The Growth of Terminal Stations in the Peri-urban Areas of Bangkok Metropolis

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Abstract

The density of activities in the central Bangkok area has accelerated the development of suburban areas to reduce the density and congestion in the housing and manufacturing sectors, including various sources of employment, causing more commuters between suburbs and urban areas. Currently, traveling by train is favored as it is a convenient, fast, and timely transportation. Consequently, the public sector has extended the train route from the urban area to the suburbs of Bangkok in all directions, causing the development around the stations undoubtedly (Transit Oriented Development: TOD). Each terminal station appears diverse growth. This study aimed to examine the growth of the area surrounding the terminal stations in the peri-urban areas of Bangkok metropolis by analyzing physical changes (number of residential units), society (number of population and households), and economy (land price) in the area surrounding the terminal station extension to suburban areas which are currently distributed throughout the perimeters of the four provinces, namely Nakhon Pathom, Samut Prakan, Pathum Thani, and Nonthaburi, comprising MRT Purple Line (Khlong Bang Phai Station), BTS Green Line (Kheha Station), MRT Blue Line (Lak Song Station), and BTS Green Line (Khu Khot Station). The findings revealed that physical changes around Khu Khot Station and Khlong Bang Phai Station have constantly increased the number of residential properties from real estate projects since the construction of the stations while Kheha Station and Lak Song Station had had already a high density of the former residential community, inducing a relatively low rate of increase. Regarding social changes, the population at Khu Khot Station had the highest rate of increase, and the increase in the number of households in all 4 stations did not affect the increase of households from construction to the opening. Regarding the economy, the price of waste lands around Khu Khot Station had the highest increase, followed by Kheha Station, Lak Song Station, and Khlong Bang Phai Station, respectively.

Keywords: *Terminal Station, Train Extension, Changes.*

Introduction

Bangkok is the capital of Thailand and the center of wealth in all aspects, namely the economic sector, politics and governance, and various service sectors. The development policy by the public sector prioritizes expanding development to nearby metropolitan areas, such as Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon, and Nakhon Pathom. Due to being the capital with ongoing activities which can be called unity, the built-up area expands rapidly to benefit the community around the areas predominantly (Ceediz, 2016). Since Bangkok is the arch city with the largest population and the center of the economy, a large influx of workers at all levels was attracted, resulting in packed and chaotic development. This affects the modes of transportation and congestion in urban areas. This led to the development of rail transportation systems in urban areas to reduce existing traffic problems.

The train is a crucial transportation infrastructure in Thailand, especially in Bangkok and its vicinity. On December 2021, users of the BTS Green Line and MRT Blue Line accounted for 674,000 and 366,000 people per time per day (Source: BTS, BEM). The mass transit system has now become a very important element in urban development, especially in Bangkok and its vicinity. Based on the concept of urban expansion to focus on the development of suburban areas around Bangkok with a large population of residents to travel into the city more conveniently, the area has changed in terms of land utilization of residences, and condominiums, which were converted from agricultural areas to residential areas. As the identified population tended to increase. Therefore, the researchers were interested in studying the growth of the 'Terminal Station' of various train lines which are junction points in Bangkok and its vicinity to see whether each area in all 4 directions progresses similarly. This is to examine the growth of the area surrounding the terminal stations in the peri-urban areas of Bangkok metropolis of all 4 provinces, namely Nakhon Pathom, Samut Prakan, Pathum Thani, and Nonthaburi, comprising MRT Purple Line (Khlong

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Bang Phai Station), BTS Green Line (Kheha Station), MRT Blue Line (Lak Song Station) and BTS Green Line (Khu Khot Station).

Objective

To study the growth of the area surrounding train terminal stations in the peri-urban areas of Bangkok metropolis.

Scope of the Study

Content

To study changes in the surrounding area of the four terminal stations, namely Khlong Bang Phai Station (Purple Line), Kheha Station (Green Line), Lak Song Station (Blue Line), and Khu Khot Station (Green Line) in terms of the physical appearance of the city, number of populations, number of households, land prices and housing prices.

Area

Study the terminal station of the MRT Purple Line "Khlong Bang Phai Station" (Nonthaburi)

Study the terminal station of the Southern Green Line "Kheha Station" (Samut Prakan)

Study the terminal station of the MRT Blue Line "Lak Song Station" (Nakhon Pathom)

Study the terminal station of the Northern Green Line "Khu Khot Station" (Pathum Thani)

Time

Study the information surrounding the terminal station from 2011 to 2021 during the pre-construction, under construction, and opening until the present.

Related Theories, Concepts and Studies

Theory of Urban Growth

Suburban expansion is the change caused by urban expansion when people are more densely populated to settle in suburbs along with the progress in terms of utilities and consumption which are part of the urbanization process.

Alonso's General Theory of Land Rent (WILLIAM ALONO, 1964) explained that land price drops when it is far away from the economic center as the land price varies according to accessibility, profitability, and utility. Accordingly, urban residents spread out to live in suburban areas where land prices were lower.

