

Identifying the Property and Functions of Corridor Space in Bangkok's Transit Oriented Development Area

Rungpansa Noichan^{1*} and Bart Dewancker²

¹Graduate School of Environmental Engineering, The University of Kitakyushu, Japan

²Department of Architecture, The University of Kitakyushu, Japan

*Corresponding author, e-mail: x6dbb005@eng.kitakyu-u.ac.jp

Abstract

Public transit passengers were designed to use corridor space in a transit station in order to access the transit services. Especially in the transit station where designed according to multimodal transport purpose, space which connects between each mode of transit within one station or one planned area plays an important role for shifting passengers from one mode to another. The characteristics of corridor spaces as well as the time that passengers have to spend in their trip or to connect between transit modes. This study conducted an exploratory analysis of the basic property and functions of corridor spaces in Bangkok. This research selected four major on-ground transportation nodes which have operated on the railway service and also bus system for identifying the characteristic of corridor spaces. The study examined the element of activities which located along the corridor space and also its architectural performance in order to conduct spatial analysis. The type of corridor space which founded in subjects areas including to three major activities are "area connection corridor", "commercial corridor" and "facility corridor". Each type of corridor contained specific function which led to its spatial performance on transit modes connection behavioral. These findings identified that the arrangement of activity in corridor space influences passenger route-choice accessibility.

Keywords: *corridor space, transit station, transit connectivity, transit-oriented development (TOD), station design*

1. Introduction

In late 1980's, Peter Calthorpe introduced the urban planning principle on transit-oriented development (TOD) (Carlton, 2007) providing convenience to people for using transit system, higher accessibility between transit modes and their destinations as well as reducing the energy consumption from the mobility which encourages the urban development along the transit services. Land use planning refers to urban activity management and the transportation system play a big role in TOD planning and development (Morimoto, 2015).

In order to promote an urban development along transit station (Sheffi, 1985), the accessibility is the primary factor for attracting people to use public transit planning system (Dial & Bunyan, 1968). The purpose of TOD is to encourage pedestrian to use public transport system in their daily life. (Singh et al., 2017)

To access transit modes through the TOD environment can be assessed in terms of architecture and built environmental design by observing TOD development. The corridor spaces are connecting the modes of public transit in one significant issue which create continuity of accessibility and encourage walkability and other characteristics of the spaces nearby. (Glick, 2009) The transit corridors contain several activities occupied by those particular spaces. The function and property of the transit corridor have a direct impact on the user in term of accessibility. Considering about the time is taken in transit station area that users spend during their trip, the connecting function of corridor space significantly affects passenger in limited time. The corridor space also offers passengers an extensive array of another pursuit during the course of travel such as restaurants, cafés, shopping malls, baking or other business facilities. These activities play a big role in TOD planning concept due to the fundamental TOD development concept which encourage the compact city by digesting the space for particular activity into a smaller size then put together in the same area or the same building for reducing the time of travel from one activity to another.

The literature review showed the roles and related issues between corridor space and land use-transportation planning. The connection of areas through particular corridor space in TOD area illustrates the impacts on surrounding environment.

