SUSTAINABLE URBAN TRANSIT BUS STOP DEVELOPMENT AND BEAUTIFICATION: AN ECONOMIC ANALYSIS

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Abstract

The study was undertaken to evaluate and propose new and modern designs for commuter bus stops throughout Bangkok's metropolitan bus system which consisted of four, six and ten meter long structures. Additionally, six different styles of billboard advertising were studied and analyzed which included internal rate of returns, net present value and the payback period in years. Results from the financial analysis showed that for the three proposed structure sizes of small, medium, and large, and with the use of six types of signage with advertising income ranging from $US142-$US284 per month, payback periods were between 7.0 to 1.4 years, 7.9 to 1.7 years, and 8.4 to 2.0 years respectively for each structure. Furthermore, each structure was proposed as having customizable applications, durable and long lasting roofs, raised and curved bench seating for moisture drainage, slotted back areas, route and bus number signs/maps showing stops/directions, easily replaceable advertising, lighting both for commuter safety and nighttime advertising, extending the revenue generation periods and possibilities and finally, commuter protection from the elements, including the hot tropical sun and rain and well as vehicle intrusion into the bus stop commuter area.

Keywords: Advertising; BMTA; commuter; financial analysis; IRR

Introduction

During the 1980's Bangkok's population increased from 8 million to almost 16 million (including those who migrate from the other areas throughout the country, and are not registered as Bangkok's citizens), a 50 percent increase that has produced some of the most severe traffic congestion and related air pollution problems of any city in the world (Public Transport Services (PTS), n/d). The Express and Rapid Transit Authority of Thailand estimates that commute time now accounts for about one-quarter of the time spent at work with resulting negative effects on business efficiency and productivity. The economic impacts of congestion, when combined with the increasing health impacts from lead-related exhaust pollution, are increasingly showing that Bangkok needs to take specific actions to address its growing traffic problems. It therefore of paramount importance to consider how existing and future transit systems can better meet the needs of this Asian urban commuter juggernaut. One such system this study will expand on is Bangkok's Mass Transit Authority bus system.

In Thailand, bus services were first introduced to serve commuters in Bangkok in 1907 with transport service first being provided by horse-drawn carriages and later by three-wheeled Ford motorcars with two long parallel benches for seating. This public transport proved very popular, and by 1933, bus services were available virtually throughout all major areas of the capital with service expansion as the city and its population grew (Bangkok Mass Transit Authority (BMTA), n/d).

During the years 1973-1975 Thailand was hard hit by high inflation with bus operators demanding an increase in fares which eventually led to the government's decision to take over the task of providing mass transit services. A 1971 study of Bangkok traffic by a team of German experts recommended merging together the then 24 private and two state bus companies, a total of 3,773 buses, into a single entity, to be operated by a private company or by the state, or alternatively by a joint private and state enterprise. The team also suggested that if no private company was able to handle the merger, the government should do it by buying all the buses and not renewing licenses which were due to expire on September 30, 1975 (Ieda, 2010).

The merger eventually took place in 1975 when the government decided to take over the bus services operated by private companies, joining them together as a non-profit company, i.e., the "Mahanakhon Transport Company Limited." Operations began in October, 1975. Unfortunately, due to certain legal constraints and a change in the government, the Mahanakhon Transport Company Limited was soon scrapped. In August, 1976, the "Bangkok Mass Transit Authority (BMTA)" was established by a Royal Decree Establishing the Bangkok Mass Transit Authority, B.E. 2519 (1976). Beginning operations the following October, the BMTA undertook to provide bus service to commuters in six provinces, i.e. Bangkok, Nonthaburi, Nakhon Pathom, Pathum Thani, Samut Sakhon and Samut Prakan (Bangkok Mass Transit Authority (BMTA), n/d).

