as the basis for financial feasibility calculations. Forecasting costs, ridership, and revenues have been very poor in the past causing the heavy burden of expectations for new project development. To some extent, a forecast will always be uncertain, but there can be efforts made to avoid the forecast being misleading (Halcrow Fox, 2000b; Wall, 2003). The initial estimates for the Bangkok subway system were 404,880 passengers per day in the year 2002 to 2003; however, in December 2000, the Office of the Commission for the Management of Land Traffic (OCMLT) re-estimated the number at 300,000 passengers per day. In May 2001, Prachachart Turakij estimated the number of passengers per day to be between 270,000 to 280,000, and then on October 17, 2001, the Bangkok Metro Company Limited (BMCL) estimated a daily ridership of 237,000 passengers per day for the first year of operations (2Bangkok, 2008c). Praditpong (2006) found that the actual ridership of the underground subway in Bangkok stood at 180,000 passengers per day in the first year of operations as compared to the 250,000 passengers per day projected at this stage.[14]

The factors that support the low ridership numbers are believed to be the initial adjustment to the system, including building confidence in the safety of the system, the limitation of the system's access to certain residential and business district areas pending future expansions, and the vague development of bus feeder systems.

Bad estimation of ridership numbers can be detrimental to the project during operations as well. Many megaprojects in RMT have extreme cost overruns, which can be attributed to the poor forecasts of capital costs, construction time, operating costs, and ridership/revenues (Halcrow Fox, 2000b). Therefore, a better understanding of the RMT ridership can only prove to be beneficial for the transportation planners, operators, and concessionaires involved in the projects. Weyrich and Lind (2001)

[14] The MRTA Subway commenced operations in 2004.

have described the trend in ridership projections as depending on the amount of information obtained from past projects. With reference to various RMT systems in the United States, the initial ridership projections were deemed too high but after more data was collected, the projected ridership numbers were quite accurate, even to the extent that some estimations were underestimated.

Another disadvantage of high ridership estimations may be that a high ridership forecast leads to a more costly system (Halcrow Fox, 2000b). With projections of more revenues, the transport planner will decide to include many other features with the system installation. RMT systems are justified from the comparison of what the system owner has to provide and the financial possibility to pay for the requirements with the projected revenues. With misleading high revenue projections, the transit owner might want to add additional features to improve the overall system.

Many considerations must be incorporated into the development of a RMT plan. The transport planner must identify the basic setup of the transit system, and also the additional features that might be needed to provide a successful system operation. RMT systems can be developed as a package to include the transport facilities, the bus system to feed the development, the design and landscape to improve the environment, controls on car use, and priorities for feeder buses (Halcrow Fox, 2000b). Finding ways to make it easier to use mass transit will in turn generate more ridership and revenue. Automated fare collection increases the attractiveness, convenience, marketability, and safety of public transportation systems (EDS Corporation, 2006). However, all these additional features will add extra cost to the system owner so careful consideration of the benefits and disadvantages is important.

Customer-focus is an organizational trend used to provide quality service (Schultz, 1994). The transportation industry is also a service provider for the major transit riders or customers. The public transportation sector will have to be customer-focused, possess innovative services, and utilize real-time technology to provide information for the customers (Daft et al., 1998; Campion et al., 2000). The mindset of the new transportation sector should employ a customer service entrepreneurial management to administer the offered transport services (Mobility for the 21st Century (M21) Task Force and Olsen, 1996). Shifts in planning orientation with emphasis on customer-oriented planning are a major factor in providing ridership increases (Stanley and Hyman, 2005).

Ridership increases are definitely beneficial to the overall transport industry. The United States Environmental Protection Agency (1998) studied three RMT systems and concluded that increase in ridership in the system from the improvements by system/service expansion, system/service operational improvements, and inducements to potential transit users. Vanderknyff (2005) quotes Marc Littman, spokesman of L.A. County Metro, stating that the basic concerns for commuters' selection to ride the RMT systems are time consumption, convenience, and safety. The more information obtained on the factors that increase RMT ridership is vital for the continued transportation development of the systems. More importantly, the provision of the RMT system will change the commuter pattern of transportation, and thus decrease traffic congestion. Factors against shifting to the use of RMT systems are the development and building of additional roads, inferior alternative modes of transport, uncomfortable alternative travel conditions, among others. The factors important in shifting motorists to making use of RMT services are the quality of service – this requires fast, comfortable, convenient, and affordable services (Litman, 2004).

RMT ridership in Bangkok is relatively low in ratio to the motorized forms of transportation compared to some other major cities globally. Much of the low ratio is due to the fact that there are few RMT systems in Bangkok. Tangpaisulkit (2007) from the Office of Transport and Traffic Policy, Ministry of Transportation points out that 55 percent of New York commuters, 66 percent of Tokyo commuters, and 72 percent of London commuters use RMT systems, while only 4 percent of Bangkok commuters use RMT systems.

2.4 Literature on Rail Mass Transit Ridership

Studies on Rail Mass Transit ridership are mostly conducted interviews with transit operators or secondary transportation data obtained from numerous systems. A customer-based approach is seldom conducted and mostly aimed to study customer satisfaction. A customer-based study for purposes to study the factors influencing

RMT ridership provides empirical evidence for future development in RMT systems. This section reviews related literature on RMT ridership as a basis for the study.

2.4.1 Case Studies and Interview Studies

Stanley (1995) utilized data from the American Public Transportation Association (APTA) concerning over forty transit systems. He summarized the strategies and initiatives leading to increased ridership as being service adjustments, fare and pricing adaptations, market and information initiatives, planning orientation, and service coordination, consolidation, and market segmentation. Qualitative interviews with the transit managers confirmed the statistical results found in the research. Stanley (1998) continued his investigation into transit ridership reconfirming that the factors concluded in the 1995 study were still influential. However, this study indicated that external factors, such as resurgence of local and regional economies, reductions in federal transit operating assistance, and integrating public transport with other public policies have been significantly more influential.

Mullins (2003) studied several European transit services and stated that ridership is influenced by the service standard of the system, which includes availability (area covered, operating hours, and frequency), accessibility (ease of boarding, transferring, and ticketing), information (availability, accuracy, and timeliness), time (travel time and punctuality), customer care (staff availability, knowledge, behavior, and ticketing ease), comfort (level of crowding, ride, and vehicle and station cleanliness), security (perception of and freedom from crime and accidents), and environmental impact (exhaust, noise, and energy consumption).

Taylor and Fink (2003) reviewed numerous literatures concerning transit ridership and categorized the factors extracted from the literature into two categories namely, external and internal influences. Externally, the research points out those factors tied to automobile accessibility such as auto ownership and parking availability explain most of the variation in ridership. Economic factors such as unemployment levels, central business district employment levels, and income levels are substantial explanations of transit usage. Spatial factors such as population and employment density, traffic congestion levels, and parking availability are relatively influential on the ridership numbers. Internally, the research identifies improvements in the service supply such as frequency, coverage, and reliability as important influences on ridership. Service qualities with variables such as on-time performance, price elasticity, and focused fare programs that target populations are very effective in attracting riders. Other factors apart from the external and internal categories are mostly out of the control of the transit operators and directly correspond to public policies that support the private vehicle usage such as provision of arterial and freeway systems, relatively low motor fuel taxations, and provision of required parking at no cost.

Taylor et al. (2002) studied public transit ridership using three research methodology approaches: an analysis of the nationwide transit data, a survey of the managers of most of the transit systems that increased patronage, and an in-depth study case analysis of 12 systems that were successful at attracting riders. External factors that were significant to increased ridership include the population growth, economic/employment growth, and worsening traffic congestion. The internal factor that was responsible for the increase in ridership was service improvements. The service improvements were a consequence of niche marketing and tailored services to satisfy the customers' needs. Universal fare coverage programs, which include combinations of fare discount, new fare media, and payment options, in combination with partnership programs proved effective for increasing the transit ridership.

Based on the study of the MRTA system in Bangkok, Chartchai Praditpong (2006) has outlined a short-term and mid-to-long-term plan to increase ridership in the system. The short-term approach to increase ridership includes marketing communications and promotions to assist passengers in adapting to the system, including the acceptance of the safety of the system and making travel behavior adjustments. Arrangement of accessibility facilities to the metro system by using short line feeder bus systems to access residential and business areas are also the short term goals for the system. The mid-to-long-term plans to increase ridership include the development of business partners along the route, marketing promotion strategies, and building an incremental convenience strategy to enhance the commuters' accessibility.

2.4.2 Cross Sectional Analysis Studies and Statistical Analysis Studies

Korb (2002) studied metro, light rail and bus transit systems in different regions of the United States, using data from the National Transit Database and the Federal Transportation's data library, to point out that population density is an influential factor affecting transit ridership. The study indicates that dense population increases the level of public transit usage, which is measured by a number of factors including income levels, levels of automobile ownership, and overall ease of driving (access to highways, traffic congestion). The study further implies that there are other innovative actions that could be taken to attract more transit ridership such as electronic passes, reduced fares and joint promotions with other parties, and bicycle parking to attract cyclists.

Kuby et al. (2003) performed cross-sectional regression analyses at station level from nine transit systems at a total of 268 stations. The study tested five categories of factors: traffic generation/land use, intermodal, citywide, network structure, and socioeconomic variables. The study concludes that all the station locations, whether inside or outside the central business district, or at the airport or residential areas, can generate ridership and are no different from each other. Combined with a good network structure aligned with intermodal junctions to major employment, dense residential areas and park and ride structures, a substantial number of riders can be generated. The citywide variable of extreme temperatures and the socioeconomic profile of renters within walking distance to stations were of significance to the selection of the rail transit usage.

Sutcliffe (2002) researched factors that influence the success of urban rail systems using statistical data and interviews provided by transit operators from eight urban rail systems in the United States, Canada, and Britain. The factors supporting urban rail system success (including ridership) are urban factors, socio-economic factors, planning factors, cost factors, operating policies, transport planning policies, and urban planning policies.

Prapatpong Upala and Borrisut Chareonveingvachakij (2003) studied customer satisfaction with the M.R.T. Chaloem Ratchamongkhon Line using customer survey data for statistical analyses by t-tests, one-way ANOVA, and correlations. The factors influencing customer satisfaction are safety, reliability, cost, comfort, security, and information and technology. The study also indicated the following problems with the system service: passenger congestion, station information and directional signs, value for service, risks of accident and personal damage, security and alarm system, and waiting time and frequency of services. Improvements suggested for the system include directional information, route expansion and feeder systems, congestion and ventilation system, and fare price. This research was prepared during the initial stages of the service. A later study, after a few months of the service inauguration, confirms the findings (Prapatpong Upala, 2005).

2.4.3 System Design and Configuration

The plans to develop RMT systems play an important role in determining the success or failure of the system. The fundamental decisions to strategize the routes, stations, access points, feeder systems and other prominent features of the system will be the governing aspects influencing the commuters' decision to utilize the system.

2.4.3.1 System Availability

With the support of governmental policies, interest from the individuals to utilize RMT systems for their daily commute has increased substantially. This increase can be seen as directly resulting from the government's promotion of effective, efficient, and convenient RMT programs (Weyrich and Lind, 2001). This trend has been proven in numerous RMT projects in America. If the system can be established in a specific city then there are no doubts regarding the popularity the system will receive. The more RMT systems that are established, the closer we will be to a paradigm where transit-based development is used to create sustainable transportation and livable communities.

Open Access Theory allows qualified rail operators to service all routes (Railway Technical Web Pages, 2005). The theory advocates competition among rail operators thus limiting monopolies. With more service availability, transit ridership increases due to the fact that the commuter can travel to any destination as desired. Therefore, there is the need for the important planning process to carefully consider the provisional requirements for the RMT systems, in which various decisions on the configuration of the system and the services must be determined. The effects of the availability of the system to cover specific areas of service will directly influence the ridership and revenue potential of the system. In order to obtain high ridership and revenue, the requirement for station locations at the right places penetrating the heart of the city center and major residential areas is a key factor (Halcrow Fox, 2000b). The route and station locations are a critical issue to the passengers in determining the operating speed of the commute and the convenience of the access to the system (Halcrow Fox, 2000b). Underground stations limit accessibility, and if the station is some distance underground, passengers are more likely to switch to other surface modes (Halcrow Fox, 2000b).

In the case of Bangkok, the Thai people perceive the car as reflecting social status, and there is an extreme "love for the car" (Chamlong Poboon, 1997). The RMT system is in the preliminary stages of development, therefore, the adaptation of commuters to the RMT systems will eventually grow. The two existing RMT systems in Bangkok will be supplemented with the new Airport Rail Link project, which is due to commence operations in the near future. In addition, the seven planned new RMT routes in Bangkok and the vicinities are forecast to accommodate 4,506,000 riders per day (Charoem Kittikanya, 2004b).

The service expansions must be continuously considered as based on the travel needs of the commuters. The usage of RMT systems grow with the significant expansion of services (Litman, 2004). This elaborates the importance of a complete system serving the commuters and, as a consequence, increasing ridership on the system. This continuous service expansion is seen in the American trend for cities, with the continuous demand for RMT systems to expand to other areas along with the continuous increase in ridership (Weyrich and Lind, 2001).

2.4.3.2 Commute Convenience

The convenience of the commute through the RMT system is another important consideration that transportation planners must provide as a feature for the transit system. The commute convenience experienced by the riders of the system will be an essential determining factor behind the continued patronage of the system. Different passengers have different expectations so there is much for the transportation planner to consider. For most commuters, the description of convenience is the time spent on the trip. For inner city commuters, the critical variable is the door-to-door convenience for the travel by transit. For urban carless commuters, the most critical factor is the continuing availability of frequent and reliable transit service (Jones, 1995).

RMT ridership levels are critically dependent on convenient pedestrian access to the commuter's destination (Jones, 1995). The transit entrance is mostly from the street level; therefore, the commuter's movement from the pedestrian level to the final travel destination is important to the selection of using the system. The BTS system in Bangkok had access problems; as a result, escalators were installed at 10 more stations following marketing research (Halcrow Fox, 2000b).

The commute by the RMT system must be convenient because the major obstacle preventing individuals from using the systems is the ownership of private motor vehicles. Owning an automobile provides the individual with flexible mobility options and social status differentiation from the "have nots" (Jones, 1995). This is one of the major obstacles to the conversion of private vehicle usage to mass transit commuters. The problem is not that easy that a quick-fix solution can solve it. Private motorized transport is a convenient and flexible mode of transportation. A substantial period of time must be sacrificed to encourage the private motor vehicle users to use RMT systems. A holistic strategy must be planned and implemented to achieve the mentioned goal.

2.4.3.3 Supplementary Systems

The Bangkok Transit System project, which is the first RMT system in operation, faced financial problems due to lower ridership from the estimated numbers during the financial assessment feasibility studies. The low ridership experienced in the BTS project was due to the lack of "feeder" systems providing less available mobility destinations (O'Grady, 2001). Therefore, the BTS operators supported the integration of additional RMT projects with the BTS system. However, the underachievement in financial goals faced by the BTS generated additional financial policy considerations for the successive MRTA system concessionaire.

2.4.4 Government Influences

In order to accomplish successful implementation for RMT systems, the government must be active in the process. The policies and actions of the government can influence the RMT ridership numbers of the system.

2.4.4.1 Traffic Calming Policy

RMT systems should be developed holistically in conjunction with complementary measures such as integration of roadspace control and automobile restraint measures (Halcrow Fox, 2000a). Traffic calming policies from the government are enacted to limit the usage of motorized vehicles in order to prevent the unsustainable consequences that follow. The reduction of motorized vehicle users is an effect of increased public transportation ridership.

Historical development has always been biased towards the development of roads and expressway infrastructure for vehicles (Chamlong Poboon, 1997; Weyrich and Lind, 2001). Moving towards a new era where the sustainable development goals must be achieved, the trend of development must change to different patterns and modes of transportation that provide future sustainability. Motorized transportation development must be limited to development as a supporting partner for RMT systems through integrated multi-modal transportation planning. Its role must be one integrated with the other modes of transportation to provide the optimal sustainable transportation provision. Motorized transport is needed in areas away from the RMT influence. The suburban developments are the main service areas for motorized transport.

Road pricing policies such as congestion pricing, distance-based fees and Pay-As-You-Drive vehicle insurance can increase RMT ridership (Litman, 2004). Policies to restrain the influence of motorized transportation must be formulated, and adopted for immediate implementation. Congested roads should be the first focus for the development policies. The congestion cost calculated indicates road surfaces used over its designed capacity (Roth and Villoria, 2001). The need to use motor vehicles can be reduced by "restraint" or "taming the car" policies that lead to alternate travel options such as walking and cycling (Kenworthy, 1995; Barter and Kenworthy, 1997; Barter, 1999; Wheeler, 2001; Sheehan, 2002). One solution to the problem is to commence "road pricing" to lower the demand of traffic usage to the level of the road supply (Skinner, 2000; Barter and Raad, 2000; Wheeler, 2001). Since the government heavily subsidizes the motorized transportation industry through taxpayer money, the concept of "road pricing" should be justified because the taxpayer money can be used for other development projects. Another possible policy is to limit and price the public parking space (Chamlong Poboon, 1997). The limit in available parking spaces limits motor vehicles to an appropriate number for use in the inner cities.

"Traffic calming", which is the process of reducing the traffic speeds in the inner city limits, will be a major catalyst in promoting various benefits within the city. The overall environment and livability of the community will be improved substantially. Pedestrians and cyclists will have a safer environment to travel in and shoppers and residents will discover a safer street environment. The community will be revitalized (TRB, 1997; Barter and Raad, 2000; Sheehan, 2002).

All in all, the most important policy is not to support unsustainable motorized transport. The policies must lead to a sustainable world. However, rigorous arguments between transit and highway supporters heavily influence the policymaker's decisions (Nelson and Shakow, 1996). Therefore, the policymaker should be well-informed of the facts and information in order to develop a sustainable transport system.

2.4.4.2 Price Regulation Policy

The investment costs in RMT systems forces the financial revenues of the system to be sufficiently high enough to acquire the financial justification for the implementation of the system. This is a major and problematic reason in the decision of whether to suspend or not consider the RMT systems in many cities around the world. Even if the project is implemented, the high surging costs of the public transportation projects may force the government to oversee the completion of the project (Railway Technical Web Pages, 2005). Policies to reduce the ridership fares such as inducing competitive system design to be able to provide appropriate affordable fares must be considered (Gwilliam, 2000). The private sector is the most capable and equipped source for funding public transportation projects. The private sector operates more efficiently using lower operating costs. The government's duty is then to provide a fair partnership with the private concessionaires and contractors to make the investment in RMT systems profitable and cost-effective.

The price regulation policy for the RMT systems has a direct influence on the ridership fares set by the operator. Usually the government will have to set a range for fares and a plan for increasing fares over the service period of the system. In the case that the government is the operator of the system, the process can be less troublesome. However, RMT systems are expensive and most often operated by private concessionaires. The two current RMT systems in Bangkok are also operated by concessionaires, which makes the governmental price regulation policy towards the systems a more complex equation.

The government can only control the fare prices to a certain degree when the system is a concessionaire to the private sector as in the case of the two RMT systems currently installed in Bangkok. The government should buy back the RMT concessionaires to be able to control the fare prices since the introduction of future systems will increase the ridership numbers in the existing systems (Watcharapong Thongrung, 2006). For this reason, the Royal Thai Government is currently in negotiations to purchase back the two RMT concessionaires, from the Bangkok Metro Company Limited and the Bangkok Mass Transit System Public Company Limited, to control and establish lower ridership fares to carry out the campaign policy promise to the people.

2.4.4.3 Subsidy

RMT systems in the United States have experienced decline up until 1995. There were a few influencing factors that ignited the decline of the RMT industry. After World War II, the vision of the future was to build massive road networks to accommodate the traffic flow within the urban area. This initiative instigated many policies to subsidize the motorized transportation industry. The dominance of the automobile has not been a free market outcome because there has been massive government intervention on behalf of the automobile, not only in the United States but everywhere in the world (Weyrich and Lind, 1996; Chamlong Poboon, 1997). Freeway and expressway construction, free parking in the inner city, and other automobile and highway subsidies were established by the government (Weyrich and Lind, 2001). Not until the rise in environmental awareness over recent years have attitudes towards motorized forms of transport changed. Environmental pollution studies demonstrate the hazardous effects of the various gases generated from motorized vehicles (Sayeg et al., 2002). The valuation of sustainable development has rapidly increased awareness amongst the transportation planners.

On the other hand the earlier RMT systems were privately owned and operated. These original systems received no subsidies from the government, and even had to pay taxes to the federal authorities (Camph, 1997; Weyrich and Lind, 2001). This was the major reason for the bankruptcy of most of the major RMT operators. Careful consideration of the RMT systems reveals that there are numerous factors that make the system superior to motorized transportation. The economic return of RMT systems are over 4 to 1 while for motorized transport hidden subsidies are in the range of hundreds of billion dollars (Camph, 1997). Since 1995, when the government started seriously supporting, promoting, and funding the RMT systems, the transit ridership has been increasing rapidly (Weyrich and Lind, 2001). The visionary future of sustainable transportation development requires RMT system to play a significant role in this major advancement of the industry.

The support for RMT projects has proved to be the ignition for the rejuvenation of the RMT industry. A constant increase in RMT ridership since 1995 has shown that the RMT industry was positively influenced by the government policies (Weyrich and Lind, 2001). With the support of the government, the RMT industry is ready to be an important role player in the future of sustainable transportation.

The government can directly influence RMT ridership by providing appropriate subsidies for the commuter who utilizes the RMT systems. An example of the federal subsidy is the incentives given by the U.S. Department of Transportation. Under the Transportation Equity Act for the 21st Century (TEA 21), financial incentives are deemed to have significant impact on commute decisions (APTA, 2005). Such programs include employer-paid benefits, employee-paid benefits, and shared-cost benefits.

Therefore, the public sector must play the leading role in guiding the project until completion. (Halcrow Fox, 2000a; Budin, 2002). The government must be the main investor in aiding the private concessionaires in the projects (ADB, 2000; Lefaver et al., 2001; World Bank, 2002). Strong support from the government would encourage the private sector to invest as a partner with the government and help make the commencement of expensive projects feasible. Strong federal and local government support favors the sustainable transportation development of RMT systems. Tax initiatives and funding strategies can be implemented by the government to financially encourage RMT development (BB+J Consult, 2000; Lefaver et al., 2001).

2.4.4.4 Information

The government must be persistent in encouraging the development of RMT systems as the future backbone for sustainable development. The benefits of the RMT systems must be promoted to convince people to use the system (Schultz, 1994). RMT systems are not like buses or cars in which the normal commuter has always been aware of the benefits and costs. Many people in cities with no RMT system do not really have the opportunity to see and learn about the actual system in use to know of its benefits (Weyrich and Lind, 2001. It is the duty of the government to inform the general public of such benefits and costs of using the system. Information to the public about the environmental, ecological, and economical benefits and the like, obtained from utilizing the RMT system can encourage the commuters to use the system.

The simplest way to make the public gain information about the RMT systems is for them to experience the system. RMT systems have become increasingly popular in the various urban areas of the United States. A pattern emerges as city after city proposes a new RMT system. Initially, voters are influenced by RMT critics, who are the proponents of motorized transportation. RMT efficiency, effectiveness, convenience, quality, and comfortability are hard to visualize for voters that have not actually seen the system before. Busways, highways, and bus systems are commonly observed and seen by the voters. Therefore, the RMT critics are usually successful in blocking most of the RMT projects in the initial stages. However, once the voters gradually learn the importance and the benefits of the RMT system, the projects are then finally approved for the city. Once the starter RMT system is in operation, the people observe the various benefits of the system and demand more extensions to the original system (Weyrich and Lind, 2001).

Therefore, the government must endeavor to develop the initial systems to gain more and more advocates with increasing information on how the system works. The starter RMT system should be simple and cost-effective (Campion et al., 2000). Commuter rails using the existing rail structures to develop RMT systems are a cost-effective way of providing a starter system (Weyrich and Lind, 1999). Rail buses, which use the old bus bodies moving on rails, are another inexpensive starter system idea (Weyrich and Lind, 1999). More advanced systems that provide the technology and advanced features should only be considered if the appropriate demand for such a system is significant in making the decision. The government's most important issue is to implement the RMT system so that the people can be knowledgeable about the system and its benefits, and then continually promote and provide information about the transit system to the general public through all the government channels and means.

2.4.5 Operator Influences

The operators of the RMT systems play an important role in making decisions that directly affect the RMT ridership in a system. Implementation of continuous service improvements making rail transit faster, more convenient, and more comfortable attracts more ridership (Litman, 2004). Convenience, privacy and personal security, fare costs, and time are the major attributes that the transit customers take into consideration (Mareck, 2003). Other actions enforced by the operator such as improvements in the facilities, promotions, and information provision will improve the ridership numbers of the system.

2.4.5.1 Service Quality

The policymaker must consider quality as one of the most important factors affecting the RMT system (Campion et al., 2000). RMT systems must provide a high quality of service to attract discretionary riders (travelers who have the option of driving) out of their cars (Litman, 2004). The competition between the RMT system and motorized transportation is determined by the quality provided by the service provider. In order to promote the patronage, the system must be somewhat comparable to the personal motorized vehicles. The quality of the transit must provide efficiency through on-time stops, clean cars and stations, polite crews, comfortable seats, appropriate and enforcement of orderly rules (Weyrich and Lind, 1999). Motorized transport is considered unsustainable as compared to the RMT systems; however, if the quality of the RMT system is degraded and lingering problems affecting the economic, environmental, and social sectors are generated then the system is as unsustainable as the motorized transportation. A top quality RMT system has positive implications for a sustainable transportation future, therefore, maintenance of the exceptional quality is essential. When the RMT system is fast, comfortable, convenient, and affordable, the system will attract discretionary riders when the traffic congestion increases (Litman, 2004).

Planning the quality level of the RMT system is dependent upon the strategy and the purpose of the transport planner. Planning comfort levels in the RMT system certainly attracts different types of passengers. The Singapore system plans for relative comfort to attract passengers who have different travel options; on the other hand, the Mexico City and Sao Paolo plans were to carry passengers at full capacity (Halcrow Fox, 2000b). Of course, a more comfortable commute and increase in quality also increases the pricing fare charged to the commuters (Gwilliam, 2000). High quality RMT services with safe and comfortable transfer points, treatment of transit riders as valued customers, clean vehicles and courteous staff, along with tight scheduling, and sound management, are attracting RMT riders to the system (Schultz, 1994).

The commute by RMT systems decreases rush hour travel time thus reducing costs caused by congestion (CSI and EDRG, 1999; Weyrich and Lind, 2001). Being stuck in traffic is not a pleasant experience especially if the individual is in a hurry to be somewhere. The use of RMT systems does not only reduce travel time, the system makes other aspects of the commute pleasant during the travel. The individual eludes the stress of being stuck in traffic and is instead serviced with a convenient, comfortable and efficient ride to the target destination. The congested motorized trip and the RMT ride give a comparison depicting a completely different experience for the commuter. When compared to the bus systems, the RMT system is advantageous with its greater comfort, larger seats with more legroom, more space per passenger, and smoother and quieter ride (Litman, 2004).

General commuters convert to being RMT system passengers when they are exposed to the convenience and efficiency of the system. The city's transportation planners must aim to achieve a convenient, comfortable and efficient RMT journey. The RMT systems must be able to provide the normal quality of transport shown in previously established RMT systems around the world. The established quality of the service has made commuters choose the RMT systems as their mode of transportation (Horowitz and Beimborn, 1995; Weyrich and Lind, 2001).

2.4.5.2 Facilities

The RMT system must provide the various facilities that the commuter might need to use. Convenience stores, shopping stores, newsstands, coffee stores, food stores, public toilets, automatic teller machines, banks, parking facilities and the like are amenities that the transportation planner, the system owner, and the concessionaire operator must choose for provision in the system. The selected facilities in the system are of importance to the commuter patronage within the system.

Clear signs and directions to the train doors and station exits also show how the appropriate facilities can make commuters satisfied and appreciate the system (Weyrich and Lind, 1999). Passenger amenities such as benches, maps, visually pleasing aesthetics, and comfort in trains may be instrumental in increasing ridership (USEPA, 1998). Improvements to the system are an ongoing task that the operators must be alert to at all times. In Bangkok, Prapatpong Upala (2005) identified improvements that could be made to the Bangkok subway system in terms of the directional signage, fare price, and safety of the commuters. Service adjustments having major effects on ridership numbers increase the frequency of service and enhance passenger amenities (Stanley, 1998; Stanley and Hyman, 2005).

The simplest measure to ensure the switching of the motorized vehicles to the RMT system is to increase the systems availability by providing more capacity in the parking facilities at the transit stations (Weyrich and Lind, 1999). The motorized users are then able to suspend their automobile usage and make use of the RMT systems. The park and ride concept mentioned is one of the main purposes of the RMT system (Weyrich and Lind, 2001). New Smart Parking solutions have resulted in a surge in RMT ridership, as seen in the pilot program of California's BART ParkingCarma case where ridership increased 14 percent (Warner, 2005).

2.4.5.3 Promotions

The RMT system ticket can be like any normal merchandise in terms of marketing the product and running promotions to attract the customers to purchase the product. Customer service and intense marketing of the transit services may increase ridership (USEPA, 1998). Basing the promotions on market research concerning the factors that attract the riders will certainly be a positive campaign to increase ridership in the system.

The ability to create workplaces in major growth centers serviced by RMT systems is an ideal method to generate increased ridership (Jones, 1995). However, the cooperation or partnership between the RMT operator and the local businesses to promote the transit ridership is also key (TRB, 1997). The transit operator and the local business could formulate low price incentives for the local business employees to use the RMT systems. Local shops and event organizers can team up with the transit operator to make special promotions to encourage the business and also encourage riding the RMT systems to the shop or event.

The system operator can cooperate with employers to implement workplace incentives to use RMT systems (Schultz, 1994). The fare and price adjustments deemed to affect RMT ridership are the introduction or expansion of deep discount passes, expansion of outlet sales, and cooperative programs with businesses or organizations or institutions (Stanley, 1998; Stanley and Hyman, 2005). These promotional campaigns organized by the employers and the transit operators will provide beneficial to the transit ridership and also to the employees. Commute Trip Reduction (CTR) programs give commuters resources and incentives to reduce automobile trips and increase rail systems ridership. The CTR programs often include financial incentives (parking cash out[15] and transit allowances), unbundling programs[16], transit promotions, parking management, flextime, and guaranteed ride home services. These programs can increase RMT ridership by 10 to 30 percent (Litman, 2004). In Bangkok, the Bangkok Transit System has utilized strategic business alliances with conference and convention organizers, hotels, shopping centers, offices, schools, hospitals, other operators (rail, bus, ferry, airlines) and government authorities (Anderson, 2005)

Service coordination, collaboration, and partnering have proved to be significant to ridership increase, with most of the relationships being with local universities (Stanley and Hyman, 2005). Campus and school transport management

[15] Parking Cash Out is the program where employees receive cash and transit subsidies instead of free parking.
[16] Unbundling programs are when the business renters pay for the parking that they actually want.

programs, where discounted transit passes for students and staffs are introduced, can increase rail transit riders by 30 to 100 percent (Litman, 2004).