Hurd's Star Shaped City Model (RICHARD M. HURD, 1924) explained that urban expansion in the case of transport routes in some directions are more accessible than others, so the urban area tends to expand along a more convenient route as shown in the figure.
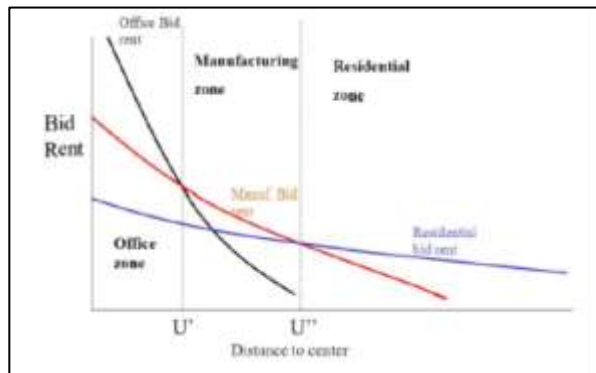

Figure 1: Relationship between Distance and Land Prices

Figure 2: Starfish Urban Expansion

Hoyt's Sector City Model (HOMER HOYT 1939) explained the pattern of urban expansion was like a crescent circle and it was found that, in each urban area, the expansion into the outer space is circular, above one crescent. The urban expansion is characterized as follows:

The expansion will expand along the transport routes connected to commercial centers and other residential areas.

The expansion will extend along the highlands, rivers, and canals in industrial development areas.

The expansion will expand along the residence of the elite community in society. Luxurious apartments are often located in business districts.

A residential area with high rental prices is located next to a residential area with moderate rental prices.
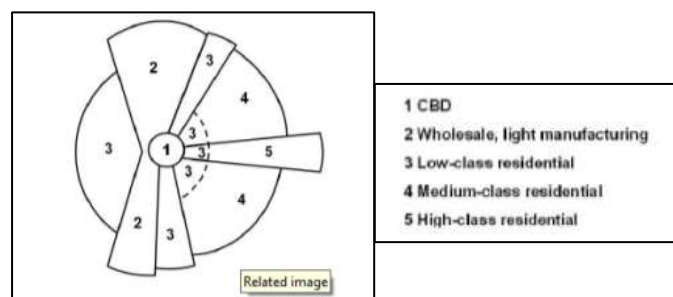

Figure 3. Utilization of Land as Proportion

Rail Transit System

Urban transportation system is significantly vital to the city, town planning, urban planning, and urban development. Mass transit system is a consequential segment of transportation which is the city's infrastructure and is one of the three main components of urban planning apart from land use, utilities, public utilities, or other public services.

Figure 4: Train Project Planning Classified by Type

(Source: MRTA Project Development Department)

Network of 20-year Mass Transit System Master Plan (2010-2029) for Bangkok and its Vicinity

Commuter Train (CT): This is the main network prioritizing services for commuters between the suburban area and the central Bangkok area which will be connected to the suburban train route that extends to the main city, namely Dark Red Line, Light Red Line, and Airport Rail Link.

Rail Mass Rapid Transit: This type prioritizes services for passengers in the city within a radius of about 20 km from the city center. Most routes are through central business districts, providing services to connect residential areas to commercial sources. Kanchanaphisek road helps to combine and distribute the commuters, including Dark Green Line, Green Line, Blue Line, Purple Line, and Orange Line.

Secondary Mass Transit Network: This is to provide services to accommodate commuters in suburban community areas to access the main train network. Most routes are perpendicular to the main routes, such as Pink Line, Yellow Line, and Gray Line.

Theory Related to the Development of the Area surrounding the Station

Robert Cervero (1998) mentioned the development of the area surrounding the mass transit station which was recognized for sustainable urban development in the United States. The area around the station was developed using various components, namely accommodation, employment sources, and areas that cause commuting activities within comfy walking distance of the station. Moreover, in 2007, Cervero studied the number of passengers traveling by public mass transit in California. The area was divided into 2 groups: Group 1, an area within a radius of 0.5 miles from the station and Group 2, a ring area between a radius of 0.5-3 miles, as shown in Figure (b). It was found that people in Group 1 traveled by mass transit approximately 4 times more than those in Group 2, indicating the potential for the development of the area surrounding the station. The area that is close to the station with convenient access would undoubtedly enhance the increase in the number of passengers in the mass transit system.
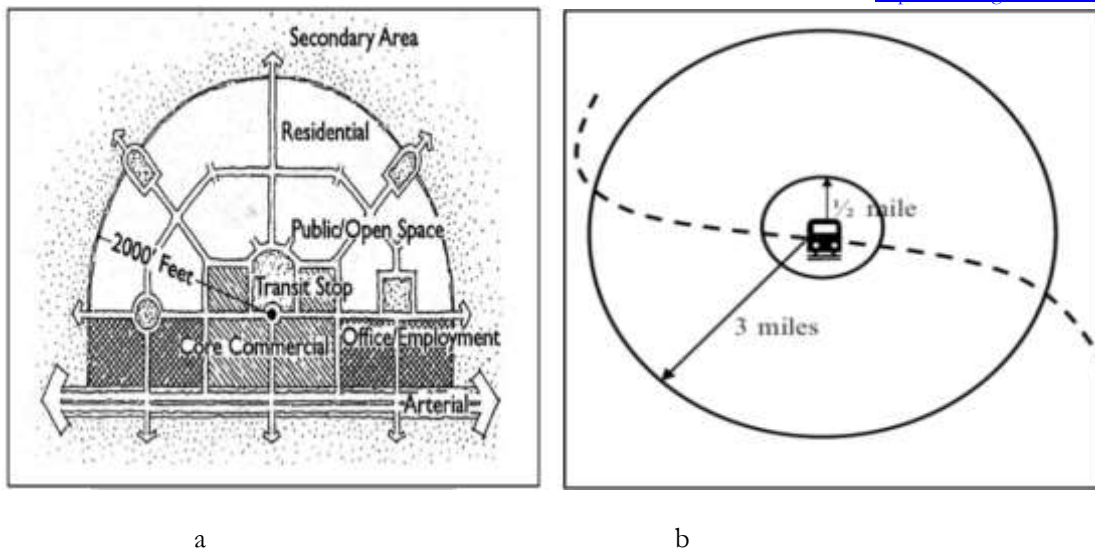
a   b