According to Thailand's Office of Transport and Traffic Policy and Planning (Office of Transport (OTP), 2013), in 2012 there were 38,462 buses registered in Bangkok out of the total of 137,609 in the entire Kingdom (Office of Transport (OTP), 2013). From these numbers nearly 11 million people (*including transfer trips*) were expected to be boarding Bangkok buses on a daily basis in 2017 (Table 1). It should be noted that many commuters ride 3 or more buses per trip per day thus possibly confusing a reader between some studies reporting 3 million riders a day compared to Table 1's data which represents the total number of trips, *including the transfer trips.*

Table 1: Extracted from Thailand's OTP's "Main Public Transport Passenger in Bangkok & Vicinities by Mode" 2013 Table. Unit: 1,000 person-trips/day. Source: Office of Transport and Traffic Policy and Planning.

Mode	Passengers Boarding							
	2009	2010	2011	2017	2022	2027	2032	2037
Bus	10,651	10,407	10,451	10,902	11,167	11,975	12,520	12,857

Bus Stop Shelters

Although buses and urban bus service have been widespread since the 1920s, bus stop shelters did not become a common part of the American landscape until the 1970s (Woodyard, 1991) with New York becoming the

first major U.S. city to provide bus stop shelters to its transit users, using designs brought from Europe (Weisman, 1984). In recent years, American bus stop shelters have come to be seen as an important part of many, if not most, urban public transit systems with previous research carefully examining the safe and efficient design of bus stop shelters (Dobies, 1996; Federal Transit Administration (FTA), 2003; Loukaitou-Sideris, 1999; Suisman, 1996/1997).

Law and Taylor (n/d) analyzed the functions of Los Angeles bus stop shelters and factors affecting their placement at stops in transit systems and determined that current shelter placement policy was found to be guided principally by the revenue-generating potential of shelter advertisements, secondarily by political concerns over geographic equity, and only peripherally on the basis of bus stop use.

Passenger security is also a major issue in bus stop design and location, because the design and location of the bus stop can positively or negatively influence a bus patron's perception of that bus stop. From the perspective of security, landscaping, walls, advertising panels and solid structures can restrict sight lines and provide spaces to hide (Texas Transportation Institute (TTI), 1999).

Well-designed shelters do not simply provide protection from the elements. They can also, and frequently do, attract riders, help people find their way along the transit system, and support an integrated pedestrian network (Transportation Research Board (TRB), 1997). Suisman (1996/1997) also suggested that bus stop shelters have the potential to shape and change public perception about cities and the transit system.

Bus Stop Signage and Route Maps

Potential transit patrons require a considerable amount of information to use any transit system. For example, to effectively use a transit bus, an individual needs to know which route to take, where the bus goes, where the bus stops, when the bus arrives and the travel time to the destination (Dobies, 1996).

This is consistent with a new 2016 online petition calling for Bangkok Metropolitan Administration to replace the adverts at all bus stops with a useful bus guide and map was initiated urging the government to create a

bilingual bus guide, which was stated as being the standard across many big cities, and the most basic thing the government should do when building a bus stop. Even the locals need to do research when they take the bus to an unfamiliar area, otherwise, they can only rely on a brief moment to read the sign on a moving bus and decide quickly if they will hop on it (Coconuts, 2016).

In a new bus stop signage rollout (Figure 1) in the US city of Minneapolis, new signs include information about the routes that serve that stop and a unique stop number that can be used to access real-time departure information through NexTrip which uses a Services Finder or Interactive Map to find the number for any transit stop (MetroTransit, 2015).

Figure 1: BMTA Bus Stop

Bus Stop Shelter Advertising

Transit advertising--placement of print ads on buses and other vehicles and in bus shelters and train stations--is an important medium for reaching an audience of all ages, backgrounds and incomes. You are not just addressing riders with these "moving billboards." You are also reaching families and professionals in their vehicles, students shopping or right on campus, and tourists finding their way around town (Kobliski, 2005). Also according to Kobliski, the reasons for using transit advertising include the following:

- You can't zap it.
- You can't ignore it.
- It can't be turned off like television.
- It reaches drivers and passengers no matter what radio stations they're listening to.
- The large, colorful, innovative designs demand attention.
- You have exclusivity in your space.
- It delivers a varied audience.
- It offers flexibility of ad size and location.