RMT ridership can be increased by transit fare innovations such as lower rates during off-peak periods, special group fares, and bulk ticket purchasing. Such programs can be implemented by the introduction of "Smart Cards", which will also make the rail transit commute more convenient as well (Litman, 2004).

2.4.5.4 Price

In order to provide a successful RMT system, a fares policy to encourage ridership yet limit the need for financial support must be carefully planned (Halcrow Fox, 2000b). In Europe, pricing is the most sensitive factor influencing the commuters' usage of the RMT systems (Nijkamp and Pepping, 1998). Appropriate pricing needs to be determined to generate enough revenue from ridership and maintain good quality. High fares reduce ridership but give the opportunity to maintain the good quality to attract ridership. Therefore, an appropriate pricing strategy is also key to determining ridership (Gwilliam, 2000). Pricing must be adjusted to fit the demand and provide the optimal balance between price and ridership to attain a cost-effective transit system that can survive operation costs (Horowitz and Beimborn, 1995; Skinner, 2000).

Fare prices are important to RMT ridership when the transit system is being compared to the alternative car commute (Mareck, 2003). Given the high investment costs for the RMT systems implemented, the fare costs tend to be expensive; however, for a motorist to convert from automobile usage to the RMT systems, the price to commute must be affordable (Litman, 2004). The Bangkok BTS has captured only 27 percent of the forecasted 600,000 ppd of the substantial commuter traffic, with much of the blame being placed on the relatively high fares when compared to buses (Halcrow Fox, 2000b).

Halcrow Fox (2000b) advises the RMT system operators to endeavor to operate efficiently by devising service levels and fares/ticketing strategies based on sound marketing information. The ridership numbers for the RMT systems alter during special events, such as concerts, and entertainment and sporting events (Kaplan et al., 2003). Ridership can be encouraged with fare policies such as weekly passes and fare simplifications (USEPA, 1998). Smart card technologies have shown to be a factor behind increasing revenue by increasing the customer's convenience and ticket price flexibility (Halcrow Fox, 2000b).

2.4.5.5 Safety and Security

Thrasher and Schnell (1974) studied six cases in five cities with regards to whether transit crime and vandalism affects the individual's decision to use urban transit systems. The research concludes that transit crime and vandalism can exert strong influence on the ridership decision. When the commuter actually sees actions such as verbal threats, nuisances, and vandalism, a sense of insecurity develops. The sense of safety is raised with the absence of the homeless and beggars, no yelling and running schoolchildren, and no "bad boys" at the back of the bus situations (Weyrich and Lind, 1999). RMT systems have impact issues and problems in the area concerning security especially as perceived by women (Halcrow Fox, 2000a). The time of the commute also factors in the ridership decision as people of all ages or sex, though to differing degrees, tend to avoid a night commute (Thrasher and Schnell, 1974). Commuters would be scared and have no confidence in using the provided RMT systems if crime reoccurred in the system (Weyrich and Lind, 2001; Wheeler, 2001). On the other hand, the system should be reliable, safe from crime, and efficient to ensure that the customers have a comfortable and relaxing ride to their destination (Schultz, 1994; TRB, 1997; World Bank, 1999; Barter and Raad, 2000; Campion et al., 2000). When people travel they want predictability, security, and sameness. Unless public transit can provide an almost compatible environment as the private car, they will drive (Weyrich and Lind, 1999).

Weyrich and Lind (2001) quote the data from the Transportation Research Board study of Needle and Cobb (1997), and summarize their findings by stating that on RMT lines violent crimes are unlikely to occur. The crimes that do occur are of a "less serious nature" as Weyrich and Lind (2001) quotes the Boyd Maier & Associates (1998) study that states 93 percent of crimes in RMT systems are quality of life crimes and property crimes, while violent crimes constitute only 6.6 percent of the crimes. Quality of life crimes[17] are detrimental to RMT systems because they drive patrons away; however, the crimes themselves are not serious and do not cause physical injuries to riders. In some

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[17] Quality of life crimes includes 67.4% as disorderly conduct, 7.5% as trespassing, 6.7% as vandalism, 4.8% as drug use, and 2.0% as loitering.

cities studied such as Birmingham in the UK, some segments of the market, especially women, resist traveling underground due to security reasons (Halcrow Fox, 2000b).

Safety/Security issues in the Bangkok commuter context are quite unique. Institutional rivalries between prime vocational schools and some high schools have led to numerous violent brawls resulting in severe injuries. These brawls often happen on public transportation systems when members of the rival institutions happen to encounter each other. Innocent bystanders have been severely injured as a result. Violence instigated by drug users is another principle concern for Thai commuters. In Thailand, the drug problem in public often associates with amphetamine users, who often instigate violent crimes in public. These issues must be addressed by the system operators. The RMT systems in Bangkok have to be differentiated from the other public transportation modes.

Safety from crime is an expensive provision for the transit authorities. However, if security or the perception of security is not established, the system loses the ability to attract riders from choice (Weyrich and Lind, 1999). Although expensive and often frustrating, lots of attention is devoted to security (Schultz, 1994). The consequences of commuters not using the RMT systems and choosing other modes of transportation, especially that of motor vehicles, might be an expensive price to pay in terms of fatalities. RMT systems are an extremely safe mode of transportation with fatalities at only one-tenth of automobile travel; therefore, a shift to RMT systems by automobile users will create fewer fatalities as computed from the fatality statistics collected from various cities (Litman, 2005).

Terrorism is another area of concern for commuters when utilizing the public transportation system. Terrorist attacks on public transit include the 7th July 2005 attack in London, the sarin gas released by the religious group in Japan in 1995, as well as other bombs which exploded in Israel, Madrid, Moscow, Paris, and others (Litman, 2005). To prevent the loss of ridership due to the fear for their safety and security, actions are taken to give confidence to the rider by showing that the safety and security within the system is adequate. Making the commuters feel safe and confident during their journey is essential. It is the responsibility of the local leader to convince the commuter to return and use the public transit after any terrorist incidents. The Monday after the London Subway bombing, Mayor Ken Livingstone encouraged

Londoners to use the underground transit by utilizing the system himself (Litman, 2005).

2.4.5.6 Information

The promotional information provided to the public about the benefits that RMT systems can give to the commuter should be clear, effective, and easily understood. In order to convince people to choose to ride the RMT systems, the commuter must be convinced that choosing the transit is in their best personal interests (Schultz, 1994).

Marketing and information initiatives to increase ridership should include public information campaigns to programs tailored to specific markets or services. Generally, the idea is to increase the available general information about the service (Stanley, 1998; Stanley and Hyman, 2005). Accurate information must be provided to the general public to promote the usage of the RMT system. Negative information and myths concerning the system are destructive to the system (Barter and Raad, 2000). A focus on the positive attributes of the system can be presented rather than trying to shame the commuters into using the system (Schultz, 1994).

In Thailand, RMT systems are generally viewed as a "poor person's means of transportation" (Nimitchai Snitbhan et al., 1997). There is an urgent need to attempt to alter this misperception, which not only limits ridership but also defies the purpose of RMT systems. The high social class in Thailand often resent interaction with other social groups. Crowded public transportation is less appealing to the upper class. The embarrassment of using RMT systems has to be got rid of with a new perception leading to the increased utilization of the system (Schultz, 1994). RMT systems are designed to serve the middle and upper class commuters with the primary aim of providing transportation choice. Indeed, the RMT systems are an alternative to the private automobiles of the middle and upper class commuters. Increased middle and upper class RMT ridership will decrease the number of vehicles on surface roads. Therefore, the government and the concessionaires must selectively encourage this group of commuters to ride the RMT system by providing useful information to the public.

The endeavor to provide persuasive information to the public requires the continued efforts from the system operator. Research on the users' attributes and needs and constant utilization of new technology could prove beneficial. Marketing and user information in the form of improved route schedules and maps, wayfinding information, web pages and marketing programs can often increase rail transit by 10 to 25 percent (Litman, 2004). Telephone information services provided by the transit operator have also shown significant increases in ridership (USEPA, 1998).

2.4.6 External Influences

The external factors, for purposes of this study, are items that can be observed by the normal commuter. Political factors, population growth, unemployment, and automobile ownership are more complex elements, which are not considered in the study. There are many external factors, which could influence the decision to utilize the RMT systems. Factors that are uncontrollable by the system operator include oil prices, traffic congestion, parking availability, regional economy among others. These factors could be influential on the selection of the mode of transportation by the commuter.

2.4.6.1 Oil Price

Oil prices are external factors which influence RMT ridership. Most commuters are aware of the oil prices in relation to travel expenses associated with automobile usage. Therefore, the oil price is a significant factor to the choice of transport mode. With oil prices soaring to new highs, the influence of their relationship on the ridership on various public transportation systems throughout the world can be clearly observed. A study of Canadian commuters concluded that there was increased ridership on RMT systems due to the increased motor fuel prices for personalized vehicles (Neff, 2001).

The recent oil price increases have provided substantial examples of RMT ridership increases around the world. Gas prices have caused increased RMT ridership across the United States (Vanderknyff, 2005). Cabanatuan (2005) states that ridership on RMT systems has increased as the gasoline prices have soared. Increases of 3.5 percent were reported in the Bay Area Rapid Transit (BART), Compared to the previous year, the figures have risen by 7.7 percent in the San Francisco Airport extension, and by 8.5 percent in Caltrain (Cabanatuan, 2005). Gasoline prices and RMT ridership are very much related as reported in King's (2006) article on the

Southeastern Pennsylvania SEPTA system. The amount of passengers rose 18 percent in September 2004 when gas prices rose to $3.11 a gallon; however, when the prices fell to $2.22 per gallon in December, the new riders vanished (King, 2006).

In Thailand, Nareerat Wiriyapong (2008) reports that skyrocketing oil prices have cause significant rises in ridership on the two RMT systems in Bangkok. The weekday daily ridership of the Bangkok Transit System rose from 400,000 passengers last year (May 2007) to 430,000 passengers last week (beginning of May 2008), while weekend daily ridership numbers have risen from 250,000 to 300,000 passengers a day. The MRTA subway system ridership has also risen from 184,000 passengers a day in 2007 to 196,000 passengers a day in March 2008 (Nareerat Wiriyapong, 2008)

2.4.6.2 Traffic Congestion and Parking Availability

The decision to utilize the services of a public transportation system is substantially influenced by the personal decisions of and factors concerning the commuter. The choice to use personal vehicles or to utilize RMT systems depends on several conditions. Traffic congestion is one primary factor, motivating commuters to use the RMT systems. This can be seen from the traffic congestion reduction that has occurred with the building of new urban rail systems (Litman, 2004). Traffic congestion serves as an external factor for this study. The normal commuters can easily observe the traffic congestion on the roads and make the decision on the transportation mode.

The cost of using private automobiles also comes into consideration. Most commuters tend to forget the hidden costs associated with automobile usage. Parking costs is one of those expenses. Urban transit systems can achieve the economies of scale when urban parking costs become an incentive for transit usage (Jones, 1995).

2.5 Dimensions Influencing Rail Mass Transit Ridership

The major content for the research study has been obtained from the numerous research studies that have been presented in the field of Rail Mass Transit transportation and ridership. Based on this body of knowledge, the research study explains the importance of a holistic and sustainable approach to developing RMT systems. The research further illustrates the importance of ridership to the developmental and implementation stages of the RMT systems. Therefore, in order to generate sufficient ridership, decision makers must be aware of the dimensions that influence the ridership in RMT systems and take into consideration these dimensions into the development of master plans.

Evaluation and review of the literature shows that there are nine core concept constructs that stand out as the dimensions influencing RMT ridership. The nine representative concepts are: Promotions, Price, Facilities, Quality, Safety/Security, Information, Convenience/Availability, Government, and External dimensions.

The Promotions dimension is the incentives given to the commuters in order to attract more ridership on the RMT system. The Price factor is the appropriate fare rate as concerns the supply and demand of the trips generated by the RMT systems. The Facilities dimension is the amenities and facilities provided within the RMT stations and system, such as parking lots, signs, banking services, among others which accommodate the personal needs of the traveler. The Quality factor is the comfort of the commute, such as the services provided by the staff and the comfort of the trains. The Safety/Security factor represents the various measures utilized to prevent crime, vandalism, and basically provides the commuter with a safe and secure feeling. The Information dimension is the knowledge provision to the public in the form of route information, station locations, ticketing directions, and the like. The Convenience/Availability factor is the overall provision of the network of systems and stations, which include the feeder systems and accessibility to the stations. The Government dimensions include the government actions that can be done to increase ridership in the RMT stations. Policies such as road pricing, traffic calming, and public parking limitations are certainly favorable to the RMT ridership. The External factors represent the dimensions that affect the RMT systems indirectly, such as oil prices, traffic congestion, and parking availability.

Table 2.6 below shows a summary of the various dimensions and the sub-concepts as extracted from the reviewed literature and the literature reviewed by Taylor et al. (2002) and Taylor and Fink (2003).

Table 2.6 Related Literature for the Dimensions Influencing RMT Ridership

Details	References	From Taylor et al., 2002	From Taylor and Fink, 2003
Price Dimension			
Discount Fares	Taylor et al. (2002); Korb (2002); Stanley (1998); Stanley and Hyman (2005)	Sale (1976); Fleishman (1993); Syed (2000)	Sale (1976)
Average Fare Price	Litman (2004); Prapatpong Upala and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Gwilliam (2000); Mareck (2003); Nijkamp and Pepping (1998)	Kain and Liu (1995); Gomez-Ibanez (1996); Kain and Liu (1996); Kohn (2000); Hartgen and Kinnamon (1999);	Chung (1997); Gomez-Ibanez (1996); Liu (1993); Kain and Liu (1995); Kohn (2000); Sale (1976)
Fare and Pricing Adaptations	Stanley (1995); Stanley (1998); Stanley and Hyman (2005); Taylor and Fink (2003); Taylor et al. (2002); Gwilliam (2000); Horowitz and Beimborn (1995); Skinner (2000); Halcrow Fox (2000b); Kaplan et al. (2003); USEPA (1998)	ECTR (1996); TCRP Research Results Digest (1995, 1998); McLeod et al. (1991); Cervero (1990)	Kain and Liu (1996); McLeod et al. (1991)
Promotions Dimension			
Marketing Initiative	Stanley (1995); Stanley (1998); Stanley and Hyman (2005); Chartchai Praditpong (2006); Sustcliffe (2002); USEPA (1998)	ECTR (1996); TCRP Research Results Digest (1995, 1998)	Sale (1976)
Fare Incentives	Sutcliffe (2002); Schultz (1994)		
Focused Fares, Niche Marketing	Taylor and Fink (2003); Taylot et al. (2002); Chartchai Praditpong (2006)		
Partnership Programs	Taylor et al. (2002); Chartchai Praditpong (2006); Korb (2002); Sutcliffe (2002); TRB (1997); Stanley (1998); Stanley and Hyman (2005); APTA (2005); Litman (2004); Anderson (2005)	Brown et al. (2001)	Bianco et al. (2000); Brown et al (2001)
Facilities Dimension			
Parking Availability	Taylor and Fink (2003); Kuby et al. (2003); Sutcliffe (2002); Weyrich and Lind (1999); Weyrich and Lind (2001); Warner (2005)	Chung (1997); TCRP (1996); Morral and Bolger (1996)	
Aesthetics	Halcrow Fox (2000b); USEPA (1998)		Syed and Kahn (2000)
Automatic Fare Collection System	EDS Corporation (2006)		
Directional Signage	Upala, Prapatpong, and Borrisut Charoenveingvachakij (2003); Upala Prapatpong (2005); Weyrich and Lind (1999)		
Amenities	USEPA (1998); Stanley (1998); Stanley and Hyman (2005)		
Facilities Provided		ECTR (1996)	

Table 2.6 (Continued)

Details	References	From Taylor et al., 2002	From Taylor and Fink, 2003
Quality (Services and System) Dimension			
Services Provided	Litman (2004); Weyrich and Lind (1999); Railway Technical Web Pages (2005); Schultz (1994); Nimitchai Snitbhan et al. (1997); Horowitz and Beimborn (1995); Weyrich and Lind (2001)	ECTR (1996); Gomez-Ibanez (1996); Syed (2000); Kain and Liu (1996); Kohn (2000)	Cervero (1990); Abdel-Aly and Jovantis (1995)
Service Adjustments and Coordination	Stanley (1995); Stanley (1998); Stanley and Hyman (2005); USEPA (1998)	TCRP Research Results Digest (1995, 1998); Cervero (1990)	Cervero (1990)
Punctuality, Comfort	Mullins (2003); Taylor and Fink (2003); Prapatpong Upala, and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Litman (2004); Railway Technical Web Pages (2005); Fox (2000b); Schultz (1994); USEPA (1998)	Syed (2000)	
Staff Quality	Mullins (2003); Schultz (1994)	Syed (2000)	Syed and Kahn (2000)
Reliability	Taylor and Fink (2003); Prapatpong Upala, and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Jones (1995)		
System Accessibility	Mullins (2003); Sutcliffe (2002); Halcrow Fox (2000b); Jones (1995)		TCRP (1980)
Safety/Security Dimension			
Crime and Vandalism effects	Thrasher and Schrell (1974); Weyrich and Lind (1999); Weyrich and Lind (2001); Wheeler (2001)		
Commute Safety and Security	Mullins (2003); Praditpong Upala (2005); Vanderknyff (2005); Sutcliffe (2002); Prapatpong Upala and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Mareck (2003); Halcrow Fox (2000a); Halcrow Fox (2000b); Weyrich and Lind (1999); Litman (2005)	Syed (2000)	Cervero (1990); Syed and Kahn (2000)
Security Staff	Sutcliffe (2002)		
Terrorism	Litman (2005)		
Information Dimension			
Route Information	Prapatpong Upala and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Litman (2004)	Syed (2000)	Syed and Kahn (2000)
More Information and Benefits	Schultz (1994); Weyrich and Lind (2001)		
Availability	Mullins (2003)		
Information Initiative	Stanley (1995); Stanley (1998); Stanley and Hyman (2005)		
Telephone Info Service	USEPA (1998)		

Table 2.6 (Continued)

Details	References	From Taylor et al., 2002	From Taylor and Fink, 2003
Convenience/Availability Dimension			
Reasonable Walking Distances	Kuby et al. (2003)	Cervero (1993)	
Service Frequency	Taylor and Fink (2003); Sutcliffe (2002); Prapatpong Upala and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Jones (1995); Stanley (1998); Stanley and Hyman (2005)	ECTR (1996); Syed (2000)	TCRP (1980); Liu (1993); Kain and Liu (1995); McLeod et al. (1991); Kohn (2000); Cervero (1990)
Service Expansion	USEPA (1998); Sutcliffe (2002); Litman (2004)	Sale (1976); Syed (2000)	Kain and Liu (1996); Sale (1976)
Feeder System	Chartchai Praditpong (2006); Halcrow Fox (2000b); O'Grady (2001)		
Coverage Area	Mullins (2003); Chartchai Praditpong (2006); Taylor and Fink (2003); Railway Technical Web Pages (2005); Weyrich and Lind (2001)		
Commute Convenience	Vanderknyff (2005); Weyrich and Lind (2001); Litman (2004); Mareck (2003)		
Time Consumption	Vanderknyff (2005); Prapatpong Upala, and Borrisut Charoenveingvachakij (2003); Prapatpong Upala (2005); Halcrow Fox (2000b); Litman (2004)		
Station Location	Sutcliffe (2002); Halcrow Fox (2000b)		
Network System Intermodal Junctions	Kuby et al. (2003); Sutcliffe (2002)		
Government Dimension			
Car Ownership Rate and usage	Halcrow Fox (2000b); Taylor and Fink (2003); Korb (2002)	Liu (1993); Kain and Liu (1995); Kitamura (1989)	Liu (1993); Kain and Liu (1995, 1996); Kitamura (1989)
Road Pricing, Car Control, Congestion Reduction	Taylor and Fink (2003); Halcrow Fox (2000a); Kenworthy (1995); Barter and Kenworthy (1997); Barter (1999); Wheeler (2001); Sheehan (2002); Skinner (2000); Barter and Raad (2000)	ECTR (1996); Dueker et al. (1998)	Bianco et al. (2000)
Government Intervention and Subsidy	Weyrich and Lind (1996);Chamlong Poboon (1997); Weyrich and Lind (2001); APTA (2005); BB+J Consult (2000); Lefaver et al. (2001)		

Table 2.6 (Continued)

Details	References	From Taylor et al., 2002	From Taylor and Fink, 2003
External Dimension			
Oil Prices	Neff (2001); Vanderknyff (2005); Cabanatuan (2005); King (2006); Nareerat Wiriyapong (2008)	Kain and Liu (1995)	Sale (1976); Liu (1993); Kain and Liu (1995)
Population Growth and Density	Taylor and Fink (2003); Taylor et al. (2002); Korb (2002); Kuby et al. (2003)	Kain and Liu (1996)	
Employment	Taylor and Fink (2003); Taylor et al. (2002); Sutcliffe (2002)	Fleishman et al. (1996); Taylor and McCullough (1998); Kain and Liu (1995); Chung (1997); McLeod et al. (1991); Gomez-Imanez (1996); TCRP (1996); Kain and Liu (1996); Kohn (2000); Hendrickson (1986)	APTA (2000); Liu (1993); Kain and Liu (1995, 1996); Chung (1997); Gomez-Ibanez (1996); Hendrickson (1986); Crane (2000); Cervero (1993); Pushkarev and Zupan (1977); TCRP (1996); Spillar and Rutherford (1998); Hendrickson (1986)
Residential Density and Job Location	Kuby et al. (2003); Sutcliffe (2002)	Liu (1993); TCRP (1996); Spillar and Rutherford (1998); Kain and Liu (1996)	Crane (2000); Cervero (1993); Pushkarev and Zupan (1977); TCRP (1996); Spillar and Rutherford (1998); Hendrickson (1986)
Land Use		Nelson and Nygaard (1995); Pushkarev and Zupan (1977); TCRP (1996)	Nelson and Nygaard (1995)
Congestion, Parking Costs, Parking Availability	Litman (2004); Taylor and Fink (2003); Taylor et al. (2002); Korb (2002); Sutcliffe (2002); Chamlong Poboon (1997); Jones (1995)	Chung (1997); Dueker et al. (1998); San Francisco County Transportation Authority (1995)	TCRP (1980); Bianco et al. (2000); Moral and Bolger (1996); Chung (1997)
Income	Taylor and Fink (2003); Korb (2002)	Liu (1993); McLeod et al. (1991); Gomez-Ibanez (1996); Spillar and Rutherford (1998)	Liu (1993); McLeod (1991); Gomez-Ibanez (1996)

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Type of Study

This study of the dimensions influencing Rail Mass Transit ridership in Bangkok is a quantitative survey based research project, using field survey questionnaires to analyze and interpret different attitudes, which are important to the selection of RMT systems as a mode of transportation. The field survey includes the commuters' travel characteristics for the research study in order to investigate the various travel choices and correspondences to the different segments of commuters. The primary data collection was obtained from actual commuters utilizing the RMT systems in the Bangkok area. Field data for the survey were collected from the 23 RMT stations of the Bangkok Transit System and the 18 stations of the Mass Rapid Transit Authority's M.R.T. Chalerm Ratchamongkhon Line.

3.2 Unit of Analysis

The survey aims at evaluating the individual commuter perceptions regarding the factors influencing Rail Mass Transit ridership; therefore, the unit of analysis is the individual commuter utilizing the Bangkok Transit System or the MRTA's M.R.T. Chalerm Ratchamongkhon Line in Bangkok.

3.3 Target Population and Sample Size

The target population for the research study concentrates on commuters of the Bangkok Transit System and the MRTA's M.R.T. Chalerm Ratchamongkhon Line in Bangkok. The sample size for data collection was determined using the Taro Yamane formula (Yamane, 1973).

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

where,

n = Sample size

N = Population

e = Sampling Error (0.05 used for 95 percent confidence)

Therefore, the sample size for this research study will be

$$n = \frac{(184{,}499^{18} + 400{,}000^{19})}{1+(184{,}499 + 400{,}000)\,(0.05)^2} = 400$$

The target population was intended to be distributed along the commuters at the 41 RMT systems in Bangkok with variations in the respective demographics. The target sample size was determined to be 1,550 samples, which is substantially in excess of the 400 samples as determined from the Yamane formula, and was collected among the stations. The large number of samples was not only aimed at an adequate data collection for every station but was intended to be segmented in separate analyses by demographics and location areas in order to maintain a credible sample size. The actual dataset collected from the 1,715 respondents is shown in Table 3.1.

[18] BMCL (2008) reports an average of 184,499 passengers per day for the first half of 2007.

[19] BTSC (2008) reports over 400,000 current passengers per day.

Table 3.1 Target and Actual Samples Collected at the Classified Station Locations

Bangkok Transit System			Mass Rapid Transit Authority System		
Station	**Target Samples**	**Actual Samples**	**Station**	**Target Samples**	**Actual Samples**
Ratchathewi	20	21	Bang Sue	40	41
Phaya Thai	20	20	Kamphaeng Phet	20	23
Victory Monument	70	73	Chatuchak Park	50	57
Sanam Pao	20	20	Phahon Yothin	70	83
Ari	20	20	Lat Phrao	20	27
Sapan Khwai	20	24	Ratchadaphisek	20	21
Mo Chit	90	94	Sutthisan	20	20
Siam	100	100	Huai Khwang	20	25
Chit Lom	70	71	Thailand Cultural Center	50	51
Phloen Chit	20	33	Phra Ram 9	50	50
Nana	20	31	Phetchaburi	20	20
Asok	50	52	Sukhumvit	50	50
Phrom Phong	70	84	Sirikit NCC	70	70
Thong Lo	20	20	QSNCC	20	20
Ekkamai	20	28	Lumphini	20	21
Phra Khanong	20	20	Si Lom	50	55
On Nut	50	61	Sam Yan	20	21
National Stadium	40	40	Hua Lamphong	40	65
Ratchadamri	20	22			
Sala Daeng	50	61			
Chong Nonsi	20	26			
Surasak	20	21			
Saphan Taksin	50	53			
Total	900	995	Total	650	720
Grand Total	1550	1715			

3.4 Sampling Design

The ideal sample of respondents is considered to be distributed among various attributes, such as gender, marital status, age, education, occupation, and income. In order to obtain a quality representative sample of the various different attributes modeled as the Rail Mass Transit commuters, the data collection strategies considered the location and time of the data collection. The target population to be surveyed was limited to the current RMT commuters from the two existing RMT systems in Bangkok, which are the Bangkok Transit System and the Mass Rapid Transit

Authority system. With a combination of 41 stations between the two systems, the sampling was ideally collected from the commuters at each station. The sampling per station was determined by the type of station, which was categorized into four groups. The "End" stations are the stations at the ending point of the systems where the commuter will have to exit the system and choose a different mode of transportation in order to complete the trip. The "Large" stations are the stations with dense commuter traffic and are usually located in heavily populated public paces, such as shopping malls, convention centers, hotels, tourist attractions, and the like. The "Interchange" stations are the stations that connect the two RMT systems. Lastly, the "Between" stations are the smaller sized stations in between the larger stations, as mentioned. This research study collected data in a distributive manner, with the greater number of samples collected from the "Large", the "Interchange", the "End", and the "Between" stations in order.

The time allowed to collect the respondents' data was another consideration in the data collection sampling. The morning commuters comprised mostly people commuting to work or to school, while late afternoon commuters were a different group of people, such as housewives, business owners, and students. The evening commuter were predominantly office workers and a variety of different groups of commuters. Lastly, the late night commuters tended to consist more of males than females. The data collection for this research gathered samples distributed during each time interval evenly; however, late night time commuters were not included in this study.

3.5 Research Instrument Questionnaire Design

The development of the questionnaire is an important stage in the research study process; therefore, the substance provided within the questionnaire, which includes the measures defined, variables, text, wording, and format, was scrupulously examined by academic professionals in order to ensure that a valid, reliable, and usable data collection was obtained from the questionnaire.

Base on the numerous research studies derived to formulate the conceptual dimensions influencing RMT ridership, the questionnaire was designed to provide the empirical data essential to perform the statistical analyses needed to explain RMT Ridership and the corresponding dimensions. The questionnaire was designed and classified into four parts.

Part 1 of the questionnaire sought to gather information on the respondents' demographics, which include gender, marital status, age, education, occupation, and income. The selections for gender are male and female. The marital status provided by the respondents was single, married, divorced, and widowed. The age groups were categorized in segments of less than 20 years, 20 to 30 years, 31 to 40 years, 41 to 50 years, 51 to 60 years, and over 60 years. The education levels were a choice from primary school, high school, vocational school, bachelor's degree, and master's degree or higher. The selection choices for the occupation of the respondent was student, government official, private company employee, self-employed, freelance, housewife/stay at home, retired, and others. Lastly, the income levels per month were categorized into groups, which were the less than 10,000 Baht, 10,001 to 20,000 Baht, 20,001 to 30,000 Baht, 30,001 to 40,000 Baht, 40,001 to 50,000 Baht, 50,001 to 60,000 Baht, and over 60,000 Baht.

Part 2 of the questionnaire was designed to compile the commuters' monthly travel characteristics. The questionnaire elicited information concerning the frequency with which the commuter used the RMT systems, an automobile, the bus system, taxis, and the motorcycles per month. The respondents were to select from the frequency groups of none, 1 to 7 days, 8 to 14 days, 15 to 21 days, and over 21 days. The questionnaire then continued to ask about the respondents' view of the future usage of the RMT systems with the question "Do you think in the future commuters will use the RMT system instead of automobiles, buses, taxis, and motorcycles?" The respondents were to respond with "yes, sometimes, most of the time, or don't know" as the selection of answers. The last question for this part of the study endeavored to determine the commuters' reasons for using the RMT systems by asking "When do you use the Rail Transit Systems?" The choices available, for which the respondents could choose more than one selection, were "to work or study, dine outside the house, entertainment (movies, music bars), shopping, meet friends, business or errands, attend functions (seminars, exhibitions), and others."