1.1 Scale of connection

The term 'corridor' refers to the hallway which is typically narrow, predominately used for circulation, connecting different parts of a building. Corridor space was designed to connect with two or more areas within the same building by allowing users effective access from one area to another. (Jarzombek, 2010) Corridors also helped increase the efficiency with which people could move through buildings and also turning rooms into a series of dead ends by separating circulation from the destination. In terms of TOD planning and development, integration between space usage and transportation services is designed to improve the accessibility of the area which encourage people to the public transit services and occupies the nearby area station. These notion makes a city more compact which reduce the motorized mode of transport and also benefit environment issue as well as the socioeconomic factors (Petersen, 2004) questioned about the impact of transport parameters on the location of the surrounding activities and land use of transit modes, planners have to consider accessibility patterns. Corridor space is related to trip production, when the surrounding activities due to over-capacity of users, additional trips would occur with a larger trip distances which have both negative and positive effects as a reduction of accessibility potential in terms of time required and the benefits on economic factor which illustrated through commercial retail corridor respectively. Pedestrian accessibility significantly affects transit system connectivity. Mode of transit service plays a big role on the level of connectivity and extensiveness which (Sanchez, 2004) has stated as a result of a relationship between transit access and employment that distance to access the bus was more important than light rail. On the expansion of the area of influence which subjected to improve the station infrastructure have (Zimbabwe & Greenberg, 2009) emphasized the connection between non-motorized accessibility especially on pedestrian access. The suggestion also introduces the pedestrian path connectivity of space between transit station areas and surrounding area for contributing to the expansion of the transit area of influence.

1.2 Activities based corridor

The measuring methodology of the local physical environment to investigate the relationship between non-motorized mode choice and physical spatial condition in the study area was introduce by Rodriguez & Joo (Rodriguez & Joo, 2004). The time difference among the subjected factors of a physic spatial condition such as topography, path, the ratio of the shortest route to closet transport mode and the road traffic condition used for the measurement. The coefficient of these variables interpreted the attractiveness of spatial configurations which related to people's propensity to access transit services by non-motorized mode choice (Papa & Bertolini, 2015) focused on the degree of spatial concentration in terms of economic activities and population through TOD degree which interpreted the concentration of urban development along rail corridors. This method result shows a strong relationship between densities and connectivity in the selected area. It strongly promotes TOD planning and development by the substantial opportunities which exist along the corridor (Venter, 2016). Due to the relationship between a change of accessibility and dynamic land and property values, corridor space must be investigated for impacts on land and property costs. (Bansiter & Goodwin, 2011) The geographical factors such as the size of the property, year of construction, and distance to public transport facilities should also consider on the investigation.

Different activity in different corridor space was observed as to how they reflected user activity with regard to transportation land use. The study classified the TOD corridor characteristic according to (The Center for Transit-Oriented Development, 2010) which characteristics based on major activities on land use classifications, type of corridor spaces in transit node can be identified into 4 types; 'area connection corridor', 'commercial corridor', 'facility corridor', 'residential corridor'. These factors contain criteria generated from the evidence found in selected TOD areas in Bangkok.

2. Objectives

Bangkok was selected as a case study for Thailand TOD development due to its large size, high population, the availability of transit services and also Bangkok is the metropolis of Thailand hosting the main hub of public transportation. This study aimed to identify the property and functions of corridor spaces which found in Bangkok in the major transit stations in order to interpret the transit mode connection

behavior according to design space. Transit station planning and design guideline were also investigated especially in terms of the components of activities expressed through the architectural structure. This paper expected to contribute a better understanding of the role of corridor space in TOD environment and the relationship with surrounding built environments.

3. Materials and Methods

The study selected 4 stations of Bangkok TOD areas that consist of BTS skytrain and MRT subway (Mo Chit/Chatuchak Park, Saphan Taksin, Hua Lamphong, and Victory Monument). Most of the selected stations were located in business or commercial areas and all the selected stations were located in a node of public transport system. The stations present different characteristics in terms of the function of stations including station building, interchange area and transit systems. Based on data collection, corridor spaces in urban mass transit nodes were identified as three types. An 'area connection corridor' is a walkway connecting between two or more functions. This interprets the connection between transit modes to other areas in the transit station. A 'commercial corridor' is a space surrounded by commercial activities, managed to support and attract passengers, and also to make the station a focal point of communities. Some stations copy shopping malls by offering interesting and useful retail outlets as a convenience store, restaurants, cafés, souvenir shops and also Bank/ATM facilities. A 'facility corridor' is the primary function of a transit station as the provider of facilities that passengers can access as shown in table 1. Station design should naturally lead passengers past a facilities corridor in a logical order and circulation should be obvious and direct.