According to Williams (2009), buses and taxis keep outdoor advertising on the move (Figure 1) and according to the US study's question, "And did you also notice ANY advertising on any of those?" (bus, bus stop or taxi), in the past seven days, respondents indicated that 21 percent noticed the advertising on bus stops from the 47% who were aware of a bus stop.

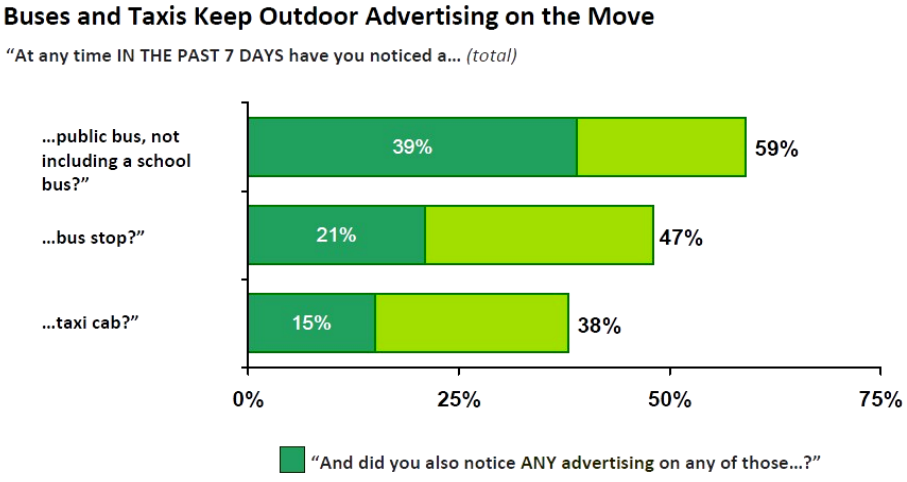


Figure 2: Buses and taxis keep outdoor advertising on the move-Source: United States residents aged 18 or older who have traveled in any vehicle in the past month

Viboonvechvanich (2007) investigated the effects of advertising at Bangkok bus shelters and its effects on passerby consumers' behaviors and attitudes toward advertisings at bus shelters, the effects of bus shelters' advertisements on consumers in terms of awareness, and finally, the main

factors which make consumers recall advertisings at bus shelters. The results revealed that most of the respondents both paid attention to advertising and were interested in the messages that bus shelters advertised, with the most powerful factors affecting passerby consumers being colors and creative designs of advertisements. The other influential elements were pictures and brand names or logos.

There are a number of things you can do with a bus shelter ad space. Static ads are fixed and can include multiple panels or a single one that stands alone. Scrolling bus shelter ads are projected on a screen and offer businesses the opportunity to scroll different panels of information. Either one can be equally as effective, though some prefer the more modern scrolling option. In a bus shelter, you can create one image or multiple images within the panels (Ranksharks, 2015).

If you don't live in a big city, you may be surprised to find that it is often alive long after a small town shuts down. This makes bus shelter advertising a beneficial piece of space that performs on a very long day. Even when the bus stops for the night, the area is lit, allowing those walking or driving by to take notice. These ads are often placed in urban areas where many people gather, pass by on their way to and from work or home, or visit for shopping or eating. All day long ads will be viewed by a multitude of current and potential customers.

Security, Crime and Customer Satisfaction

In a 2014 study from Thailand's Ministry of Finance on public services for the 2014 financial year, focus was given to performance indicators of the BMTA. From the research it was concluded that the BMTA passed just two of the four indicators, and in terms of customer satisfaction, the BMTA recorded a score of 86.6 per cent, when 90 per cent was considered an acceptable level (The Nation, 2015). From the report it was also made clear that passengers viewed the buses in general as being too old and simply not good enough, but the report did indicate that the BMTA system overall is 'safe'.