Part 3 of the survey questionnaire compiled data on the commuters' attitudes regarding the importance of each constructed core concept, which were: price, promotions, facilities (in the stations and trains), quality of the service and of the system, safety and security, information on the system, system availability and convenience, external factors (oil price, traffic congestion, and lack of parking spaces), and governmental policies and support, with the question, "What level of importance should the Rail Transit give to the following dimensions?" The respondents were to provide the best answer based on a 5 point Likert Method interval rating scale, where 1 represents "very unimportant" and 5 represents "very important." The respondents were then asked to choose the "most important" and "second most important" of the nine concepts.

Part 4 of the questionnaire focused attention on determining the commuters attitudes on the various measures of the nine core concepts classified into four groups of questions, which are common for the daily commuter. The measures were categorized into questions relating to management, the system, expenses, and others. The respondents were to answer the question, "What level of consideration should the Rail Transit give to the following items?" The respondents were to provide the best answer based on a 5 point Likert Method interval scale, where 1 represents "very unimportant" and 5 represents "very important."

3.6 Operational Definitions and Measurements of the Study

The measurements for the nine core concepts developed in the conceptual model were an essential element for the outcome of the research study. The measurements constructed to represent and define each dimension were developed from the substances extracted from the literature review of the various concepts and collectively represented the various attributes of the variables. The various measurements were evaluated by the respondents in Part 4 of the survey questionnaire in order to determine the levels of consideration that the Rail Mass Transit systems have given to each measure.

3.6.1 Dimensions Influencing Rail Mass Transit Ridership

3.6.1.1 The Promotions Concept

The Promotions dimension is a concept that influences increased ridership on the RMT system with benefit packages, which would effectively reduce the cost of commutes and are aimed at attracting frequent users of the system. Therefore, the measures were created by emphasizing the importance of attractive prices for commute savings for the frequent users of the system, benefits available, and incentives to attract passengers. The scores from the following measures were used in the questionnaire to define the "Promotions" concept.

1) Attractive promotional fares (C4)
2) Promotions for regular commuters (C5)
3) Special benefits for frequent users (C6)
4) Promotions providing incentives for usage of the system (C7)

3.6.1.2 The Price Concept

The Pricing independent variable represents the economical relation between the services provided to the customer and the cost to be paid for the services. The measures in this category reflect the attractiveness of the average costs required for the RMT services and the justification for setting the costs. The scores from the following measures were used in the questionnaire to define the "Price" concept.

1) Appropriate average fare rates (C1)
2) Attractive discounted fares (C3)

3.6.1.3 The Facilities Concept

The Facilities factor defines the various provisions in the RMT systems to support the overall commute. The measures constructed for this concept reflect the items that will satisfy the specific needs of the commuter during his or her commute with the system. Such facilitators as parking facilities, Automatic Teller Machines, directional signage, and a well-maintained environment in the station are some of the measurements of this dimension. The scores from the following measures were used in the questionnaire to define the "Facilities" concept.

1) Clean and well-maintained system (B1)
2) Aesthetically beautiful system (B2)
3) Provision of sufficient amenities, such as ATM,

convenience stores and the like (B3)

4) Sufficient parking facilities (B4)

5) Clear and useful directional signage (B5)

3.6.1.4 The Quality Concept

The Quality dimension concept characterizes the overall standard of excellence performed by the staff services and the system. The measures on the staffing portion include interactions with the customers with enthusiasm and willingness to serve, and appearance while on duty. The system quality measures focus on the system's ability to provide a better commute in terms of travel comfort and good design accessibility for the trains. The scores from the following measures were used in the questionnaire to define the "Quality" concept.

1) Polite and willing to serve staff (A1)

2) Well and appropriately dressed staff (A2)

3) Staff provide service with enthusiasm (A3)

4) Knowledgeable staff that can assist commuters with problems (A4)

5) Comfortable commuter trains (B6)

6) Easily accessed commuter trains from street level (B7)

3.6.1.5 The Safety/Security Concept

The Safety/Security concept demonstrates the relationship between RMT ridership and the concern for safety and security of the commuters during the time spent in the system. The safety measures that illustrate the core concept include the commuters' perception of the safety of the main mode of transportation, which is the commuter train, and the abundance of safety equipment as observed in the stations. The security measures for this concept evaluate the security personnel provided within the system and the perception of reliability as viewed by the commuter. The scores from the following measures were used in the questionnaire to define the "Safety/Security" concept.

1) Appropriate safety measures for the system (A5)

2) Reliable security within the system (A10)

3) Sufficient security guards within the system (A11)

4) Sufficient safety equipment provided within the system (A12)

5) Safe commuter trains for transportation (B8)

3.6.1.6 The Information Concept

The Information core concept represents the important informational aspects the commuter might need in order to plan his or her commute. The measures developed to explain the dimension concern the important characteristics of the RMT systems, such as the station locations, route information, and services provided within the system. The availability of the information requested by the customer was also another measure in this group concept. The scores from the following measures were used in the questionnaire to define the "Information" concept.

1) Useful route information (A6)
2) Available detailed information about the system (A7)
3) Information on the stations and amenities (A8)
4) Information requests that can easily be obtained (A9)

3.6.1.7 The Convenience/Availability Concept

The Convenience/Availability variable was mainly aimed at the general system functions provided for the commuter. The measures in this category direct attention to the availability and accessibility of the stations and projected future stations to accommodate the customers' commute, the services to help the commuter reach the stations, such as feeder systems and walking proximity, and the punctuality and adequacy of the train services. The scores from the following measures were used in the questionnaire to define the "Convenience/Availability" concept.

1) Punctual train service (A13)
2) System that is conveniently accessible within walking distance (B9)
3) Sufficient stations to facilitate the commute (B10)
4) Convenient and easily accessed feeder system for commuters to stations (B11)
5) Adequate train service (B12)
6) System expansions that will improve availability and convenience in the future (B13)

3.6.1.8 The Government Concept

The Government factors described in the research framework include the various influences that the government can provide with consequences affecting the RMT ridership. The important measures utilized to explain the notion are in the areas of governmental actions, such as auto restraining policies, federal control on pricing, tax deduction benefits and other benefits for RMT users to attract more ridership in the system. The scores from the following measures were used in the questionnaire to define the "Government" concept.

1) Campaign to use the system (A14)
2) Government control to provide appropriate prices (C2)
3) Auto restraint policies (D1)
4) Government should subsidize the RMT system (D5)
5) Information on environmental benefits of the RMT system (D6)
6) Information of economic benefits of the RMT system (D7)

3.6.1.9 The External Concept

The External factors are the influences external to the RMT systems but directly influence the ridership of the system. The measures identify these items that play an important role for the commuters to decide to use the services of the RMT systems, such as oil prices, road congestion, and parking spaces in the inner city. The scores from the following measures were used in the questionnaire to define the "External" concept.

1) Oil prices (D2)
2) Traffic congestion on roadways (D3)
3) Parking spaces in the inner city (D4)

3.6.2 Demographic and Location Factors

The independent variables, which consist of demographic and location data, can be expected to affect the dimensions influencing RMT ridership. The operational and measurements of the variables are discussed in this section.

3.6.2.1 Demographic Factors

The demographic data used to evaluate the affects on the dimensions influencing RMT ridership are comprise of gender, marital status, age, education, occupation, and income factors. The data for each of the factors were compiled from the empirical data collected from the questionnaire on the demographic and location of the respondents. The gender factor is divided into male and female respondents.

Marital status was classified into the single and married respondents. The age groups were classified into four groups, which consists of respondents under 21 years of age, respondents between 21 to 40 years of age, respondents between 41 to 60 years of age, and respondents over 60 years of age. The education levels were classified into respondents with educations less than a bachelor's degree and respondents with education levels of a bachelor's degree or higher. The occupation groups used for analysis were student and working groups. The income per month levels were divided according to respondents with incomes under 10,000 Baht, between 10,001 to 30,000 Baht, between 30,001 to 50,000 Baht, and over 50,000 Baht.

3.6.2.2 Location Factors

The Location factors used for analysis are the inner city, outer city, and the intermediate locations between the inner and outer city stations. The inner city locations consist of respondents at the Sukhumvit, Queen Sirikit National Convention Center, Si Lom, Ratchathewi, Phaya Thai, Victory Monument, Siam, Chit Lom, Phloen Chit, Nana, Asok, Phrom Phong, Thong Lo, Ekkamai, National Stadium, Ratchadamri, and Sala Daeng stations. The outer city locations consist of respondents at the Bang Sue, Kamphaeng Phet, Sam Yan, Hua Lamphong, Sapan Khwai, Mo Chit, Phra Khanong, On Nut, Chong Nonsi, Surasak, and Saphan Taksin stations. The intermediate locations consist of respondents at the Sanam Pao, Ari, Chatuchak Park, Phahon Yoyhin, Lat Phrao, Ratchadaphisek, Sutthisan, Huai Khwang, Thailand Cultural Center, Phra Ram 9, Phetchaburi, Khlong Toei, and Lumphini stations.

3.7 Data Collection

A total of 1,715 RMT users were sampled at 41 Rail Mass Transit stations in Bangkok during the period of October and November 2007. The decision to sample only RMT users, and to exclude non-RMT users, was based on the premise that users' familiarity with the existing systems would enable them better to identify factors conducive to promoting ridership, whereas nonusers would have no experiential basis for making the identifications. Accidental sampling was used to collect data from the commuters. Most samples were collected late in the morning, throughout the afternoon, and evenings.

Since the completion of data collection, oil prices have escalated tremendously. The PTT website (PTT, 2008) reports on 14 November 2007 that the commercial prices for Unleaded Gasoline 95 to be at 31.69 Baht, while the Diesel price was at 28.64 Baht. On 7 July 2008, the commercial price of Gasoline Unleaded 95 has jumped to 43.89 Baht, while the Diesel price was at 44.29 Baht. The 38.5 percent increases in the commercial price for Unleaded Gasoline 95, and the 54.5 percent increase for the Diesel prices, have caused a significant ridership increase on the two RMT systems in Bangkok (Nareerat Wiriyapong, 2008). The reader should take note that the findings presented in the research report are based on data prior to the mentioned event.

The data collected from the questionnaires were coded and then inputted into the Statistical Package for Social Sciences (SPSS) processor for evaluation. The analyses performed by the SPSS include basic descriptive statistics, reliability analysis, factor analysis, bivariate correlation analysis for validity, Chi-square tests, analysis of variance (ANOVA), and multivariate hierarchal cluster analysis.

3.8 Reliability and Validity of the Constructs

3.8.1 Pilot Study

The questionnaire was evaluated through the use of a pilot study prior to the actual field collection process. The pilot study was to clarify the core constructed concept factors influencing RMT ridership and to give the researcher a deeper understanding of the constructed questionnaire. The pilot study included an initial reliability analysis of the measures used to define the dimensions of the study, where the Cronbach Alpha values would indicate the reliability in which the measures used define the study dimensions. The modified pilot questionnaire was distributed to a pilot sample of respondents to test if the understanding of the respondents was in conjunction with the intended content designed for the research. The pilot study performed serves as a preliminary indication of the actual data collection and suggested the vulnerabilities of the questionnaire. With this vital information, the researcher was able to make significant altercations in the questionnaire in order to assure the best results from the fieldwork data collection.

3.8.2 Reliability

The core concept measures constructed for the research were evaluated for reliability in order to validate the measures' explanatory power for each separate concept. The Cronbach Alpha values gave the researcher an indication of the appropriateness of the collective measures in representing the definitive core dimensions. The Cronbach Alpha provided the researcher with the ability to justify the reliability of the set of measures that corresponded to the various independent and dependent dimensions. A Cronbach Alpha value of 0.5 was considered the standard cutoff point to determine the reliability of a group of measures of the core concept. The study of the nine core concepts were evaluated for reliability, which yielded results that were strongly satisfactory. The overall Cronbach Alpha for the nine independent variables and the dependent variables all yielded results of over 0.73, therefore strongly justifying the reliability of these measures with respect to their concepts. The results for the reliability analyses are shown in Table 3.2.

Table 3.2 Reliability Analysis Results

Factor	Cronbach Alpha	Measures
Promotions	0.9035	c4, c5, c6, c7
Pricing	0.7347	c1, c3
Facilities	0.7936	b1, b2, b3, b4, b5
Quality	0.8421	a1, a2, a3, a4, b6, b7
Safety/Security	0.8841	a5, a10, a11, a12, b8
Information	0.8507	a6, a7, a8, a9
Convenience/Availability	0.8698	a13, b9, b10, b11, b12, b13
Government	0.8016	a14, c2, d1, d5, d6, d7
External	0.8269	d2, d3, d4

3.8.3 Validity

3.8.3.1 Factor Analysis

The validity of the construct core concepts was important for reinsuring the researcher that the various concepts used for the research study were well-defined. Factor analysis was utilized for scale purification serving to eliminate ambiguous measure questions from the set of concept representative measures. The results from the factor analysis determined the set of measures that would create a weaker explanation in the latter stages of analyses, where the researcher would need to eliminate these probable problems to ensure a solid representation during the Multivariate Analyses process. The factor analysis also verified the dimension measures collaboration by identifying the measures that were associated with the same concept characteristics. The results from this process could be a basis for rearranging the measures and regrouping the conceptual dimensions, given that the researcher could explain the redirection within the terms of the existing body of knowledge and literature.

The results of the factor analysis performed on the nine components of the nine construct concepts showed that the nine component structure was not the ideal solution for this set of constructs. The factor analysis results using principle component extraction and varimax rotation sorting for higher scores are shown in Table 3.3 below.

Table 3.3 Factor Analysis Results for Nine Component Solution

	Factor								
measure	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
C02	0.59								
C03	0.75								
C04	0.82								
C05	0.80								
C06	0.76								
C07	0.75								
A5		0.73							
A10		0.76							
A11		0.73							
A12		0.74							
B09			0.70						
B10			0.73						
B11			0.72						
B12			0.72						
B13			0.64						
A6				0.68					
A7				0.75					
A8				0.73					
A9				0.68					
D04					0.62			0.31	0.32
D01					0.64				
D02					0.84				
D03					0.77				
B05						0.58			0.33
B06						0.75			
B07						0.71			
B08						0.64			
A1							0.78		
A2							0.77		
A3							0.73		
A4							0.51		
D05								0.65	
D06								0.80	
D07								0.79	
B03									0.67
B04						0.32			0.61

Note: Factor Loadings with absolute magnitude less than 0.3 are not disclosed

From the results as presented, the researcher eliminated measures a13, a14, b01, b02, and c01 because of low communalities or from failure to load into any of the 9 components. The 9 components accounted for 70.90% percent of the variation in the data on attitudes. The 9 factors defined are shown in Table 3.4 below.

Table 3.4 Resulting Dimensions for the Nine Component Factor Analysis Solution

Factor	Measures	notes
Pricing/Promotions	c2, c3, c4, c5, c6, c7	Combines original measures for pricing and promotions factors
Safety/Security	a5, a10, a11, a12	
System Availability	b9, b10, b11, b12, b13	Part of the original Convenience/Availability concept
Information	a6, a7, a8, a9	
Commute Convenience	b5, b6, b7, b8	Part of the original Convenience/Availability concept
External	d1, d2, d3, d4	
Service Quality	a1, a2, a3, a4	Part of the original Quality of Service and System concept
Government	d5, d6, d7	
Facilities	b3, b4	Part of the original Facilities concept

Although the 9 component factors were defined quite clearly, the last two components' eigenvalue failed to reach the practical cutoff level of 1. The eighth component eigenvalue of 0.96 was very close to 1 and could probably be used for the data, but the researcher opted to find the most appropriate solution, which resulted in a factor analysis with 7 component factors.

The results from the factor analysis performed on the seven components using principle component extraction and varimax rotation sorting for higher scores are shown in Table 3.5 below.

Table 3.5 Factor Analysis Results for Seven Component Solution

	Factor						
	1	2	3	4	5	6	7
C01	0.54		0.36				
C02	0.62		0.31				
C03	0.75						
C04	0.81						
C05	0.78						
C06	0.75						
C07	0.73			0.32			
D01		0.59					
D02		0.73					
D03		0.75					
D04		0.69					
D05		0.63					
D06		0.65		0.45			
D07		0.65		0.47			
A5			0.72				
A10			0.76				
A11			0.71				
A12			0.73				
A6				0.57			
A7				0.68			
A8			0.30	0.62			
A9			0.32	0.63			
A14				0.59			
B09					0.70		
B10					0.73		
B11					0.70		
B12					0.71		
B13					0.63		
B03				0.32		0.56	
B04						0.59	
B05						0.67	
B06						0.73	
B07						0.68	
B08			0.45			0.55	
A1							0.76
A2				0.34			0.71
A3							0.72
A4			0.44				0.54

Note: Factor Loadings with absolute magnitude less than 0.3 are not disclosed

The results produced from this solution yielded a satisfactory loading of 7 principal factors. Measures a13, b01, and b02 were cut out due to low communalities or failure to load into any of the 7 components. The solution explains approximately two-thirds of the variance at 66.10% percent of the variation. The 7 factors defined are shown in Table 3.6 below.

Table 3.6 Resulting Dimensions for the Seven Component Factor Analysis Solution

Factor	Measures	notes
Pricing/Promotions	c1, c2, c3, c4, c5, c6, c7	Combines original measures for pricing and promotions factors
Government/External	d1, d2, d3, d4, d5, d6, d7	Combines original measures for government and external factors
Safety/Security	a5, a10, a11, a12	
Information	a6, a7, a8, a9, a14	
System Availability	b9, b10, b11, b12, b13	Part of the original Convenience/Availability concept
Facilities and Commute Convenience	b3, b4, b5, b6, b7, b8	Part of the original Facilities concept and the Commute Convenience concept from the 9 component solution
Service Quality	a1, a2, a3, a4	Part of original Service Quality and System concept

The first component of the solution with almost two-fifths of the total variance consisted of the seven measures of the "Price" and "Promotions" concept. The combination of the "Price" and "Promotions" concept was not considered to be a surprise considering that both concepts deal with the amount of money a commuter has to pay in order to use the services. Promotions are a form of price discount and the variations of the prices are often marketed as promotions. The questionnaire provided for the respondents also group the two concepts as the expenses section questions, with the intention of classifying the set of measures into different groups with respect to the commuters' point of view on the RMT systems. Therefore, the unity of the two concepts in this solution can be considered as an acceptable variable for the research.

The next component in the solution was also a combination of two original concepts, which are the "Government" and the "External" variables. The two concepts are the only variables that have indirect influences on the RMT systems. Therefore, the combination of these two concepts can be classified as a more general grouping of the indirect factors on RMT ridership. In a way, the "External" concept has measures dealing with gas prices, traffic congestion, and parking availability in the inner cities, which are also problems that are associated with and in response to government policies. Therefore, the alignment of these two indirect concepts can be determined as acceptable and in line with each other.

The third component loaded into the seven factor solution was the "Safety/Security" concept, which maintained all the original measures and loaded as one component in this solution. This factor analysis component confirms the original concept construct.

The fourth component formulated in this solution was the "Information" core concept with an additional measure grouped. The original "Information" concept measure regrouped by the factor analysis solution indicates that the concept was valid and acceptable. The addition of measure a14, which was originally a "Government" concept, actually also fit well with the "Information" scheme. The measure was government campaigning for people to utilize the RMT systems. The content of campaigning provided vital information for commuters, which corresponds perfectly with the idea of "Information" as an influence on RMT ridership. Therefore, the addition of this measure to the original concept of "Information" was an acceptable solution.

The next component was the fifth component as determined by the solution, where a portion of the original "Convenience/Availability" concept was represented. The original idea was constructed grouping two attributes related to the RMT systems that allow the traveler to easily utilize the system for commuting. However, the measures in the original "Convenience/Availability" concept could easily be distinctive as a notation of the system in one part, and as a commute in the other part. Therefore the division of "Commuter Convenience" and "System Availability" between the measures was not difficult. The measures grouped to formulate this component solution were the actual components that define the "System Availability" concept.

The sixth component of the solution yielded a combination of three previously discussed concepts as a group. The composition of the measures in this component consisted of the original "Facilities" concept, the "Commuter Convenience" portion of the original "Convenience/Availability" concept, and a portion of the "Quality" concept. The "Quality" concept, similar to the "Convenience/Availability" concept, was comprised of two very identifiable sets of measures pertaining to the quality provision of the RMT systems for commuters. However, the two sets of measures could be further classified as "Service Quality," which focuses on the services provided and "System Quality," which focus on the RMT systems. This component solution includes the "System Quality" measures, which are actually the quality aspects in conjunction with the actual mobility of the commuter through the RMT systems. The new "Facilities and Commuter

Convenience" concept actually is related to provisions in order to facilitate the commuters' trip through the RMT systems.

The last component of the seven component solution was the "Service Quality" portion of the original "Quality" concept. The "Service Quality" fraction measures represented the quality provided by the RMT personnel within the systems.

3.8.3.2 Bivariate Correlation Analysis

The new set of core concepts were checked statistically for validity by observing the various correlations between the various measures. A bivariate correlation analysis was performed with the Pearson correlation analysis for validity. The results for each dimension are shown in Appendix A.

The results of the Pearson Correlation Analyses were satisfying. All of the measures from all of the dimensions proved to be significant to the 0.01 level. The results validate that the group of measures in the corresponding core concept significantly correlate with each other measures, thus proving that the dimensions' validity was acceptable.

3.9 Data Analysis

The analyses of the data collected by the questionnaire were performed to provide empirical evidence to analyze the dimensions influencing Rail Mass Transit ridership. Quantitative methods of analyses were utilized for the research analyses, which included descriptive statistics, reliability analysis, factor analysis, bivariate correlation analysis for validity, Chi-square tests, analysis of variance (ANOVA), and multivariate hierarchal cluster analysis.

3.9.1 Commute Characteristics

Descriptive statistics were performed to transform the collected data into general information and to demonstrate the different statistic data in percentages for the respondents. The statistics show the classification of respondents in terms of gender, marital status, age, education, occupation, and income.

The descriptive statistics were then utilized to demonstrate the respondents' personal commute characteristics showing the choices of travel with different modes of transportation, such as by RMT systems, automobile, bus, taxi, and motorcycle. The classification of the commuters' reason for utilization the RMT systems were determined from their responses to the questionnaire. The information obtained provided an idea as to why commuters use the system and provided vital information for future route planning for new systems.

The analyses of the commute characteristic behavior of the different groups of commuters, classified by demographics and location area, were investigated for variations amongst the groups. Chi-square statistics determined the significant variations between the groups. The groups of users with the potential to convert from motor vehicle usage to RMT utilization, which are occasional RMT users and frequent motorized transportation users, were the primary focus of the analyses.

3.9.2 Dimensions Influencing Rail Mass Transit Ridership

Descriptive statistics and ANOVA were utilized in order to determine the variations in attitudes towards the factors influencing RMT ridership. The results from this section show the differentiation in the commuters' attitudes towards the dimensions influencing RMT ridership between the sub-groups of the RMT and motorized transportation users. Descriptive statistics and ANOVA were then utilized to determine whether demographics and location area factors caused differentiation in commuters' attitudes to the RMT ridership.

The next set of descriptive statistics illustrate the rankings of the different dimensions that influence the RMT Ridership. The questionnaire provided for the respondents collected data on the top two factors that the respondents' perceived to be the most influential regarding their choice to use the RMT systems as the mode for transportation.

3.9.3 Segmentation of Respondents by Commuter Attitudes (Adapted from Malhotra (1999).

A hierarchical cluster analysis was executed to allocate the commuter segments of the various respondents into homogeneous groups based on the respective attitudes on the dimensions influencing RMT ridership. The analysis utilized the factor analysis scores of the core concept constructs for statistical analyses.

A square Euclidean difference, which is the sum of the squared differences in values for each variable, was the common distance measurement selected for the procedures. The clustering procedure utilized for the analysis was the agglomerative hierarchical clustering using Ward's variance method. The stepwise process combines the two cases with the smallest increase in the overall sum of squares within cluster distance. One by one the cases were combined into a cluster until all of the cases were considered. The agglomerative schedule display information on the cases being combined at each stage of the hierarchical clustering process. Based on the information, a line plot of the squared Euclidean distances could be formed. The cluster number could then be determined by observing the break in the plotted line where the squared Euclidean distances increased sharply.

The Ward method clustered the data case by case where the means for each cluster was constantly changing until the entire process was completed. At the end, some cases may be to be similar to later cluster groups. K means nonhierarchical clustering would be utilized to rearrange the misplaced cases into the most suitable groups. The analysis by agglomerative hierarchical clustering using Ward's variance method and then refining the results with K means nonhierarchical clustering is a common practice for analyses of this type. Agglomerative hierarchical clustering by Ward's method will determine the number of resulting clusters; however, the limitations might have resulted in some misplaced cases during the process. K means nonhierarchical clustering corrected the misplaced cases; however, the method could not initially be used because the number of clusters has to be known and specified prior to the analysis.

Descriptive statistics were utilized to describe the resulting clusters, and Chi-square tests were performed to distinguish variations in attitudes between the cluster groups. The variations in attitudes amongst the clusters were plotted in order to illustrate the differences.

CHAPTER 4

FINDINGS AND DISCUSSIONS ON COMMUTE CHARACTERISTICS

This chapter reports the findings from the survey data and also discusses these findings. The primary focus of the chapter is on the investigation of commuter characteristics for utilization of the various modes of transportations and on the endeavor to segregate the respondents travel selection with corresponding commuter groups in order to determine the attributes that may convert motor vehicle users to Rail Mass Transit usage.

4.1 The Sample

4.1.1 General Demographic Characteristics of the Sample

The samples can be classified into the different characteristics of the respondents, such as gender, marital status, age, education, occupation, and income. The following Tables (4.1 and 4.2) summarize the demographics of the respondents.

Table 4.1 Gender, Marital Status, and Age

Demographics	Percent
Gender	
Male	40.6
Female	59.6
Total	100.0
Marital Status	
Single	63.1
Married	33.2
Divorced	2.0
Widowed	1.6
Total	100.0

Table 4.1 (Continued)

Demographics	Percent
Age	
Under 21 years	14.7
21 to 30 years	34.8
31 to 40 years	26.3
41 to 50 years	13.2
51 to 60 years	8.9
Over 60 years	2.2
Total	100.0

Note: Sample size (n=1715)

The respondents from the field work survey can be classified by gender, with 40.6 percent of the respondents being male, and almost 60 percent of the respondents being female. Most of the respondents surveyed were single, comprising 63.1 percent of the total, while married respondents accumulated over one-third of the total data collected. The marital status of the remaining 3.6 percent was responds from the divorced and widowed respondents, which accrued to become quite a non-significant amount. The age differentiation of the respondents was moderately distributed over the different age groups. Almost 35 percent of the respondents were between 21 to 30 years of age. The next highest collections of respondents were in the age group of between 31 to 40 years, with 26.3 percent of the total respondents allocated to the group. The groups comprising individuals under 21, between 41 and 50, between 51 and 60, and over 60 years of age were represented with a total percentage of respondents as 14.7 percent, 13.2 percent, 8.9 percent, and 2.2 percent, respectively.

Table 4.2 Education Level, Occupation, and Income per Month

Demographics	Percent
Education	
Primary School	2.7
High School	14.3
Vocational School	11.5
Bachelor's Degree	56.4
Master's Degree or Higher	15.0
Total	100.0
Occupation	
Student	19.8
Government Official	23.1
Private Company Employee	38.8
Self-Employed	7.1
Freelance	6.4
Housewife/Stay at Home	2.9
Retired	1.8
Others	0.2
Total	100.0
Income per Month	
Less than 10,000 Baht	27.7
10,001 to 20,000 Baht	30.0
20,001 to 30,000 Baht	21.1
30,001 to 40,000 Baht	10.2
40,001 to 50,000 Baht	5.2
50,001 to 60,000 Baht	2.6
Over 60,000 Baht	3.1
Total	100.0

Note: Sample size (n=1715)

The respondents are classified in terms of education, with the largest group of respondents having a bachelor's degree, at 56.4 percent of the total. Fifteen percent of the respondents hold a master's degree or higher and almost 15 percent have a high school diploma. The remaining groups of respondents total approximately 14 percent of the respondents and are classified as having vocational school and primary school education levels, with a total of 11.5 percent and 2.7 percent of the total respondents.

The occupation breakdown for the respondents of the field survey questionnaire reveals that the highest number of respondents at 38.8 percent of the total is employees from private companies and organizations. The next segment of respondents is comprised of governmental officials with a response accruing to 23.1 percent of the total sample. The respondents that are students collectively tallied almost one-fifth of the total respondents at 19.8 percent of the samples. The remaining occupation classification groups were less significant in numbers, totaling less than one-fifth of the respondents, and these are self-employed individuals, freelancers, housewives or people that stay at home, retired persons and others at 7.1 percent, 6.4 percent, 2.9 percent, 1.8 percent, and 0.2 percent, respectively.

Thirty percent of the respondents earn an income of 10,001 to 20,000 baht per month, followed by the group of respondents with earnings of less than 10,000 baht per month at 27.7 percent. The group of respondents with incomes of 20,001 to 30,000 baht per month totaled 21.1 percent of the sample, and over 10 percent of respondents have a monthly income of between 30,001 to 40,000 baht per month. The remaining income groupings were respondents earning 40,001 to 50,000 baht per month, 50,001 to 60,000 baht per month, and over 60,000 baht per month with respectively 5.2 percent, 2.6 percent, and 3.1 percent of the total respondents in each category.

From the data illustrated in Tables 4.1 and Tables 4.2, the actual percentage of commuters on the two Rail Mass Transit systems, almost half of the respondents are under the age of 30 years. This generally corresponds to the observation that the RMT passengers consist of mainly the young working class and high school or university students. The occupation breakdown then confirms that the majority of respondents, which comprise over 60 percent of the total sample, are either employees of private companies and organizations, or government officials. The education breakdown identifies that over 55 percent of the respondents have a bachelor's degree, which also indicates the working class of people. Considering that over three-fifths of respondents are between 21 and 40 years of age, the deduction that working class respondents are the commuters' largest occupation subgroup is logical.

In terms of occupation, the next large groups of sampled respondents are the students, at almost one-fifth of the sample. Over one-quarter of these respondents have primary school, high school, or vocational school education. This is an indication that these particular respondents are in the process of obtaining a higher degree of education and are students. Considering that 15 percent of respondents are under 21 years of age, the conclusion that there are a substantial number of students is reasonable.

