



Bangkok's mass rapid transit system's commuter decision-making process in using integrated smartcards

Peerakan Kaewwongwattana ^{a,*}, Vinai Panjakajornsak ^b, Paitoon Pimdee ^c

^a Doctoral Program in Administration and Management, Faculty of Administration and Management, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand

^b Faculty of Administration and Management, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand

^c Faculty of Industrial Education, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand

ARTICLE INFO

Article history:

Received 12 February 2015

Received in revised form 21 July 2015

Accepted 27 July 2015

Available online 24 June 2016

Keywords:

Bangkok

CFA

integrated smartcard
transit

ABSTRACT

This paper studied the decision-making process to use an integrated smartcard ticketing system by Bangkok metropolitan transit commuters. A second-order Confirmatory Factor Analysis using LISREL 9.10 was undertaken on Bangkok commuter's decision-making process on the use of an integrated smartcard system. The sample consisted of 300 Bangkok commuters obtained by accidental sampling using questionnaires with a 5-point Likert scale. The tools in the research questionnaires used scale estimation that achieved a confidence value of 0.84. The research instruments used rating scales measuring information search, alternative choices, and use decision on the 15 variables in the decision-making process which had factor loadings between 0.49 and 0.89 weight elements when sorted in descending order and overall had a high level. Use decision, alternative choices and information search had a factor of 0.89, 0.65 and 0.49, respectively. There was a good fit of the decision-making model to the empirical data (chi-square = 34.55, probability (p) = 0.94, df = 49, RMSEA = 0.00, GFI = 0.98, AGFI = 0.96, SRMR = 0.04). Copyright © 2016, Production and hosting by Elsevier B.V. on behalf of Kasetsart University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The most critical urban problems in Bangkok today probably evolve around transportation issues. Since 1967, the population of Thailand has more than doubled. In 1972, police records showed that there were about 243,000 cars in Bangkok (not including motorcycles), and the average speed achieved on a main road was about 23 km/h (Lo & Yeung, 1997). In 1990, the number of cars had increased to 1 million, with official statistics now stating that the total number of vehicles with Bangkok license plates has

reached 8.55 million—double the 4.28 million registered in 2004 (Bangkok Post, 2014).

The title of the 'world's worst commute' has been given to Bangkok, where people now spend on the average 2 h a day traveling to and from work (Express, 2014) while at peak times, the average speed of commuters using vehicles in and out of Bangkok is only 11 km/h. Therefore, the critical need for an efficient and effective mass rapid transit system is all too easy to see with government planners from the Bangkok Metropolitan Administration (BMA) setting an ambitious target to reduce the use of private cars in the city by 30 percent over the next 15 years and to encourage more motorists to turn to mass transit as an alternative mode of traveling (ThaiPBS, 2014). This appears to be working as only 1263 owners registered their vehicles each day in 2014 compared with 1954 vehicles a day in

* Corresponding author.

E-mail address: peerakan99@gmail.com (P. Kaewwongwattana).

Peer review under responsibility of Kasetsart University.

2013 (Bangkok Post, 2014). In 2012, plans for a commuter-friendly Bangkok were laid out with officials promising a cheaper, more convenient and integrated ticketing system as early as 2015. The easiest and least expensive part of the government's plan was the introduction of a joint-ticketing system whereby commuters could gain access to all forms of mass transit — elevated trains, subway trains, buses and boats — by using a single ticket (Bangkok Post, 2012).

The intent of this research was therefore to study the linking strategies of an integrated smartcard ticketing system that would better serve Bangkok metropolitan area commuters as well as to provide information to agencies involved in marketing strategies concerning an integrated smartcard ticketing system for Bangkok's metropolitan commuter systems. A Structural Equation Model was employed to analyze the variables either directly or indirectly affecting Bangkok consumer use of an integrated smartcard ticketing system decision-making process.