Given the urban sprawl of the BMTA's bus operating area however, crime and destitution is a growing factor playing upon any decision to improve current and future bus commuter systems and its associated bus stops

as operations include both high-end and low-end Bangkok neighborhoods. To solve these issues, the researchers envision an environment that is well-lighted, convenient, comfortable, safe, and secure both from crime and the elements. These features however cost money and mechanisms need to be implemented to pay for the upgrades.

The researchers therefore have undertaken a costing analysis to study investments required at developing and implementing modern, attractive, functional and convenient bus stop prototypes consisting of small-4 meter (S) medium-6 meter (M) and large-10 meter (L) designs. Furthermore, capital growth, internal rate of return (IRR) and net present value (NPV) is analyzed as well as payback period on advertising revenue for the BMTA system.

Research Methodology

According to Gallo (2014), comparing the value of money now with the value of money in the future is done through the process of **net present value** (NPV) with the two most-used measures for evaluating an investment being the net present value and the internal rate of return (IRR), where NPV represents the relationship between a project's expected cash flow and the cost of capital (Griff, 2014). NPV also compares the value of a unit of money today versus the value of the same unit in the future, after taking inflation and return into account. NPV is primarily used to analyze the profitability of an investment or project and is sensitive to the reliability of future cash inflows that an investment or project will yield. NPV and cost of capital can help assess potential external investments.

This is consistent with Berman, Knight and Case (2013) which stated that NPV is the present value of the cash flows at the required rate of return of a project compared to an initial investment. In practical terms, it's a method of calculating a return on investment (ROI), for a project or expenditure. When a manager needs to compare projects and decide which ones to pursue, there are generally three options available: internal rate of return, payback method, and net present value.

Net Present Value

NPV is the tool of choice for most financial analysts for two main reasons which is; NPV considers the *time value of money*, translating future

cash flows into today's money units and two, it provides a concrete number that managers can use to easily compare an initial outlay of cash against the present value of the return (Berman, Knight and Case, 2013).

Using an organization's cost of capital, the net present value is the sum of the discounted cash flows minus the original investment. Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used by organization's capital budgeting to analyze the profitability of a projected investment or project.

The following is one formula for calculating NPV:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_o$$

where; C_t = net cash inflow during the period t, C_o = total initial investment costs, r = discount rate, and t = number of time periods.

A positive net present value indicates that the projected earnings generated by a project or investment (in present dollars) exceed the anticipated costs (also in present dollars). Generally, an investment with a positive NPV will be a profitable one and one with a negative NPV will result in a net loss. This concept is the basis for the Net Present Value Rate, which dictates that the only investments that should be made are those with positive NPV values.

Internal Rate of Return

According to Investopedia (n/d), the internal rate of return (IRR) on a project is the rate of return at which the projects NPV equals zero. At this point, a project's cash flows are equal to the project's costs. Similar to how management must establish a maximum payback period, management must also set what is known as a "hurdle rate", the minimum rate of return a company will accept for a project.

When a project is reviewed with a hurdle rate in mind, the greater the IRR is above the hurdle rate, the greater the NPV, and conversely, the further the IRR is below the hurdle rate, the lower the NPV. Decision rules are as follows: If IRR > hurdle rate, accept the project and if IRR< hurdle rate, reject the project or stated another way, for a project to be accepted, the IRR must

be greater than or equal to the hurdle rate. If a company is deciding between two projects, the project with the highest IRR is the project to be accepted.

Data Collection

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, available information was assembled from numerous sources; including a number of public transportation agencies, both foreign and domestic. A topic panel of nine experts in the subject area was established to guide the researchers in organizing and evaluating the collected data, and to review the final synthesis report which included experts in transportation system design, engineering and business management or economics. This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation.