A comparison of the samples collected with the representative samples of the Tonghor et al. (2007) report (Details shown in Appendix B) for the Mass Rapid Transit Authority shows that the research samples collected from this study are made up of significantly more females, fewer respondents are of the age between 21 to 30 years, more respondents have a bachelor's degree or higher, and fewer respondents earn less than 10,000 Baht per month.

A comparison of the samples with the information obtained from the BTSC (Details shown in Appendix B) shows that the research study has significantly fewer females, a substantial number are older in age, have higher education levels, few are student, more are in the working class and have higher income levels.

With reservations for the actual disparity on the representative sample collected, the research study evaluates the sample for commuter attitudes on RMT ridership and interprets the results in the next sections. The sample will be evaluated as demographic groups in order to eliminate the overall prejudice on demographics and in an endeavor to generate valuable and constructive results for the study. Furthermore, evaluations for each subgroup will provide specific detail information on commute characteristics and attitudes for the subgroup, which can be utilized to customize measures attracting the subgroup to use RMT systems.

4.1.2 Commute Characteristics by Mode of Transportation

The survey samples collected data on the modes of transportation selected by each of the respondents. The data collected identify the frequency the commuter travels with the RMT system, automobiles, buses, taxis, and motorcycles. The frequency with which passengers selected RMT systems as the mode of transportation defines commute on a sustainable system for transportation. On the other hand, the selection of automobiles, buses, taxis, and motorcycles as the mode of transportation identifies a motorized form of transportation being used. Table 4.3 shows the respondents commute characteristics collected for this research study.

Table 4.3 Commute Characteristics by Mode of Transportation (Percentages)

Usage per month	Mode of Transportation				
	RMT	Automobiles	Buses	Taxis	Motorcycles
0 to 7 days (Occasional Users)	65.3	53.5	55.9	88.8	74.4
8 to 14 days (Moderate Users)	12.2	8.6	8.1	5.1	5.1
Over 15 days (Frequent Users)	22.5	37.9	36.0	6.1	20.5
Total	100.0	100.0	100.0	100.0	100.0

Note: Sample size (n=1715)

Over 65 percent of the respondents use the RMT system 1 to 7 days per month. This number implies that the majority of the commuters are not frequent users and are only occasional users of the system. Over 12 percent of the sample uses the RMT system 8 to 14 days, while respondents using the system 15 to 21 days were collectively 9.7 percent of the total. The number of frequent users of the RMT system with over 21 days of using the service amount to 12.8 percent of the total sampled. Since the survey data were collected at the RMT stations and are intended to survey the RMT users, there were no non-users of the system in this sampling data.

Automobile usage numbers show that the largest group of respondents, or over 30 percent of the total, uses automobiles as the mode of transportation over 21 days a month. On the other extreme, almost 30 percent of the respondents do not utilize automobiles for transportation at all. Non-frequent automobile users that use automobiles as a mode of transportation in the range of 1 to 7 days a month account for 23.7 percent of the sample. The remaining automobile usage statistics indicate that 8.6 percent of the respondents use automobiles 8 to 14 days a month, and 7.6 percent of the total sample use automobiles 15 to 21 days a month.

The data collected showing the respondents' usage of buses as the mode of transportation show that the largest response (28.2 percent of the sample) do not use the bus system at all. The next large group that represent non-frequent bus users 1 to 7 days a month combine to a substantial amount of 27.7 percent of the sample. Frequent bus users with over 21 days a month use of the system account for over one- quarter of the total respondents, while the remaining bus user groups of between 15 to 21 days a month and between 8 to 14 days a month have respective shares of 10 percent and 8 percent of the samplings.

Information on taxi usage per month show that the majority of the respondents of over 56 percent of the total sample use taxis 1 to 7 days per month. Substantially, the respondents that do not use taxi services as a mode of transportation at all amount to 32.6 percent of the total samplings. Taxi users using taxis frequently as a mode of transportation, between 8 to 14 days per month, between 15 to 21 days per month, and over 21 days per month, have respective distributions of 5.1 percent, 3.7 percent, and 2.4 percent of the total.

In terms of using motorcycles as a mode of transportation, the largest segment, consisting of almost half of the respondents, never use motorcycles at all. Almost a quarter of the respondents are non-frequent motorcycle users and utilize motorcycles from 1 to 7 days a month. Frequent motorcycle users of over 21 days a month add up to over 15 percent of the sample, while the remaining collections of motorcycle users of between 8 to 14 days of use per month and between 15 to 21 days of use per month have respective shares of 5.1 percent and 5.4 percent of the total responses.

The data from Table 4.3 show that the commuters of the RMT systems in Bangkok mainly utilize the system in conjunction with other modes of transportation. Almost two-thirds of RMT users only utilize this mode of transportation between 1 to 7 days a month and this strongly suggests that the system is not selected as the main mode of transportation but rather as a means or choice of transportation. The research study will point out the major influences on RMT ridership in order to provide empirical evidence for decision makers so that they can attract more ridership on the systems.

Investigation of motorized modes of transportation, i.e., commute by automobile, bus, taxi, and motorcycle, show an interesting trait. The number of occasional users (1 to 7 days per month) of motorized transportation modes constitutes over half of the respondents for each and every form of motorized transportation mode. The percentages of occasional users of automobiles comprise over 52 percent of the total, while the number of occasional users of the bus as a mode of transportation is even more at almost 56 percent of the sampling. The number of occasional users of taxis accounts for an enormous 88.8 percent of the total respondents. Lastly, almost three-fourths of the respondents occasionally use motorcycles as a mode of transportation. These statistics suggest that most of the commuters in the survey seldom use a motorized transportation system as a daily mode of transportation.

Another interesting group of users is the frequent motorized transportation users. The number of these users is substantially high for the various motor transportation modes, with an exception for taxi users. Frequent automobile users constitute 27.8 percent of the sample, while frequent bus users comprise of 36.0 percent of the sample. Frequent taxi users constitute only 6.1 percent of the sample, while frequent motorcycle users consist of 21.5 percent of the sample. The purpose of studying the group of frequent motor vehicle users is to endeavor to convert these commuters to utilization of the RMT systems. In order to achieve sustainable transportation development, the number of motorized transportation users must decrease and they must utilize the RMT systems. The data indicates that the majority of RMT users seldom use motorized forms of transportation; however, the majority does not utilize the RMT systems as a primary mode of transportation either. This is important information, and policy makers need to formulate measures in order to attract and convert more people to RMT ridership.

4.1.3 Rail Mass Transit Commute Destinations

The survey questionnaire results provide the researcher with information concerning the main destinations for which the respondents utilize the RMT systems as a mode of transportation. Each respondent can select the multiple destinations that best fit their reason for using the RMT systems as their means of commuting. The following Table 4.4 summarizes the information results obtained from the survey.

Table 4.4 Reasons for Using Rail Mass Transit

Reason for Using the RMT System (respondents can select more than one reason)	Percent
Business or Errands	74.3
Work or Study	54.3
Shopping	31.4
Meet Friends	25.7
Attend Seminars, Exhibitions, Functions (etc)	22.9
Entertainment (Movies, Music Bars)	21.4
Dine Outside the House	15.7
Others	8.6

Note: Sample size (n=1715)

The most frequently stated reason why RMT commuters utilize the system is for running errands or business-related trips; the data show that almost three-quarters of the respondents are represented. Over 54.3 percent of the respondents use the RMT system to travel to work or to go to school. The commute to go shopping is another popular reason for the commuters to use the system and the data show that over 31 percent of the respondents go shopping by commuting with the system. The research data results show that over one-quarter of the respondents use the RMT systems to commute to see their friends and acquaintances, while almost 23 percent of the total samples use the system to attend seminars, exhibitions or functions. The reason for using the RMT systems for 21.4 percent of the total sample is to seek entertainment in terms of watching movies, listening to music at bars and restaurants, and other sources of entertainment. The results of the survey also show that 15.7 percent of the total respondents use the RMT system to travel to dine out.

The data from the research results indicate that 8.6 percent of the commuters utilize the RMT systems for other purposes than those mentioned above. Most of the reasons are for avoiding traffic congestion, usage while the automobile is being repaired, selective use for areas with no easy parking availability, and use for areas where the RMT systems passes in the vicinity. With increased coverage of the RMT systems, commuters will definitely increase their patronage of the system and thus reduce traffic congestion and increase parking availability in the inner city areas. The group that represents 8.6 percent of responses in this category will definitely convert to using the RMT systems and thus increase RMT ridership numbers.

4.2 Rail Mass Transit Users

The groups of Rail Mass Transit users are investigated in this section. The study of these groups of commuters will provide more empirical information on the groups in order to encourage the RMT users to increase their utilization of the RMT systems. RMT users' commute characteristics are analyzed in order to determine the significant differences between the demographic subgroups. Variations in RMT usage by gender, marital status, age, education level, occupation, and income per month will provide specific information for RMT policymakers and system operators so that they can introduce custom policies and plans to encourage increased RMT usage. The RMT users are then evaluated in terms of the alternative modes of transportation used. The information obtained will show the commute selection other than the usage of the RMT systems. The essential data can provide RMT policymakers and system operators with an understanding of the commute behavior of this group of commuters.

4.2.1 Commute Characteristics by Demographic Subgroups

This section investigates the RMT users' commute characteristics in order to determine the significant differences between the demographic categories. The demographic categories, which are used to classify the respondents, are discussed according to gender, marital status, age, education, occupation, and income per month. Chi-square tests were run separately for the RMT users' commute characteristics and demographics in order to determine significant associations between the variables. Table 4.5 reports the RMT users' commuter characteristic behaviors and investigates the differences by gender, marital status, and age.

Table 4.5 Rail Mass Transit Users' Commute Characteristics by Gender, Marital Status, and Age (Percentages)

Demographics	Rail Mass Transit Users					
	Occasional	Moderate	Frequent	Total		
Gender						
Male	65.4	12.1	22.5	100.0	(697)	n.s.
Female	65.1	12.4	22.5	100.0	(1018)	
Marital Status						
Single	60.6	13.6	25.8	100.0	(1082)	χ^2=35.80, d.f.=4, p=.00
Married	74.9	9.3	15.8	100.0	(570)	
Divorced/Widowed	57.1	15.9	27.0	100.0	(63)	
Age						
Under 21 years	57.2	20.6	22.2	100.0	(252)	χ^2=31.11, d.f.=6, p=.00
21 to 40 years	64.5	10.9	24.6	100.0	(1047)	
41 to 60 years	72.3	10.0	17.7	100.0	(379)	
Over 60 years	65.2	12.2	22.5	100.0	(37)	

Note: n.s. denotes no significance

Table 4.5 shows that there are significant variations in the RMT users' commute characteristics based on marital status and age. Single respondents (25.8 percent) significantly frequently use RMT systems more than married respondents (15.8 percent). On the other hand, there are significantly more married respondents (74.9 percent) that are occasional RMT users than single respondents (60.6 percent). Respondents between 21 to 40 years of age (24.6 percent) have the most respondents utilizing RMT systems frequently. Respondents over 60 years of age (22.5 percent) and respondents under 21 years of age (22.2 percent) use RMT systems slightly less frequently, while respondents between 41 to 60 years of age (17.7 percent) have the least number of respondents utilizing RMT systems frequently. Respondents between 41 and 60 years of age (72.3 percent) significantly have the most respondents using RMT systems occasionally. Respondents over 60 years of age (65.2 percent) and respondents between 21 and 40 years of age (64.5 percent) have an average number of respondents using the RMT systems occasionally, while respondents under 21 years of age (57.2 percent) significantly have the least number of respondents using the RMT systems occasionally.

Table 4.6 reports the RMT users' commute characteristics and investigates variations by education level, occupation, and income per month.

Table 4.6 Rail Mass Transit Users' Commute Characteristics by Education Level, Occupation, Income per Month (Percentages)

Demographics	Rail Mass Transit Users					
	Occasional	Moderate	Frequent	Total		
Education						
Less Than a Bachelor's Degree	69.8	13.7	16.5	100.0	(490)	χ^2=14.21, d.f.=2, p=.00
Bachelor's Degree or Higher	63.4	11.7	24.9	100.0	(1225)	
Occupation						
Student	56.8	21.7	21.5	100.0	(340)	
Government Official	77.3	7.3	15.4	100.0	(396)	
Private Company Employee	58.4	10.1	31.5	100.0	(666)	
Self-Employed	76.9	13.2	9.9	100.0	(121)	χ^2=115.02, d.f.=14, p=.00
Freelance	71.6	7.3	21.1	100.0	(109)	
Housewife/Stay at Home	77.5	18.4	4.1	100.0	(49)	
Retired	61.3	22.6	16.1	100.0	(31)	
Others	100.0	0.0	0.0	100.0	(3)	
Income per Month						
Less than 10,000 Baht	67.0	16.6	16.4	100.0	(475)	
10,001 to 30,000 Baht	62.8	11.5	25.7	100.0	(876)	χ^2=27.17, d.f.=6, p=.00
30,001 to 50,000 Baht	67.9	7.9	24.2	100.0	(265)	
Over 50,000 Baht	71.7	9.1	19.2	100.0	(99)	

Table 4.6 shows that there are significant variations in the RMT users' commute characteristics based on education level, occupation, and income level. Respondents with education levels of a bachelor's degree or higher (24.9 percent) significantly have more respondents using RMT systems frequently than respondents with an education less than a bachelor's degree (16.5 percent). Respondents with an education less than a bachelor's degree (69.8 percent) significantly have more respondents utilizing the RMT systems occasionally than respondents with education levels of a bachelor's degree or higher (63.4 percent). Private company employees

(31.5 percent) significantly have more respondents using RMT systems frequently. Students (21.5 percent), freelance (21.1 percent), retired (16.1 percent), and government officials (15.4 percent) subgroups have lower number of frequent RMT users, while the self-employed (9.9 percent), and housewife/stay at home (4.1 percent) subgroups have the lowest number of respondents using RMT systems frequently. The subgroups with flexible working schedules that include housewife/stay at home (77.5 percent), self-employed (76.9 percent), freelance (71.6 percent), and retired (61.3 percent) respondents have substantially higher numbers of respondents utilizing the RMT systems occasionally. The subgroups with a fixed working schedule show significant variations, with government officials (77.3 percent) comprising a high number of occasional RMT users and private company employees (58.4 percent) consisting of lower numbers of occasional RMT users. The student subgroup (56.8 percent) with a semi-fixed schedule has significantly fewer respondents using the RMT systems occasionally. Respondents with incomes between 10,001 and 30,000 Baht per month (25.7 percent) and between 30,001 and 50,000 Baht per month (24.2 percent) significantly have the most respondents using the RMT systems frequently. Respondents with incomes over 50,000 Baht per month (19.2 percent) have lower number of respondents using RMT systems frequently, while respondents with incomes less than 10,000 Baht per month (16.4 percent) have the least number of respondents using RMT systems frequently. Respondents with incomes over 50,000 Baht per month (71.7 percent) significantly have the most respondents using the RMT systems occasionally. Respondents with incomes between 30,001 and 50,000 Baht per month (67.9 percent) and respondents with incomes under 10,000 Baht per month (67.0 percent) have an average amount of respondents using the RMT systems occasionally, while respondents with incomes between 10,001 and 30,000 Baht per month (62.8 percent) have the least amount of respondents using the RMT systems occasionally.

4.2.2 Commute Characteristics by Other Transportation Modes

This section investigates the RMT users' commute characteristics utilizing other modes of transportation in order to determine the commuters' other selection of transport in conjunction with the utilization of the RMT systems. This investigation of other modes of transportation is essential for developing an understanding of the commute behavior of the occasional RMT users in order to bring about improvement of the RMT services so that transportation needs can be fulfilled and so that the number of people that use the RMT services only occasionally can be increased. Chi-square tests were run separately for the RMT users' commute characteristics and the other modes of transportation in order to determine the significant associations between the variables. Table 4.7 reports the RMT users' commuter characteristic behaviors and investigates the other modes of transportation utilized by RMT users.

Table 4.7 Rail Mass Transit Users' Commute Characteristics by Other Transportation Modes (Percentages)

Transportation Mode	Rail Mass Transit Usage			
	Occasional	Moderate	Frequent	
Automobile Usage				
Occasional	46.6	59.5	70.5	
Moderate	7.9	14.8	7.5	χ^2=94.10, d.f.=4, p=.00
Frequent	45.6	25.7	22.0	
Total	100.0 (1119)	100.0 (210)	100.0 (386)	
Bus Usage				
Occasional	58.2	42.9	56.5	
Moderate	7.6	14.8	5.7	χ^2=25.85, d.f.=4, p=.00
Frequent	34.2	42.4	37.8	
Total	100.0 (1119)	100.0 (210)	100.0 (386)	
Taxi Usage				
Occasional	91.6	84.8	82.6	
Moderate	4.0	8.6	6.5	χ^2=31.85, d.f.=4, p=.00
Frequent	4.4	6.7	10.9	
Total	100.0 (1119)	100.0 (210)	100.0 (386)	
Motorcycle Usage				
Occasional	75.8	70.0	73.1	
Moderate	4.3	10.5	4.4	χ^2=15.77, d.f.=4, p=.00
Frequent	19.9	19.5	22.5	
Total	100.0 (1119)	100.0 (210)	100.0 (386)	

Table 4.7 indicates that there is a substantial number of frequent automobile (22.0 percent), bus (37.8 percent), and motorcycle (22.5 percent) users that actually

are frequent RMT users also. This group of users represent commuters utilizing multi-modal transportation systems for daily commute.

A substantial number of occasional RMT users frequently use automobiles (45.6 percent), buses (34.2 percent), and motorcycles (19.9 percent) as their mode of transportation. The empirical data in this case suggest that the occasional RMT users utilize the system as an alternative mode of transportation for the primary mode of transport, which is a motorized form of transportation. However, the occasional RMT users that occasionally utilize automobiles (46.6 percent), buses (58.2 percent), taxis (91.6 percent), and motorcycles (75.8 percent) as an alternative mode of transportation suggest utilization of the most convenient transportation mode based on their transportation needs.

4.3 Motorized Transportation, Frequent Users

The group that frequently uses motorized transportation, including automobiles, buses, and motorcycles, is investigated in this section. Frequent taxi users are not evaluated because of the insignificant number of commuters in this group. Frequent motorized transportation users are an essential group of commuters that have to be studied in order to understand their travel characteristics. The information obtained from this study can be utilized to formulate strategies in order to bring about group conversion or to encourage them to switch from motor vehicles for transportation to the Rail Mass Transit systems. The frequent motorized transportation users' commute characteristics are evaluated in order to determine the significant variations between the demographic subgroups. The different travel behaviors seen between the subgroups can provide RMT policymakers and system operators with data with which they can make plans, policies, and improvements to the existing RMT systems and thereby encourage frequent motorized transportation users to increase their RMT usage. The frequent motorized transportation users are then evaluated in terms of RMT system usage. The information obtained will show the groups' actual RMT usage, and the results will indicate whether the frequent motorized transportation users utilize the RMT systems as a part of their commute or only on an occasional basis.

4.3.1 Commute Characteristics by Demographic Subgroups

This section investigates the motorized transportation users' commute characteristics in order to determine the variations between the demographic categories. Automobile, bus, and motorcycle users were analyzed according to the demographic categories, which are gender, marital status, age, education, occupation, and income per month. Chi-square tests were run separately for the motorized transportation users' commute characteristics and respective demographic classifications so that the significant associations between the groups could be determined.

4.3.1.1 Automobile, Frequent Users

Table 4.8 reports the automobile users' commute characteristics and reports the variations by gender, marital status, and age.

Table 4.8 Automobile Users' Commute Characteristics by Gender, Marital Status, and Age (Percentages)

Demographics	Automobile Users					
	Occasional	Moderate	Frequent	Total		
Gender						
Male	51.8	8.5	39.7	100.0	(697)	n.s.
Female	54.7	8.8	36.5	100.0	(1018)	
Marital Status						
Single	62.8	8.0	29.2	100.0	(1082)	χ^2=110.57, d.f.=4, p=.00
Married	36.5	9.5	54.0	100.0	(570)	
Divorced/Widowed	49.2	11.1	39.7	100.0	(63)	
Age						
Under 21 years	69.8	10.7	19.5	100.0	(252)	χ^2=104.12, d.f.=6, p=.00
21 to 40 years	56.6	8.3	35.1	100.0	(1047)	
41 to 60 years	34.8	7.9	57.3	100.0	(379)	
Over 60 years	46.0	10.8	43.2	100.0	(37)	

Note: n.s. denotes no significance

Table 4.8 illustrates that there are significant variations in the automobile users' commute characteristics based on marital status and age. The number of frequent married automobile users (54.0 percent) is significantly greater than the frequent single automobile users (29.2 percent). Respondents between 41 and 60 years of age (57.3 percent) significantly have the most respondents using the automobile frequently. Respondents over 60 years of age (43.2 percent) and respondents between 21 and 40 years of age (35.1 percent) have an average amount of respondents using automobiles frequently, while the respondents under 21 years of age (19.5 percent) significantly have the least amount of respondents using automobiles frequently.

Table 4.9 reports the automobile users' commute characteristics and reports the variations by education level, occupation, and income per month.

Table 4.9 Automobile Users' Commute Characteristics by Education Level, Occupation, Income per Month (Percentages)

Demographics	Automobile Users					
	Occasional	Moderate	Frequent	Total		
Education						
Less Than a Bachelor's Degree	59.8	9.4	30.8	100.0	(490)	χ^2=14.44, d.f.=2, p=.00
Bachelor's Degree or Higher	51.0	8.3	40.7	100.0	(1225)	
Occupation						
Student	68.2	9.7	22.1	100.0	(340)	
Government Official	43.4	6.8	49.8	100.0	(396)	
Private Company Employee	54.3	9.5	36.2	100.0	(666)	χ^2=107.80, d.f.=14, p=.00
Self-Employed	34.7	5.8	59.5	100.0	(121)	
Freelance	68.8	6.4	24.8	100.0	(109)	
Housewife/Stay at Home	34.7	12.2	53.1	100.0	(49)	
Retired	48.4	16.1	35.5	100.0	(31)	
Others	100.0	0.0	0.0	100.0	(3)	
Income per Month						
Less than 10,000 Baht	69.7	8.8	21.5	100.0	(475)	
10,001 to 30,000 Baht	54.9	8.8	36.3	100.0	(876)	χ^2=161.56, d.f.=6, p=.00
30,001 to 50,000 Baht	31.3	6.8	61.9	100.0	(265)	
Over 50,000 Baht	23.2	11.1	65.7	100.0	(99)	

Table 4.9 shows that there are significant variations in the automobile users' commute characteristics based on education level, occupation, and income per month. Respondents with a bachelor's degree or higher (40.7 percent) significantly have more respondents using the automobile frequently than the respondents with education levels less than a bachelor's degree (30.8 percent). The occupation subgroups with significantly substantial frequent automobile users are the self-employed (59.5 percent), housewife/stay at home (53.1 percent), and government officials (49.8 percent). Private company employees (36.2 percent) and retired (35.5 percent) respondents have an average amount of respondents using automobiles frequently. Freelance (24.8 percent) and student (22.1 percent) respondents significantly have the least amount of respondents using automobiles frequently. Respondents with incomes over 50,000 Baht per month (65.7 percent) and respondents with incomes between 30,001 and 50,000 Baht per month (61.9 percent) have significantly substantial numbers of frequent automobile users. Respondents with incomes between 10,001 and 30,000 Baht per month (36.3 percent) have an average amount of respondents using automobiles frequently, while respondents with incomes less than 10,000 Baht per month (21.5 percent) have the least number of respondents using automobiles frequently.

4.3.1.2 Bus, Frequent Users

Table 4.10 reports the bus users' commute characteristics and reports the variations by gender, marital status, and age.

Table 4.10 Bus Users' Commute Characteristics by Gender, Marital Status, and Age (Percentages)

Demographics	Bus Users					
	Occasional	Moderate	Frequent	Total		
Gender						
Male	61.3	8.7	30.0	100.0	(697)	χ^2=18.65, d.f.=2, p=.00
Female	52.2	7.6	40.2	100.0	(1018)	
Marital Status						
Single	49.1	8.0	42.9	100.0	(1082)	χ^2=63.39, d.f.=4, p=.00
Married	67.9	8.2	23.9	100.0	(570)	
Divorced/Widowed	65.1	6.3	28.6	100.0	(63)	
Age						
Under 21 years	36.1	9.1	54.8	100.0	(252)	χ^2=85.26, d.f.=6, p=.00
21 to 40 years	55.4	7.2	37.4	100.0	(1047)	
41 to 60 years	68.6	9.5	21.9	100.0	(379)	
Over 60 years	75.7	10.8	13.5	100.0	(37)	

Table 4.10 shows that there are significant differences in the bus users' commute characteristics based on the gender, marital status, and age subgroups. There are significantly more females (40.2 percent) that are frequent bus users than males (30.0 percent). There are significantly more single respondents (42.9 percent) that are frequent bus users than married respondents (23.9 percent). The information shows that there are significantly more frequent bus users in the younger age groups. The respondents under 21 years of age (54.8 percent) are the most frequent bus users. The respondents between 21 and 40 years (37.4 percent), between 41 and 60 years (21.9 percent) and over 60 years (13.5 percent) of age have significantly decreasing frequent bus users.

Table 4.11 reports the bus users' commute characteristics and reports the variations by education level, occupation, and income per month.

Table 4.11 Bus Users' Commute Characteristics by Education Level, Occupation, Income per Month (Percentages)

Demographics	Bus Users					
	Occasional	Moderate	Frequent	Total		
Education						
Less Than a Bachelor's Degree	48.4	8.6	43.0	100.0	(490)	χ^2=16.63, d.f.=2, p=.00
Bachelor's Degree or Higher	59.0	7.8	33.2	100.0	(1225)	
Occupation						
Student	35.0	7.1	57.9	100.0	(340)	
Government Official	60.9	9.8	29.3	100.0	(396)	
Private Company Employee	60.7	7.2	32.1	100.0	(666)	
Self-Employed	79.3	5.8	14.9	100.0	(121)	χ^2=140.72, d.f.=14, p=.00
Freelance	46.8	5.5	47.7	100.0	(109)	
Housewife/Stay at Home	51.0	16.3	32.7	100.0	(49)	
Retired	74.2	16.1	9.7	100.0	(31)	
Others	0.0	33.3	66.7	100.0	(3)	
Income per Month						
Less than 10,000 Baht	34.5	8.9	56.6	100.0	(475)	
10,001 to 30,000 Baht	56.0	8.6	35.4	100.0	(876)	χ^2=212.57, d.f.=6, p=.00
30,001 to 50,000 Baht	82.7	6.0	11.3	100.0	(265)	
Over 50,000 Baht	85.9	5.0	9.1	100.0	(99)	

Table 4.11 illustrates that there are significant variations in the bus users' commute characteristics based on education level, occupation, and income per month. Respondents with educations less than a bachelor's degree (43.0 percent) significantly have more respondents using bus systems frequently than the respondents with an education level of a bachelor's degree or higher (33.2 percent). The occupation subgroups with significantly substantial frequent bus users are students (57.9 percent) and freelance commuters (47.7 percent). Housewife/stay at home commuter (32.7 percent), private company employee (32.1 percent) and government official (29.3 percent) respondents have an average number of respondents using buses frequently. Self-employed (14.9 percent) and retired (9.7 percent) respondents significantly have the least amount of respondents using buses

frequently. Frequent bus users decreases as income levels increase. Respondents with incomes less than 10,000 Baht per month (56.6 percent) significantly have more frequent bus users. Respondents with incomes between 10,001 and 30,000 Baht per month (35.4 percent) and respondents with incomes between 30,001 and 50,000 Baht per month (11.3 percent) have an average amount of respondents using buses frequently, while respondents with incomes over 50,000 Baht per month (9.1 percent) have the least amount of respondents using buses frequently.

4.3.1.3 Motorcycle, Frequent Users

Table 4.12 reports the motorcycle users' commute characteristics and reports the significant variations by gender, education levels, and income per month.

Table 4.12 Motorcycle Users' Commute Characteristics by Gender, Education Levels, and Income per Month (Percentages)

Demographics	Bus Users					
	Occasional	Moderate	Frequent	Total		
Gender						
Male	71.4	5.2	23.4	100.0	(697)	χ^2=6.34, d.f.=2, p=.04
Female	76.5	5.0	18.5	100.0	(1018)	
Education						
Less Than a Bachelor's Degree	66.5	7.4	26.1	100.0	(490)	χ^2=23.51, d.f.=2, p=.00
Bachelor's Degree or Higher	77.6	4.2	18.2	100.0	(1225)	
Income per Month						
Less than 10,000 Baht	69.7	6.5	23.8	100.0	(475)	χ^2=38.25, d.f.=6, p=.00
10,001 to 30,000 Baht	72.0	5.6	22.4	100.0	(876)	
30,001 to 50,000 Baht	85.7	2.6	11.7	100.0	(265)	
Over 50,000 Baht	88.9	0.0	11.1	100.0	(99)	

Table 4.12 shows that there are significant differences in motorcycle users' commute characteristics based on gender, education levels, and income per month. There are significantly more male commuters (23.4 percent) that are frequent motorcycle users than the females (18.5 percent). Respondents with an education less than a bachelor's degree (26.1 percent) significantly have more respondents using motorcycles frequently

than respondents with education levels of a bachelor's degree or higher (18.2 percent). Respondents with incomes less than 10,000 Baht per month (23.8 percent) and between 10,001 and 30,000 Baht per month (22.4 percent) have more commuters using motorcycles frequently than respondents with incomes between 30,000 and 50,000 Baht per month (11.7 percent) and over 50,000 Baht per month (11.1 percent).

4.3.2 Commute Characteristics by Rail Mass Transit Usage Subgroups

This section investigates the motorized transportation users' commute characteristics in terms of RMT system usage in order to determine the frequent motorized transportation users' selection of RMT use. The information obtained from the evaluation will indicate the commuters' utilization of the RMT systems as an alternative method of transportation or in conjunction with their frequent use of motorized transportation. Table 4.13 reports the frequent motorized transportation users' commuter characteristic behaviors and investigates RMT use by motorized transportation users.

Table 4.13 Frequent Motorized Transportation Users' Commute Characteristics by Rail Mass Transit Use (Percentages)

Transportation Mode	Frequent Automobile Users	Frequent Bus Users	Frequent Taxi Users	Frequent Motorcycle Users
RMT Usage				
Occasional	78.6	62.0	46.7	63.5
Moderate	8.3	14.4	13.3	11.7
Frequent	13.1	23.6	40.0	24.8
Total	100.0 (649)	100.0 (618)	100.0 (105)	100.0 (351)

Table 4.13 illustrates that a significant number of frequent motorized transportation users utilize the RMT systems only occasionally. Over three-quarters of frequent automobile users (78.6 percent), over three-fifths of frequent bus users (62.0 percent), almost one-half of taxi users (46.7 percent), and over three-fifths of motorcycle users (63.5 percent) use the RMT systems occasionally. This group of

frequent motorized transportation users utilizes the RMT systems as an alternative mode of transport.

