Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 25C (2017) 3740–3759

Transportation Research Procedia

www.elsevier.com/locate/procedia

World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016

# A multi-actor multi-criteria transit system selection model: A case study of Bangkok feeder system

Ackchai Sirikijpanichkul[a], Sarintorn Winyoopadit[b], Anchalee Jenpanitsub[c]

[a]*Lecturer, Department of Civil Engineering, Faculty of Engineering, Kasetsart University,*
*50 Ngam Wong Wan Rd, Ladyaow, Chatuchak, Bangkok 10900, Thailand*
[b]*Advisor, Kasetsart University Rail Engineering Center: KU Rail, Kasetsart University*
*50 Ngam Wong Wan Rd, Ladyaow, Chatuchak, Bangkok 10900, Thailand*
[c]*Chief of Project Analysis Section, Acting Director of Analysis and Development Division, The Mass Rapid Transit Authority of Thailand,*
*175 Rama IX Road, Huai Khwang, Bangkok 10320, Thailand*

**Abstract**

Selection of transit systems is one of the most complicated decisions as it concerns several decision factors and stakeholders. Governments' objectives are to maximize overall social, economic and environmental benefits including connectivity and mobility enhancement, transport service equality, economic revitalization, and environmental restoration but to minimize all possible conflicts. Designers and developers' objectives are to minimize construction time but to maximize network expansion opportunities. Financial institutes' objectives is to minimize the investment costs including capital and operating costs. Communities' objectives are to minimize environment impacts, traffic impact, land acquisition, and loss of revenues on the local transport modes but to maximize road users' safety. Transit users and operators' objective is to maximize riding comfort, mobility and accessibility. Each stakeholder's objectives are usually conflicting with the others'. To avoid and resolve such conflicts, governments or policy makers need a decision tool to help them make a transit choice that not only satisfies but also balances all stakeholders' needs. This research study introduces a transit system selection model that is developed on the multi-attribute utility theory (MAUT) to normalize the score of the alternative in each decision factor and criteria and the rank-order centroid (ROC) theory to allocate weights to each decision factor and criteria. Finally, the final decision is suggested by the proposed multi-actor multi-criteria decision model. A decision to Bangkok feeder system choice is considered as a case study.


Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.

*Keywords:* Transit system selection model; Multi-criteria decision analysis (MCDA); Multi-attribute utility theory (MAUT); Rank-order centroid (ROC); Multi-actor multi-criteria analysis (MAMCA); Stakeholder negotiation; Decision factors

2352-1465 
Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.
10.1016/j.trpro.2017.05.228

## 1. Introduction

Selection of transit systems is one of the most complicated decisions as it concerns several decision factors and stakeholders. Governments' objectives are to maximize overall social, economic and environmental benefits including connectivity and mobility enhancement, transport service equality, economic revitalization, and environmental restoration but to minimize all possible conflicts. Designers and developers' objectives are to minimize construction time but to maximize network expansion opportunities. Financial institutes' objectives are to minimize investment costs including capital and operating costs. Communities' objectives are to minimize environment impacts, traffic lane intrusion, land acquisition, and loss of revenues on the local transport modes but to maximize road users' safety. Transit users and operators' objective is to maximize riding comfort, safety, mobility and accessibility. Each stakeholder's objectives are usually conflicting with the others'. To avoid and resolve such conflicts, governments or policy makers need a decision-making tool to help them make a transit development decision choice that not only satisfies but also balances all stakeholders' needs.

## 2. Literature reviews

### *2.1. Mass rapid and semi-rapid transit network in Bangkok*

The existing mass rapid and semi-rapid transit network in Bangkok, as shown in Fig. 1, is composed of four distinguishing systems including Bangkok Mass Transit System (BTS Skytrain) with a total length of approximately 37 kilometers and 34 stations and Bangkok Bus Rapid Transit (Bangkok BRT) with a total length of approximately 16 kilometers and 12 stations operated by Bangkok Mass Transit System Public Company Limited (BTSC) under the concession of the Bangkok Metropolitan Administration (BMA), Metropolitan Rapid Transit (MRT Underground Train) with a total length of approximately 21 kilometers and 18 stations operated by the Bangkok Metro Public Company Limited (BMCL) under a concession of the Mass Rapid Transit Authority of Thailand (MRTA), and Suvarnabhumi Airport Rail Link (SARL) with a total length of approximately 44 kilometers and 11 stations operated by the State Railway of Thailand. Considering the population of approximately 8.4 million habitats (Ministry of Interior, 2011) in the vicinity of 1,570 square kilometers of Bangkok, the existing network provides a service coverage of approximately only 14 kilometers per million of capita or 0.048 stations per square kilometers which is lower than a half of the service coverage provided by each of the other major capital cities in Asia including Beijing (38, 0.197), Seoul (31.3, 0.499), Singapore (33.5, 0.187), Tokyo (34, 0.458) as appeared in LTA Academy (2013), please noted that the units of figures in the parenthesis are kilometers per million of capita and stations per square kilometers, respectively. These figures indicate that the accessibility of mass rapid transit network in Bangkok is still limited and needs major improvement. The government of Thailand plans to expand the mass rapid transit network in Bangkok to cover a total length of 495 kilometers within the year 2029. To fulfill such unprecedented target, capital intensive and time-consuming effort is expected. Therefore, a parallel plan is to develop feeder transit systems to enhance the accessibility of residents to the core transit network as soon as possible. The needs for alternative transit systems are not only limited with Bangkok but also extended to other regional hubs in Thailand which are also facing chronical problems in traffic congestion.

### *2.2. Feeder transit system selection criteria*

A feeder transit system is defined by AASHTO (2009) as a local public transit service that provide access or egress transport between trip origins or destinations and mass rapid transit stations, intermodal transfer facilities or terminals. According to Garrison and Levinson (2014), there are emerging urban transit system technologies considered by transport planners to function as feeder transit systems including Monorail, Automated guided transit (AGT), Light rail transit (LRT), High speed surface transport (HSST) in addition to the more conventional ones including tram and Bus rapid transit (BRT). These transit systems are expected to fill the gap of transportation services between bus and railway with the service range of between 3,000 to 10,000 passengers – kilometers per day per direction in travelling distance of 1 to 10 kilometers. Selecting an appropriate feeder transit system for a city is one of the crucial decisions for city and transport planners. A trade-off between system performance and capital cost is needed to be carefully