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Important Factors Analysis Toward Land Use Development Surrounding the Public Sky Train Station: A case study of the Dark Green Line, Bangkok Metropolitan Administration (BMA)

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Abstract

The area surrounding the public sky train station, in Bangkok is highly dynamic, has many complicated and important factors to response land development according to the sky train lines of urban development, so the study objectives are 1) to study the important factors toward land use development surrounding the public sky train stations in urban and suburb areas, and 2) to study the trend of land use change surrounding the public sky train stations in urban and suburb areas. Asoke and Udomsuk stations represented the urban and suburban areas, respectively. The researchers collected data by field study to survey the physical characteristics of the area around both train stations, following the concept of Transit-Oriented Development (TOD) and using the Multiple Criteria Analysis (MCA) for interviewing 12 experts to assess 10 important factors toward the development of land use around the Dark Green Line stations (BTS). The study results indicated that there were 2 groups of important factors toward land use development around Asoke Station (urban area) and Udomsuk Station (suburb area). For Asoke Station; The main factors were: Factor 9: Criteria announced in the Town Planning Law, Factor 2: Connectivity to housing, workplaces, and other mass transits; Factor 10: The importance of business and trade in the area, and Factor 7: Land and housing prices surrounding the train stations, respectively. Likewise, for Udomsuk Station; The main factors included Factor 9: Criteria according to the Town Planning Law, Factor 10: The importance of business and trade in the area, Factor 2: Connection with housing and workplaces and other mass transits, and Factor 4: The distance to the train station, respectively. The important factor has to be in conformance with town planning clarification. The area surrounding the Asoke station could be a big business development because it is an urban area with high land and house prices and it is the economic center of Bangkok. For the area around Udomsuk station, it could be a small business development as it is a suburban area focused on living and convenience /safety distance travel to the station.

Keywords : land use; sky train; urban; suburban; Transit-Oriented Development (TOD)

Introduction

Bangkok Metropolitan Administration (BMA) is the most populous city in Thailand [1], in 2019 found Bangkok has a population 5,701,394 person [2] because it is the capital, administrative center, education, transportation, banking, commerce, business, various communications, causing people relocate to live in Bangkok. Due to congestion and traffic jams and in the year 1999, the dark green line sky train started to service. As a result, the area surrounding the station must be developed according to the concept of Transit-Oriented Development (TOD) Land development consists of many factors that are important and complex to make the right development decisions. TOD means integrated urban places designed to bring people, activities, buildings, and public space together, with easy walking and cycling connection between them and near-excellent transit service to the rest of the city. It means inclusive access for all to local and citywide opportunities and resources by the most efficient and healthful combination of mobility modes, at the lowest financial and environmental cost, and with the highest resilience to disruptive events. Inclusive TOD is a necessary foundation for long-term sustainability, equity, shared prosperity, and civil peace in cities. [3] Therefore, there has been a study on this issue. By choosing to study the development of land use around 2 stations, represent of urban and suburb area. It has two main objectives: 1) to study the important factors toward land use development surrounding the public sky train stations in urban and suburb areas, and 2) to study the trend of land use change surrounding the public sky train stations in urban and suburb areas. Asoke and Udomsuk stations represented the urban and suburban areas, respectively.

The concept of this study is to developing the area around the mass transit station, Peter Calthorpe, who initiated this idea, said that the concept of developing the area around the transit station means developing the area to mixed use of land with high density and promoting the use of mass transit systems, create a variety of activities in the areas surrounding mass transit stations. There are residences, commercial buildings, offices, and other types of utilization, and designed to support mass transit users, and environment conductive to walking, bicycle lane to have a variety of travel options and reduce private car used [4]. Thanyalak Srirattanachot [5] found that the development of the area around the station according to the concept TOD in the area of 96,000 sq.m. of the Treasury Department of Thailand will develop building connections by designing footpath and bicycle lane for travel. Supachara Jingjit [6] found that the proportion management according to the TOD concept and the analysis of demand, it is a design to promotes easy access with convenient to all activities. Witthaya Duangthima and Chakarin Petcharanon [7] found that the concept of developing the area around the rail mass transit station is an application of TOD's concept to urban areas by promoting stronger land use that leads to the development of public spaces to support future activities as well as increasing the livability in the area, which must consider the factors that will affect residential development, such as density, diversity utilization, design of space conditions, distances to train stations, etc. TOD around the stations e.g. the use of car parking management, bus and traffic management, placemaking of each station, and the appropriate use of land related to people's lives affected to the decision making process for Metropolitan Rapid Transit [8-10]. Atchara Limmonthon [11] study of mass transit development in 4 provinces, Chiang Mai, Phuket, Nakhon Ratchasima, and Phitsanulok, found that the projects have low rate of return on investment because the regional cities are the under developing. Although the cities growth and population have increased continuously. The impacts of the public transport projects are both positive and negative and have the influence of the mass transit station to the change of land use in its surrounding area. According to the result, there was an increase of the residential and large commercial building spaces around the station [12, 13]. Roger & Marion [14] found that there is increasing concern about dependence on the car and the need to improve