Furthermore, from the research from both domestic and foreign bus stop designs, it was determined that bus stop shelters should include sustainable materials that blend in harmoniously with the modern urban landscape. In Germany, bluespot terminals (bluespot, n/d) equipped with advanced technologies including telephone, WiFi, solar panel roofs, dynamic displays for schedule updates and announcements have become standard along with advertising display cases, benches, and waste bins. This is consistent with the study commissioned by Peruvian national transport company which selected a design by Beatriz Cockburn. The 'TU colibri' is a modular bus stop which comes with an intuitive color identification system which is capable of recognizing buses easily catering to foreign tourists, while displaying route and time statistics on the touch sensitive information block while the bus stop uses LEDs to indicate the changed routes (Ubergizom, nd). Solar panels on its roof will be its primary source of renewable energy to further make this a sustainable structure.

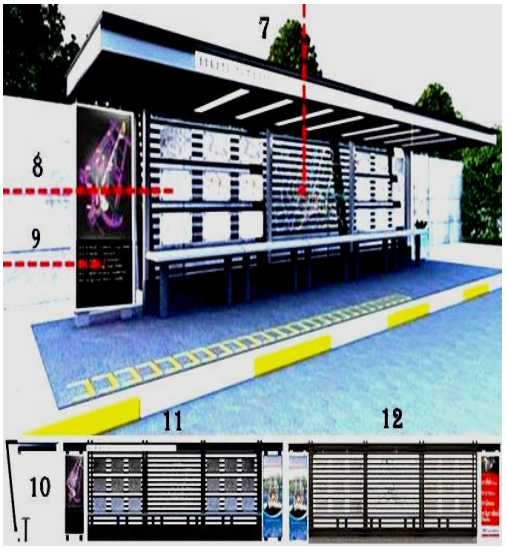
It was determined from the above examples and other research that Bangkok bus stops must include removal/replaceable advertising, durable roofs giving waiting commuters protection from the intense tropical sun and rain, and benches for passengers, including the elderly, to wait comfortably for buses. When compared to foreign countries, Thailand is presently missing key elements such electronic showing routes, cultural and heritage

information in the local area and modern designs which appeal to both tourists and local commuters.

Given the above factors, the researchers are proposing the implementation of the 3 designs which have been labeled as small-4 meters (S), medium-6 meters, (M) and large-10 meters (L) for the Bangkok Mass Transit Authority (Figures 3, 4 and 5 below).

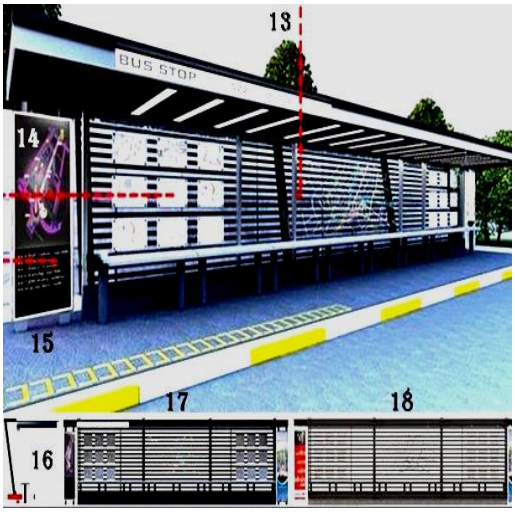
1. Area 1 consists of strips spaced apart for visual security in an area of 1.20 x 1.20 meters square.
2. 12 clear slots for replaceable advertising. Dimensions are 0.42 by 0.297 meters.
3. Area 3 consists of intelligent design of advertising or commuter information.
4. Side view of bus stop.
5. Front view of bus stop.
6. Back view of bus stop.

Figure 3: Small Bus Stop – 4 meters



7. Area 7 consists of strips spaced apart for visual security in an area of 1.20 by 1.80 meters.
8. 18 clear slots for replaceable advertising. Dimensions for each is 0.420 by 0.297 meters.
9. Area 9 consists of intelligent design of advertising or commuter information.
10. Side view of bus stop.
11. Front view of bus stop.
12. Back view of bus stop

Figure 4: Medium Bus Stop – 6 meters



13. Area 13 consists of strips spaced apart for visual security in an area of 1.20 by 2.40 meters.
14. 18 clear slots for replaceable advertising. Dimensions for each is 0.420 by 0.297 meters.
15. Area 9 consists of intelligent design of advertising or commuter information.
16. Side view of bus stop.
17. Front view of bus stop.
18. Back view of bus stop.