Figure 5: TOD Development Area Scope (A) Peter Calthorpe's Concept; (B) Robert Cervero's Idea

City and County of Denver have determined station typology to enhance the development of mass transit stations to be appropriate based on location, physical appearance, and the context of the development of that station, which can be classified into 5 types as follows:

Downtown is the most economically developed TOD center in the city. Large buildings and tall buildings were built with high pedestrian activity, including the complete connection of travel by various mass transit systems.

The urban center is a highly developed TOD center. There has been a utilization of land with an emphasis on commercial and residential purposes. The community network and roads are grid and alley block patterns, completely connected to the walkway network as well as being multimodal transport hubs.

The general urban is a TOD center located in the area of the main road or the area near the main road. There has been the utilization of land in multi-family residential. Community networks and roads are grid patterns as well as being multimodal transport hubs.

The urban residential area is a typical TOD center of the urban area, located in the area of the main road or the area near the main road. Community networks and roads are grid patterns. It is a single-family residential.

The suburban commercial center is a suburban TOD center with a compound of residential, community areas, and public spaces in the neighborhood.

Concepts Related to Sustainable Transport Development Zones

Urban development (cited in Tharawut Boonlue 2008: 137-138) concerns planning, including physical design with an emphasis on sustainable transport. So, as for developed or developing countries, sustainable urban form and sustainable urban transport are noteworthy components of sustainable development, concerning the concept of urban development and the design of areas at the transit zones for Thailand, Bangkok. Urban designers and executives of relevant agencies tried to find various elements of the city as a guide to energy-saving cities, resulting in faster transportation and time-saving in consonance with sustainable development guidelines. The concept of developing sustainable transport zones is novel based on the concept of Transit Oriented Development (TOD). The experiences from the development of these two concepts abroad were utilized to produce clear and concrete results, prioritizing the development under the theory of sustainable development and can be used as a guideline for the energy-saving city. An example

of both concepts revealed the pros and cons of development. Therefore, the selection of advantages according to the urban development guidelines for improvement in the development of sustainable transit zones is required for the development. Satisfactory urban shape elements should consist of a high-density environment and the development of integrated land use, especially vertical mixed-use, the size of the concept development of a radius of 400 meters or 5-10 minutes by foot to the public transport station which is the center of the transit zones. In addition, it should be located in the urban community area close to the current economic district. Infrastructure in traffic should have elements of public transport rather than a road network and the accessibility of various areas should be inclusively connected within the transit zones. Therefore, every key component of STDZ should be an important guideline in the development of energy-saving cities for development in different urban communities.

Urban Transportation System: Relationship between Land Use and Transportation

The urban transportation system (cited in Nattapol Theowpanich 2010: 21-23) is to comprehend the nature and form of transportation systems in the city, such as public transportation to learn about types and definitions of different types of public transportation systems. This includes the classification of public transportation by type of service based on the type of service providers and users, as well as the physical components of the transportation system in general. The relationship between land use and transportation is to comprehend the nature of the trip which is to create a relationship between trip ends volume and land use, including socio-economic characteristics in each zone. The trip volume may be at the origin or destination. The emergence of a trip is related to the condition of land use in various modes. The intensity of land use is usually represented in units of housing per area or the number of employees per area. The intensity of land use is related to the number of trips produced as described below.

Characteristics of Land Use: The intensity of land use still could not completely explain the emergence of the trip. Despite a clear relationship identified, the intensity of land use could not explain the changes in trips. Variables related to characteristic land use would reflect the relationship in increased trips, such as family income and personal car ownership.

Location of Land Use Activity refers to the spatial distribution of land use and the nature of land use, such as residential, commercial, agricultural, or industrial areas. The different nature of the land use would cause different trips as well.

Procedures and Hypothesis

Problems and Hypotheses in the Study

This study had the objective to examine the changes in the development of transportation routes at the terminal stations of 4 lines, running in different directions from Bangkok that may affect the urban expansion in terms of land prices, number of housing estates, and number of households and the population to see whether the growth of each zone has the potential for the development equally.