The groups using an automobile (13.1 percent), bus (23.6 percent), taxi (40.0 percent), or motorcycle (24.8 percent) use the RMT systems in conjunction with the motorized form of transportation for their daily commute.

4.4 Discussion

The findings from the study illustrate the fact that most of the Rail Mass Transit users utilize the system occasionally, while only some are frequent users. The primary purpose for using the RMT systems is for normal routine commute for business, errands, work, and study. Occasional RMT users and frequent automobile users' commute characteristics show variations in terms of marital status, age, education, occupation, and income levels. Bus users' commute characteristics have variations in terms of gender, marital status, age, education, occupation, and income levels, while motorcycle users' commute characteristics show differences in the gender, education, and income level subgroups. Analyses for occasional RMT users commute characteristics indicate that most of the groups use motorized transportation only occasionally, while a significant number of commuters use motorized transportation frequently. On the other hand, frequent motorized transportation users mostly utilize the RMT systems occasionally and a significant number of commuters frequently.

The data on commute characteristics suggest that there are few frequent RMT users (22.5 percent), and that the majority use the system only occasionally (65.3 percent). The commuter target for conversion to utilization of the RMT systems is the frequent automobile (40.8 percent), bus (36.0 percent), and motorcycle (20.5 percent) users. The low number of RMT riders and substantial frequent automobile users confirm Kenworthy's (1995) and Chamlong Poboon's (1997) studies, which state that Bangkok's RMT network is still inefficient and that vehicle ownership rates are high. Chamroon Tangpaisulkit (2007) states that Bangkok's RMT systems, which supports only 4 percent of the commuters as compared to the comparable system in New York (55 percent), Tokyo (66 percent), and Tokyo (72 percent), are still very limited in capacity and that major expansions should be implemented. The empirical results on commuter characteristics confirm Chamroon Tangpaisulkit's (2007) observations.

The challenging task is to convince the frequent automobile users to use the RMT system regularly. Automobile users have "love for the car" and the car is considered as social status that distinguishes the "haves" from the "have nots" (Jones, 1995; Chamlong Poboon, 1997). Enhancing the RMT systems by expansion of services and by providing a quality system, comfortable rides, attractive prices and promotions, safety and security provisions will attract motor vehicle users to the RMT systems. However the full support of the government is essential for pushing forward the measures.

The evaluation of the subgroup of samples by demographics illustrates the idea that marital status, age, education, occupation, and income are significant variables in the RMT usage data. Location subgroups were investigated but do not have significant effects on commuter selection of RMT usage, which corresponds to Kuby et al.'s (2003) findings.

Single respondents use the RMT systems more than married commuters. Single commuters have more mobility as compared to married commuters, who have to take their spouse's needs into consideration as well. Married commuters have more tendencies to own motor vehicles. The combined income with a spouse, the need to send and pick up children, and the choice of carpooling with the spouse provide a better justification for ownership of a motor vehicle. On the other hand, the single commuter can easily utilize the RMT systems more frequently to move around. Older commuters prefer automobile usage over RMT usage, as noted by the Skinner (2000) study, which elaborates on the idea that older citizens enjoy using automobiles for mobility. The empirical evidence shows that RMT usage decreases as age increases. Education, occupation, and income are in correlation. Students, who have lower education and income, use the RMT systems less than the working class, who has a higher education and income. Horowitz and Beimborn (1995) stated that bus systems are the true mode of transportation for the poor, which corresponds to the findings that over one-half and up to almost two-thirds of students, select the bus systems.

The empirical data from the study indicates a low number of frequent RMT users. A confluence of many problems undermines the selection of the RMT systems. The numerous agencies responsible for transportation development with fragmented policies, agendas, visions, and directions with no holistic plan (Chamlong Poboon, 1997; ADB, 2000) have created implementation problems with uncoordinated development in the projects (Unger, 1998). The time-consuming process of developing RMT systems has prolonged the insufficient RMT systems in the Bangkok area. Commuter mobility throughout Bangkok is unsatisfactory because the RMT systems in Bangkok are limited (Chamlong Poboon, 1997; O'Grady, 2001).

In order to attract frequent automobile users, the RMT systems must provide the convenience and comfort that can assumed by automobile transport. Convenience in travel destinations can only be accomplished with extensive RMT systems in the Bangkok area. As more RMT systems are completed and service is expanded throughout Bangkok, an increase in RMT ridership will be evident (Litman, 2004). This RMT development must come about as a package, with an appropriate feeder system and park and ride structures at the transit stations (Weyrich and Lind, 1999; O'Grady, 2001).

The occasional RMT users and frequent bus users represent the lower income commuters. Since the bus system is the means of transport for the poor, the RMT system must compete by providing affordable prices to attract this particular group of commuters (Litman, 2004). Customer services and intense marketing promotional programs can be targeted to the group to attract RMT usage (USEPA, 1998). The Thai government is aiming at purchasing back the two RMT concessionaires in order to create affordable prices for the systems and consequently to attract more RMT users from among the motor vehicle commuters. Government control of the RMT systems can facilitate intermodal connections between the systems.

The empirical data demonstrate that two-thirds of the commuters utilize other modes of motorized transportation in conjunction with the RMT systems; therefore, intermodal transfer between systems is crucial. Kuby et al.'s (2003) findings indicate the importance of the intermodal junction factor. With government control of the two RMT systems, intermodal common ticketing and connections between the systems can be improved.

CHAPTER 5

FINDINGS AND DISCUSSIONS ON THE DIMENSIONS INFLUENCING RAIL MASS TRANSIT RIDERSHIP

This chapter reports the findings from the survey data and also discusses the findings. The primary focus of this chapter is to investigate the factors influencing Rail Mass Transit ridership in the Bangkok Metropolitan area.

5.1 Dimensions Influencing Rail Mass Transit Ridership

The commuters attitudes towards the dimensions influencing Rail Mass Transit ridership was investigated for the various group of commuters including RMT, automobile, bus, taxi, and motorcycle users. A one way analysis of variance to study the association between RMT and motorized transportation user groups and the dimensions influencing RMT ridership were conducted separately. Post hoc bonferroni tests for multiple comparisons were performed subsequently to determine significant differences between the groups. The statistical tables are presented in Appendix C.

5.1.1 Rail Mass Transit Users

5.1.1.1 Commuter Attitudes Towards the Dimensions Influencing Rail Mass Transit Ridership

This section reports the various attitudes of Rail Mass Transit users. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Post hoc bonferroni tests for multiple comparisons were performed to determine the significant differences between the RMT user groups. The corresponding detailed statistics are presented in Appendix C.

1) Price/Promotions Dimension

The analysis of variance to study the association between the RMT user groups and the Price/Promotion dimension yields significant differences among RMT user groups ($F(2,1712) = 21.74$, $p<0.05$). A Post hoc bonferroni test indicated that frequent ($\bar{X} = 4.28$, *s.d.* = 0.69) and moderate ($\bar{X} = 4.25$, *s.d.* = 0.62) RMT users gave higher scores than occasional ($\bar{X} = 4.04$, *s.d.* = 0.71) RMT users on the Price/Promotion dimension ($p<0.05$). There were no significant differences between frequent and moderate RMT users on the Price/Promotion dimension ($p>0.05$).

2) Government/External Dimension

The analysis of variance to study the association between the RMT user groups and the Government/External dimension yields significant differences among RMT user groups ($F(2,1712) = 9.25$, $p<0.05$). A Post hoc bonferroni test indicated that moderate RMT users ($\bar{X} = 4.22$, *s.d.* = 0.59) gave the highest scores to the Government/External dimension, followed by frequent RMT users ($\bar{X} = 4.14$, *s.d.* = 0.63), and finally by occasional RMT users ($\bar{X} = 4.04$, *s.d.* = 0.65), ($p<0.05$).

3) Safety/Security Dimension

The analysis of variance to study the association between the RMT user groups and the Safety/Security dimension yields significant differences among RMT user groups ($F(2,1712) = 7.34$, $p<0.05$). A Post hoc bonferroni test indicated that moderate ($\bar{X} = 4.54$, *s.d.* = 0.56) and frequent ($\bar{X} = 4.49$, *s.d.* = 0.64) RMT users gave higher scores than occasional ($\bar{X} = 4.38$, *s.d.* = 0.69) RMT users on the Safety/Security dimension ($p<0.05$). There were no significant differences between moderate and frequent RMT users on the Safety/Security dimension ($p>0.05$).

4) Information Dimension

The analysis of variance to study the association between the RMT user groups and the Information dimension yields significant differences among RMT user groups ($F(2,1712) = 5.40$, $p<0.05$). A Post hoc bonferroni test indicated that moderate ($\bar{X} = 4.15$, *s.d.* = 0.62) and frequent ($\bar{X} = 4.03$, *s.d.* = 0.67) RMT users gave higher scores than occasional ($\bar{X}$ = 3.99, *s.d.* = 0.66) RMT users on the Information dimension (p<0.05). There were no significant differences between moderate and frequent RMT users on the Information dimension (p>0.05).

5) System Availability Dimension

The analysis of variance to study the association between the RMT user groups and the System Availability dimension yields significant differences among RMT user groups (F(2,1712) = 11.93, p<0.05). A Post hoc bonferroni test indicated that moderate ($\bar{X}$ = 4.38, *s.d.* = 0.57) and frequent ($\bar{X}$ = 4.31, *s.d.* = 0.59) RMT users gave higher scores than occasional ($\bar{X}$ = 4.18, *s.d.* = 0.68) RMT users on the System Availability dimension (p<0.05). There were no significant differences between moderate and frequent RMT users on the System Availability dimension (p>0.05).

6) Facilities and Commuter Convenience Dimension

The analysis of variance to study the association between the RMT user groups and the Facilities and Commuter Convenience dimension yields significant differences among RMT user groups (F(2,1712) = 6.15, p<0.05). A Post hoc bonferroni test indicated that moderate RMT users ($\bar{X}$ = 4.24, *s.d.* = 0.59) gave the highest scores to the Facilities and Commuter Convenience dimension, followed by frequent RMT users ($\bar{X}$ = 4.12, *s.d.* = 0.61), and finally by occasional RMT users($\bar{X}$ = 4.08, *s.d.* = 0.63), (p<0.05).

7) Service Quality Dimension

The analysis of variance to study the association between the RMT user groups and the Service Quality dimension yields significant differences among RMT user groups (F(2,1712) = 9.62, p<0.05). A Post hoc bonferroni test indicated that moderate ($\bar{X}$ = 4.22, *s.d.* = 0.64) and frequent ($\bar{X}$ = 4.12, *s.d.* = 0.61) RMT users gave higher scores than occasional ($\bar{X}$ = 4.03, *s.d.* = 0.66) RMT users on the Service Quality dimension (p<0.05). There were no significant differences between moderate and frequent RMT users on the Service Quality dimension (p>0.05).

5.1.1.2 Rankings of the Dimensions Influencing Rail Mass Transit Ridership by Rail Mass Transit Users

This section reports the Rail Mass Transit users' rankings of the dimensions influencing RMT ridership. The respondents are to rank the first and second dimensions that they think most influence RMT ridership. Table 5.1 presents the results.

Table 5.1 Rankings of Dimensions Influencing Rail Mass Transit Ridership

Percentage of Respondents Ranked the Dimension as First and Second Most Important	Price	Safety/ Security	Convenience/ Availability	Quality	Facilities	External	Government	Promotions	Information	Total	
Rail Mass Transit Users											
Occasional	56.7	52.4	24.0	19.8	19.1	14.8	7.3	3.9	2.0	200.0	(1119)
Moderate	57.6	60.9	15.7	21.0	10.5	15.2	8.6	8.1	2.4	200.0	(210)
Frequent	58.0	51.0	21.5	27.0	17.1	10.1	5.2	7.8	2.3	200.0	(386)

The data from Table 5.1 show that the "Price" concept was the dimension that the respondents identify as having the most influence on Rail Mass Transit ridership by Rail Mass Transit users ranking the dimension as first or second most important. The concept of "Safety/Security" was the second ranked concept significantly considered as important to RMT ridership. The top two concepts of "Price" and "Safety/Security" were the distinctive standout dimensions, gaining more than double the frequencies of each of the other dimensions. The two dimensions both gathered over half of the respondents' selection as the first and second most ranked factors influencing RMT ridership.

Apart from the top two dimensions ranked, the next group of dimensions was bundled closely. The next dimensions ranked in the next pier were the "Convenience/Availability," "Quality," "Facilities," and "External" dimensions. The last ranked were the "Government," "Promotions," and "Information" dimensions.

5.1.2 Motorized Transportation Users

5.1.2.1 Automobile Users' Attitudes Towards the Dimensions Influencing Rail Mass Transit Ridership

This section reports the various attitudes of automobile users. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Post hoc bonferroni tests for multiple comparisons were performed to determine the significant differences between the automobile user groups. The corresponding detailed statistics are presented in Appendix C.

1) Service Quality Dimension

The analysis of variance to study the association between the automobile user groups and the Service Quality dimension yields significant differences among automobile user groups ($F(2,1712) = 4.39$, $p<0.05$). A Post hoc bonferroni test indicated that moderate ($\bar{X} = 4.17$, $s.d. = 0.61$) automobile users gave higher scores than frequent ($\bar{X} = 4.02$, $s.d. = 0.67$) automobile users on the Service Quality dimension ($p<0.05$). There were no significant differences between moderate nor frequent and occasional automobile users on the Service Quality dimension ($p>0.05$).

5.1.2.2 Taxi Users' Attitudes Towards the Dimensions Influencing Rail Mass Transit Ridership

This section reports the various attitudes of taxi users. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Post hoc bonferroni tests for multiple comparisons were performed to determine the significant differences between the taxi user groups. The corresponding detailed statistics are presented in Appendix C.

1) Facilities and Commuter Convenience Dimension

The analysis of variance to study the association between the taxi user groups and the Facilities and Commuter Convenience dimension yields significant differences among taxi user groups ($F(2,1712) = 3.91$, $p<0.05$). Post hoc bonferroni test indicated that moderate ($\bar{X} = 4.24$, $s.d. = 0.56$) taxi users gave higher scores than frequent ($\bar{X} = 3.99$, $s.d. = 0.71$) taxi users on the Facilities and Commuter Convenience dimension ($p<0.05$). There were no significant differences between moderate nor frequent and occasional automobile users on the Service Quality dimension ($p>0.05$).

5.1.2.3 Rankings of the Dimensions Influencing Rail Mass Transit Ridership by Motorized Transportation Users

This section reports the motorized transportation users' rankings of the dimensions influencing RMT ridership. The respondents were to rank the first and second dimensions that they thought were the most influential on RMT ridership. Table 5.2 presents the results.

Table 5.2 Rankings of Dimensions Influencing Rail Mass Transit Ridership

Percentage of Respondents Ranked the Dimension as First and Second Most Important	Price	Safety/ Security	Convenience/ Availability	Quality	Facilities	External	Government	Promotions	Information	Total	
Automobile Users											
Occasional	62.2	52.3	21.1	23.1	17.1	9.8	5.1	6.8	2.5	200.0	(918)
Moderate	52.7	66.2	20.9	16.9	16.2	14.9	6.1	2.0	4.1	200.0	(148)
Frequent	50.8	51.3	24.7	20.5	18.6	19.3	9.9	3.8	1.1	200.0	(649)
Bus Users											
Occasional	50.6	52.3	22.1	24.7	17.2	16.0	8.2	6.5	2.4	200.0	(959)
Moderate	62.3	55.1	25.4	14.5	15.2	15.2	5.8	2.9	3.6	200.0	(138)
Frequent	66.0	53.9	22.3	18.3	18.8	10.2	5.3	3.9	1.3	200.0	(618)
Taxi Users											
Occasional	58.2	53.2	22.0	21.8	16.9	13.7	7.1	4.9	2.2	200.0	(1522)
Moderate	50.0	53.4	20.5	19.3	26.1	13.6	9.1	5.7	2.3	200.0	(88)
Frequent	46.7	52.4	30.5	20.0	21.0	15.2	3.8	9.5	0.9	200.0	(105)
Motorcycle Users											
Occasional	56.0	54.3	22.1	22.0	17.4	13.8	7.0	5.2	2.2	200.0	(1277)
Moderate	63.2	55.2	21.8	13.8	17.2	11.5	5.8	9.2	2.3	200.0	(87)
Frequent	59.6	48.4	23.9	21.9	18.2	14.3	7.4	4.6	1.7	200.0	(351)

The various motorized transportation users produced similar rankings for the dimensions influencing RMT ridership, where the top two dimensions ranked were the "Price" and "Safety/Security" factors. The next dimensions ranked were the "Convenience/Availability," "Quality," "Facilities," and "External" dimensions.

Lastly, the lower ranked factors were the "Government," "Promotions," and "Information" dimensions.

5.2 Dimensions Influencing Rail Mass Transit Ridership by Demographic Subgroups

The research study focuses on the attitudes of the commuters as classified by the different demographics in this section. The samples were investigated for significant differences in the various groups to seek the differences in attitudes over the seven component dimensions influencing Rail Mass Transit ridership. A one way analysis of variance to study the association between demographic subgroups and the dimensions influencing RMT ridership were conducted separately. Post hoc bonferroni tests for multiple comparisons were performed subsequently to determine significant differences between the groups. The statistical tables are presented in Appendix D.

5.2.1 Gender

This section reports the various attitudes of the respondents with respect to gender subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Comparison of the means indicated significant differences between the gender subgroups. The corresponding detailed statistics are presented in Appendix D.

5.2.1.1 Price/Promotions Dimension

The analysis of variance to study the association between the gender subgroups and the Price/Promotions dimension yields significant differences among gender subgroups ($F(1,1713) = 19.13, p<0.05$). The results indicate that females ($\bar{X}=$ 4.18, $s.d.$ = 0.68) gave higher scores than males ($\bar{X}$ = 4.03, $s.d.$ = 0.72) on the Price/Promotion dimension.

5.2.1.2 Government/External Dimension

The analysis of variance to study the association between the gender subgroups and the Government/External dimension yields significant differences among gender subgroups ($F(1,1713) = 4.09, p<0.05$). The results indicate that females

($\bar{X}$= 4.11, *s.d.* = 0.62) gave higher scores than males ($\bar{X}$= 4.04, *s.d.* = 0.64) on the Government/External dimension.

5.2.1.3 Safety/Security Dimension

The analysis of variance to study the association between the gender subgroups and the Safety/Security dimension yields significant differences among gender subgroups ($F(1,1713) = 14.11, p<0.05$). The results indicate that females ($\bar{X}$= 4.48, *s.d.* = 0.64) gave higher scores than males ($\bar{X}$ = 4.35, *s.d.* = 0.69) on the Safety/Security dimension.

5.2.1.4 Information Dimension

The analysis of variance to study the association between the gender subgroups and the Information dimension yields significant differences among gender subgroups ($F(1,1713) = 26.20, p<0.05$). The results indicate that females ($\bar{X}$= 4.08, *s.d.* = 0.64) gave higher scores than males ($\bar{X}$= 3.92, *s.d.* = 0.68) on the Information dimension.

5.2.1.5 System Availability Dimension

The analysis of variance to study the association between the gender subgroups and the System Availability dimension yields significant differences among gender subgroups ($F(1,1713) = 13.66, p<0.05$). The results indicate that females ($\bar{X}$= 4.28, *s.d.* = 0.64) gave higher scores than males ($\bar{X}$= 4.16, *s.d.* = 0.66) on the System Availability dimension.

5.2.1.6 Facilities and Commuter Convenience Dimension

The analysis of variance to study the association between the gender subgroups and the Facilities and Commuter Convenience dimension yields significant differences among gender subgroups ($F(1,1713) = 8.81, p<0.05$). The results indicate that females ($\bar{X}$= 4.15, *s.d.* = 0.60) gave higher scores than males ($\bar{X}$= 4.05, *s.d.* = 0.65) on the Facilities and Commuter Convenience dimension.

5.2.1.7 Service Quality Dimension

The analysis of variance to study the association between the gender subgroups and the Service Quality dimension yields significant differences among gender subgroups ($F(1,1713) = 17.77, p<0.05$). The results indicate that females ($\bar{X}$=

4.13, *s.d.* = 0.63) gave higher scores than males ($\bar{X}$= 3.99, *s.d.* = 0.68) on the Service Quality dimension.

5.2.2 Marital Status

This section reports the various attitudes of the respondents with respect to marital subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. The results show no significant difference based on marital status.

5.2.3 Age

This section reports the various attitudes of the respondents with respect to age subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. The results show no significant difference based on age.

5.2.4 Education

This section reports the various attitudes of the respondents with respect to education subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Comparison of the means indicated significant differences between the education subgroups. The corresponding detailed statistics are presented in Appendix D.

5.2.4.1 Price/Promotions Dimension

The analysis of variance to study the association between the education level subgroups and the Price/Promotions dimension yields significant differences among education level subgroups ($F(1,1713) = 3.84, p<0.05$). The results indicate that the subgroup with education levels of a bachelor's degree or higher ($\bar{X}$= 4.14, *s.d.* = 0.71) gave higher scores than the subgroup with educations less than a bachelor's degree ($\bar{X}$= 4.07, *s.d.* = 0.69) on the Price/Promotion dimension.

5.2.4.2 Safety/Security Dimension

The analysis of variance to study the association between the education level subgroups and the Safety/Security dimension yields significant differences among education level subgroups ($F(1,1713) = 18.94, p<0.05$). The results indicate that the subgroup with education levels of a bachelor's degree or higher ($\bar{X}$ = 4.47, *s.d.* = 0.65) gave higher scores than the subgroup with educations less than a bachelor's degree ($\bar{X}$ = 4.31, *s.d.* = 0.69) on the Safety/Security dimension.

5.2.4.3 System Availability Dimension

The analysis of variance to study the association between the education level subgroups and the System Availability dimension yields significant differences among education level subgroups ($F(1,1713) = 16.79$, $p<0.05$). The results indicate that the subgroup with education levels of a bachelor's degree or higher ($\bar{X}$ = 4.27, *s.d.* = 0.65) gave higher scores than the subgroup with educations less than a bachelor's degree ($\bar{X}$ = 4.13, *s.d.* = 0.66) on the System Availability dimension.

5.2.5 Occupation

This section reports the various attitudes of the respondents with respect to occupation subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Post hoc bonferroni tests for multiple comparisons were performed to determine the significant differences between the occupation subgroups. The corresponding detailed statistics are presented in Appendix D.

5.2.5.1 Safety/Security Dimension

The analysis of variance to study the association between the occupation subgroups and the Safety/Security dimension yields significant differences among occupation subgroups ($F(7,1707) = 2.67$, $p<0.05$). A Post hoc bonferroni test indicated that government officials ($\bar{X}$ = 4.50, *s.d.* = 0.64) and private company employees ($\bar{X}$ = 4.45, *s.d.* = 0.67) subgroups gave higher scores than students ($\bar{X}$ = 4.31, *s.d.* = 0.69) subgroup on the Safety/Security dimension ($p<0.05$). There were no significant differences among other occupation subgroups on the Safety/ Security dimension ($p>0.05$).

5.2.5.2 System Availability Dimension

The analysis of variance to study the association between the occupation subgroups and the System Availability dimension yields significant differences among occupation subgroups ($F(7,1707) = 2.50$, $p<0.05$). A Post hoc bonferroni test indicated that private company employees ($\bar{X}$ = 4.29, *s.d.* = 0.68) subgroups gave higher scores than students ($\bar{X}$ = 4.13, *s.d.* = 0.63) subgroup on the System Availability dimension (p<0.05). There were no significant differences among other occupation subgroups on the System Availability dimension (p>0.05).

5.2.6 Income per Month

This section reports the various attitudes of the respondents with respect to income level subgroups. A one way analysis of variance was conducted separately for each dependent variable, which are the dimensions influencing RMT ridership. Post hoc bonferroni tests for multiple comparisons were performed to determine significant differences between the income level subgroups. The corresponding detailed statistics are presented in Appendix D.

5.2.6.1 Price/Promotions Dimension

The analysis of variance to study the association between the income level subgroups and the Price/Promotions dimension yields significant differences among income level subgroups ($F(7,1707) = 2.63, p<0.05$). A Post hoc bonferroni test indicated that the subgroup with incomes between 10,001 to 30,000 Baht per month ($\bar{X}$ = 4.15, *s.d.* = 0.71) gave higher scores than the subgroup with incomes over 50,000 Baht per month ($\bar{X}$ = 3.95, *s.d.* = 0.61) on the Price/Promotions dimension (p<0.05). There were no significant differences among other income level subgroups on the Price/Promotions dimension (p>0.05).

5.2.6.2 Safety/Security Dimension

The analysis of variance to study the association between the income level subgroups and the Safety/Security dimension yields significant differences among income level subgroups ($F(7,1707) = 4.30, p<0.05$). A Post hoc bonferroni test indicated that the subgroup with incomes between 30,001 to 50,000 Baht per month ($\bar{X}$ = 4.51, *s.d.* = 0.62) gave higher scores than the subgroup with incomes less than 10,000 Baht per month ($\bar{X}$ = 4.35, *s.d.* = 0.67) on the Safety/Security dimension (p<0.05). There were no significant differences among other income level subgroups on the Safety/Security dimension (p>0.05).

5.2.6.3 System Availability Dimension

The analysis of variance to study the association between the income level subgroups and the System Availability dimension yields significant differences among income level subgroups ($F(7,1707) = 3.51, p<0.05$). A Post hoc bonferroni test indicated that the subgroup with incomes between 30,001 to 50,000 Baht per month ($\bar{X} = 4.31$, $s.d. = 0.62$) gave higher scores than the subgroup with incomes less than 10,000 Baht per month ($\bar{X} = 4.16$, $s.d. = 0.64$) on the System Availability dimension ($p<0.05$). There were no significant differences among other income level subgroups on the System Availability dimension ($p>0.05$).

5.3 Rankings of Dimensions Influencing Rail Mass Transit Ridership by Demographic Subgroups

This section reports the rankings of the dimensions influencing Rail Mass Transit ridership by demographic subgroups. The respondents were to rank the first and second dimensions that they thought were the most influential on RMT ridership. Table 5.3 presents the results.

Table 5.3 Rankings of Dimensions Influencing Rail Mass Transit Ridership by Demographic Subgroups

Percentage of Respondents Ranked the Dimension as First and Second Most Important	Price	Safety/ Security	Convenience/	Availability	Quality	Facilities	External	Government	Promotions	Information	Total	
Gender												
Male	57.5	50.2	19.7	20.5	19.7	15.2	9.3	5.7	2.2		200.0	(697)
Female	56.8	55.1	24.4	22.3	16.2	12.9	5.4	4.9	2.0		200.0	(1018)
Marital Status												
Single	57.1	53.1	22.8	22.1	19.7	12.9	4.3	5.9	2.1		200.0	(1082)
Married	57.0	53.5	21.8	20.9	14.2	15.6	11.2	4.0	1.8		200.0	(570)
Divorced/ Widowed	57.1	50.8	22.2	19.0	12.7	12.7	15.9	4.8	4.8		200.0	(63)
Age												
Under 21 years	59.9	54.4	17.5	19.4	20.6	10.3	3.2	9.9	4.8		200.0	(252)

Table 5.3 (Continued)

Percentage of Respondents Ranked the Dimension as First and Second Most Important	Price	Safety/ Security	Convenience/ Availability	Quality	Facilities	External	Government	Promotions	Information	Total	
21 to 40 years	57.7	52.5	24.2	21.7	18.5	13.9	4.9	4.5	2.1	200.0	(1047)
41 to 60 years	55.2	52.8	21.9	21.6	13.7	16.1	14.0	4.2	0.5	200.0	(379)
Over 60 years	40.6	64.9	13.5	32.4	10.8	10.8	21.6	5.4	0.0	200.0	(37)
Education											
Less than Bachelor's Degree	54.1	50.8	24.9	19.2	15.9	14.5	7.9	9.0	3.7	200.0	(490)
Bachelor's Degree or Higher	58.3	54.0	21.5	22.5	18.3	13.5	6.6	3.8	1.5	200.0	(1225)
Occupation											
Student	59.7	54.1	17.9	17.1	20.0	12.7	3.5	10.9	4.1	200.0	(340)
Government Official	56.6	53.3	25.0	22.2	15.4	13.9	10.3	2.0	1.3	200.0	(396)
Private Company Employee	61.1	50.9	23.1	22.4	19.2	13.4	4.7	4.2	1.0	200.0	(666)
Self-Employed	41.3	59.5	23.1	28.1	11.6	16.5	11.6	5.8	2.5	200.0	(121)
Freelance	50.5	46.8	26.6	18.3	19.3	19.3	7.3	6.4	5.5	200.0	(109)
Housewife/Stay at Home	49.0	65.3	20.4	20.4	12.3	12.2	14.3	4.1	2.0	200.0	(49)
Retired	48.4	61.3	9.7	35.5	12.9	6.4	22.6	3.2	0.0	200.0	(31)
Others	33.4	100.0	33.3	0.0	0.0	33.3	0.0	0.0	0.0	200.0	(3)
Income per Month											
Less than 10,000 Baht	57.5	58.7	21.3	17.9	17.0	12.6	4.4	7.4	3.2	200.0	(475)
10,001 to 30,000 Baht	59.8	51.2	22.8	20.9	18.2	13.6	6.7	5.0	1.8	200.0	(876)
30,001 to 50,000 Baht	54.3	48.7	20.8	26.4	18.5	13.9	11.7	3.8	1.9	200.0	(265)
Over 50,000 Baht	38.4	55.6	29.3	32.3	13.1	21.2	9.1	1.0	0.0	200.0	(99)

The various demographic subgroups produced similar rankings of the dimensions influencing RMT ridership, where the top two dimensions ranked were the "Price" and "Safety/Security" factors. The next dimensions ranked were the Convenience/Availability," "Quality," "Facilities," and "External" dimensions. Lastly, the lower ranked factors were the "Government," "Promotions," and "Information" dimensions.

5.4 Segmentation of Commuters by Attitudes

A hierarchical cluster analysis was performed to distinguish the different group of respondents in the research data based on the respondents' attitudes toward the dimensions influencing Rail Mass Transit ridership.