Research by Kotler and Armstrong (2001) has become a pillar in discussions concerning consumer-buying decision processes. In earlier research, they described two types of factors that help in determining and encouraging the consumer purchase intention covering personal and stimulating factors. Later, they expanded the research and went on to discuss the stages and importance of the consumer process's dependence on the individual with the decision-making process being divided into five stages: Need Recognition, Information Search, Evaluation and Alternatives, Purchase Decision, and Post Purchase Behavior.

Installing trust between sellers and customers in an E-commerce environment is not easy. This is why it is necessary to understand several marketing models such as the types of buying decision behavior or the different characteristics affecting the customer behavior (Kotler & Armstrong, 2008).

Information Search on Decision-making

When a consumer buy a new good, they are waiting for some information about it. This information could be given directly by a seller in a shop store; however on a web site this practice is more complicated. Customers clearly can access certain information. However, if this information does not answer the questions raised, customers can feel confused. The more customers become confused about a product, the more they will need explanations and knowledge transfer in order to decrease consumer fear and perceived risk (Corbitt, Thanasankit, & Yi, 2003).

Consumers engage in both internal and external information searching (Perner, 2010). Internal searching involves the consumer identifying alternatives from memory. For certain low involvement products such as fast food restaurants, consumers must be able to retrieve a restaurant from memory before it will be considered. For high involvement products, consumers are more likely to use an external search. Before buying a car, for example, the consumer may ask friends' opinions, surf the Internet or visit several dealerships. Thus, firms that make products that are selected predominantly through external searching must invest in having information available to the consumer in need.

Kotler and Armstrong (2001) stated that among the consumer decision-making process, understanding consumers' sources of information for the product is crucial because it is the early phase of consumer behavior and it may influence the rest of the consumer decision-making process. Personal factors include consumer personality with respect to demand, incentive, attitude, access of information, and adaptability.

Consumer knowledge can often be obtained from the product vendors themselves. To obtain and then provide this information, by often implementing a 'smart card' collection system is a great advantage. In Bangkok's case a 'smart card' system across multiple mass transit networks could potentially provide information to both operators and consumers such as providing information search ability, consumer protection and consumer service in the following areas (Diyar, 2010).

They eliminate the need for transit system personnel handling tickets as they can be purchased from outside commercial vendors for long periods of time.

1. They can be re-filled, even further reducing system staff requirements.
2. They can obtain and store accurate information on ticket sales from all systems.
3. Smartcards can eliminate mistakes and theft in ticket collection procedures.
4. Distribution of tickets/cards to commuters occurs in a secure, safe, and efficient manner.
5. It is easy to generate powerful daily reports on ticket sales and system utilization such as load factors.
6. Decision-making process are improved. Organizations can make better decisions based on complete and full information on ticket sales at any point of time.
7. Better service can be provided to commuters and increase customer satisfaction.

Alternative Choices on Decision-making

Life is full of trade-offs. People must choose how to spend scarce money and time. The decisions they make reflect their options, needs, and preferences. Economists call these *demands*, which refers to the amount and type of goods people and businesses will consume under specific conditions (Litman, 2012).

According to Litman (2012), price changes can affect consumption in various ways. Transport activities tend to follow this pattern. When transport prices decline, mobility tends to increase, and if prices increase, mobility declines. Transport price changes can affect trip frequency, route, mode, destination, scheduling, vehicle type, parking location, and the type of service selected.

Use Decision in Decision-making

EMTA (European Metropolitan Transport Authorities) issued a report after studying the issue of electronic ticketing in Europe. Decision-making about fare levels varies from one city to another and generally is decided by