Study Area

This study designated four terminal stations from various train color lines around Bangkok, namely Khlong Bang Phai Station (Purple Line), Kheha Station (Green Line), Lak Song Station (Blue Line), and Khu Khot Station (Green Line), and the area around the stations within a radius of not more than 10 km from the terminal station was studied, covering a wide range of districts as follows:

Khu Khot Station: Sai Mai Subdistrict, Bangkok, Khu Khot Subdistrict, Pathum Thani

Kheha Station: Tai Ban Mai Subdistrict, Samut Prakan

Lak Song Station: Bang Khae Nuea Subdistrict, Bang Khae Subdistrict, Lak Song Subdistrict, Bangkok (Nakhon Pathom)

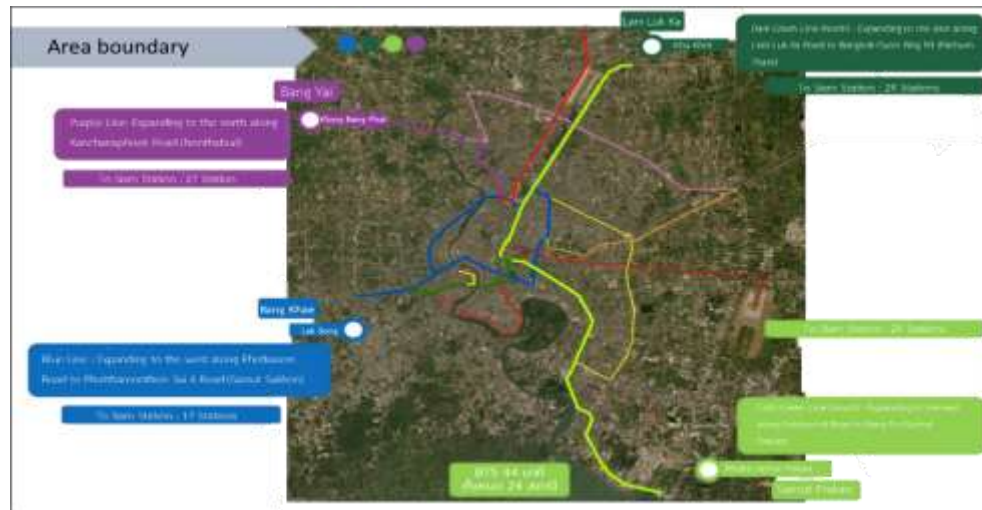Khlong Bang Phai Station: Bang Rak Phatthana Subdistrict, Nonthaburi

Figure 6: Map of the Four Terminal Stations

Data Collection

Land price data for growth rates comparison (from: Real Estate Information Center, Government Housing Bank)

Census data (from: Bureau of Registration Administration, Department of Provincial Administration)

Data on the number of new real estate projects (from: Think of living / Homenayoo /REIC)

Satellite imagery data surrounding the stations during 2011-2021 (from: Google Earth)

Data Analysis

Physical

The data were analyzed from aerial photographs, land use planning, historical background data, such as land use, wasteland, and a number of housing projects. This was studied before the mass transit project and after the opening of the train project by using a comparative analysis from 2011 to 2021.

Social

Demographic data related to households around the stations were analyzed by comparative/statistical methods of the population in the area from 2010 to 2020.

Economics

Land prices around the station were analyzed by comparative/statistical methods from the appraisal price of wasteland before the development from 2018 to 2020.

Results

Terminal Station Basic Information

Based on the study of basic information and condition of train lines, namely Pathum Thani (Green Line "Mo Chit - Saphan Mai - Khu Khot"), Samut Prakan (Green Line "Bearing - Kheha"), Nonthaburi (Purple Line, Chalong Ratchadham Line) and Nakhon Pathom and Samut Sakhon (Blue Line, Chaloem Ratchamongkhon Line), the terminal station is the destination station of that line at that time, or it can be said that the terminal station at this time may not be a terminal station in the future. With an extension, such as Mo Chit or On Nut Station which used to be the terminal station before but now changed to "Khu Khot Station and Kheha Station" respectively. The function of the terminal station is to be the last station connecting other types of public transportation that serves to help people enter and exit the city every day. Most of the terminal stations are Park & Ride Stations or stations with large parking and ride buildings with more than 500 parking spaces. Most of them are located in suburbs or HUBs near urban areas. This research studied areas around the terminal stations at a distance of not more than 10 kilometers from the stations in 4 areas. General information about the stations is as follows:

Khlong Bang Phai Station: Purple Line "Tao Poon - Bang Yai" or "Chalong Ratchadham Line"

Construction started: 2009 / Open: 6 August 2016

Station: 16 Stations / Distance: 23 kilometers

Interchange Station: Pink Line / Brown Line

Park and Ride Building: Available

Kheha Station: Extended Sothern Green Line "Samrong - Kheha"

Construction started: 2012 / Open: 6 December 2018

Station: 9 Stations / Distance: 13 kilometers

Interchange Station: Yellow Line / Monorail

Park and Ride Building: Available

Lak Song Terminal Station: Extended Blue Line "Hua Lamphong - Bang Khae"

Construction started: 2011 / Open: 21 September 2019

Station: 11 Stations / Distance: 16 kilometers

Interchange Station: Green Line / Blue Line (extension)