the environment in many cities. One approach is to construct new public transport systems. Many of these are being planned and constructed in cities around the world. Oliver & Milan [15] found that Public transport is a key element in cities to meet the transport needs of the population. The current trend in Slovakia shows the preference of individual transport over public transport. However, cities are limited by the possibility of constantly building transport infrastructure. The trend towards building smart cities can positively affect different areas of the city, including transport.

Therefore, this study will select only Asoke station and Udomsuk Station, both of which are located in different areas in the context of urban and suburban areas, but both stations are meaningful stations in the area and it is a station that is very important to the area. The Asok station is in the economic district consisting of shopping malls, large stores, workplaces and investments. For Udomsuk Station in a residential area, small shops.

Methodology

The researcher chose to use urban and suburban areas, with urban areas referring to urban area defined by an area with a population of 10,000 or more, or an area where people gather, houses and important places of that city. In this case, it means the surrounding area around Asoke Station and suburban referring to a residential area that is either a part of a city or an urban area or a residential community that is not very far apart from each other. In this case, it means the surrounding area Udom Suk Station [16].

For this study, the researcher synthesized the factors obtained from the literature review from the TOD concept, Urban resilience Principle concept, case studies from Osaka Station, Shin-Imamiya Station and related research review work makes it possible to determine alternatives for making a choice critical factors analysis toward land use development surrounding the public sky train station: a case study of the Dark Green Line, BMA 10 Factors.

The researchers used the Multiple Criteria Analysis (MCA) for city planners, land developers, socialists, environmentalists, economists, and lawyers to decision making and priotize of land use development issues surrounding Asoke and Udomsuk stations because it is a suitable way to compare factors in such a way that any factor is better than any other. It will inspect 10 factors. Factor 1: Parking area around the station, Factor 2: Connection to residence, workplace and other mass transit, Factor 3: Pedestrian and bicycle land, Factor 4: Distance to the station, Factor 5: Population Density, Factor 6: Housing Density, Factor 7: Land and housing price surrounding stations, Factor 8: Diversity to development for various activities, Factor 9: Criteria according to the announcement of the Town Planning Law, and Factor 10: Importance of business and trade in the area. The evaluation criteria are as follows:

0 point means the same factors do not affect the comparison.

1 point means the factor is less important than the comparative factor.

2 points mean that the two comparable factors are of equal importance.

3 points mean that the factor is more important than the comparative factor.

After that, the total score of each factor were summed and divided into groups which are more than 80% and less than 80%.

For research tools, including an MCA assessment form for an interview with a sample of 12 people and surveying the physical characteristics of the two areas within a radius of 800 meters around Asoke and Udomsuk stations.

Result and Discussion

Physical characteristics of the area

1. Asoke station

The area surrounding the station is for parking. There are many Park and Ride near Asoke station which hourly, daily and monthly [17]. Because of connected to housing, workplace, and other public transportation between condominium, hotels, workplaces, department stores, shops, restaurant, sky train stations, bus stops and Sukhumvit Line MRT

(subway) [18]. But have no bicycle lane which in the future may need because it one of the important thoroughfares according to the concept of developing the area around the mass transit station, including the TOD concept, has set a development area of about 800 meters for the city around the mass transit station as a high-density area. There is a mixed use of the building. and encourage traveling on foot. From survey, it found that throughout the distance traveling to the Asoke station within 800 meters, there was a mixed use of buildings, including commercial buildings, and residential buildings. shopping malls, schools, shops, and restaurants, make the traffic comfortable. For population density and the density of housing and workplaces was found to be very dense around Asoke Station.

Because of Central Business District (CBD) of Bangkok. make both Thai people and foreign residents or activities in this area continuously. The area along Sukhumvit Road is one of the areas with the highest of foreign residents in Bangkok. Employed at September 2020 about 80,991 foreigners who come to work and live in the Asoke area. For this reason, the land and housing price around the sky train station is rising accordingly. The various development of the area to be various activities, as well as the increase of business and trade. The various development can be shown in Figure 1.