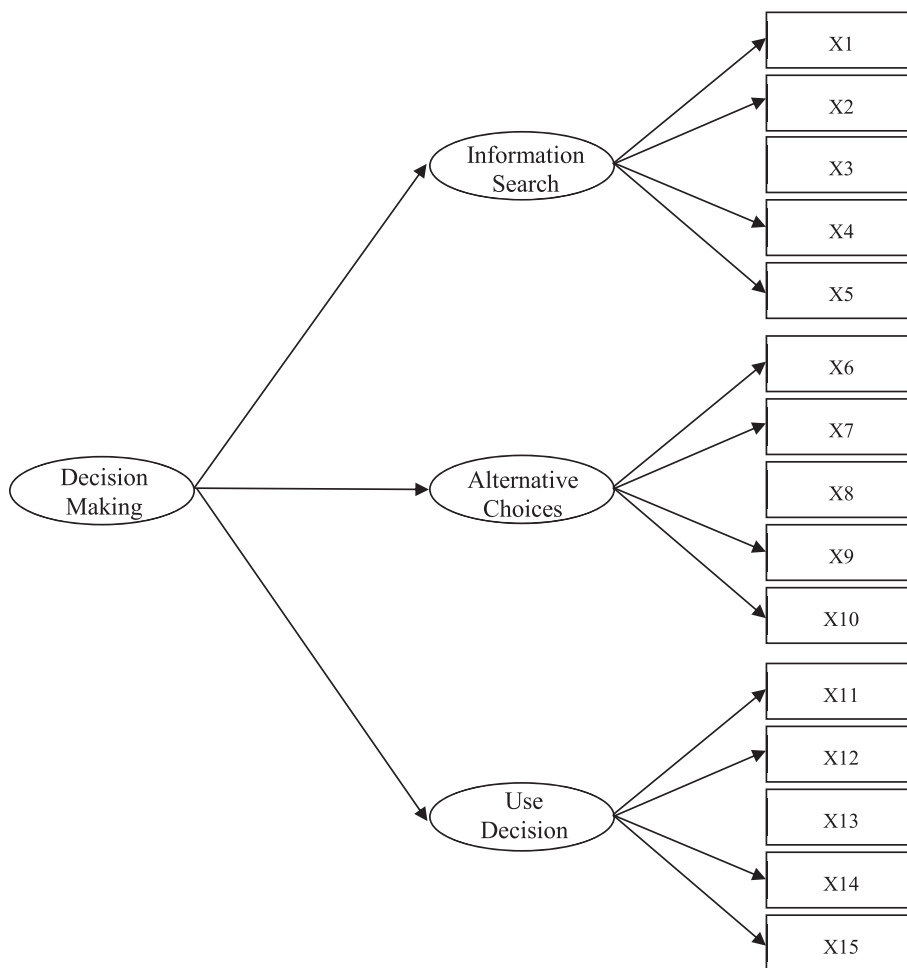


Figure 1 Confirmatory Factor Analysis of information search, alternative choices and use decision on decision-making by BMRT commuters to use a unified ticketing system

operators and authorities. Outside this however, even though the user is not involved in the initial fare rate decision-making process, he/she influences it indirectly because fare levels take into account affordability for the user. A high fare level will be perceived as anti-social and will reduce public transport use, unless it is part of a voluntary marketing policy targeting high-income people (EMTA, 2008). When defining a fare structure, it is important to carefully consider the following issues (EMTA, 2008): ease-of-use for passengers, equity (types of users, types of trips), simplicity of revenue collection, ease-of-control for operators, attractiveness to passengers, inter-modality (transfer tickets), simplicity of clearing and sharing revenues between operators, maximizing fare box revenues, and reducing fraud.

Paper tickets are an obsolete technology — just about every city in the world is abandoning them in favor of the transport smartcards pioneered in Hong Kong and London (CityMetric, 2014). Hong Kong wasn't quite the first city to introduce transport smartcards (that honor goes to Seoul), but it was the first to adapt them to work across a truly complex modern transport network. The Octopus card

system first appeared in 1997 and takes the form of a stored-value, pay-as-you-go (PAYG) card which works across multiple public and private transport providers.

Providers set their own fares, debited from the money stored on the card; the system allowed no season ticket, no bulk discount, and no caps on fares when they reached a certain point. So the system was, as these things go, relatively simple. Rather than being specific to transport, MTR had accidentally invented pre-paid contactless payment cards: indeed, Octopus is now used in Hong Kong for all kinds of low-value retail transactions. Therefore, after a review of the literature, a second-order Confirmatory Factor Analysis (CFA) was undertaken on Bangkok's Mass Rapid Transit (BMRT) system's commuter decision-making process for using integrated smartcards as seen below in Figure 1.