Park and Ride Building: Available

Khu Khot Station: Extended Northern Green Line "Mo Chit - Saphan Mai - Khu Khot"

Construction started: 2015 / Open: 16 December 2020

Station: 16 Stations / Distance: 19 kilometers

Interchange Station: Pink Line / Brown Line / Blue Line

Park and Ride Building: Available

Figure 7: Train Routes of Stations Source: www.mrta.co.th/ www.bts.co.th

Park and Ride Building : Khlong Bang Phai
Open: from 05.00 - 01.00
Area: 3 floor building for 1,986 cars
Service rate: for train clients, 2 hours for 10 baht
Those who are not clients, 1 hour for 20 baht
Monthly service, 1000 baht
Occupancy Rate: Mon – Fri 6%, Sat – Sun 1%

Park and Ride Building : Kheha Samut Prakan
Open: from 05.00 - 01.00
Area: 18 Rai yard for 720 cars
Service rate: for train clients, 2 hours for 10 baht
Those who are not clients, 1 hour for 20 baht
Monthly service, 1000 baht
Occupancy Rate: Mon – Fri 11%, Sat – Sun 5%

Park and Ride Building : Lak Song
Open: from 05.00 - 01.00
Area: 1 10 Floor Parking Building (inwards) for 713 cars, 8 Floor Parking Building 1 (outwards) for 350 cars, totaling 1,063 cars
Service rate: for MRT clients, 2 hours for 10 baht
Those who are not MRT clients, 1 hour for 20 baht
Monthly service, 1000 baht
Occupancy Rate: Mon – Fri 57%, Sat – Sun 44%

Park and Ride Building : Khu Khot
Open: from 05.00 - 01.00
Area: 6 Floor Parking Building for 713 cars
Service rate: N/A (at present)
Occupancy Rate: Data could not be obtained as it's free service.

Figure 8: Terminal Stations with Park and Ride Buildings

Source: www.mrta.co.th/ www.bts.co.th

Physical Changes were considered from the growth of real estate around the station, and it was found that the number of residential real estate in the areas surrounding the four terminal stations had more than 70% of the residential areas, especially condominiums and apartments of residential real estate within 1 kilometer away from the stations. This indicates a relatively dense area of land use and a change from horizontal to vertical housing to support the growth of population who evidently expand out of the city along the train route, according to the concept of Hoyt's Sector City Model (HOMER HOYT, 1939). The urban expansion would go along the transport routes connecting to commercial centers and other residential areas.
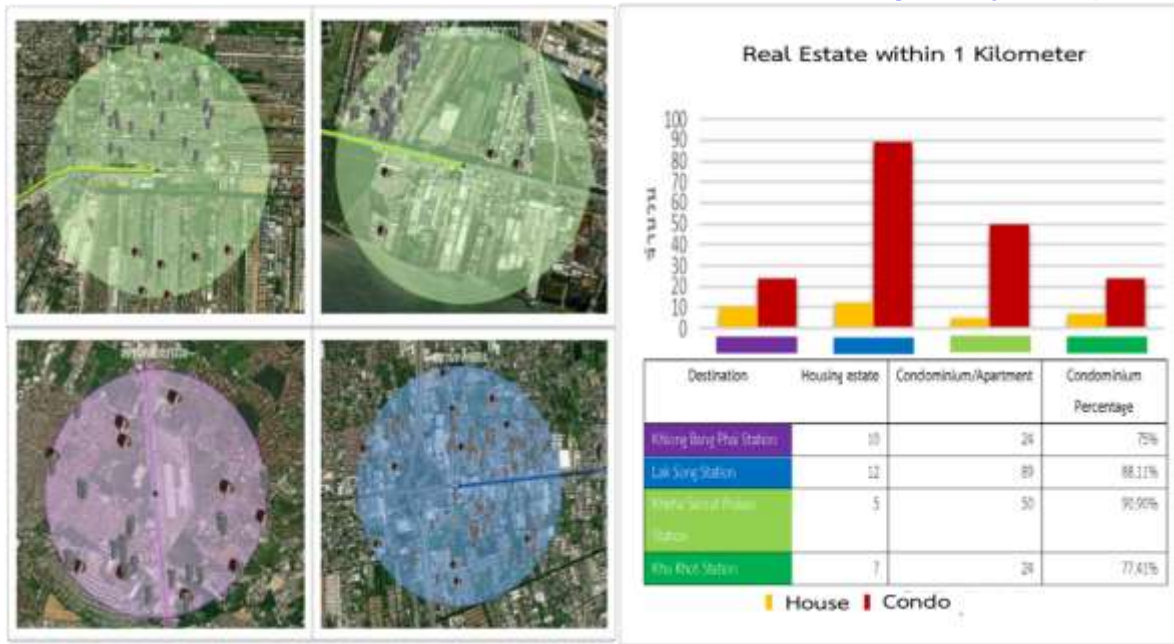
Figure 9: Volume of Real Estate around the Stations at a Distance of 1 Kilometer

When considering the growth of the areas surrounding the stations according to the concept of Robert Cervero (1998), considering the number of new condominium properties surrounding the stations from 2011 to 2021, the number of residential units in 2011 before the train stations' construction, compared to 2021 or after opening achieved a prominent growth in the number of residential units. Both housing estates and condominiums have emerged over 30 projects in the past 10 years (around Khlong Bang Phai Station, Lak Song Station, Khu Khot Station), especially from 2018 to 2019, with a large number of about 5 - 10 projects per year, but after the Covid-19 outbreak, new projects opened from 2020 to 2021 had decreased significantly. However, the original projects still run. Kheha Station did not have much space for development due to a limited area and an old community area. Therefore, there were only 6 new projects in the last 10 years.