In addition, from the map showing land utilization around Asok Station, 3.50 square kilometers, it was found that land use was used for residential purposes such as condominiums, detached houses, and apartments, represented in yellow, the total area is 1.59 square kilometers, representing 45.47 percent of the total area, followed by the use of land for other activities instead of white, using an area of 0.63 square kilometers, representing 18.07 percent of the total floor use the land for commerce, represented in red, using an area of 0.60 square kilometers, representing 17.09 percent of the total area It can be noticed that commerce exists in almost every alley of the area, because Asoke is an area with office buildings, large shopping center and diverse sources of work. Later, the use of land for government institutions and other public facilities was represented in blue, taking up an area of 0.22 square kilometers, representing 6.39 percent of the total area mixed use of land, represented by red and yellow occupying an area of 0.18 square kilometers, representing 5.22 percent of the total area use of land for educational institutions such as Wattana Wittayalai School, etc., is replaced by dark green, occupying 0.15 square kilometers of land, representing 4.41 percent of the total floor use of land for recreation, such as Benjakiti Forest Park, etc., is represented by light green, occupying 0.08 square kilometers of land, representing 2.40 percent of the total area land use for religious institutions, such as temples, Christian churches, are represented in gray, taking up an area of 0.02 square kilometers, representing 0.61 percent of the total area and land use for public utilities represented by blue and red, using an area of 0.01 square kilometers, representing 0.3 percent of the total area. (Figure 2)

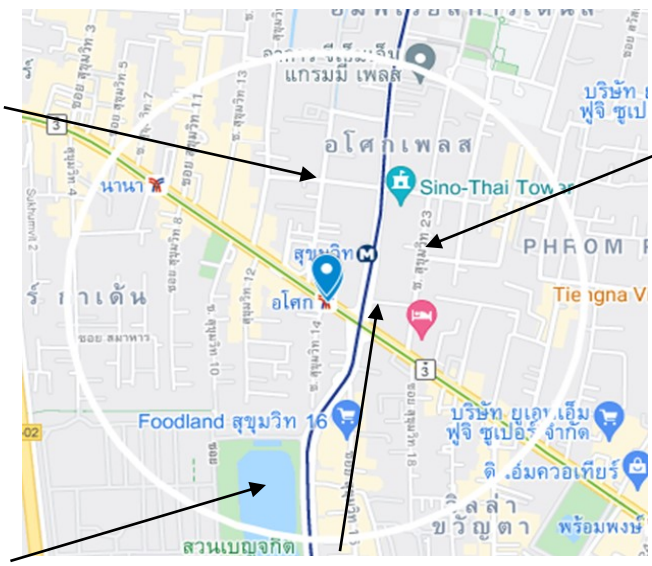
2. Udomsuk Station

The area surrounding the station is space for parking both cars and motorcycles. As well as being connected to housing, workplace and other public transportation. A type of mass transit that found in the suburbs but not found in the urban area is a small minibus. Travel to Udomsuk station it more difficult than Asoke area because the traffic not comfortable. Especially along the alleys in the community, it was found that there were no sidewalks or bicycle lane, therefore, it is necessary to use a motorcycle, taxi to other public transportation. It was found housing density denser than workplace, because around Udomsuk Station is a residential area with detached houses, townhouses, condominium, dormitories, apartments, include many communities such as Mahasin Market Community, Thanin factory. The land and housing price around Udomsuk station is not high compared to the Asoke area. There is also various to activities develop. Due to it a residential area, there are shops, markets, gold shops, pawnshops, and department stores. The variety of development in the Udomsuk area can be shown in Figure 3.

In addition, from the map showing land use around Udom Suk Station. There are a total of 7,407 buildings, consisting of land use for