Material and Methods

This study carried out the following stages of research methods.

The population and samples were composed of commuters who were utilizing public mass transit systems in the Bangkok metropolitan area from June 2013 to July 2013. This included the three primary light-rail systems of the BTS Skytrain, the MRT subway, and the SRT (State Railway of Thailand) Airport Rail Link line (ART). The sample size was determined by Schumacker and Lomax (1996) with 10 commuters selected for each survey variable. The research studied 15 observed variables. Therefore, the total sample number to be gathered was not less than 150 samples. However, from the actual survey, 300 samples were obtained for the analysis using accidental sampling.

A Second-Order CFA was used for analysis with LISREL 9.10 used to analyze the latent variables using a structural equation model of the relationship factors in the decision-making process of consumers wishing to use an integrated smartcard ticketing system in the Bangkok mass transit systems, which showed the diagnostic accuracy of the model and the influence of variables in the model using path analysis with latent variables. Analysis of LISREL 9.10

was used to validate the model, while the Goodness of Fit Measurement was used to measure the level of harmony of functions (Ungsichote, 2008; Wiruchchai, 1995). The Hosmer-Lemeshow test (Hosmer & Lemeshow, 2000) for logistic regression is widely used to answer the question “How well does my model fit the data?” It is used frequently in risk prediction models. The test assesses whether or not the observed event rates match expected event rates in subgroups of the model population.

This analysis considered whether the Chi-square was insignificant, statistically significant ($p > .05$) or $\chi^2/df < 2.00$ with other test levels being RMSEA $< .05$ GFI $> .90$ AGFI $> .90$ and SRMR $< .05$. Analysis of the construct validity was undertaken with a Second-Order CFA using the LISREL 9.10 program and using criteria consideration for model confirmation with empirical data that applied from some parts of Ungsichote (2008) and Wiruchchai (1995) as the Chi-square showed no statistical significance at levels of $.05$ ($p > .05$), RMSEA $< .05$, GFI $> .90$, AGFI $> .90$, RMR $< .05$ and SRMR $< .05$.