Figure 10: Number of Residencial Units at Stations from 2011 to 2021

As shown in satellite imagery from 2011 to 2021, in the past 10 years, the areas around the stations have been constantly growing. As for housing purposes, it can be seen that there are prominent developers coming to occupy more areas. Due to the potential growth of the land with a lot of remaining development space, the project was opened in a horizontal mode, including detached houses, townhomes, and semi-detached houses which are suitable for people who want to stay at home with possession of their own land but also easy to transit into the city.
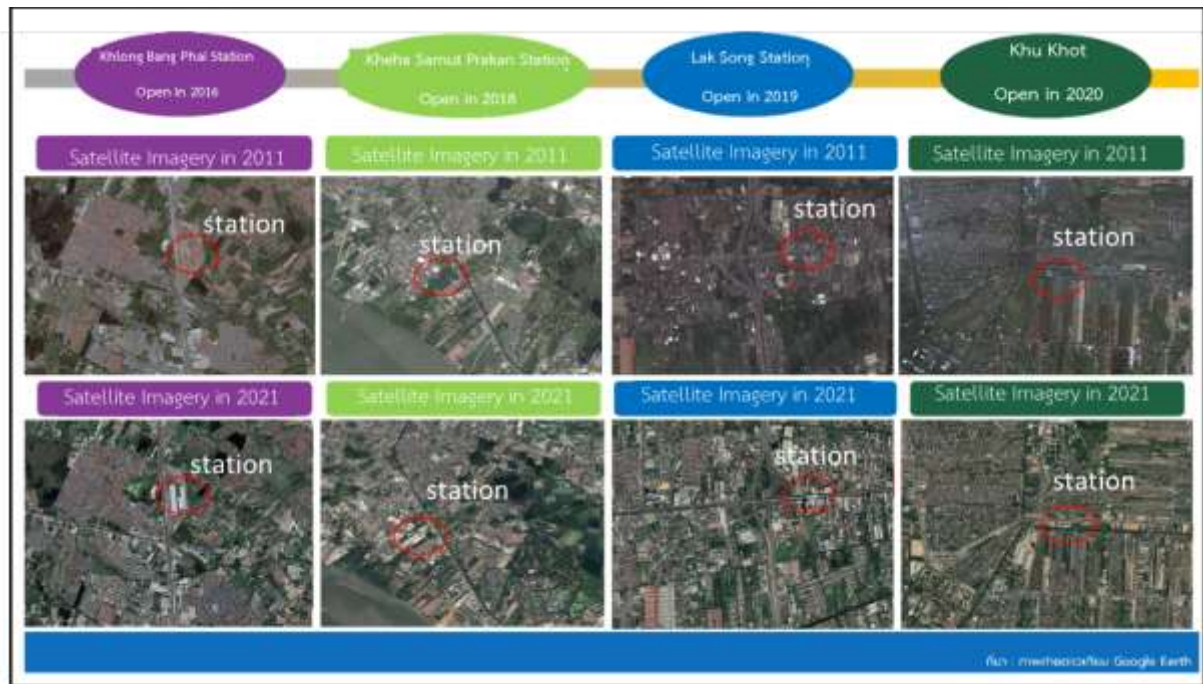

Figure 11: Satellite Imagery of Residential Areas around the Stations from 2011 to 2021

Social Changes

As for a shift in population from 2010 to 2020, the population of the four terminals over the past 10 years has been rising every year with different growth rates in each station as follows:

Khu Khot Station: There was the highest population of about 190,000 people in the past 10 years with a growth rate of 0.6 - 1.9% per year.

Khlong Bang Phai Station, Samut Prakan Station, and Lak Song Station: There is a small growth rate of about 0.1 - 1.3% and in some years, the population has decreased -0.1-0.5% compared to the prior year.

Figure 12: Population Growth around Four Terminal Stations

Based on the above information, the stations with the high population include Khu Khot Station with 190,901 people, Lak Song Station 153,395 people, Kheha Station with 47,766 people, and Khlong Bang Phai Station with 46,986 people, respectively. The increasing population caused the number of residents in the area to rise consequently.

Figure 13: Growth of Households around Four Terminal Stations

As for the number of residential units, each station has grown more in the past **10** years with different leap growth periods.

Khlong Bang Phai Station: From 2014 to 2017, the growth rate of residential units was 0.7%, 8.3%, 1.5%, and 6.4%, respectively (opened in 2016). It is noticed that the rate increased from 2 years before and until the station was opened.

Kheha Station: From 2017 to 2020, the growth rate of residential units was 0.3%, 5.7%, 1.2%, and 5.8%, respectively (opened in 2018). It is noticed that the new residential units appeared during the station opening.