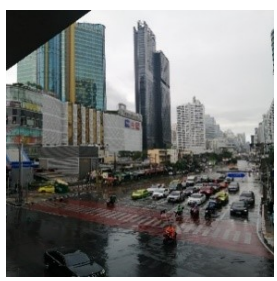
residential purposes the most, represented by yellow, 5,664 houses, accounting for 76.47 percent of the total building utilization, represented by red and yellow, 839 houses, accounting for 11.33 percent of all building utilization. Commercial building utilization, represented by red color, amounting to 431 units, accounting for 5.82% of the total building utilization. industrial use of buildings Represented by purple, 120 houses, accounting for 1.62 percent of all building utilization. Utilization of buildings for educational institutions Represented by dark green, 107 houses, accounting for 1.44 percent of all building utilization. Utilization of buildings for warehouses, represented by pink, 74 houses, accounting for 1.00 percent of all building utilization. Building use for other purposes is represented by white, accounting for 0.99 percent of the total building use. Utilization of buildings for religious institutions, represented by 51 units in gray, representing 0.69 percent. Utilization of buildings for government institutions and other public facilities, represented by blue, amounting to 38 units, representing 0.51 percent of all building utilization. Utilization of buildings for public utilities Represented by blue and red, 6 houses, accounting for 0.08 percent of all building utilization. and the use of buildings for recreation, represented by 4 light green houses, accounting for 0.05 percent of all building utilization. (Figure 4)

Sukhumvit 19
- Entrance to Terminal 21
- Near Sky Train station
- Many entrance and exit, including Soi Nana, Phetchaburi, and Sukhumvit 19



Sukhumvit 23
- Near Srinakharinwirot University and Demonstration School, Srinakharinwirot University
- There are many restaurants and accommodation.
- 2-lane road.

Benchakitti Park



Sukhumvit 21
4 – 7 lanes of road, a lot of office buildings and exit to Kamphaeng Phet Road