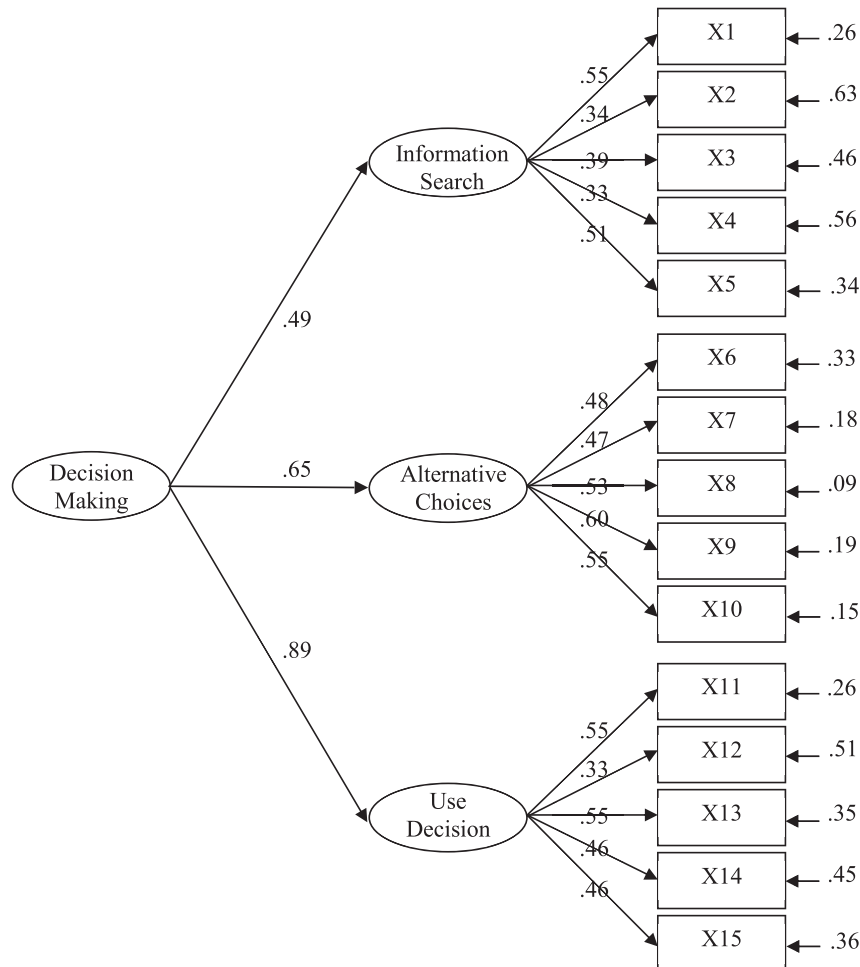


Figure 2 CFA of the causal relationships of the decision-making process to use a unified ticketing system by the BMRT

The instruments used in the study to analyze the decision-making process to use an integrated smartcard centers by querying commuters about the composition of their decision to use a smartcard to travel in Bangkok, was developed and derived from the literature and related research. A 5-point Likert Scale (Likert, 1972) was used to determine if commuters 'agreed' or 'disagreed' with the query questions.

The survey questions were obtained from the literature and related research. Commuters were queried with 15 questions from three separate categories which included five variables each. Questionnaire content validity was confirmed by a panel of experts from their related fields. According to the analysis result of scale validity and reliability, scale investigation was conducted using internal consistency measurement coefficient alpha (α -coefficient) of Akron BAC (Cronbach) to calculate the average value of the correlation coefficient, whose value of 0.84 was found to be highly reliable.

Results and Discussion

A second-order CFA was undertaken on the BMRT system's commuter decision-making process to use integrated smartcards as seen below in Figure 2. Table 1 shows the averages and the standard deviation and the historical interpretation of the average.

From Figure 2 and Table 2, the decision-making variables by BMRT commuters to use a unified ticketing system showed that the three casual variables had 15 variables with each element of the variable having a weight between 0.49 and 0.89 and a weighted standard component of each variable with a value between 0.33 and 0.60.

Priorities of the composition by weight of the elements in descending order are shown below:

Sequence 1: use decision (0.89).
Sequence 2: alternative choices (0.65).
Sequence 3: information search (0.49).

Consumers engage in both internal and external information searching (Perner, 2010). Internal searching involves the consumer identifying alternatives from his or her memory. In online purchasing research by Racherla, Mandviwalla, and Connolly (2012), it was shown that both argument quality and perceived similarity contribute

Table 1

CFA of the independent variables of Information Search, Alternative Choices and Use Decision on the dependent variable, the Decision-Making Process

Casual variable	Average variance extracted	Construct reliability
Information Search	0.305	0.675
Alternative choices	0.526	0.846
Use decision	0.371	0.741

Table 2
Results of confirmatory factor analysis of the variables that influence the dependent variable