Figure 5: Large Bus Stop – 10 meters

Figure 6: Curved, bus route sign which presents a curved, bus route sign to indicate the line number and associated bus routes

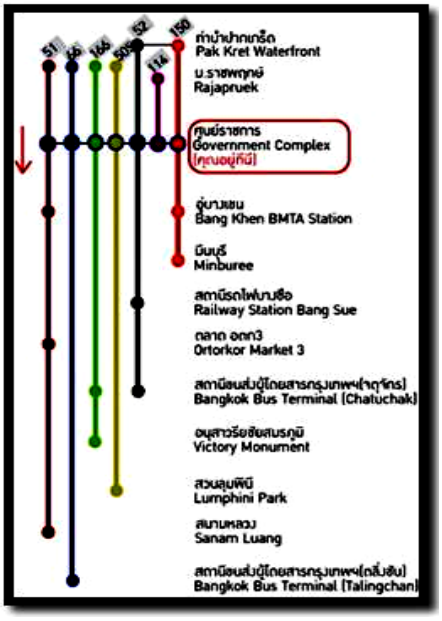


Figure 7: Color-coded, English and Thai language bus number and route information

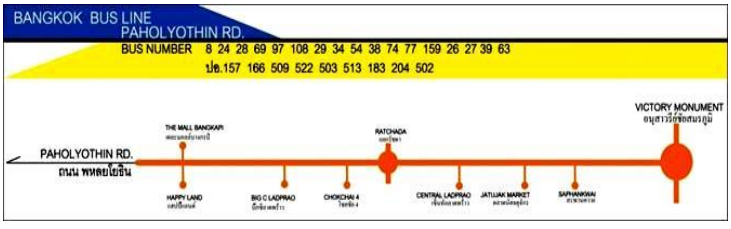


Figure 8: Bus stop's top route information in a horizontal format centered on stop's upper roof

Figure 9: Commuter bench design which is curved and made from fiberglass. This allows moisture and rain to drain off, while also making sleeping on more difficult and less comfortable than a typical flat design

Figure 10: Bus number back sign which is a 5 mm acrylic bus number back sign

The bus stop strips are made from clear acrylic material spaced so that commuters can view from either side for safety and security as well as reducing the amount of water from outside rain. Additionally, the route map can be easily removed and replaced as shown in Figure 11. Light and air is allowed to flow through the design, thus giving better security and comfort to the waiting commuters.

Figure 11: Front side route maps

Focus Group Input

The study's focus group concluded that to improve bus stops line information, each stop should display all line information for each bus stopping at the bus stop as well as a map depicting the routes and directions, from start to termination. Every sign should also show the interconnection stops between the different bus routes.

Financial Results and Return on Investment Analysis

In analyzing the financial results and return on investment, the researchers determined the following results as follows:

It was determined that the initial cost for a small-4 meter (S) bus stop structure was 110,334 THB, not including the clear, acrylic slots for

advertiser's billboards/signs and the other 5 styles/models of proposed signage (6 total as shown in Table 2).

Calculations were based upon Thailand's standard 3 percent inflation rate used in financial projections. Construction is anticipated to take 60 days to complete with structures projected to be usable for at least 10 years. Electricity for signage and safety is estimated at 1,000 THB (approximately $US30.00) per month. Results are shown in Table 2 and Figure 12.

Table 2: Results of financial analysis underlying the implementation of a small-4 meter city bus stop showing internal rate of return (IRR), net present value (NPV) and Pay Back Period analysis. Please note that on March 4, 2016 1,000 THB = 28.25 USD.