Figure 1 Areas around Asoke Sky Train Station

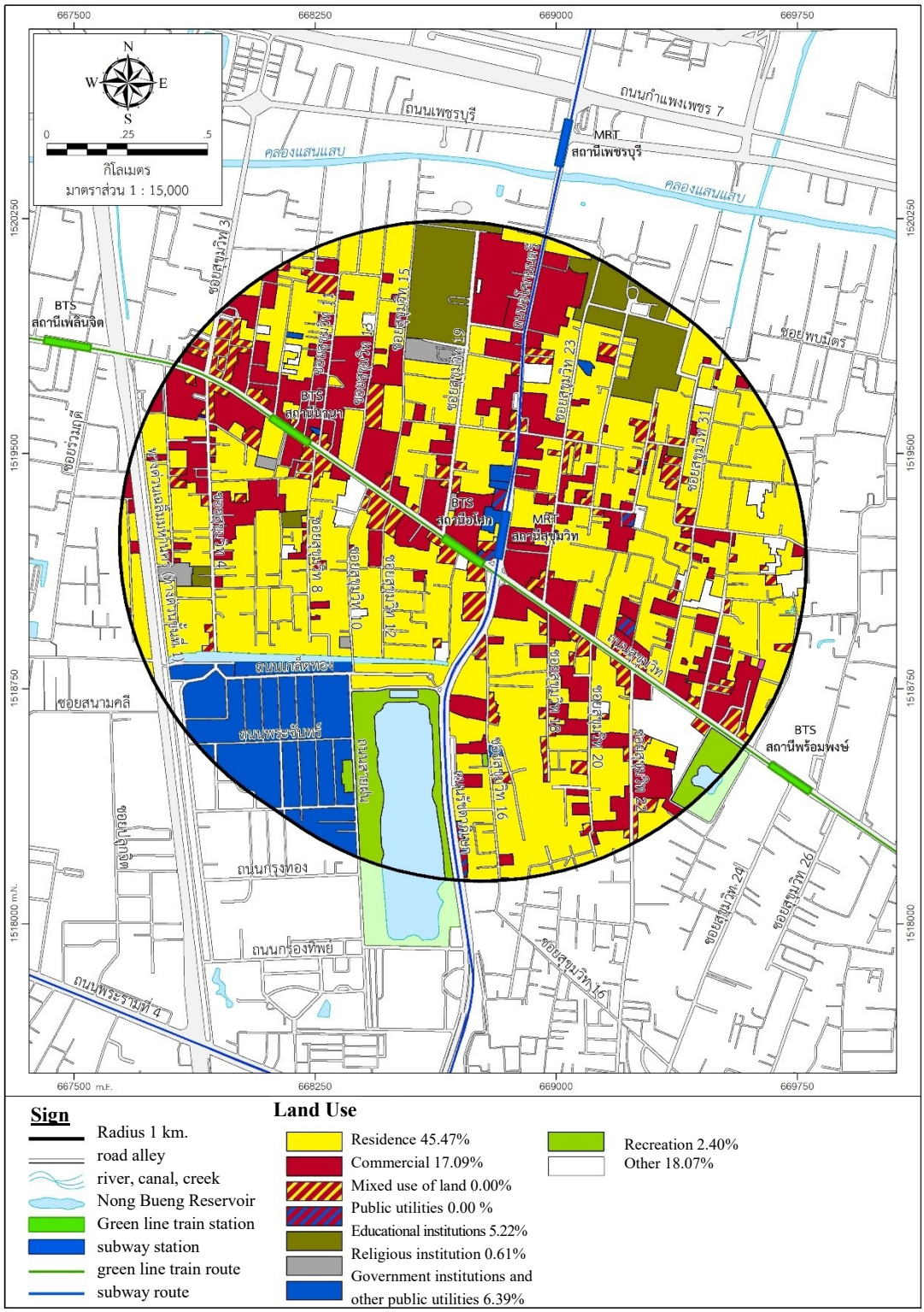


Figure 2 Map of building utilization around Asoke Sky Train station, scale 1 : 15,000 in 2020
Source: Huai Khwang District Office, 2020