Causal variable/item	Loading	t-test	Sequence
Information search			
1. X1: You will find more information about the integrated smartcard ticketing system before you decide to use.	0.55	—	1
2. X2: You will find information about the integrated smartcard ticketing system from your relatives/family only.	0.34	4.69*	4
3. X3: You will find information about the integrated smartcard ticketing system from a friend/colleague who works with you.	0.39	4.79*	3
4. X4: You can find information from the Internet about using an integrated smartcard ticketing system.	0.33	3.94*	5
5. X5: You will find information about the integrated smartcard ticketing system from location-based advertising.	0.51	5.14*	2
Alternative choices			
1. X6: Integrated smartcard ticketing system should have various options including style and price.	0.48	—	4
2. X7: Integrated smartcard ticketing system should be available from various sources such as a vendor or kiosk.	0.47	12.27*	5
3. X8: The decision to purchase and use an integrated smartcard ticketing system is based on the card's use as a major advantage.	0.53	12.33*	3
4. X9: An integrated smartcard ticketing system fare card should last for a long time.	0.60	7.63*	1
5. X10: An integrated smartcard ticketing system's fare card should be allowed to be re-filled at convenient locations such as convenience stores and shopping malls.	0.55	7.71*	2
Use decision			
1. X11: Buying and using an integrated smartcard ticketing system is an individual decision.	0.55	—	1
2. X12: You will get advice from people who have used an integrated smartcard ticketing system already and then decide to use it.	0.33	4.52*	5
3. X13: A decision to buy and use an integrated smartcard ticketing system will not take long.	0.55	7.61*	1
4. X14: You could try buying and using an integrated smartcard ticketing system to test whether to repeat the use of not.	0.46	6.77*	3
5. X15: The main reason for buying and using an integrated smartcard ticketing system is its utility, functionality and convenience.	0.46	7.87*	3

* $p < .05$

to increased trust but to varying degrees. The results provided mixed support to the moderating role of involvement. While argument quality played an important role in the high involvement mode, perceived similarity explained more variance in the low involvement mode.

Atchariyachanvanich, Okada, and Sonehara (2007) in research concerning Japanese consumer purchase and repurchase factors in Internet shopping that affected purchase decisions found that the perception of ease-of-use, awareness of the benefits received, offered products, and the perceived quality of service impact the intention of shopping on the Internet. As a result, repeat purchase behavior by gender concentrated on the Internet. People accept innovations.

Affecting the Adoption of Shopping on the Internet

Basically, behavior intention occurs when the perception of the reward from the purchase of goods or services by the consumer meets or exceeds his/her perceived sacrifice (Anderson, 1996; Yi, 1988). Therefore, it is very important to analyze the relationship between geographical locations, demographic factors, vehicle factors, social influence, and NGV attributes, all of which influence the behavior intention of car owners in Thailand (Combs, Likitsuwannakool, & Chaipoopirutana, 2012).

This is consistent with Patwardhan and Ramaprasad (2005) who conducted an empirical test among consumers in both the USA and India and found that each conceptualized stage of online decision-making was significantly impacted by the stages preceding it, either directly or indirectly. In terms of direct effects, an antecedent Internet belief variable (pre-purchase search beliefs) impacted a consequent belief variable (purchase beliefs), and an antecedent action variable (pre-purchase search) impacted a consequent action variable (purchase). Further, the consequent belief variable (purchase beliefs) impacted the immediately following antecedent action variable (pre-purchase search). In terms of indirect effects, all antecedent variables impacted consequent variables at each stage of the model.

Conclusion

It was determined that there is a great desire to use an integrate smartcard ticketing system by Bangkok commuters who use the multiple mass rapid transit systems. Historical research suggests government officials and agencies are also aware of the importance of the issue with the most recent government moving the issue to the top of a long list of national priorities. What is probably unsaid, however in all the discussion, is how politics play a role in hindering the implementation of such a system in the Bangkok metropolitan area. This is something that probably needs to be addressed in future research.

As can be seen from the first integrated smartcard ticketing systems, such as in Seoul and Hong Kong, they become more than a way to pay for transportation. The Octopus card system, run by the Hong Kong Mass Transit Railway took the form of a stored-value, pay-as-you-go

card which works across multiple public and private transport providers. Providers set their own fares which are debited from the money stored on the card. Thus, the system is relatively simple and rather than being specific to transport, MTR has actually invented pre-paid contactless payment cards. Today, Hong Kong's Octopus system is commonly used for all kinds of low-value retail transactions.

Commuters and officials in Japan, Korea, Moscow, London, and now Sydney have all discovered the long list of advantages from using integrated smartcards, turning the average commuter into a traveling consumer. Knowing this, Bangkok's government officials would be well advised to take advantage of this aspect of a 'consuming commuter' and develop and implement a system where a 'win/win' scenario is built-in for everyone.