5.4.1 Number of Clusters

Agglomerative hierarchical clustering using Ward's variance method and squared Euclidean difference as measurement indicates two primary groups of respondents and seven subgroups within the groups. The dimensions influencing RMT ridership were the variables utilized to segregate the samples into similar cluster groups. The data are grouped into clusters using Ward's variance method measured by quantifying the distance with the squared Euclidean distance technique, which is one of the most commonly used techniques. A hierarchical cluster using Ward's method produces an agglomerative schedule, where the data are reduced stepwise joining one case with a cluster at each step. The empirical data collected for this study have 1,715 cases; therefore, 1,714 steps were performed by hierarchical cluster analysis.

The determination on the number of cluster groups is quite judgmental but various procedures can be utilized for the decision. Dendograms and icicle plots are popular graphical methods for determination of the number of clusters; however, the huge data cases in this study would create difficulties when using the dendograms or icicle plots. A numerical analysis of the agglomerative schedule, then, using graphical interpretation of the agglomerative schedule, was the most appropriate method for this study.

The agglomerative schedule shows the stages and the corresponding cases that were combined at that particular stage. The information also shows the coefficient, which is the square Euclidean distance between the two cases. The cutoff point is when the coefficient magnitude jumps from the previous value. A graphical plot of the coefficient magnitude and the stage number, which can also be interpreted as the number of clusters remaining, can determine the cutoff point. Figure 5.1 shows the agglomerative schedule that indicates the number of cluster groups.

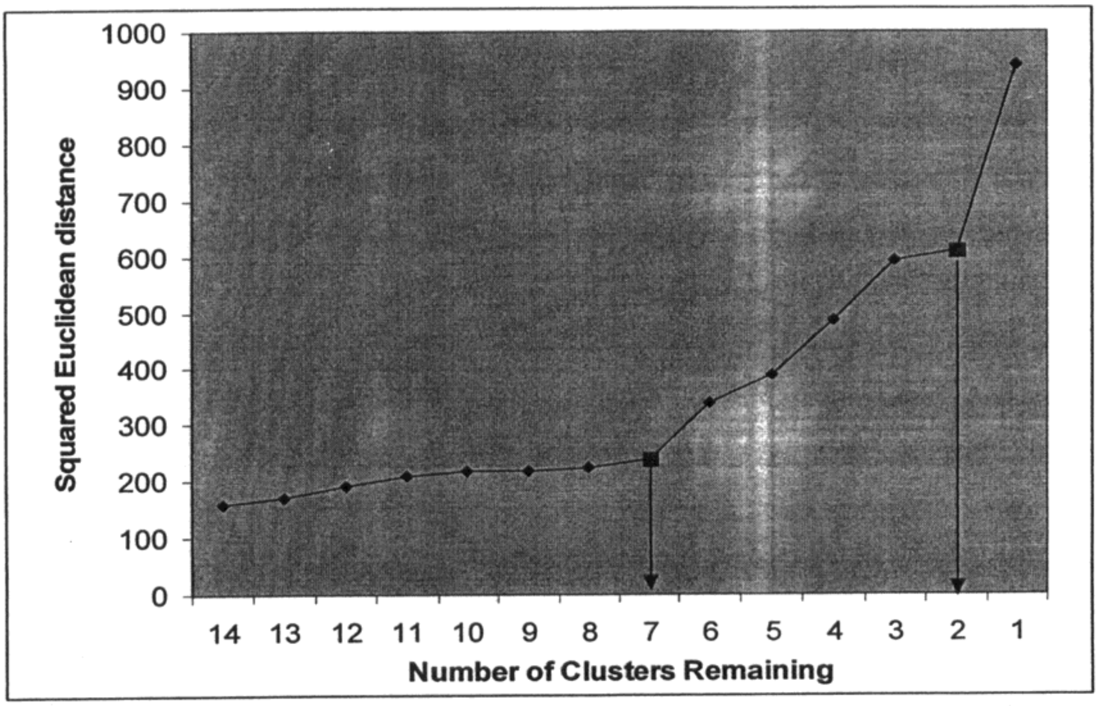


Figure 5.1 Agglomerative Schedule for the Classification of Statistical Wards

Figure 5.1 shows the cutoff points with 2 remaining clusters (stage 1,713) and 7 remaining clusters (stage 1,708). The graph indicates that there are 2 primary groups of respondents with similar attitudes on the dimensions influencing RMT ridership, and 7 subgroups of respondents with similar attitudes on the dimensions influencing RMT ridership.

5.4.2 K- Means Refinement

The K- means nonhierarchical cluster analysis using the optimizing partitioning method is an iterative algorithm based on an error sum of squares, where the cases are rearranged into the most appropriate cluster. The hierarchical cluster procedure using Ward's method does not reallocate the cases after the initial allocation of the cases to the cluster group; therefore, some cases may not be in the most appropriate cluster at the completion of the analysis. The K- means cluster analysis is optimal for huge amounts of data; however, the limitation of the procedure is that there must be a pre-determined number of clusters. For this particular reason, hierarchical clustering was performed initially and K- means nonhierarchical clustering was used for refinement of the groups.

5.4.3 Profiling the Clusters

The different cluster group of respondents can be profiled by the respective demographics. The demographic details will demonstrate the characteristics of each cluster group and will help to identify attitudes towards RMT ridership with respect to the different types of commuters on the system.

5.4.3.1 Primary Cluster Groups

A K- means nonhierarchical cluster analysis was performed to obtain two primary cluster groups with relatively homogeneous attitudes on the dimensions influencing RMT ridership. The two primary cluster groups were evaluated for the significant differences between the groups. Chi-square tests were run separately for the cluster groups and demographics in order to determine the significant associations between the variables. Table 5.4 shows the demographic breakdown of each group and the significant differences between the variables.

Table 5.4 Demographic Characteristics of the Primary Cluster Groups (Percentages)

	Cluster 1		Cluster 2		
Gender					
Male	46.1		38.1		
Female	53.9		61.9		χ^2=9.67, d.f.=1,p=.00
Total	100.0	(538)	100.0	(1177)	
Marital Status					
Single	62.4		63.4		
Married	33.5		33.1		n.s.
Divorced/Widowed	4.1		3.5		
Total	100.0	(538)	100.0	(1177)	
Age					
Under 21 years	17.5		13.4		
21 to 40 years	59.1		61.9		
41 to 60 years	20.8		22.7		n.s.
Over 60 years	2.6		2.0		
Total	100.0	(538)	100.0	(1177)	

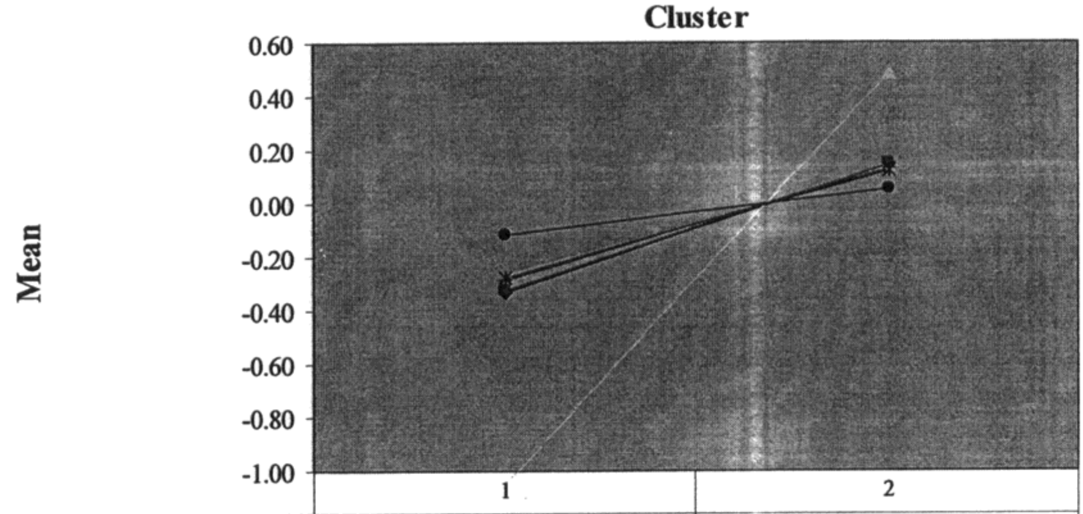
Table 5.4 (Continued)

	Cluster 1		Cluster 2		
Highest Education					
Less than Bachelor's Degree	34.2		26.0		χ^2=12.17, d.f.=1, p=.00
Bachelor's Degree or Higher	65.8		74.0		
Total	100.0	(538)	100.0	(1177)	
Occupation					
Student	24.0		17.9		
Government Official	18.8		25.1		
Private Company Employee	37.6		39.4		
Self-Employed	6.3		7.4		χ^2=17.58, d.f.=7, p=.01
Freelance	7.8		5.7		
Housewife/Stay at Home	3.3		2.6		
Retired	2.0		1.7		
Others	0.2		0.2		
Total	100.0	(538)	100.0	(1177)	
Income per month					
Less than 10,000 Baht	32.0		25.7		
10,001 to 30,000 Baht	50.0		51.6		χ^2=10.49, d.f.=3, p=.02
30,001 to 50,000 Baht	12.3		16.9		
Over 50,000 Baht	5.7		5.8		
Total	100.0	(538)	100.0	(1177)	

Note: n.s. denotes no significance

Table 5.4 shows the demographic data of the 2 cluster groups, where cluster group 1 consists of 538 respondents and cluster group 2 comprises 1,177 respondents. Cluster group 1 can be characterized as having more females and students with lower education and income levels, while cluster group 2 can be characterized as having more males and government officials with higher education and income levels.

The attitudes on the dimensions influencing RMT ridership are clearly identified graphically. Figure 5.2 shows the distinctive attitudes of the two cluster groups.



	1	2
Price/ Promotions	-0.33	0.15
Government/ External	-0.32	0.15
Safety/ Security	-1.05	0.48
Information	-0.25	0.12
System Availability	-0.27	0.13
Facilities and Commuter Convenience	-0.12	0.05
Service Quality	-0.29	0.13

Figure 5.2 Commuter Attitudes on Dimensions Influencing Rail Mass Transit Ridership by Primary Cluster Groups

The two groups have significant difference in attitudes on the dimensions influencing RMT ridership. Cluster group 1 is more likely to have negative attitudes (below average) on all the dimensions influencing RMT ridership when compared to the attitudes of cluster group 2. Based on the attitudes, the study will call cluster group 1 the "Skeptical" group and cluster group 2 the "Optimistic" group.

5.4.3.2 Cluster Groups Subgroups

The results from the hierarchical cluster analysis using Ward's method indicated that the "Skeptical" group can be further segmented into 2 subgroups, while the "Optimistic" group can be divided into 5 subgroups. This section will investigate the various subgroups on the attitudes towards the dimensions influencing RMT ridership.

1) Cluster Group1, the Skeptical Subgroups

A K- means nonhierarchical cluster analysis was performed on the Skeptical group of respondents in order to identify the two subgroups with similar attitudes on the dimensions influencing RMT ridership. The two Skeptical subgroups are evaluated for the significant differences between the subgroups. Chi-square tests were run separately for the Skeptical subgroups and demographics in order to determine the significant associations between the variables. The results yield that there were no significant variations based on the demographics of the Skeptical subgroups.

2) Cluster Group 2, the Optimistic Subgroups

A K- means nonhierarchical cluster analysis was performed on the Optimistic group of respondents in order to identify the five subgroups with similar attitudes toward the dimensions influencing RMT ridership. The five Optimistic subgroups were evaluated for the significant differences between the subgroups. Chi-square tests were run separately for the Optimistic subgroups and demographics to determine the significant associations between the variables. Table 5.5 shows the demographic breakdown of each Optimistic subgroup and the significant differences between the variables.

Table 5.5 Demographic Characteristics of the Cluster 2, Optimistic Subgroups (Percentages)

	Cluster 2, Optimistic Group (n=1177)					
	Sub Group 1	Sub Group 2	Sub Group 3	Sub Group 4	Sub Group 5	
Gender						
Male	35.1	38.7	41.4	43.2	35.6	
Female	64.9	61.3	58.6	56.8	61.9	n.s.
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	
Marital Status						
Single	63.5	64.3	55.7	67.8	65.8	
Married	33.0	32.7	39.4	29.5	31.1	n.s.
Divorced/Widowed	3.5	3.0	4.9	2.7	3.1	
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	

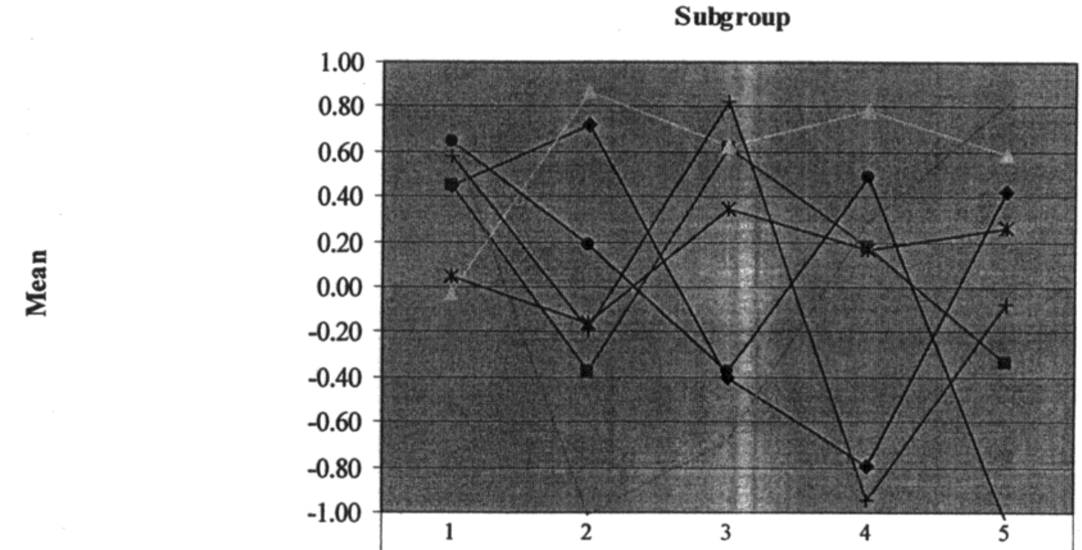
Table 5.5 (Continued)

	Cluster 2, Optimistic Group					
	Sub Group 1	Sub Group 2	Sub Group 3	Sub Group 4	Sub Group 5	
Age						
Under 21 years	18.7	9.6	9.9	11.5	13.1	
21 to 40 years	61.6	62.3	52.7	67.8	65.8	χ^2=53.67, d.f.=12, p=.00
41 to 60 years	18.6	27.1	31.0	20.2	19.8	
Over 60 years	1.1	1.0	6.4	0.5	1.3	
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	
Highest Education						
Less than Bachelor's Degree	35.9	15.6	23.6	23.0	23.4	χ^2=32.50, d.f.=4, p=.00
Bachelor's Degree or Higher	64.1	84.4	76.4	77.0	76.6	
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	
Occupation						
Student	24.6	13.6	13.3	16.4	16.2	
Government Official	23.2	29.6	29.6	27.3	18.0	
Private Company Employee	30.3	49.8	39.4	36.0	48.2	
Self-Employed	8.9	2.0	5.4	11.5	8.1	χ^2=100.48, d.f.=28, p=.00
Freelance	9.2	2.0	4.4	4.4	5.4	
Housewife/Stay at Home	3.2	1.5	2.0	3.3	2.7	
Retired	0.3	1.5	5.9	1.1	0.9	
Others	0.3	0.0	0.0	0.0	0.5	
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	
Income per month						
Less than 10,000 Baht	36.2	18.6	19.2	21.9	23.9	
10,001 to 30,000 Baht	49.7	55.8	51.2	52.5	50.5	χ^2=57.63, d.f.=12, p=.00
30,001 to 50,000 Baht	10.8	22.1	20.2	15.3	20.7	
Over 50,000 Baht	3.2	3.5	9.4	10.4	5.0	
Total	100.0 (370)	100.0 (199)	100.0 (203)	100.0 (183)	100.0 (222)	

Note: n.s. denotes no significance

The Optimistic subgroups are identified in Table 5.5. Subgroup 1 comprises 370 respondents and features more young students with lower education levels. Subgroup 2 comprises 199 respondents and features more highly educated private company employee and government officials. Subgroup 3 consists of 203 respondents and features older retired high income government officials. Subgroup 4 consists of 183 respondents and features high income middle aged commuters. Subgroup 5 comprises 222 respondents and features high income private employees.

The Optimistic subgroups' attitudes on the dimensions influencing RMT ridership are clearly identified graphically. Figure 5.3 shows the distinctive attitudes of the five Optimistic subgroups.



	1	2	3	4	5
Price/ Promotions	0.45	0.72	-0.40	-0.80	0.42
Government/ External	0.44	-0.38	0.62	0.18	-0.33
Safety/ Security	-0.03	0.87	0.63	0.79	0.59
Information	0.66	-1.01	-0.68	0.29	0.81
System Availability	0.05	-0.15	0.35	0.17	0.26
Facilities and Commuter Convenience	0.64	0.18	-0.37	0.49	-1.03
Service Quality	0.58	-0.19	0.82	-0.94	-0.08

Figure 5.3 Commuter Attitudes on Dimensions Influencing Rail Mass Transit Ridership by Cluster 2 Subgroups

The five subgroups of the Optimistic group show significant difference in attitudes on the dimensions influencing RMT ridership. Subgroup 1 shows strong positive attitudes on the Information, Facilities and Commuter

Convenience, Service Quality, Price/Promotions, and Government/External dimensions. Subgroup 2 shows strong positive attitudes on the Safety/Security and Price/Promotions dimensions. Subgroup 3 shows strong positive attitudes on the Service Quality, Safety/Security, Government/External, and System Availability dimensions. Subgroup 4 shows strong positive attitudes on the Safety/Security, Facilities and Commuter Convenience, and Information dimensions. Subgroup 5 shows strong positive attitudes on the Information, Safety/Security, Price/Promotions, and System Availability dimensions. Table 5.6 summarizes the Optimistic subgroups profile and corresponding attitudes on the dimensions influencing RMT ridership.

Table 5.6 Cluster 2, Optimistic Subgroups Profile and Attitudes on Dimensions Influencing Rail Mass Transit Ridership

Sub group	Feature Demographics	Strong Optimistic Attitudes	Optimistic Attitude	Less Optimistic Attitude
1	Young students with lower education levels	Information Facilities and Commuter Convenience Service Quality Price/Promotions Government/External	System Availability Safety/Security	
2	Highly educated private company employee and government officials	Safety/Security Price/Promotions	Facilities and Commuter Convenience System Availability Service Quality	Government/External Information
3	Older retired high income government officials	Service Quality Safety/Security Government/External System Availability		Facilities and Commuter Convenience Price/Promotions Information
4	High income middle aged commuters	Safety/Security Facilities and Commuter Convenience Information	Government/External System Availability	Price/Promotions Service Quality
5	High income private company employees	Information Safety/Security Price/Promotions System Availability	Service Quality	Government/External Facilities and Commuter Convenience

5.5 Discussion

The findings from the study indicate interesting empirical evidence that can be utilized by Rail Mass Transit policymakers and system operators in order to increase RMT usage. Frequent and moderate RMT users significantly give higher scores than the occasional RMT users on all dimensions influencing RMT ridership, which include the Price/Promotions, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality dimensions. Moderate RMT users also significantly scored higher than frequent RMT users on the Government/External and Facilities and Commuter Convenience dimensions.

Moderate automobile users significantly scored higher than frequent automobile users on the Service Quality dimension. No significant variations were found from the automobile user groups or the other dimensions influencing RMT ridership. Moderate taxi users significantly scored higher than frequent taxi users on the Facilities and Commuter Convenience dimension. No significant variations were found from the taxi user groups or the other dimensions influencing RMT ridership.

Investigation of the demographic subgroups' effect on the dimensions influencing RMT ridership produced useful empirical data. Females significantly scored higher than male respondents on all dimensions influencing RMT ridership, which include the Price/Promotions, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality dimensions. Respondents with education levels of a bachelor's degree or higher significantly scored higher than respondents with less than a bachelor's degree on the Price/Promotions, Safety/Security, and System Availability dimensions. Government officials and private company employees significantly score higher than students on the Safety/Security and System Availability dimensions. Respondents with incomes between 10,001 and 30,000 Baht per month significantly scored higher than respondents with incomes over 50,000 Baht per month on the Price/Promotion dimension. However, respondents with incomes between 30,001 and 50,000 Baht per month significantly scored higher than the respondents with incomes less than 10,000 Baht per month on the Safety/Security and System Availability dimensions. Investigations of the location areas' effect on the dimensions influencing RMT ridership yield no significant variations.

Respondents' rankings of the dimensions influencing RMT ridership reveal that the most ranked dimensions were the Price and Safety/Security concept. The Convenience/Availability and Quality dimensions were also significantly ranked among the top dimensions. Investigations by subgroups, which include the RMT user groups, motorized transportation user groups, demographics, and location areas yield no significant change in the rankings, where the top dimensions were the Price, Safety/Security, Convenience/Availability, and Quality dimensions.

Segmentation of commuters according to attitudes toward the dimensions influencing RMT ridership yields two primary cluster groups of respondents. The first cluster group, which had negative attitudes with scores less than the average, was labeled as the Skeptical group of respondents. The second cluster, which had positive scores as compared to the average, was labeled the Optimistic group of respondents. There were significant variations between the two groups based on gender, education levels, occupation, and income levels.

The Optimistic group of respondents was further segmented into five subgroups of respondents. The subgroups had significant variations between the subgroups based on age, education, occupation, and income levels. Subgroup 1, identified as young students with lower education levels, had strong optimistic attitudes on the Information, Facilities and Commuter Convenience, Service Quality, Price/Promotions, and Government/External dimensions. Subgroup 2, identified as highly educated private company employee and government officials, had strong optimistic attitudes on the Safety/Security and Price/Promotions dimensions. Subgroup 3, identified as older retired high income government officials, had strong optimistic attitudes on the Service Quality, Safety/Security, Government/External, and System Availability dimensions. Subgroup 4, identified as the high income middle aged commuters, had strong optimistic attitudes on the Safety/Security, Facilities and Commuter Convenience, and Information dimensions. Lastly, Subgroup 5, identified as high income private company employees, had strong optimistic attitudes on the Information, Safety/Security, Price/Promotions, and System Availability dimensions.

The empirical evidence shows that the moderate and frequent RMT users have higher scores on the dimensions influencing RMT ridership than the occasional RMT users. RMT policymakers and system operators need to provide measures to encourage the occasional user to increase usage of the RMT systems. Improvements in the numerous policies and measures discussed in the literature review section can help to increase RMT usage; however, RMT policymakers and system operators must adopt measures suitable for the RMT systems in Bangkok. The empirical evidence indicates that the commuters ranked the Price/Promotions, Safety/Security, Convenience/Availability, and Quality dimensions as the primary factors influencing RMT ridership.

The empirical evidence shows that the RMT users in Bangkok consider the Price/Promotions dimension as the most important factor influencing RMT ridership. The result confirms the studies conducted by Stanley (1995, 1998), Taylor and Fink (2003), Taylor et al. (2002), Korb (2002), Sutcliffe (2002), Prapatpong Upala and Borrisut Chareonveingvachakij (2003), and Prapatpong Upala (2005). Policies and measures to improve the Price/Promotions area of the RMT system are a means to increase RMT ridership. Reasonable fares and specially developed target promotions are prolific measures that can be utilized for the RMT systems in Bangkok. The empirical evidence in the study indicates the specific user groups to focus on. Male respondents, respondents with educations less than a bachelor's degree, and high income commuters score lower on the Price/Promotions factor; therefore, the mentioned groups would be an obvious target for promotions. Price deductions are a more complex task for the RMT systems in Bangkok. The Royal Thai government does not have direct control of fare prices since all RMT systems in Bangkok are concessionaire operated. The only solution for the RTG to have full control of the price levels is to buy back the RMT systems' concessionaire agreements, initial negotiations for which have been ongoing.

The empirical evidence shows that the RMT users in Bangkok consider the Safety/Security dimension as one of the most important factor influencing RMT ridership. The result confirms the studies conducted by Mullins (2003), Chartchai Praditpong (2006), Prapatpong Upala and Borrisut Chareonveingvachakij (2003), and Prapatpong Upala (2005). Safety/Security factors should be emphasized in order to ensure commuters' satisfactory travel. The high score on the Safety/Security factor from the females, respondents with an education of a bachelor's degree or higher, and higher income commuters, show their special concern for safety and security while utilizing the RMT systems. The insecurity felt by the commuters should be fear of violent crimes from institutional rivalry brawls and uncontrollable drug users. The system operators must assure all commuters of the safety and security of the RMT commute and in comparison be better than the bus, taxi, and motorcycle modes of transportation. This safety and security must also be within acceptable standards when compared to the private automobile transportation in order to encourage motorized transportation users to increase RMT usage.

The empirical evidence shows that the RMT users in Bangkok consider the Convenience/Availability dimension as one of the most important factor influencing RMT ridership. The result confirms the studies conducted by Mullins (2003), Taylor and Fink (2003), Prapatpong Upala and Borrisut Chareonveingvachakij (2003), and Prapatpong Upala (2005). The Convenience/Availability factor is an important area that can be improved considerably. Improvements in service expansion, walking distances to the RMT systems, coverage area, and station location are areas that require full involvement of the government. The RTG has extensive plans to develop at least 200 kilometers more of the RMT systems in order to increase service coverage and station locations, which means shorter walking distances to RMT stations. The system operator can improve on service frequency, commute convenience, and time consumed for commuting. Systematic routine maintenance, escalators and moving sidewalks where necessary, and optimizing the numbers of trains to service the appropriate number of passengers are strategies the system operator must carefully consider for improvements. Other measures for improving the convenience of commuting require the joint involvement of many parties, such as the operations for feeder systems and intermodal transfer of commuters.

The empirical evidence shows that the RMT users in Bangkok consider the Quality dimension as one of the most important factor influencing RMT ridership. The result confirms the studies by Stanley (1995, 1998), Taylor and Fink (2003), Taylor et al. (2002), Prapatpong Upala and Borrisut Chareonveingvachakij (2003), and Prapatpong Upala (2005). The Quality factor of the service and system is an area where improvement can lead to increased RMT patronage. Service adjustments and quality staff support are measures that the system operators can improve for service quality. System quality can also be improved with continuous maintenance of the trains for reliability, punctuality, and comfort.

The results of the study indicate that moderate automobile users have significantly higher scores than frequent automobile users on the Service Quality concept. A high quality commute is an important factor for encouraging discretionary automobile users to switch to increased RMT usage (Litman, 2004). Service quality must be exceptional, especially when Bangkok commuters perceive the automobile as a social status, and there is an extreme "love for the car" (Chamlong Poboon, 1997).

The results indicate that moderate taxi users have significantly higher scores than frequent automobile users on the Facilities and Commuter Convenience concept. Taxi users utilize taxis for flexibility of the commute; therefore, the strong attitude toward the Facilities and Commuter Convenience was not surprising. The system operator must improve on providing a convenient commute in order to increase patronage from the frequent taxi users.

Segmentation of the commuters by attitudes on the dimensions influencing RMT ridership provided interesting empirical evidence. The results of the study show two primary group of respondents: the Skeptical and Optimistic groups. The Skeptical group of respondents, who have lower scores on all the dimensions influencing RMT ridership, consists of more females and students with lower education and income levels. Some polices that can be directly useful for encouraging the Skeptical group of commuters to utilize RMT systems are special prices and promotions for students and females, joint benefit programs with universities, and special trains for women to travel on at night.

The Optimistic group of respondents (who have higher scores on all dimensions influencing RMT ridership) can be classified into 5 subgroups. Subgroup 1, which consists of young students with lower education levels, shows positive concerned with most of the dimensions. Some policies suitable for Subgroup 1 are discount prices and targeted promotions, partnership programs with universities, and overall service improvement for quality and convenience. Subgroup 2, which consists of the highly educated private company employee and government officials, is mostly concerned with safety, security, price, and promotion issues. Some measures appropriate for this subgroup are partnership promotions with private and governmental offices, discount rates for routine working commuters, and special attention to safety and security measures in the system. Subgroup 3, which consists of older, retired, high income government officials, is primarily focused on service quality, safety, security, and government and external factors. Subgroup 3 members most probably use RMT systems on an elective and flexible basis and therefore some appropriate measures are maintaining an exceptional quality of service, attention to safety and security measures, promotional packages for older government officials, and cooperative programs with government offices. Subgroup 4, which consists of high income middle aged commuters, pays special attention to the safety, security, facilities, and convenience of the commute. Appropriate policies for this subgroup should include measures to assure their safety and security, and general periodic improvements for convenience and for the facilities in the RMT stations and trains. Subgroup 5, which consists of high income private company employees, is concerned with the information provided, safety, security, price, promotions, and with system availability. Appropriate measures for this subgroup are brochures or newsletters on system updates provided to private companies, reliable safety and security measures, reasonable fare prices and attractive promotions, and improvement in overall service coverage.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This dissertation on the dimensions influencing Rail Mass Transit ridership in the Bangkok Metropolitan Area set out to investigate three major subject areas: the commute characteristics for selected modes of transportation, the factors important for switching from motorized transportation to RMT systems, and the dimensions influencing RMT ridership and the affects of demographic and location factors.

The study has six objectives: to review the major advantages of RMT based development; to examine the commute characteristics of commuters and to identify the major factors for the switch to utilizing the RMT systems; to indicate the commuters' actual reasons for using the RMT systems; to determine the rankings of the dimensions influencing RMT ridership; to determine the demographic and location effects on the dimensions influencing RMT ridership; and to utilize the study findings for policy implications.

Empirical data was obtained from RMT users at the stations of the two existing systems in Bangkok, which are the Bangkok Transit System and the Mass Rapid Transit Authority's M.R.T. Chalerm Ratchamongkhon Line. The research tool used was the survey questionnaire, which was designed to collect empirical evidence on the dimension components and the transportation selection and usage of the RMT commuters at the RMT stations in Bangkok. Data were collected from 1,715 commuters at 41 RMT stations during October and November of 2007.

The dimension influencing RMT ridership was constructed based on the literature, as reviewed at the beginning stages of the research study. The factors constructed include nine core concepts deemed to influence RMT ridership. These factors are: Promotions, Price, Facilities, Quality, Safety/Security, Information, Convenience/Availability, Government, and External concepts. Reliability and validity analyses were performed on the collected empirical data to justify the dimensions influencing RMT ridership constructed from the related literature. The results of the reliability and validity analyses yield satisfactory results. The factor analyses performed realigned the nine component concepts, slightly combined to form seven core concept dimensions influencing RMT ridership. These seven concepts used for the analyses were the Price/Promotions, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality concepts.