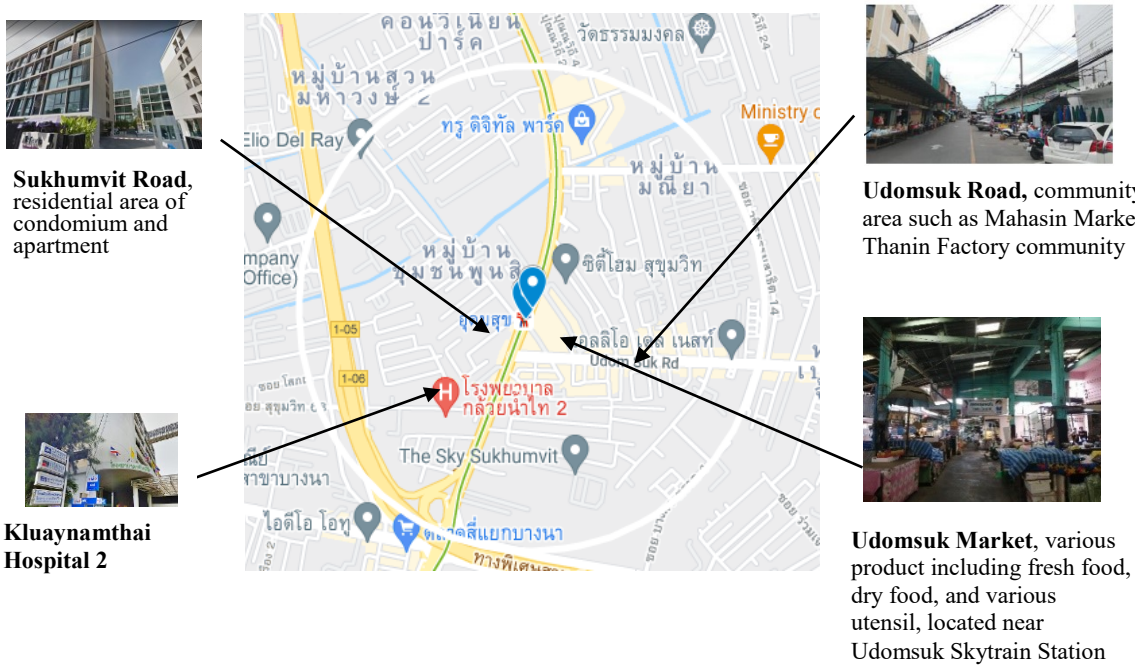


Figure 3 Areas around Udomsuk Sky Train Station

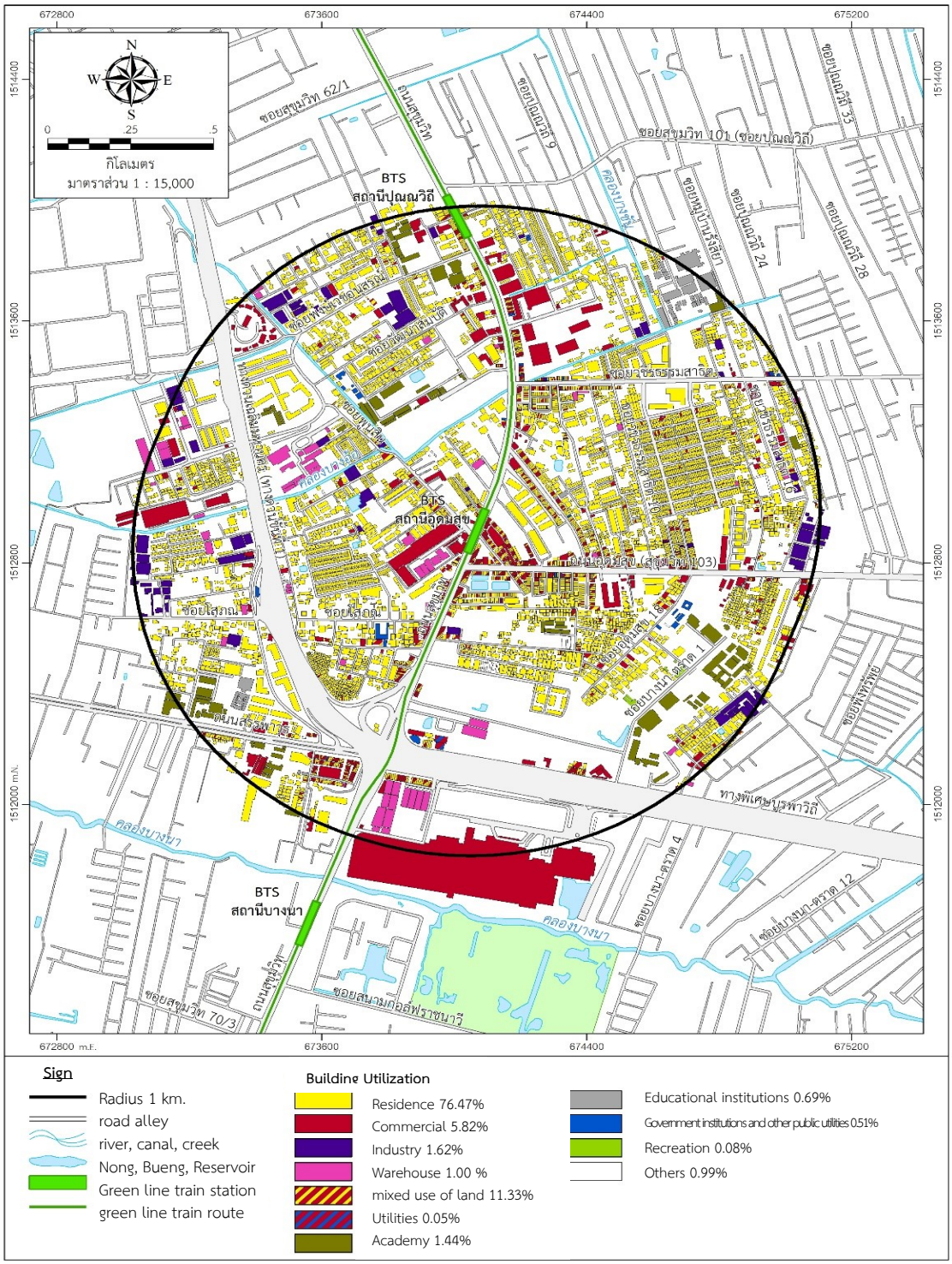


Figure 4 Map of building utilization around Udomsuk Sky Train Station, scale 1 : 15,000 in 2020
Source: Bagna District Office, 2020

Multiple Criteria Analysis (MCA) results by experts

Asoke Station

The study found that the important factors for land use development surrounding the urban dark green line station were divided into 2 groups, which the study used the expert assessment scores compared with total score. Factors with and average more than 80% of the total score is the main factor contributing to the development and the factor with an average of less than 80 percent of the total score is minor factors to development are as follows:

1) The main factors to development are the Factor 9: Criteria announced by the town planning law (95.19 percent of the total score), Factor 2: Connection to housing, work sources, and other mass transit and Factor 10: Business and trade importance in the area (83.70 percent of the total score equal), and Factor 7: Land and housing price surrounding the station (81.48 percent of the total score)

2) Minor factors to development, Factor 3: Footpaths and bicycle lane and Factor 4: The distance to the train station (77.78 percent of the total score equal), Factor 5: Population density and Factor 6: Housing density and workplace (77.04 percent of the total score equal), Factor 8: Diversity to development the area for various activities (76.30 percent of the total score) and Factor 1: Parking area around the station (72.22 percent of the total score), respectively, as shown in Table 1.