Lak Song Station: From 2014 to 2018, the growth rate of residential units was 2.3%, 8.3%, 0.8%, 3.0%, and 4.6%, respectively (opened in 2019). It is noticed that the new residential units appeared 5 years before the station opening.

Khu Khot Station: From 2012 to 2014, the growth rate of residential units was 2.5%, 3.5%, and 3.2%, respectively (open for use in 2020). It is noticed that the new residential units appeared 8 years before the station opening.

Regarding the household per population, one house has a smaller population every year. This may be due to many factors that may not directly involve the urban growth in that area but the direction of real estate that there is a higher demand due to the increasingly isolated behavior observed by emerging products. Most of the housing is in the price range of 2-4 million baht for people who are just starting a family, living together with 2-4 people.
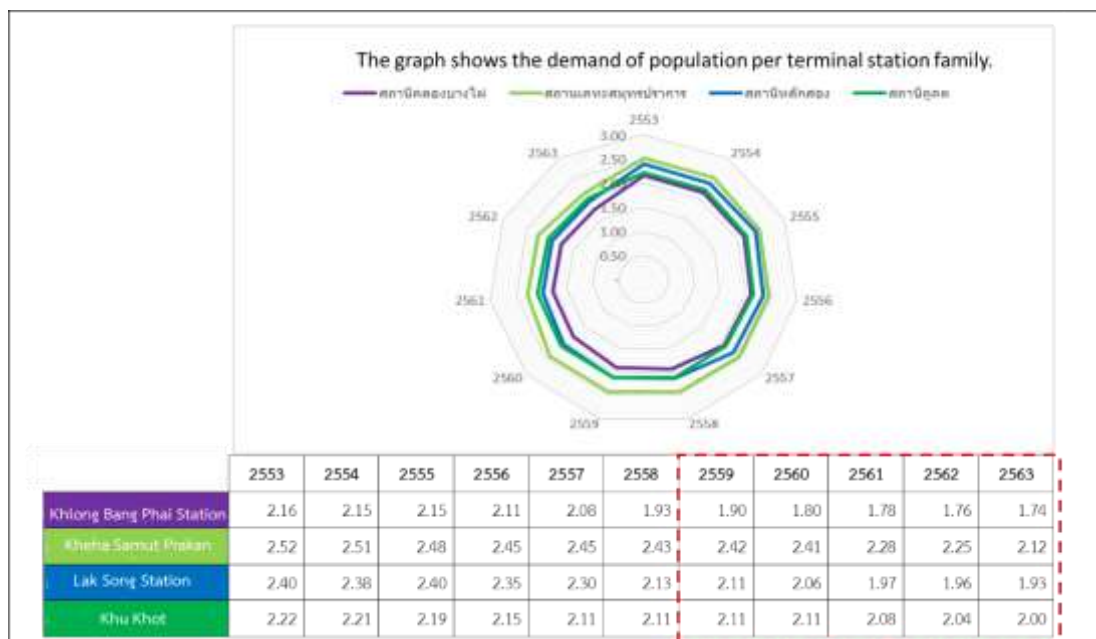

The graph shows the demand of population per terminal station family.

	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563
Khlong Bang Phai Station	2.16	2.15	2.15	2.11	2.08	1.93	1.90	1.80	1.78	1.76	1.74
Kheha Samut Prakan	2.52	2.51	2.48	2.45	2.45	2.43	2.42	2.41	2.28	2.25	2.12
Lak Song Station	2.40	2.38	2.40	2.35	2.30	2.13	2.11	2.06	1.97	1.96	1.93
Khu Khot	2.22	2.21	2.19	2.15	2.11	2.11	2.11	2.11	2.08	2.04	2.00

Figure 14: Proportion of Average Population Per Household Around Four Stations (No Official Data In 2021)

Khlong Bang Phai Station: The population per household rapidly dropped from 2014 to 2020. This station had the lowest population per household every year, compared to other terminal stations.

Kheha Station: The population per household rapidly dropped from 2017 to 2020. This station had the highest population per household every year, compared to other terminal stations.

Lak Song Station: The population per household rapidly dropped from 2014 to 2018 due to the relatively small population growth during this period, compared to the number of households.

Khu Khot Station: The population per household slightly dropped from 2010 to 2020 due to similar population and household growth.

Economic changes were considered from the shift in land prices around the terminal station area. The purchase price and land price from the Treasury Department have risen in the past few years, "the price of wasteland before the development around the station", with an upward trend compared to year over year. In 2019 and 2020, despite the Covid-19 situation, land prices have risen since the pre-opening period. According to real estate data from the REIC after following up on the change of land transfer prices in Bangkok and its vicinity to provide a quarterly pre-development price index, in the first quarter of 2020, it was found that the pre-development wasteland price index was 293.3 points, increased by 3% compared to the previous quarter and increased by 27.7%, compared to the previous year with the same period. The land prices on the Northern Green Line (Khu Khot - Lam Luk Ka), an extension of the Green Line (Mo Chit - Saphan Mai - Khu Khot) increased by 61.3%. This was the highest land price increase in the previous 4 quarters.