The findings with regards to the first objective identified numerous benefits and the importance of developing the RMT systems to direct transportation development in Bangkok in a sustainable direction. The study shows that the RMT systems are more sustainable with the environment and ecology, reduce traffic congestion, provide a better quality of life, are useful for urban development with mixed land use, and are beneficial to economic development. On the other hand, motorized transportation is detrimental, causing unsustainable development, traffic congestion, environmental and ecological decline, and deteriorating the quality of life.

The findings with regards to the second objective indicate that there is a substantial number of occasional RMT users (65.3 percent) and a significant number of frequent motorized transportation users categorized by automobile (37.9 percent), bus (36.0 percent) and motorcycle (20.5 percent). The occasional RMT users and frequent motorized transportation users represent a large group of commuters that should be targeted in order to encourage increased RMT usage. Further analyses on the occasional RMT users' subgroup indicate differences based on marital status, age, education level, occupation, and income level. Furthermore, a substantial number of occasional RMT users frequently use automobiles (45.6 percent), buses (34.2 percent), and motorcycles (19.9 percent). Evaluation of the frequent automobile users' subgroup indicates differences based on marital status, age, education level, occupation, and income per month. Only a small number of frequent automobile users frequently use the RMT systems (13.1 percent). Evaluation of the frequent bus users' subgroup yields differences based on gender, marital status, age, education level, occupation, and income per month. A significant number of frequent bus users frequently use the RMT systems (23.6 percent). Investigation of the frequent motorcycle users' subgroup indicates differences based on gender, education level, and income per month. A substantial number of frequent motorcycle users frequently use the RMT systems (24.8 percent). The empirical data demonstrates that there are a substantial number of commuters using motorized transportation for their daily commute, while the number of routine RMT users is limited. Based on the significant demographic factors affecting the commute characteristics, policies and measures can be implemented so that switching from using motorized transportation to the RMT systems can be encouraged.

The findings with regards to the third objective show that the commuters' prime reason for using the RMT systems is for business or to run errands (74 percent). Next, the commuters use the RMT systems to go to work or to study (54.3 percent), followed by shopping (31.4 percent) and to meet friends (25.7 percent). The empirical data show that the two most cited reasons for using the RMT systems are routine and work related, while the next two following reasons are recreational. The empirical data can benefit policy makers and system operators so that they can arrange attractive benefits for routine RMT users and cooperative programs with workplaces in order to increase RMT ridership.

The findings with regards to the fourth objective indicate that the commuters rank the Price and Safety/Security dimensions as the top two dimensions influencing RMT ridership. The next level of factors which commuters feel to be important is the Convenience/Availability and Quality concepts. The top four factors ranked as important by the commuters are the same as the top four dimensions that should be deemed important by RMT policymakers and operators as perceived by the commuters. Appropriate actions, based on the ranked dimensions, can be implemented in order to ensure commuters' increasing utilization of the RMT systems.

The findings with regards to the fifth objective investigate the commuters' attitudes toward the dimensions influencing RMT ridership. Significant variations in the attitudes of the RMT users are in the concept areas of the Price/Promotions, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality dimensions. Differences in attitudes on the part of motorized transportation users were significantly observed by automobile users in the Service Quality dimension, and by taxi users in the Facilities and Commuter Convenience concept. Gender subgroups have significant differences in attitudes regarding the Price/Promotion, Government/External, Safety/Security, Information, System Availability, Facilities and Commuter Convenience, and Service Quality dimensions. Education level subgroups show significant variation in attitudes in the Price/Promotions, Safety/Security, and System Availability dimensions. Occupation subgroups show significant variation in attitudes toward the Safety/Security, and System Availability dimensions. Last, Income level subgroups show significant differences in attitudes toward the Price/Promotions, Safety/Security, and System Availability dimensions. Location area subgroups indicate no difference in attitudes regarding the dimensions influencing RMT ridership.

The commuters' attitudes on the dimensions influencing RMT ridership were used to perform segmentation analyses in order to identify the prominent group of respondents with different perspectives on the dimensions. The cluster analyses results show that there were two distinctive primary groups of users: the Skeptical and Optimistic cluster groups. The Skeptical cluster group refers to commuters who have lower scores in all dimensions influencing RMT ridership, while Optimistic cluster group refers to commuters who have higher scores on these dimensions. The Optimistic cluster group can be further segregated into 5 subgroups. Demographic details were utilized to profile the various groups and subgroups. The Skeptical group was characterized as having more females and students with lower education and income levels. The Optimistic group was characterized as having more males and government officials with higher education and income levels. Optimistic subgroup 1 comprises young students with lower education levels. Optimistic subgroup 2 comprises highly educated private company employees and government officials. Optimistic subgroup 3 comprises older retirees and high income government officials. Optimistic subgroup 4 comprises high income middle aged commuters. Lastly, Optimistic subgroup 5 comprises high income private company employees. The demographic differences of the various groups and subgroups can be utilized with the corresponding attitudes on the dimensions influencing RMT ridership to create policies appropriate for each group of respondents in order to attract and encourage more RMT users.

The findings with regards to the sixth objective provide policy implications based on the empirical evidence from the research study. This study on the dimensions influencing RMT ridership in the Bangkok metropolitan area presented essential and viable information that policymakers and system operators can utilize to contribute new ideas, agendas, and plans to encourage commuters to utilize the RMT systems in Bangkok. With provisions of better RMT systems, commuters dependent on the various motorized transportation systems will have an alternative mode of transportation for selection.

6.2 Policy Implications

Policy implications that will attract more Rail Mass Transit ridership to the systems of Bangkok can be based on the empirical information obtained from the various analyses presented in this chapter. The results obtained from the analyses show that most of the current RMT users are occasional users of the system. The commuters are dependent on other modes of transportation in conjunction with the RMT system to satisfy their travel needs. Therefore, the current RMT system will need to expand its services to cover areas where the commuter can travel to and also provide a comfortable trip so that automobile commuters can have the choice of using the RMT systems as an alternative to normal automobile use.

6.2.1 Overall Service Improvements

As seen from the results of the analyses, the occasional users of the RMT systems have significant attitude differences from the more frequent RMT users in the areas of service provided by the RMT systems, which are the Safety/Security, Information, Facilities and Commuter Convenience, and Service Quality concept areas. The commuter rankings indicate that the Safety/Security and Quality dimensions were amongst the primary dimensions deemed important. Schultz (1994), Horowitz and Beimborn (1995), Stanley (1995, 1998), Nimitchai Snitbhan et al. (1997), USEPA (1998), Weyrich and Lind (1999, 2001), Litman (2004), and Stanley and Hyman (2005) suggest service adjustments and improvement to increase RMT ridership. These overall service improvements can be improved to attract the occasional RMT user to more frequent usage of the system. Improving the overall service will prove to be beneficial for all commuters, including the frequent users of the automobile, bus, taxi, and motorcycle systems, who would be able to use the RMT systems more frequently. Especially in the case of automobile users, an improvement in service to provide a more comfortable ride is one of the essential tasks to be carried out in order to attract the group. The results of the study indicate that automobile user groups have different attitudes toward the Service Quality dimension. Improvement in the Facilities and Commuter Convenience area, which plays a significant role for frequent bus users, can also provide amenities to attract bus users and to increase the number of RMT riders.

6.2.2 Price and Promotions

Price and promotions are one of the factors that had a substantial influence on RMT ridership. The RMT users demonstrated significant variations in their attitudes toward the Price/Promotions concept area. The commuter rankings confirm that the Price/Promotion dimension is considered as one of the most important dimensions. The empirical evidence shows that the strategies of the system operators with respect to pricing and promotions must be carefully designed and packaged to fit the various groups of commuters. Demographic considerations must be considered since the empirical information obtained shows that the marital status, age, education, occupation, and income of the RMT and automobile users create significant attitude variations. Bus users exhibited significant differences in their attitudes within all demographic subgroups. Horowitz and Beimborn (1995), Stanley (1995, 1998), USEPA (1998), Skinner (2000), Gwilliam (2000), Halcrow Fox (2000b), Taylor et al. (2002), Taylor and Fink (2003), Kaplan et al. (2003), and Stanley and Hyman (2005) suggest fares and pricing adaptations to increase RMT ridership. Taylor et al. (2002), Taylor and Fink (2003), and Chartchai Praditpong (2006) suggest focused fares, niche marketing, and partnership programs. Pricing and promotions strategies must be designed and customized for the variations. Cooperative programs with schools and universities can be designed to lure young students, while cooperative programs with the workplace could provide incentives for the middle aged working class. Special senior discounts and discounts for retired citizens can specifically attract more senior commuters.

The segmentation of respondents based on their attitudes toward the dimensions influencing RMT ridership segregates the different commuter groups according to their different attitudes. Profiling each group and the corresponding attitudes can be beneficial for intensive marketing, with price discounts and targeted promotions for specific groups of commuters. The commuters' reasons for using the RMT system also suggest that routine and work related trips are the top reasons for using the RMT system. Intensive marketing and collaboration with the workplace can also boost RMT ridership.

6.2.3 The Government's Role in Rail Mass Transit Development

RMT user groups differ in their attitudes toward the Government/External and System Availability factors according to the empirical data obtained from the study. This notion is not so surprising because the review of the literature from many scholars has already stated that the government must play a leading role in the development of the RMT systems. The empirical data obtained from this research study only support the previous claims presented from the various studies and from the literature on the topic. The government will have to provide measures to control the external factors and to assist with the RMT systems. Service expansion to provide increased coverage areas for the RMT systems is essential to encourage greater RMT patronage. With the importance of government involvement with RMT system improvements being laid out, discussion on the actions and policies of the government is needed.

6.2.3.1 Service Expansions

The substantial number of occasional RMT users and significant lower number of frequent RMT users show that the RMT systems are not being optimally utilized. RMT user groups show significant differences in their attitudes toward the System Availability factor. The demographic subgroups of gender, education level, occupation, and income level all indicate significant variations regarding the System Availability concept. The commuters' ranks also show the dimension as one of the most important for influencing RMT ridership. Kenworthy (1995, 2005), Chamlong Poboon (1997), and Chamroon Tangpaisulkit (2007) have pointed out that the RMT network in Bangkok is inefficient and very limited as compared to other major cities in the world. The government is moving in a positive direction, however, with the massive proposal of the RMT systems in Bangkok. Nevertheless, the government must continue to develop the RMT networks and corresponding systems for a sustainable transportation system in Bangkok.

6.2.3.2 Automobile Restraint

Automobile restraint policies are the set of policies that actually restrain automobile usage and encourage RMT usage for commuters. No such policy has been seriously implemented in Bangkok. Kenworthy (1995, 2005), Barter and Kenworthy (1997), Barter (1999), Skinner (2000), Barter and Raad (2000), Halcrow Fox (2000a), Wheeler (2001), Sheehan (2002), and Taylor and Fink (2003) advocate road pricing, car control, and congestion reduction policies. Road pricing policies, which charge automobile drivers for the use of the inner city road system, will reduce the traffic volume in the inner city. Limitations of available parking spaces will make the automobile user consider the use of the vehicle when traveling to the inner city areas of the city. Increased vehicle registration taxes and fuel taxes are also means to encourage automobile restraint. Laws for environmental protection, pollution pricing, and air emission standards, such as high standards to prevent vehicle emissions into the air, can help reduce air pollution and the number of sub-standard vehicles on the road. Limitations regarding the automobile's lifetime is essential in order to eliminate sub-standard automobiles from the roads. With the awareness of global warming, the enforcement of such environmental protection policies will be easier to implement and gain public support. Overall, the reduction of automobile usage provides commuters with an opportunity to utilize more frequently the RMT systems for their commute.

6.2.3.3 Government Intervention and Subsidies

Weyrich and Lind (1996, 2001), Chamlong Poboon (1997), and LaFaver et al. (2001) are supporters of government intervention and subsidies for the RMT systems. The government will have to be assertive and provide heavy subsidies for the development of the RMT systems in Bangkok. Reduction in government subsidies for the encouragement of motor vehicle transport must be implemented parallel to RMT system encouragement plans in order significantly to reduce transportation problems in Bangkok.

6.2.3.4 Government Control of External Factors

The government must play an important role in enforcing RMT usage in order to develop a sustainable transportation future. Government subsidies for such external factors as the subsidies provided for oil prices should be limited. The government should also allow oil prices to fluctuate with respect to global oil market prices in order to reflect the actual expenses associated with motor vehicle usage. Chamlong Poboon (1997), Barter and Raad (2000), Halcrow Fox (2000a), Laird (2000), Weyrich and Lind (2001), Sheehan (2002), and Taylor et al. (2002) suggest mix land use policies so that sustainable urban development in line with the sustainable transportation direction can be assured. Government policies on mixed land usage are also an important provision for providing more RMT usage. Mixed land usage and allocation of major travel destinations along the RMT routes are essential for reducing travel trips, thus making it possible for the commuter to travel less distance.

6.2.3.5 Implementations of Government Policies

The implementation of the aforesaid policies is not an easy task to be accomplished in Bangkok. Opposition from various influence groups that will lose long favorable benefits will provide tremendous difficulties for the implementation of these policies. Bangkok commuters, with a high degree of automobile dependence, are a problematic group of commuters to encourage in terms of RMT usage. However, the government must implement policies in order to reduce automobile transport and to encourage RMT usage for the development of sustainable transportation systems in Bangkok. In the long run, such policies will be proven to be more beneficial for the country.

The Thai government has gone in the right direction by investing a government budget to develop the seven planned RMT systems in Bangkok. However, the initial investment in the RMT systems is only the beginning. In order to develop a sustainable transportation system, the government must take the lead in informing and providing knowledge for the commuters to bring about a total paradigm shift in travel behavior. The auto dependence of the Bangkok commuter is a behavior that needs an abundance of effort to break.

Aggressive policies must be implemented in order to create this change. The RMT users pay high fares to use the system, which actually provide favorable outcomes in terms of sustainable transportation and good results for the environment. Instead of subsidizing the factors that encourage motor usage, the budget should be transferred to subsidize the RMT systems and the supporting agendas. Development of a motor vehicle infrastructure, such as expressways and roads, should be limited to normal maintenance of the infrastructures. The budget should be allocated, rather, to the reduction of the average RMT fares and provision of accessibility to the systems in the form of spatial shaded walkways and moving sidewalks around the station perimeter. Non-motorized forms of transportation such as walking and cycling should be promoted. Limitation of automobile usage in the inner city areas by provision of only public buses, bus rapid transit systems, and limited road space for controlled amount of vehicles will provide more inner city space for developing systems to support rail commutes. Strategic roads in the inner city should be converted to the above-mentioned system. Half of the original road space can be used for special permitted private vehicles and public buses, while the other half could be dedicated to bus rapid transit systems and more walkways and bicycle tracks with provision for tall trees for shade. The government must send the message to the public that the motor form of transportation is unsustainable and motor vehicle users should be responsible for the costs that occur as a consequence.

Overall, the above-mentioned policies will not be easily implemented; however, the road to sustainable transportation systems must be commenced as soon as possible. Despite the difficulties from the groups that will oppose aggressive plans, the government can find ways to slowly implement policies. Continuous provision of information concerning sustainable transportation to the public will slowly provide knowledge and eventually gain support. The group of commuters, which are highly dependent on automobile commuting, requires sufficient time and improved travel conditions on the part of the RMT system in order to possibly convert to using the RMT systems. The aggressive policies mentioned should be implemented incrementally in stages for slow but positive sustainable development in the right direction.

6.3 Contributions

6.3.1 Academic Contributions

This research study collects various concepts and ideas from a wide variety of scholars, academics, and experts in the field of transportation, especially in Rail Mass Transit systems, from all over the world. The review of the empirical data presented by researchers is representative of the numerous RMT systems globally. The study adopts various concepts, models and theories to formulate a unique and customized research project to evaluate the RMT systems in Bangkok, specifically in the area of ridership.

Research on RMT ridership in Bangkok is very limited. Most of this is in the form of customer satisfaction for commercial purposes for the system operators and is based on a small sample of commuters. This research study contributes as an in-depth evaluation with more sophisticated analyses on the dimensions that are influential on the RMT ridership; studies of this magnitude of enormity are extremely limited if not unavailable entirely. The research study on the dimensions influencing RMT ridership, as extracted and constructed from numerous academic research studies, was proven to be significant to the RMT systems and for the commuters of Bangkok. The conformity of the results of this study only increases the empirical evidence to support the previous research findings from other commuter attitudes and RMT systems studies globally.

This research study on RMT ridership and its implications for the sustainability of the transportation systems in Bangkok will provide partial contributions to the development of sustainable transportation studies in Bangkok. The research study thus will be a part of the increasing sustainable transportation knowledge and another step in providing awareness of the subject matter to Thai policymakers, system operators, concessionaire operators and to the general public.

6.3.2 Contributions to Rail Mass Transit Management

The customer approach utilized in this study contributes to specific knowledge on the management of the RMT systems in Bangkok. Most studies on RMT systems are based on the attitudes and perspectives of the system operators and transportation planners. A customer based perspective will provide an additional viewpoint for the development of RMT systems. In Bangkok, the primary studies on ridership focus on customer satisfaction. This research study concentrates on the dimensions that are influential on Rail Mass Transit ridership, and represents a more holistic approach, where customer satisfaction is only a partial component.

The empirical information obtained from the research study provides specific indications for the important variations in attitudes of customers, where the management of the Rail Mass Transit systems in Bangkok can develop customized strategies for each of the segments of commuters. The research study also demonstrates and confirms the dimension concepts, which have an immense impact on the RMT ridership numbers in the systems in Bangkok. The system operators can use the information data to create new and improved management plans for the respective systems.

6.3.3 Contributions to Policy Formulation

The research study identifies some of the holistic problems in transportation planning in Thailand and urges policymakers to develop a sense of urgency to develop a sustainable transportation system, with RMT systems as a primary function to achieve sustainability. The focus on RMT ridership identifies the major dimensions that can influence an increase in commuter usage of the RMT systems. The empirical deductions from the research study concerning the primary influential factors can be utilized by policymakers to formulate agendas and development plans to encourage motorized vehicle users to use the RMT systems. This increase in RMT users would create financial feasibility for additional RMT development and extended formulation of policies where RMT systems are utilized for sustainable transportation development.

6.4 Recommendations

Based on the major findings of the research study, specific policy implications can be generated to support Rail Mass Transit ridership in Bangkok. The policies essential for the conversion of the motorized vehicle users for the utilization of the

RMT systems must be aggressive and supported fully by the government. A surge in public awareness of the extremity of the problems created by motorized forms of transportation, and the extended benefits of RMT systems that lead to sustainability of the transportation development schemes, must be expedited by the government sector. The current attention to global warming effects and their association with motorized vehicles, supplemented with the escalating oil prices around the world, offers an opportune opening for the government to take strong action on these issues. An increase in RMT ridership can be used to provide positive reinforcement to plan and implement more RMT systems and to assert Transit Oriented Development schemes for the National Transportation Development Plans.

The dimensions influencing RMT ridership are indicators for system operators to make additional adjustments to the services based on the variations of attitudes within the different commuter groups. The empirical evidence obtained from the study can convince system management to improve specified areas and make provisions to attract commuters to use the RMT systems more frequently. The identification of potential RMT users and their respective attitudes will provide overwhelming evidence for system operators to make management plans targeted to increasing RMT ridership of these systems in Bangkok.

The significance of RMT ridership to the development of new projects and its contribution to sustainable transportation can be used to increase public knowledge of the importance of sustainable transportation systems in Thailand. The government and the system operators need to be assertive in order to communicate the message to the public and to generate more advocates. The tremendous devastating dependence on motor vehicles by Bangkok commuters calls for the government to publicize the benefits of RMT systems and the consequential problems associated with motorized transportation.

Furthermore, the government must play a major role in the Transit Oriented Development plans utilizing RMT systems by agreeing to subsidize the development plans and to lower motorize transportation subsidies in all forms. These aggressive policies will be needed to punctuate the necessity for an unprecedented transformation of transportation commute patterns for the movement towards sustainability.

6.5 Further Research

This study of the factors influencing Rail Mass Transit ridership in Bangkok was limited in terms of political context. Future study should investigate the political factors and their political impact on RMT ridership, including the corresponding plans to integrate the systems as the primary element of the National Transportation Development Plans.

Policy implementation is another area where future research can be conducted. Aggressive policy implications, to be combined into prominent policies to advocate the RMT systems, will be opposed by various stakeholders with decreasing benefits as a consequence of the plans. Further studies should evaluate these scenarios from a political science perspective in order to determine the feasibility of these progressive RMT plans. The Thai political arena with deliberate time-consuming bureaucratic processes should be analyzed in terms of the Transit Based Development schemes to point out probable obstacles to policy formulation and implementation.

With the commencement of the seven additional RMT systems, and the near completion of the Airport Rail Link project, which will be the third RMT system in Bangkok, a follow up research study should be conducted in order to determine whether the primary findings from this research study are still valid. There are many aspects worth investigating, such as the impact caused by the provision of more routes, stations, service coverage, and accessibility that will come with these new developments. The connectivity of the three RMT systems should be studied. Later, the seven planned RMT systems should be investigated during all stages of the project.

With more RMT systems commencing in Bangkok, an interesting investigation of the statistics of commuting and the switching over of occasional RMT users and frequent motorized commuters to utilization of the RMT systems should be studied. With more RMT systems implemented, a future research study on the new balance of commuters using each mode of transportation should be conducted. The information can confirm, refurbish, and extend the findings provided with this research study.

All in all, empirical research studies in the field of RMT ridership and their implications for the development of RMT systems for sustainable transportation systems should increasingly be conducted in the context of the Bangkok transportation system. The researcher hopes that the present research study will be a beginning of increasing research studies on the subject and anticipates, with optimism, that serious developments in terms of sustainable transportation will take place in Bangkok.

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APPENDICES

APPENDIX A

BIVARIATE CORRELATION ANALYSIS FOR VALIDITY OF CORE CONCEPTS

Pearson Correlation Analysis for Pricing/ Promotions Dimension

Measures	C01	C02	C03	C04	C05	C06	C07
C01	1.000						
C02	.683	1.000					
C03	.581	.607	1.000				
C04	.494	.548	.723	1.000			
C05	.463	.520	.614	.719	1.000		
C06	.458	.498	.604	.661	.746	1.000	
C07	.443	.487	.583	.688	.691	.700	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for Government/ External Dimension

Measures	D01	D02	D03	D04	D05	D06	D07
D01	1.000						
D02	.566	1.000					
D03	.483	.674	1.000				
D04	.463	.564	.612	1.000			
D05	.361	.379	.425	.432	1.000		
D06	.423	.372	.427	.471	.521	1.000	
D07	.433	.380	.430	.481	.539	.779	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for Safety/ Security Dimension

Measures	A5	A10	A11	A12
A5	1.000	.648	.581	.623
A10	.648	1.000	.707	.695
A11	.581	.707	1.000	.748
A12	.623	.695	.748	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for Information Dimension

Measures	A6	A7	A8	A9	A14
A6	1.000	.595	.568	.554	.431
A7	.595	1.000	.605	.572	.537
A8	.568	.605	1.000	.636	.446
A9	.554	.572	.636	1.000	.478
A14	.431	.537	.446	.478	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for System Availability Dimension

Measures	B09	B10	B11	B12	B13
B09	1.000	.718	.582	.541	.563
B10	.718	1.000	.588	.579	.563
B11	.582	.588	1.000	.643	.523
B12	.541	.579	.643	1.000	.576
B13	.563	.563	.523	.576	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for Facilities and Commute Convenience Dimension

Measures	B03	B04	B05	B06	B07	B08
B03	1.000	.450	.403	.407	.422	.302
B04	.450	1.000	.539	.512	.486	.459
B05	.403	.539	1.000	.616	.559	.518
B06	.407	.512	.616	1.000	.699	.613
B07	.422	.486	.559	.699	1.000	.600
B08	.302	.459	.518	.613	.600	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Pearson Correlation Analysis for Service Quality Dimension

Measures	A1	A2	A3	A4
A1	1.000	.620	.650	.562
A2	.620	1.000	.564	.429
A3	.650	.564	1.000	.636
A4	.562	.429	.636	1.000

** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX B

SAMPLE COMPARISON WITH OTHER RESEARCH STUDIES

MRTA Study (Tonghor et al, 2007)

Gender	%	Age	%	Education	%
Male	45.9	Under 21 years	6.7	Less than Bachelor's degree	34.8
Female	52.9	21 to 30 years	47.2		
No response	1.2	31 to 40 years	24.3	Bachelor's degree or Higher	56.8
		41 to 50 years	16.6		
		51 to 60 years	4.7	No education	2.2
		Over 60 years	0.5		
Total	100.0	Total	100.0	Total	100.0
		Occupation	%	Income	%
		Student	45.0	Less than 10,000 Baht	45.4
		Government Official	7.6	10,001 to 20,000 Baht	30.7
		Private Company Employee	30.4	20,001 to 30,000 Baht	13.3
		Self-Employed	8.4	Over 30,000 Baht	10.6
		Freelance	3.5		
		Unemployed	2.2		
		Others	2.9		
		Total	100.0	Total	100.0

Note: Sample size (n=1404)

BTS Study (Source: BTSC)

Gender	%	Age	%	Education	%
Male	35.9	Under 19 years	10.8	Less than Bachelor's degree	34.5
Female	64.1	19 to 22 years	19.8		
		23 to 26 years	22.8	Bachelor's degree or Higher	65.3
		27 to 30 years	14.3		
		31 to 34 years	8.2	No response	0.2
		35 to 38 years	6.8		
		39 to 42 years	5.8		
		43 to 46 years	4.6		
		47 to 50 years	4.4		
		51 to 54 years	1.2		
		Over 55 years	0.6		
		No response	0.8		
Total	100.0	Total	100.0	Total	100.0
		Occupation	%	Income	%
		Student	31.3	Less than 10,000 Baht	29.2
		Government Official	7.2	10,001 to 20,000 Baht	32.0
		Private Company Employee	34.4	20,001 to 30,000 Baht	11.8
		Self-Employed	10.8	30,001 to 40,000 Baht	6.0
		Freelance	9.1	40,001 to 50,000 Baht	3.1
		Housewife	2.6	Over 50,000 Baht	3.3
		Unemployed	0.8	No Income	8.7
		No response	3.8	No response	5.9
		Total	100.0	Total	100.0

Note: Sample size (n=1563)

APPENDIX C

ANALYSIS OF VARIANCE COMMUTER ATTITUDES ON THE DIMENSIONS INFLUENCING RMT RIDERSHIP

1. Rail Mass Transit Users

1.1 Effect of RMT User Groups on Price/ Promotions Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.91	2	10.45	21.74	.000
Within Groups	823.21	1712	.48		
Total	844.12	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.04	0.71
Moderate	210	4.25	0.62
Frequent	386	4.28	0.69
Total	1715	4.12	0.70

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) RMT Users	(J) RMT Users				Lower Bound	Upper Bound
Occasional	Moderate	-0.21	0.05	0.00	-0.34	-0.09
	Frequent	-0.24	0.04	0.00	-0.34	-0.14
Moderate	Occasional	0.21	0.05	0.00	0.09	0.34
	Frequent	-0.03	0.06	1.00	-0.17	0.11
Frequent	Occasional	0.24	0.04	0.00	0.14	0.34
	Moderate	0.03	0.06	1.00	-0.11	0.17

* The mean difference is significant at the .05 level.

1.2 Effect of RMT User Groups on Government/ External Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.29	2	3.65	9.25	.000
Within Groups	675.04	1712	.39		
Total	682.33	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.04	0.65
Moderate	210	4.22	0.58
Frequent	386	4.14	0.59
Total	1715	4.08	0.63

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) RMT Users	(J) RMT Users				Lower Bound	Upper Bound
Occasional	Moderate	-0.18	0.05	0.00	-0.29	-0.07
	Frequent	-0.10	0.04	0.02	-0.19	-0.01
Moderate	Occasional	0.18	0.05	0.00	0.07	0.29
	Frequent	0.08	0.05	0.40	-0.05	0.21
Frequent	Occasional	0.10	0.04	0.02	0.01	0.19
	Moderate	-0.08	0.05	0.40	-0.21	0.05

* The mean difference is significant at the .05 level.

1.3 Effect of RMT User Groups on Safety/ Security Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.49	2	3.24	7.34	.001
Within Groups	756.38	1712	.44		
Total	762.87	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.38	0.69
Moderate	210	4.54	0.56
Frequent	386	4.49	0.64
Total	1715	4.43	0.67

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) RMT Users	(J) RMT Users				Lower Bound	Upper Bound
Occasional	Moderate	-0.16	0.05	0.00	-0.28	-0.04
	Frequent	-0.10	0.04	0.02	-0.20	-0.01
Moderate	Occasional	0.16	0.05	0.00	0.04	0.28
	Frequent	0.06	0.06	0.92	-0.08	0.19
Frequent	Occasional	0.10	0.04	0.02	0.01	0.20
	Moderate	-0.06	0.06	0.92	-0.19	0.08

* The mean difference is significant at the .05 level.

1.4 Effect of RMT User Groups on Information Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.69	2	2.35	5.40	.005
Within Groups	743.53	1712	.43		
Total	748.22	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	3.99	0.66
Moderate	210	4.15	0.62
Frequent	386	4.03	0.67
Total	1715	4.02	0.66

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(I) RMT Users	(J) RMT Users					
Occasional	Moderate	-0.16	0.05	0.00	-0.28	-0.04
	Frequent	-0.05	0.04	0.67	-0.14	0.05
Moderate	Occasional	0.16	0.05	0.00	0.04	0.28
	Frequent	0.11	0.06	0.14	-0.02	0.25
Frequent	Occasional	0.05	0.04	0.67	-0.05	0.14
	Moderate	-0.11	0.06	0.14	-0.25	0.02

* The mean difference is significant at the .05 level.

1.5 Effect of RMT User Groups on System Availability Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.99	2	5.00	11.93	.000
Within Groups	716.79	1712	.42		
Total	726.79	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.18	0.68
Moderate	210	4.38	0.57
Frequent	386	4.31	0.59
Total	1715	4.23	0.65

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(I) RMT Users	(J) RMT Users					
Occasional	Moderate	-0.20	0.05	0.00	-0.31	-0.08
	Frequent	-0.13	0.04	0.00	-0.22	-0.04
Moderate	Occasional	0.20	0.05	0.00	0.08	0.31
	Frequent	0.06	0.06	0.75	-0.07	0.20
Frequent	Occasional	0.13	0.04	0.00	0.04	0.22
	Moderate	-0.06	0.06	0.75	-0.20	0.07

* The mean difference is significant at the .05 level.