Udomsuk station

Factors that are important to the development of land use around dark green line suburbs stations was divided into 2 groups based on the same criteria as the urban dark green line station (Asoke Station) are as follows:

1) The main factors to development are the Factor 9: Criteria announced by the town planning law (97.41 percent of the total score), Factor 10: Business and trade importance in the area (86.67 percent of the total score), Factor 2: Connection to housing, work sources, and other mass transit (83.33 percent of the total score), and Factor 4: The distance to the train station (81.85 percent of the total score), respectively.

2) Minor factors to development, Factor 8: Diversity to development the area for various activities (78.52 percent of the total score), Factor 3: Footpaths and bicycle lane and Factor 6: Housing density and workplace (77.41 percent of the total score equal), Factor 7: Land and housing price surrounding the station (75.19 percent of the total score), Factor 1: Parking area around the station (73.33 percent of the total score), and Factor 5: Population density (70.37 percent of the total score) respectively, as shown in Table 2.

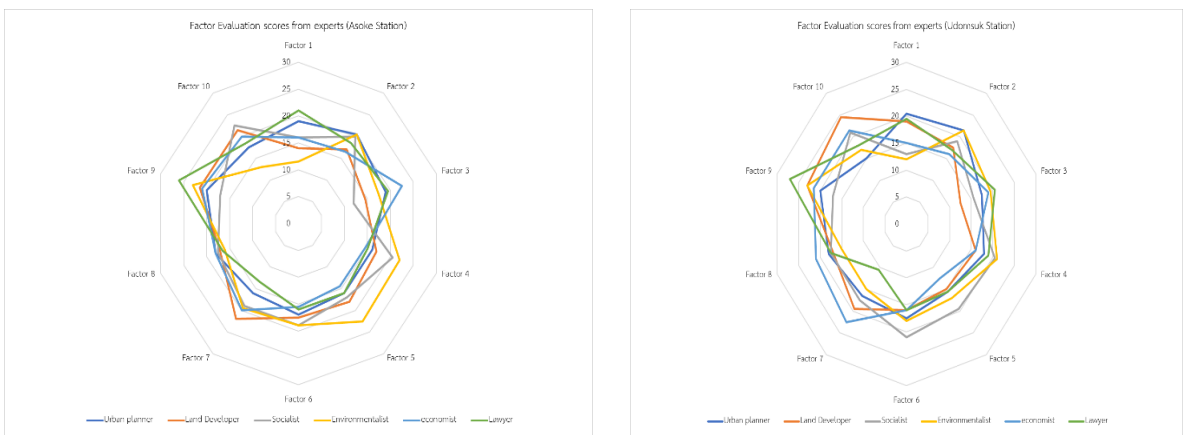
Table 1 Scores of factors that important to land use development surrounding Asoke station

NO.	Experts	Factors									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Urban planner (1)	14	25	22	17	21	19	18	17	16	11
2	Urban planner (2)	24	16	16	15	11	15	14	19	24	24
3	Land Developer (1)	11	17	11	17	16	17	21	18	26	26
4	Land Developer (2)	17	17	18	17	20	18	23	16	17	17
5	Socialist (1)	16	17	14	18	17	20	19	20	19	20
6	Socialist (2)	16	23	10	23	17	18	19	15	15	25
7	Environmentalist (1)	12	17	22	21	22	19	21	22	21	12
8	Environmentalist (2)	11	24	13	23	23	19	18	10	25	14
9	economist (1)	23	13	24	10	17	18	18	15	21	21
10	economist (2)	9	20	21	19	12	13	22	21	21	19
11	Lawyer (1)	19	19	18	12	18	18	13	18	27	18
12	Lawyer (2)	23	18	21	18	14	14	14	15	25	19
Total		**195**	**226**	**210**	**210**	**208**	**208**	**220**	**206**	**257**	**226**
Percentage of total score		**72.22**	**83.70**	**77.78**	**77.78**	**77.04**	**77.04**	**81.48**	**76.30**	**95.19**	**83.70**

Table 2 Scores of factors that important to land use development surrounding Udomsuk station

NO.	Experts	Factors									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Urban planner (1)	26	23	23	17	19	17	17	14	15	9
2	Urban planner (2)	15	20	12	19	12	18	16	22	25	21
3	Land Developer (1)	22	17	12	15	14	18	17	18	23	24
4	Land Developer (2)	16	18	13	17	16	14	22	16	23	25
5	Socialist (1)	17	17	19	17	17	23	21	14	18	20
6	Socialist (2)	9	21	12	24	22	19	14	21	16	22
7	Environmentalist (1)	13	21	19	20	21	19	15	16	19	15
8	Environmentalist (2)	11	22	20	22	13	17	15	14	27	19
9	economist (1)	13	13	17	13	14	17	24	23	23	23
10	economist (2)	17	19	21	19	11	15	21	19	20	20
11	Lawyer (1)	15	19	18	18	17	17	12	18	27	19
12	Lawyer (2)	24	15	23	20	14	15	9	17	27	17
	Total	**198**	**225**	**209**	**211**	**190**	**209**	**203**	**212**	**263**	**234**
	Percentage of total score	**73.33**	**83.33**	**77.41**	**81.85**	**70.37**	**77.41**	**75.19**	**78.52**	**97.41**	**86.67**