Compensation	Advertising Income from 6 proposed sign types (THB per month)					
	5,000	6,000	7,000	8,000	9,000	10,000
IRR or ERR	24%	50%	81%	121%	180%	275%
NPV	77,000	184,000	292,000	400,000	508,000	615,000
Pay Back Period (Years)	7.0	4.8	2.4	1.7	1.5	1.4

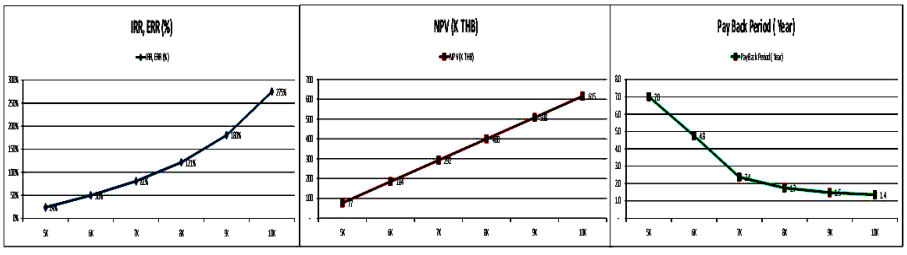


Figure 12: shows the calculation of IRR, NPV and Pay Back Period underlying the installation and use of a small-4 meter bus stop

It was determined that the initial cost for a medium-6 meter (M) bus stop structure was 143,768 THB, not including the clear, acrylic slots for advertiser's billboards/signs and the other 5 styles/models of proposed signage (6 total as shown in Table 2).

Calculations were based upon Thailand's standard 3 percent inflation rate used in financial projections. Construction is anticipated to take 60 days

to complete with structures projected to be usable for at least 10 years. Electricity for signage and safety is estimated at 1,000 THB (approximately $US30.00) per month. Results are shown in Table 3 and Figure 12.

Table 3: Results of financial analysis underlying the implementation of a medium-6 meter city bus stop showing internal rate of return (IRR), net present value (NPV) and Pay Back Period analysis. Please note that on March 4, 2016 1,000 THB = 28.25 USD.

Compensation	Advertising Income from 6 proposed sign types (THB per month)					
	5,000	6,000	7,000	8,000	9,000	10,000
IRR or ERR	13%	32%	51%	73%	100%	135%
NPV	43,000	151,000	259,000	367,000	474,000	582,000
Pay Back Period (Years)	7.9	4.5	2.9	2.3	2.0	1.7

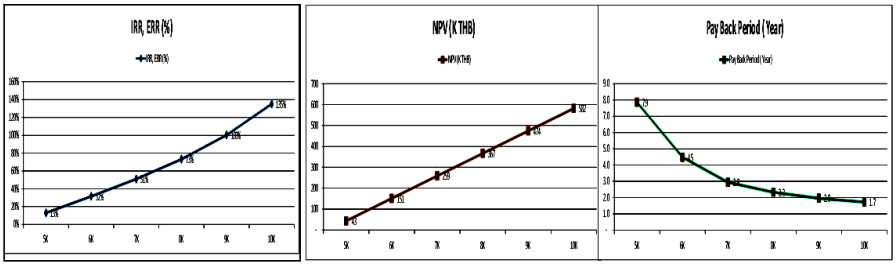


Figure 13: shows the calculation of IRR, NPV and Pay Back Period underlying the installation and use of a medium-6 meter bus stop

It was determined that the initial cost for a small-4 meter (S) bus stop structure was 165,582 THB, not including the clear, acrylic slots for advertiser's billboards/signs and the other 5 styles/models of proposed signage (6 total as shown in Table 2).

Calculations were based upon Thailand's standard 3 percent inflation rate used in financial projections. Construction is anticipated to take 60 days to complete with structures projected to be usable for at least 10 years. Electricity for signage and safety is estimated at 1,000 THB

(approximately $US30.00) per month. Results are shown in Table 4 and Figure 14.

Table 4: Results of financial analysis underlying the implementation of a large-4 meter city bus stop showing internal rate of return (IRR), net present value (NPV) and Pay Back Period analysis. Please note that on March 4, 2016 1,000 THB = 28.25 USD.