Conflict of interest

There is no conflict of interest with any author of this manuscript.

References

- Anderson, G. (1996). *Fundamentals of education research*. London, UK: Falmer Press.
- Atchariyachanvanich, K., Okada, H., & Sonehara, N. (2007). Theoretical model of purchase and repurchase in internet shopping: Evidence from Japanese online customers. In *Paper presented at the AMC International Conference on electronic commerce proceeding series* (Vol. 258, pp. 243–252).
- Bangkok Post. (2012). *Plans for a commuter-friendly Bangkok*. Retrieved from <http://tinyurl.com/oz4agl9>.
- Bangkok Post. (2014). *Same roads, more cars in Bangkok*. Retrieved from <http://tinyurl.com/kzotofk>.
- CityMetric. (2014). *Everyone hates Sydney's new smart ticketing system – even though it's quite good*. Retrieved from <http://tinyurl.com/p8ddwxb>.
- Combs, H. W., Likitsuwannakool, N., & Chaipoopirutana, S. (2012). A comparative study of prospective natural gas for vehicle (NGV) buyers' behavior intention in Thailand. *Journal of International Business and Cultural Studies*, 6, 1–10.
- Corbitt, B. J., Thanasankit, T., & Yi, H. (2003). Trust and e-commerce: A study of consumer perceptions. *Electronic Commerce Research and Applications*, 2(3), 203–215.
- Diyar. (2010). *Smart fare collection system*. Retrieved from <http://www.diyarme.com/smartfare.htm>.
- EMTA. (2008). *Study on electronic ticketing in public transport*. Final Report. European Metropolitan Transport Authorities.
- Express. (2014). *How long does it take you to get to work?*. Retrieved from <http://tinyurl.com/kw2rznc>.
- Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression*. New York, NY: Wiley.
- Kotler, P., & Armstrong, G. (2001). *Principles of marketing* (9th ed.). Upper Saddle River, NJ: Prentice Hall.
- Kotler, P., & Armstrong, G. (2008). *Principles of marketing* (12th ed.). Upper Saddle River, NJ: Prentice Hall.
- Likert, R. (1972). Likert technique for attitude measurement. In W. S. Sahakian (Ed.), *Social psychology: Experimentation, theory, research*. Scranton, PA: Intext Educational Publishers.
- Litman, T. A. (2012). *Understanding transportation demand and elasticities*. Canada: Victoria Transport Policy Institute. Retrieved from <http://tinyurl.com/poo98ft>.
- Lo, F., & Yeung, Y. (1997). *Emerging world cities in Pacific Asia*. United Nations University Press. Retrieved from <http://tinyurl.com/o7u2o87>.
- Patwardhan, P., & Ramaprasad, J. (2005). Rational integrative model of online consumer decision making. *Journal of Interactive Advertising*, 6(1), 2–13.
- Perner, L. (2010). *Consumer behavior: The psychology of marketing*. Retrieved from <http://www.consumerpsychologist.com/>.

- Racherla, P., Mandviwalla, M., & Connolly, D. J. (2012). Factors affecting consumers' trust in online product reviews. *Journal of Consumer Behaviour*, 11(2), 94–104.
- Schumacker, R. E., & Lomax, R. G. (1996). *A beginner's guide to structural equation modeling*. Upper Saddle River, NJ: Taylor and Francis.
- ThaiPBS. (2014). *BMA sets target to reduce private car use by 30 percent in 15 years*. Retrieved from <http://tinyurl.com/qj3c4qc>.
- Ungsuchote, S. (2008). *Statistical analysis for research in social science and behavioral science: Technique of LISREL program*. Bangkok, Thailand: Mission Media. [in Thai]
- Wiruchchai, N. (1995). *Linear structural equation relationship model LISREL* (2nd ed.). Bangkok, Thailand: Chulalongkorn University Press. [in Thai]
- Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–79.