Treasury Department land price	Land Appraisal (Baht/Square Wah) 2016-2019 (Treasury Department)	Land Appraisal (Baht/Square Wah) 2022 (ddproperty)	Change (%) YOY
Khlong Bang Phai Station (Kanchanaphisek Road)	10,000-100,000	10,000-170,000	0.25
Lak Song Terminal Station (Petchkasem Road)	120,000 - 175,000	140,000 - 225,000	2.45
Kheha Station (Sukhumvit Road)	10,000-110,000	12,500-160,000	5.36
Khu Khot Station (Phahon Yothin Road - Lam Luk Ka)	9,000-50,000	6,000-100,000	7.07

Figure 15: Land Prices Source: Treasury Department 2016-2019, https://www.ddproperty.com

Conclusion and Recommendation

Conclusion

This study examined the changes in the growth of "the four terminal stations", including MRT Purple Line (Khlong Bang Phai Station), BTS Green Line (Kheha Station), MRT Blue Line (Lak Song Station) and BTS Green Line (Khu Khot Station), physical aspect (number of residential units), social aspect (number of population and households), and the economic aspect (land price) towards the areas surrounding the train extension to suburban areas. This was conducted by searching, collecting, and analyzing data from 2011 to 2021, totaling 10 years, from the beginning of the construction to the opening. It can be concluded as follows:

Physical

Number of New Real Estate Projects

Based on the graph, the opening of Lak Song Station, Khu Khot Station, and Khlong Bang Phai Station affected the increase in real estate projects with a noticeable increase during the year the stations were opened and continued to rise. It can be concluded that the opening of the terminal stations resulted in the growth of residential units in all such stations. This is in line with Hurd's Star Shaped City Model (RICHARD M. HURD,1924) about the concept of urban expansion in accordance with adequate transportation practices.

However, Kheha Station had only one new project launched per year, and it is considered that the opening of the terminal station enhanced the expansion. Since the initial area already has a dense number of residential units, the development was not as prominent as other stations.

The results from the interpretation of aerial photographs of the areas around "4 terminals" demonstrated that all 4 stations have distinct characteristics, which can be divided into 2 types. As for Lak Song Station and Kheha Station, the area was a traditional community area with a low level of development space which is noticeable in the aerial photographs that have not changed much but the opening of the terminal station resulted in an increase in real estate projects along wastelands which can be developed for some projects in some areas. As for Khu Khot Station and Khlong Bang Phai Station, the area had a lot of wastelands waiting for development into real estate projects. Consequently, during the opening, there has been a large number of real estate projects that often occur near or easy to travel to the terminal station before spreading the radius out to a wide area along the unused space.

The opening of all 4 terminal stations has increased real estate growth but it varied due to the prior different density in each station.

Social

Population

The population of all 4 terminal stations increased and decreased differently each year, but overall, Khlong Bang Phai Station, Lak Song Station, and Kheha Station had a slight increase in the population while Khu Khot Station had a noticeable increase in the population. However, the population of some stations did not increase. It may be caused by the latent population in the area, such as Lak Song Station being a residential area for migrant workers since it is a zone near the industrial estate. Therefore, the study of the population from the population registration may have gaps caused by this latent population.

Household

Each station had significant growth over the past 10 years with different periods of household growth as follows:

- Khlong Bang Phai Station progressed highly from 2014 to 2017.

- Kheha Station from 2017 to 2020

- Lak Song Station progressed highly from 2014 to 2018.

- Khu Khot Station from 2012 to 2014

When considering the year of the opening, a difference was found. For example, some stations grew since the construction plan or before the construction while some stations grew during the station's opening. In conclusion, the increase in the number of households was not clearly correlated with the construction until the station's opening.

Population Per Household

In all 4 terminal stations, the population per household continued to drop, caused by the increase of the population at a smaller proportion than the increase in the number of households. It can be said that people's behavior has changed from a large family to a small one or living without children. This shows that even if the population does not increase, real estate can grow due to people's changing living habits.

Economic

Despite the epidemic of Covid-19 and its impact in the past 2-3 years, the price of wastelands has fluctuated at a certain level. However, the "wasteland prices around the station" still tend to rise, compared to year over year. Comparing the purchase price of real estate around the stations, the price has grown exponentially but was still cheaper than the economic center, like the central areas in Bangkok. However, the expansion of the real estate sector is often related to the development of infrastructure networks, especially the train routes. When the government has built the extension to the vicinity, this creates a selling point and can stimulate the decision of those looking for suburban accommodation, causing the growth of the economic sector around the terminal station. Alonso's General Theory of Land Rent (WILLIAM ALONO, 1964) explained that land price drops when it is far away from the economic center as the land price varies according to accessibility, profitability, and utility. Accordingly, urban residents spread out to live in suburban areas where land prices were lower. Similarly, if the land is far from the terminal station, land prices would be lower.

Recommendation for Future Research

- Due to the limitation of the demographic data with governance, when studying a radius from the center of the station, district or sub-district level data must be used for analysis. For future research, if the population data can be used within the study radius according to the actual household, it will lead to more accurate study findings.

- Due to the nature of the land appraisal data as an overall appraisal of the extension line, not for each station, the resulting price was average throughout the line. For the next study, if analyzing the appraisal price by station or the market price separately per station is available, this would result in more accurate data.

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