Compensation	Advertising Income from 6 proposed sign types (THB per month)					
	5,000	6,000	7,000	8,000	9,000	10,000
IRR or ERR	8%	25%	40%	58%	77%	101%
NPV	21,000	129,000	237,000	345,000	452,000	560,000
Pay Back Period (Years)	8.4	4.5	3.3	2.7	2.3	2.0

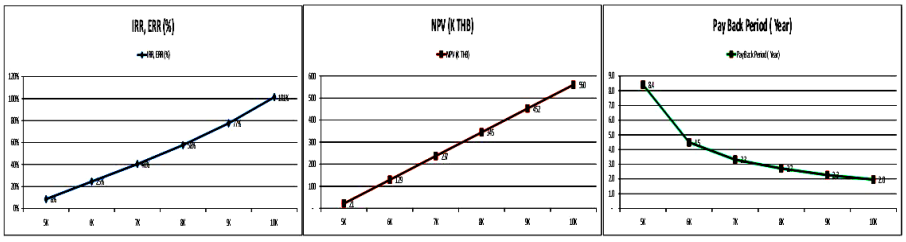


Figure 14: shows the calculation of IRR, NPV and Pay Back Period underlying the installation and use of a large-10 meter bus stop

Conclusion

From the study's analysis, three separate designs have been proposed consisting of a small-4 meter (S), medium-6 meter (M), and large-10 meter (L) bus stops for implementation by the BMTA. Structure size selection for each site is conditional on local conditions, the surrounding environment and size of available space.

Each design is proposed to have the following features:

1. customizable applications;
2. durable and long lasting roofs;
3. raised and curved bench seating for moisture drainage as well as to lessen the comfort for sleeping by non-commuter;

4. slotted rear panels for air circulation and cooling as well as commuter visibility for safety and security (no hiding places);
5. route and bus number signs and maps showing stops and directions;
6. advertising billboards easily replaceable and managed;
7. lighting both for commuter safety in the evening and night-time hours as well as to increase visibly for both pedestrian and vehicular traffic. This will also assist the night-time visibility of the advertising billboards extending the revenue generation possibilities and types of possible vendors;
8. commuter protection from the elements including the hot tropical sun and rain and well as vehicle intrusion into the bus stop commuter area

The study is also in accordance with study designs from Germany, France, Poland, USA, Australia, Peru, China, Korea and Japan. Materials to be used are highly resistant to the elements and use and are very durable, easy to install and clean with long lifespans making use of non-toxic, lightweight materials. All elements are easily viewable from either a vehicle or as a pedestrian and adhere to the '60 degree' rule for advertising visibility (American Institute of Graphic Arts (AIGA), 2000; Panero & Zelnick, 1979). Each bus stop design is planned for maximum commuter safety and will implement design shapes that serve as barricades from vehicle instruction using modern simplicity in tune with the local environment. Decorative colors and patterns are planned to maximize impact as well as increase the beauty of the route and sidewalks.

Financial analysis from the study showed each of the three sizes of bus stops had an initial procurement and installation costs of; small (S), medium (M) and large (L) 110,334 THB, 143,768 THB, and 165,582 THB respectively. Calculations were based upon Thailand's standard 3 percent inflation rate used in financial projections. Construction is anticipated to take 60 days to complete with structures projected to be usable for at least 10 years. Electricity for signage and safety is estimated at 1,000 THB (approximately $US30.00) per month.

Financial analysis showed that for the three proposed structure sizes of small (S), medium (M) and large (L) and with the use of 6 types of signage, revenue collection ranges from 5,000-10,000 THB per month. Payback periods ranged from 7.0 to 1.4 years, and 7.9 to 1.7 years and 8.4 to 2.0 years, as shown in the above Tables 2, 3, and 4, respectively. The payback period is the period of return from operations and is equal to the cost or capital investment (Needles, Powers and Crosson, 2013).

Acknowledgements

The research was assisted by the Bangkok Mass Transit Authority.

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