1.6 Effect of RMT User Groups on Facilities and Commuter Convenience Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.76	2	2.38	6.15	.002
Within Groups	662.79	1712	.39		
Total	667.55	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.08	0.63
Moderate	210	4.24	0.59
Frequent	386	4.12	0.61
Total	1715	4.11	0.62

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) RMT Users	(J) RMT Users				Lower Bound	Upper Bound
Occasional	Moderate	-0.16	0.05	0.00	-0.27	-0.05
	Frequent	-0.04	0.04	0.79	-0.13	0.05
Moderate	Occasional	0.16	0.05	0.00	0.05	0.27
	Frequent	0.12	0.05	0.07	-0.01	0.25
Frequent	Occasional	0.04	0.04	0.79	-0.05	0.13
	Moderate	-0.12	0.05	0.07	-0.25	0.01

* The mean difference is significant at the .05 level.

1.7 Effect of RMT User Groups on Service Quality Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.07	2	4.03	9.62	.000
Within Groups	718.18	1712	.42		
Total	726.25	1714			

RMT Usage	Count	Mean	s.d.
Occasional	1119	4.03	0.66
Moderate	210	4.22	0.64
Frequent	386	4.12	0.61
Total	1715	4.07	0.65

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) RMT Users	(J) RMT Users				Lower Bound	Upper Bound
Occasional	Moderate	-0.19	0.05	0.00	-0.31	-0.08
	Frequent	-0.10	0.04	0.03	-0.19	-0.01
Moderate	Occasional	0.19	0.05	0.00	0.08	0.31
	Frequent	0.10	0.06	0.25	-0.04	0.23
Frequent	Occasional	0.10	0.04	0.03	0.01	0.19
	Moderate	-0.10	0.06	0.25	-0.23	0.04

* The mean difference is significant at the .05 level.

2. Automobile Users

2.1 Effect of Automobile User Groups on Service Quality Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.70	2	1.85	4.39	.013
Within Groups	722.55	1712	.42		
Total	726.25	1714			

Automobile Usage	Count	Mean	s.d.
Occasional	918	4.09	0.64
Moderate	148	4.17	0.61
Frequent	649	4.02	0.67
Total	1715	4.07	0.65

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(I) Auto Users	(J) Auto Users					
Occasional	Moderate	-0.08	0.06	0.46	-0.22	0.06
	Frequent	0.07	0.03	0.09	-0.01	0.15
Moderate	Occasional	0.08	0.06	0.46	-0.06	0.22
	Frequent	0.15	0.06	0.03	0.01	0.30
Frequent	Occasional	-0.07	0.03	0.09	-0.15	0.01
	Moderate	-0.15	0.06	0.03	-0.30	-0.01

* The mean difference is significant at the .05 level.

3. Taxi Users

3.1 Effect of Taxi User Groups on Facilities and Commuter Convenience Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.03	2	1.52	3.91	.020
Within Groups	664.52	1712	.39		
Total	667.55	1714			

Taxi Usage	Count	Mean	s.d.
Occasional	1522	4.11	0.62
Moderate	88	4.24	0.56
Frequent	105	3.99	0.71
Total	1715	4.11	0.62

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
(I) Taxi Users	(J) Taxi Users					
Occasional	Moderate	-0.13	0.07	0.18	-0.29	0.03
	Frequent	0.12	0.06	0.16	-0.03	0.27
Moderate	Occasional	0.13	0.07	0.18	-0.03	0.29
	Frequent	0.25	0.09	0.02	0.04	0.47
Frequent	Occasional	-0.12	0.06	0.16	-0.27	0.03
	Moderate	-0.25	0.09	0.02	-0.47	-0.04

* The mean difference is significant at the .05 level.

APPENDIX D

ANALYSIS OF VARIANCE COMMUTER ATTITUDES ON THE DIMENSIONS INFLUENCING RMT RIDERSHIP BY DEMOGRAPHICS

1. Gender

1.1 Effect of Gender on Price/ Promotions Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.32	1	9.32	19.13	.000
Within Groups	834.80	1713	.49		
Total	844.12	1714			

Gender	Count	Mean	s.d.
Male	697	4.03	0.72
Female	1018	4.18	0.68
Total	1715	4.12	0.72

1.2 Effect of Gender on Government/ External Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.62	1	1.62	4.09	.043
Within Groups	680.71	1713	.40		
Total	682.33	1714			

Gender	Count	Mean	s.d.
Male	697	4.04	0.64
Female	1018	4.11	0.62
Total	1715	4.08	0.63

1.3 Effect of Gender on Safety/ Security Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.23	1	6.23	14.11	.000
Within Groups	756.64	1713	.44		
Total	762.87	1714			

Gender	Count	Mean	s.d.
Male	697	4.35	0.69
Female	1018	4.48	0.64
Total	1715	4.43	0.67

1.4 Effect of Gender on Information Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.27	1	11.27	26.20	.000
Within Groups	736.95	1713	.43		
Total	748.22	1714			

Gender	Count	Mean	s.d.
Male	697	3.92	0.68
Female	1018	4.08	0.64
Total	1715	4.02	0.66

1.5 Effect of Gender on System/ Availability Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.75	1	5.75	13.66	.000
Within Groups	721.04	1713	.42		
Total	726.79	1714			

Gender	Count	Mean	s.d.
Male	697	4.16	0.66
Female	1018	4.28	0.64
Total	1715	4.23	0.65

1.6 Effect of Gender on Facilities and Commuter Convenience Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.42	1	3.42	8.81	.003
Within Groups	664.13	1713	.39		
Total	667.55	1714			

Gender	Count	Mean	s.d.
Male	697	4.05	0.65
Female	1018	4.15	0.60
Total	1715	4.11	0.62

1.7 Effect of Gender on Service Quality Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.46	1	7.46	17.77	.000
Within Groups	718.80	1713	.42		
Total	726.25	1714			

Gender	Count	Mean	s.d.
Male	697	3.99	0.68
Female	1018	4.13	0.63
Total	1715	4.07	0.65

2. Education Level

2.1 Effect of Education Level on Price/ Promotion Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.89	1	1.89	3.84	0.050
Within Groups	842.23	1713	0.49		
Total	844.12	1714			

Education Level	Count	Mean	s.d.
Less than Bachelor's Degree	490	4.07	0.69
Bachelor's Degree or Higher	1225	4.14	0.71
Total	1715	4.12	0.70

2.2 Effect of Education Level on Safety/ Security Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.34	1	8.34	18.94	0.000
Within Groups	754.53	1713	0.44		
Total	762.87	1714			

Education Level	Count	Mean	s.d.
Less than Bachelor's Degree	490	4.31	0.69
Bachelor's Degree or Higher	1225	4.47	0.65
Total	1715	4.43	0.67

2.3 Effect of Education Level on System Availability Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.05	1	7.05	16.79	0.000
Within Groups	719.73	1713	0.42		
Total	726.79	1714			

Education Level	Count	Mean	s.d.
Less than Bachelor's Degree	490	4.13	0.66
Bachelor's Degree or Higher	1225	4.27	0.65
Total	1715	4.23	0.65

3. Occupation

3.1 Effect of Occupation on Safety/ Security Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.25	7	1.18	2.67	.010
Within Groups	754.63	1707	.44		
Total	762.87	1714			

Occupation	Count	Mean	s.d.
Student	340	4.31	0.69
Government Official	396	4.50	0.64
Private Company Employee	666	4.45	0.67
Self Employed	121	4.45	0.68
Freelance	109	4.32	0.66
Housewife/ Stay at Home	49	4.43	0.65
Retired	31	4.48	0.59
Others	3	4.25	0.50
Total	1715	4.43	0.67

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) Occupation	(J) Occupation				Lower Bound	Upper Bound
Student	Government Official	-0.19	0.05	0.00	-0.34	-0.03
	Private Company Employee	-0.14	0.04	0.06	-0.27	0.00
Government Official	Student	0.19	0.05	0.00	0.03	0.34
Private Company Employee	Student	0.14	0.04	0.06	0.00	0.27

* The mean difference is significant at the .05 level.
Note: Only significant comparisons shown

3.2 Effect of Occupation on System Availability Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.38	7	1.05	2.50	.015
Within Groups	719.41	1707	.42		
Total	726.79	1714			

Occupation	Count	Mean	s.d.
Student	340	4.13	0.63
Government Official	396	4.28	0.61
Private Company Employee	666	4.29	0.68
Self Employed	121	4.18	0.57
Freelance	109	4.17	0.71
Housewife/ Stay at Home	49	4.22	0.66
Retired	31	4.12	0.65
Others	3	4.20	0.40
Total	1715	4.23	0.65

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) Occupation	(J) Occupation				Lower Bound	Upper Bound
Student	Private Company Employee	-0.16	0.04	0.01	-0.29	-0.02
Private Company Employee	Student	0.16	0.04	0.01	0.02	0.29

* The mean difference is significant at the .05 level.
Note: Only significant comparisons shown

4. Income Level

4.1 Effect of Income Level on Price/ Promotions Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.88	3	1.29	2.63	0.049
Within Groups	840.24	1711	0.49		
Total	844.12	1714			

Income per Month	Count	Mean	s.d.
Less than 10,000 Baht	475	4.11	0.69
10,001 to 30,000 Baht	876	4.15	0.71
30,001 to 50,000 Baht	265	4.11	0.71
Over 50,000 Baht	99	3.95	0.61
Total	1715	4.12	0.70

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) Income per Month	(J) Income per Month				Lower Bound	Upper Bound
10,001 to 30,000 Baht	Over 50,000 Baht	0.20	0.07	0.04	0.01	0.40
Over 50,000 Baht	10,001 to 30,000 Baht	-0.20	0.07	0.04	-0.40	-0.01

* The mean difference is significant at the .05 level.
Note: Only significant comparisons shown

4.2 Effect of Income Level on Safety/ Security Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5.71	3	1.90	4.30	0.005
Within Groups	757.17	1711	0.44		
Total	762.87	1714			

Income per Month	Count	Mean	s.d.
Less than 10,000 Baht	475	4.35	0.67
10,001 to 30,000 Baht	876	4.43	0.69
30,001 to 50,000 Baht	265	4.51	0.62
Over 50,000 Baht	99	4.50	0.57
Total	1715	4.43	0.67

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) Income per Month	(J) Income per Month				Lower Bound	Upper Bound
Less than 10,000 Baht	30,001 to 50,000 Baht	-0.17	0.05	0.01	-0.30	-0.03
30,001 to 50,000 Baht	Less than 10,000 Baht	0.17	0.05	0.01	0.03	0.30

* The mean difference is significant at the .05 level.
Note: Only significant comparisons shown

4.3 Effect of Income Level on System Availability Dimension

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.45	3	1.48	3.51	0.015
Within Groups	722.34	1711	0.42		
Total	726.79	1714			

Income per Month	Count	Mean	s.d.
Less than 10,000 Baht	475	4.16	0.64
10,001 to 30,000 Baht	876	4.25	0.68
30,001 to 50,000 Baht	265	4.31	0.62
Over 50,000 Baht	99	4.29	0.50
Total	1715	4.23	0.65

Bonferroni		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
(I) Income per Month	(J) Income per Month				Lower Bound	Upper Bound
Less than 10,000 Baht	30,001 to 50,000 Baht	-0.15	0.05	0.02	-0.28	-0.02
30,001 to 50,000 Baht	Less than 10,000 Baht	0.15	0.05	0.02	0.02	0.28

* The mean difference is significant at the .05 level.
Note: Only significant comparisons shown

APPENDIX E

Questionnaire (Thai)

แบบสอบถาม	สถานี	
	เวลา	

การวิจัยเรื่องปัจจัยที่มีอิทธิพลต่อการใช้รถไฟฟ้าในกรุงเทพฯ เป็นส่วนหนึ่งของวิทยานิพนธ์ โครงการปริญญาเอก คณะรัฐประศาสนศาสตร์ สถาบันบัณฑิตพัฒนบริหารศาสตร์ จึงใคร่ขอความร่วมมือจากท่าน กรุณาให้ข้อมูลตามความเป็นจริง เพื่อให้ข้อมูลสามารถนำมาใช้ประโยชน์ทางการศึกษาและเสนอแนะได้อย่างถูกต้อง ขอบพระคุณอย่างยิ่งที่ท่านได้สละเวลาในการกรอกแบบสอบถาม

- รถไฟฟ้า คือ รถขนส่งมวลชนที่ใช้ไฟฟ้า อย่างเช่น รถไฟฟ้าลอยฟ้า (BTS) หรือ รถไฟฟ้าใต้ดิน (รฟม)

ส่วนที่ 1 ข้อมูลส่วนตัว

เพศ	1 ☐ ชาย	2 ☐ หญิง	
สถานภาพ	1 ☐ โสด	2 ☐ แต่งงาน	
	3 ☐ หย่าร้าง	4 ☐ หม้าย	
อายุ	1 ☐ น้อยกว่า 21 ปี	2 ☐ 21 - 30 ปี	3 ☐ 31 - 40 ปี
	4 ☐ 41 - 50 ปี	5 ☐ 51 - 60 ปี	6 ☐ มากกว่า 60 ปี
ระดับการศึกษา	1 ☐ ประถมศึกษา	2 ☐ มัธยมศึกษา	
	3 ☐ วิทยาลัย (ปวช./ปวส.)	4 ☐ ปริญญาตรี	5 ☐ ปริญญาโทขึ้นไป
อาชีพ	1 ☐ นักเรียน/นักศึกษา	2 ☐ รับราชการ/รัฐวิสาหกิจ	3 ☐ พนักงานเอกชน
	4 ☐ ธุรกิจส่วนตัว	5 ☐ รับจ้างทั่วไป	6 ☐ พ่อบ้าน แม่บ้าน
	7 ☐ เกษียณ	8 ☐ อื่นๆ (โปรดระบุ) ____________	
รายได้ต่อเดือน	1 ☐ น้อยกว่า 10,000 บาท	2 ☐ 10,001-20,000 บาท	3 ☐ 20,001-30,000 บาท
	4 ☐ 30,001-40,000 บาท	5 ☐ 40,001-50,000 บาท	6 ☐ 50,001-60,000 บาท
	7 ☐ มากกว่า 60,000 บาท		

พนักงานเก็บแบบสอบถาม ____________

ส่วนที่ 2 ข้อมูลการเดินทาง

ท่านใช้รถไฟฟ้า (ลอยฟ้า/ใต้ดิน) เดือนละกี่วัน?

1 ☐ ไม่เคย 2 ☐ ใช้ 1-7 วัน 3 ☐ ใช้ 8-14 วัน

4 ☐ ใช้ 15-21 วัน 5 ☐ ใช้มากกว่า 21 วัน

ท่านใช้ รถยนต์ เดือนละกี่วัน?

1 ☐ ไม่เคย 2 ☐ ใช้ 1-7 วัน 3 ☐ ใช้ 8-14 วัน

4 ☐ ใช้ 15-21 วัน 5 ☐ ใช้มากกว่า 21 วัน

ท่านใช้ รถเมล์ เดือนละกี่วัน?

1 ☐ ไม่เคย 2 ☐ ใช้ 1-7 วัน 3 ☐ ใช้ 8-14 วัน

4 ☐ ใช้ 15-21 วัน 5 ☐ ใช้มากกว่า 21 วัน

ท่านใช้ รถแท็กซี่ เดือนละกี่วัน?

1 ☐ ไม่เคย 2 ☐ ใช้ 1-7 วัน 3 ☐ ใช้ 8-14 วัน

4 ☐ ใช้ 15-21 วัน 5 ☐ ใช้มากกว่า 21 วัน

ท่านใช้ มอเตอร์ไซค์ เดือนละกี่วัน?

1 ☐ ไม่เคย 2 ☐ ใช้ 1-7 วัน 3 ☐ ใช้ 8-14 วัน

4 ☐ ใช้ 15-21 วัน 5 ☐ ใช้มากกว่า 21 วัน

ท่านคิดว่าในอนาคตคนทั่วไปจะหันไปใช้รถไฟฟ้าแทนรถยนต์ รถเมล์ แท็กซี่ มอเตอร์ไซค์ไหม?

1 ☐ ใช้ 2 ☐ ใช้เป็นบางครั้ง 3 ☐ ใช้เป็นส่วนมาก

4 ☐ ไม่ทราบ

ท่านใช้รถไฟฟ้าเมื่อไร? (เลือกได้มากกว่า 1 ข้อ)

☐ ไปทำงาน/เรียน ☐ ไปกินข้าวนอกบ้าน ☐ ไปดูหนัง ฟังเพลง

☐ ไปซื้อของ ☐ ไปเจอเพื่อน ☐ ไปทำธุระ

☐ ไปชมนิทรรศการหรือร่วมงานต่างๆ

☐ อื่นๆ (โปรดระบุ) ____________________

ส่วนที่ 3					
ท่านคิดว่ารถไฟฟ้าควรให้ความสำคัญกับสิ่งต่อไปนี้มากน้อยเพียงใด?	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
(กรุณาใส่เครื่องหมาย x ในช่องที่เหมาะสมที่สุดเพียงช่องเดียว)	1	2	3	4	5
• ราคา					
• รายการส่งเสริมการขาย					
• สถานที่ (ในสถานีและรถโดยสาร)					
• คุณภาพบริการและระบบ					
• ความปลอดภัยและระบบรักษาความปลอดภัย					
• ข้อมูลเกี่ยวกับระบบ					
• การบริการและความสะดวก					
• ราคาน้ำมัน, รถติด, หาที่จอดรถยาก					
• นโยบายและการสนับสนุนจากรัฐ					

รายการไหนมีความสำคัญที่ 1 (โปรดเลือกเพียงรายการเดียว)

1 ☐ ราคา 2 ☐ รายการส่งเสริมการขาย

3 ☐ สถานที่ (ในสถานีและรถโดยสาร) 4 ☐ คุณภาพบริการและระบบ

5 ☐ ข้อมูลเกี่ยวกับระบบ 6 ☐ ความปลอดภัยและระบบรักษาความปลอดภัย

7 ☐ การบริการและความสะดวก 8 ☐ ราคาน้ำมัน, รถติด, หาที่จอดรถยาก

9 ☐ นโยบายและการสนับสนุนจากรัฐ

รายการไหนมีความสำคัญที่ 2 (โปรดเลือกเพียงรายการเดียวที่ไม่ซ้ำอันดับ 1)

1 ☐ ราคา 2 ☐ รายการส่งเสริมการขาย

3 ☐ สถานที่ (ในสถานีและรถโดยสาร) 4 ☐ คุณภาพบริการและระบบ

5 ☐ ข้อมูลเกี่ยวกับระบบ 6 ☐ ความปลอดภัยและระบบรักษาความปลอดภัย

7 ☐ การบริการและความสะดวก 8 ☐ ราคาน้ำมัน, รถติด, หาที่จอดรถยาก

9 ☐ นโยบายและการสนับสนุนจากรัฐ

ส่วนที่ 4					
ท่านคิดว่ารถไฟฟ้าควรให้ความสำคัญกับสิ่งต่อไปนี้มากน้อยเพียงใด? (กรุณาใส่เครื่องหมาย x ในช่องที่เหมาะสมที่สุดเพียงช่องเดียว)	น้อยที่สุด 1	น้อย 2	ปานกลาง 3	มาก 4	มากที่สุด 5
การบริหารจัดการ					
• พนักงานที่มีความสุภาพและเต็มใจให้บริการ					
• พนักงานที่แต่งกายเหมาะสมและเรียบร้อย					
• พนักงานที่มีความกระตือรือร้นในการให้บริการ					
• พนักงานที่มีความรู้ความสามารถที่จะแก้ปัญหาให้ผู้โดยสารได้					
• มาตรการความปลอดภัยที่เหมาะสมสำหรับระบบ					
• มีข้อมูลการเดินทางที่มีประโยชน์					
• การให้ข้อมูลรายละเอียดเกี่ยวกับระบบ					
• ข้อมูลด้านสถานีรถโดยสารและสิ่งอำนวยความสะดวก					
• การที่ผู้โดยสารสามารถติดต่อขอข้อมูลได้ง่าย					
• การรักษาความปลอดภัยของระบบที่น่าเชื่อถือ					
• การจัดเจ้าหน้าที่รักษาความปลอดภัยในระบบอย่างเพียงพอ					
• อุปกรณ์ด้านความปลอดภัยอย่างเพียงพอในระบบ					
• รถโดยสารเข้า - ออกสถานีตรงตามเวลา					
• การรณรงค์ให้ใช้ระบบ					
• ท่านคิดว่าหมวดการบริหารจัดการนี้ มีความสำคัญมากน้อยขนาดไหนกับจำนวนผู้เลือกใช้รถไฟฟ้า					
ระบบ					
• ความสะอาดและการบำรุงรักษาระบบที่ดี					
• ความสวยงามของระบบ					
• การจัดหาสิ่งอำนวยความสะดวกอย่างเพียงพอ เช่น ATM, ร้านสะดวกซื้อ,...					
• การจัดหาที่จอดรถอย่างเพียงพอ					
• การจัดหาป้ายนำทางที่ชัดเจน และมีประโยชน์					

	1	2	3	4	5
• รถโดยสารที่มีความสะดวกสบายในการเดินทาง					
• รถโดยสารที่สามารถขึ้นได้ง่ายจากระดับถนน					
• รถโดยสารที่มีความปลอดภัยในการเดินทาง					
ท่านคิดว่ารถไฟฟ้าควรให้ความสำคัญกับสิ่งต่อไปนี้มากน้อยเพียงใด?	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
(กรุณาใส่เครื่องหมาย x ในช่องที่เหมาะสมที่สุดเพียงช่องเดียว)	1	2	3	4	5
• สถานีอยู่ในระยะที่สามารถจะเดินไปถึงได้โดยสะดวก					
• การมีสถานีเพื่อให้บริการผู้โดยสารอย่างเพียงพอ					
• รถบริการรับส่งผู้โดยสารถึงสถานีได้ง่ายและสะดวก					
• รถโดยสารเพียงพอ					
• การขยายระบบเพื่อให้การเดินทางสะดวกขึ้น					
• ท่านคิดว่าหมวดระบบนี้ มีความสำคัญมากน้อยขนาดไหนกับจำนวนผู้เลือกใช้รถไฟฟ้า					
ค่าใช้จ่าย					
• การตั้งราคาค่าโดยสารโดยเฉลี่ยเหมาะสม					
• รัฐควรควบคุมราคาค่าโดยสารให้เหมาะสม					
• ส่วนลดค่าโดยสารที่จูงใจ					
• รายการส่งเสริมการขายด้านราคาที่จูงใจ					
• รายการส่งเสริมการขายให้กับผู้โดยสารประจำ					
• การให้ผลประโยชน์พิเศษกับผู้โดยสารประจำ					
• การส่งเสริมการขายที่สร้างแรงจูงใจให้ใช้ระบบ					
• ท่านคิดว่าหมวดค่าใช้จ่ายนี้ มีความสำคัญมากน้อยขนาดไหนกับจำนวนผู้เลือกใช้รถไฟฟ้า					
อื่นๆ					
• มาตรการควบคุมการใช้รถยนต์					
• ราคาน้ำมัน					
• การจราจรที่แออัดบนท้องถนน					

• ที่จอดรถในตัวเมืองชั้นใน					
• รัฐควรให้งบประมาณสนับสนุนแก่รถไฟฟ้า					
• การให้ข้อมูลผลประโยชน์ด้านสิ่งแวดล้อม ที่ได้รถไฟฟ้า					
• การให้ข้อมูลผลประโยชน์ด้านเศรษฐกิจ ที่ได้รถไฟฟ้า					
• ท่านคิดว่าหมวดอื่นๆ นี้ มีความสำคัญมากน้อยขนาดไหนกับจำนวนผู้เลือกใช้รถไฟฟ้า					

APPENDIX F

Questionnaire (English)

Questionnaire	station	
	time	

Research on Dimensions Influencing Rail Mass Transit ridership in Bangkok is a part of the dissertation for the Ph.d. program. The School of Public Administration, NIDA would appreciate your cooperation to provide actual information in order to use the information for academic study and accurate recomendations. Thank you very much for your time and response in completing the questionnaire.

- Rail Mass Transit systems are public trains using electricity such sa the Skytrain (BTS) or Subway (MRTA)

Part 1 Personal Data

Gender	1 ☐ Male	2 ☐ Female	
Marital Status	1 ☐ Single	2 ☐ Married	
	3 ☐ Divorced	4 ☐ Widowed	
Age	1 ☐ Under 21 years	2 ☐ 21 - 30 years	3 ☐ 31 - 40 years
	4 ☐ 41 - 50 years	5 ☐ 51 - 60 years	6 ☐ Over 60 years
Education level	1 ☐ Primary school	2 ☐ Secondary school	
	3 ☐ Vocational School	4 ☐ Bachelor's degree	5 ☐ Master's degree or higher
Occupation	1 ☐ Student	2 ☐ Government Official	3 ☐ Private company employee
	4 ☐ Self employed	5 ☐ Freelance	6 ☐ Housewife/Stay at home
	7 ☐ Retired	8 ☐ Others (Specify) ____________	
Income per month	1 ☐ Less than 10,000 Baht	2 ☐ 10,001-20,000 Baht	3 ☐ 20,001-30,000 Baht
	4 ☐ 30,001-40,000 Baht	5 ☐ 40,001-50,000 Baht	6 ☐ 50,001-60,000 Baht
	7 ☐ มากกว่า 60,000 บาท		

Staff ____________

Part 2 Commute Information

How many days do you use Rail Mass Tranist (Skytrain/Subway) per month'

1 ☐ Never 2 ☐ 1-7 days 3 ☐ 8-14 days

4 ☐ 15-21 days 5 ☐ more than 21 days

How many days do you use automobiles per month'

1 ☐ Never 2 ☐ 1-7 days 3 ☐ 8-14 days

4 ☐ 15-21 days 5 ☐ more than 21 days

How many days do you use buses per month?

1 ☐ Never 2 ☐ 1-7 days 3 ☐ 8-14 days

4 ☐ 15-21 days 5 ☐ more than 21 days

How mant days do you use taxis per month?

1 ☐ Never 2 ☐ 1-7 days 3 ☐ 8-14 days

4 ☐ 15-21 days 5 ☐ more than 21 days

How many days do you use motorcycles per month?

1 ☐ Never 2 ☐ 1-7 days 3 ☐ 8-14 days

4 ☐ 15-21 days 5 ☐ more than 21 days

Do you think in the future commuters will use Rail Mass Transit systems instead of automobiles, buses, taxis, motorcycles

1 ☐ Yes 2 ☐ Sometimes 3 ☐ Most of the time

4 ☐ Don't know

When do you use the Rail Transit system?

☐ Work/Study ☐ Dine outside the house ☐ Entertainment

☐ Shopping ☐ Meet friends ☐ Business or errands

☐ Attend functions (seminars, exhibitions)

☐ Others (specify) ____________________

Part 3 What level of importance should the Rail Mass Transit give to the following dimensions? (Please mark only one X in the most appropriate box)	very unimportant 1	unimportant 2	neutral 3	important 4	very important 5
• Price					
• Promotions					
• Facilities (inside Stations and Trains)					
• Quality (Service and System)					
• Safety/Security					
• Information					
• Convenience/Availability					
• Oil Price, Traffic Congestion, Parking Availability					
• Government					

Please choose the most important dimension (Please select only one answer)

1 ☐ Price
2 ☐ Promotions
3 ☐ Facilities (station and trains)
4 ☐ Quality (Service and System)
5 ☐ Information
6 ☐ Safety/Security
7 ☐ Convenience/Availability
8 ☐ Oil Price, Traffic Congestion, Parking Availability
9 ☐ Government Policy

Please choose the second most important dimension (Please select only one answer)

1 ☐ Price
2 ☐ Promotions
3 ☐ Facilities (station and trains)
4 ☐ Quality (Service and System)
5 ☐ Information
6 ☐ Safety/Security
7 ☐ Convenience/Availability
8 ☐ Oil Price, Traffic Congestion, Parking Availability
9 ☐ Government Policy

Part 4	very unimportant	unimportant	neutral	important	very important
What level of consideration should the Rail Mass Transit give to the following items?					
(Please mark only one X in the most appropriate box)	1	2	3	4	5
Management					
• Polite and willing to serve staff					
• Well and appropriately dressed staff					
• Staff providing service with enthusiasm					
• Knowledgable staff that can assist commuters with problems					
• Appropriate safety measures for the system					
• Useful route information					
• Available detailed information about the system					
• Information on the stations and amenities					
• Information requests that can easily be obtained					
• Reliable security within the system					
• Sufficient security gaurds within the system					
• Sufficient safety equipment provided within the system					
• Punctual train service					
• Campaign to use the system					
• What level of importance does the measures in the Management section have on commuters selection to use Rail Mass Transit					
System					
• Clean and well maintained system					
• Aesthetically beautiful system					
• Provision of sufficient amenities such as ATM, convenience stores and etc.					
• Sufficient parking facilities					

	1	2	3	4	5
• Clear and useful directional signage					
• Comfortable commuter trains					
• Easily accessed commuter trains from street level					
• Safe commuter trains for transportation					

What level of consideration should the Rail Mass Transit give to the following items? **(Please mark only one X in the most appropriate box)**	very unimportant 1	unimportant 2	neutral 3	important 4	very important 5
• System that is conveniently accessible within walking distance					
• Sufficient stations to facilitate the commute					
• Convenient and easily accessed feeder system for commuters to stations					
• Adequate train service					
• System expansions that will improve availability and convenience in the future					
• What level of importance does the measures in the System section have on commuters selection to use Rail Mass Transit					
Expenses					
• Appropriate average fare rates					
• Government control to provide appropriate prices					
• Attractive discounted fares					
• Attractive promotional fares					
• Promotions for regular commuters					
• Special benefits for frequent users					
• Promotions providing incentives for usage of system					
• What level of importance does the measures in the Expenses section have on commuters selection to use Rail Mass Transit					

Others					
• Auto restraint policies					
• Oil prices					
• Traffic congestion on roadways					
• Parking spaces in the inner city					
• Government should subsidize the Rail Mass Transit system					
• Information on environmental benefits of the Rail Mass Transit system					
• Information on economic benefits of the Rail mass Transit system					
• What level of importance does the measures in the Others section have on commuters selection to use Rail Mass Transit					

BIOGRAPHY

NAME	Mr. Sopat Voravivatana
ACADEMIC BACKGROUND	1996 Master of Science Civil Engineering San Jose State University 1993 Bachelor of Science Civil Engineering San Francisco State University
PRESENT POSITION	Engineering Manager Ch. Karnchang Public Company Limited