The scores to be displayed with a Radar Chart to showing the views of experts in each field on what factors are important to the development of the areas surrounding the 2 stations. The results showed that Asoke station, the graphs are skewed towards Factor 9: Criteria announced by the town planning law, Factor 2: Connection to housing, work sources, and other mass transit, Factor 10: Business and trade importance in the area, and Factor 7: Land and housing price surrounding the station, respectively. For the area around Udomsuk Station, curves that are skewed towards Factor 9: Criteria announced by the town planning law, Factor 2: Connection to housing, work sources, and other mass transit, Factor 10: Business and trade importance in the area, and Factor 4: The distance to the train station, respectively, as shown in Figure 5.



(a) Asoke station (b) Udomsuk station

Figure 5 Scores of key factors affecting land use development surrounding (a) Asoke station and (b) Udomsuk station

It found that the factors that experts give priority to the land use development around the 2 stations accordance with the concept of TOD that wants to promote the connection of various modes of transportation. In order to have a quick and comfortable travel. As well as the distance to the station is also important to the development of the area. It accordance with Chookiat Salakkham [19] or the use of transportation as a catalyst for new development by placemaking around the station [20]. Importantly, the area development around the mass transit station needs consider to the criteria announced by the town planning law, accordance with Sarit Tiyawongsuwan [21] who has studied the Criticizing transit oriented development patterns between original concept and Khon Kaen comprehensive plan act found that the determination of land use in the Ministerial Regulations of Town Planning all affects the conditions for design and development of the town plan. In addition, Area around Asoke Station, which is representative of the urban area, experts focus on land and housing prices around the station accordance with the Charoensuk Wannapha [22] who said that the changes in the city parallel the Bangkok Mass Rapid Transit Green Line, Asoke section, are housing price and land price and the distance to the stations. Therefore, the main difference of the two stations is the price of land, especially stations in urban areas. The land price has a greater effect on the area development than suburban stations.

Therefore, from the expert assessment, the trend of land use around the Asoke station would be for business purposes in the area as a large business suitable for investors. Because the price of land and housing in this areas are high, taking into account the connection between housing, workplace and various of public transportation. Most importantly, it must comply with the criteria according to the town planning law announcement. For the trend of land use around Udomsuk stations will be for doing business and various trades, but as a small business to suit the physical characteristics and the role of the area that is a residential area taking into account the connection between residence, workplace and various of public transportation, as well as the distance to the station will be more convenient and safer Most importantly, it must comply with the criteria announced by the town planning law.

Conclusion

Important factors analysis toward land use development surrounding the public sky train stations: A case study of the Dark Green Line, Asoke and Udomsuk station in expert opinions that are according with TOD concept and the physical characteristics obtained from the survey are Factor 9: Criteria announced by the town planning law, Factor 2: Connection to housing, work sources, and other mass transit, and Factor 10: Business and trade importance in the area. Therefore, the trend of changing land use around the 2 stations is expected around the Asoke station, it will be developing the area to connections between residences, workplace and other public transportation. Asoke is an important economic area of Bangkok suitable for investing in real estate, including condominium, offices, shops, as well as doing business because of the land and housing prices are high. For the trend of land use around Udomsuk station, developing the area to have a connection between residences, small shops, markets and local public transportation such as such as minibuses in the form of small minibuses. Including the distance to the station must be convenient and safe must strictly comply with the town planning law in order to develop correctly and continue to be appropriate.

This study is a study by integrating spatial data, theories, concepts, and opinions of experts in various fields. In addition, additional information is also needed in order to maximize the efficiency of urban development, such as comparing and extracting lessons from case studies, public hearings study of government area development policies, etc.

So, the benefits of this study are the key factors in the development of land use around the Dark Green Line stations in urban and suburban areas can be used as data for potential land use development and use the results from this study to be used as information or guidelines for the development of other areas

of the mass transit system in Bangkok or other provinces.

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