Table 1 Bangkok transit oriented development corridor space typology

Corridor Type	Type of activity	Space Type		Circulation type	Station			
		inside	outside		Victory monument	Mo chit/Chatuchak park	Saphan Taksin	Hua Lam Phong
Area connection corridor	Closed space	√	X	N	X	√	X	√
	Open space	√	√	N	√	√	√	√
	Bridge	√	√	N	√	X	X	
Commercial corridor	Café/Souvenir	√	√	W	√	√	X	√
	Restaurant	√	√	W	X	√	X	√
	Convenience store/drug store	√	√	W	√	√	X	√
	Clothes/Accessories	√	√	W	√	√	X	√
	Financial (bank/ATM)	√	√	N	√	√	√	√
Facility corridor	Safety facility	√	√	W	√	√	√	√
	Ticketing	√		W	√	√	√	√
	Storage (coin locker)	√	√	N	X	√	X	√
	Toilets	√	X	W	X	√	X	√
	Parking	X	√	W	X	√	X	√

N = non-motorize (human powered transportation includes walking, bicycling, and variants such as small-wheeled)

W = walkway

√ = Available

X = Unavailable

4. Results and Discussion

4.1 Identify of corridor spaces

The types of activity and explanations of architectural space elements as shown on tables 2, 3, and 4. Mo chit station and Victory monument station had variety of commercial activities in the station area attracting more passenger into the commercial corridor. Passenger movement in the commercial corridor was directly connected to the main circulation. Financial corridors were located in unoccupied more secure

areas than other commercial corridors as shown in table 2. The main access routes to station building and platforms were area connecting corridors, and all the selected stations were designed with easy passenger access to the station area as shown in table 3. Facility corridors were located in the main circulation areas, except for parking areas that were found in sub circulation or outside station buildings as shown in table 4.

Table 2 Commercial corridor spaces in TOD areas found in Bangkok

Corridor space	Station	Type of activity	Explanation
	Mo chit/ Chatuchak park	Clothes/ Accessories	The space in this corridor is located in the main circulation, sometimes obstruct the movement during peak hours. Activities include shopping for clothes and accessories.
	Hua Lamphong	Restaurant	Space in the corridor provides a seating area for restaurant function with activity time longer than other areas. This corridor is located in sub-circulation and does not obstruct movement of the main circulation.
	Mo chit/ Chatuchak park	Café/ Souvenir	Café activity was found in a selected station, also souvenir shop was not found in all station.
	Saphan Taksin	Financial (Bank/ATM)	Unoccupied secure spaces are mostly used for ATM's not located in the main circulation space. Activities in this corridor need more security than others. The ATM corridor is designed to make passengers feel safe and secure.
	Mo chit/ Chatuchak park		
	Hua Lamphong		

Table 3 Area connecting corridor spaces in TOD areas found in Bangkok

Corridor space	Station	Type of activity	Explanation
	Victory monument	Open space	The open space courtyard can be inside or outside the building. This corridor is usually a gathering place and event location. Circulation in this area are various and uncontrollable, the circulation route depends on passenger availability.
	Hua Lamphong		
	Mo chit/ Chatuchak park		
	Victory Monument	Bridge	Bridge corridor connects between station entrance and the surrounding areas such as shopping street and other building. Some corridors are connected to main access points of station such as Victory Monument station.
	Saphan Taksin	Connecting/ Close space	This corridor is a pathway that connects different corridors or transit node as a walkway, it can be inside or outside the station. Circulation characteristics are linear and designed to optimize flow.
	Hua Lamphong		
	Mo chit/ Chatuchak park		

Table 4 Facility corridor spaces in TOD areas found in Bangkok

Corridor space	Station	Type of activity	Explanation
	Victory Monument	Ticketing	Space in the main circulation of station area usually provide ticketing function. Circulation designs naturally lead passengers here and it is often located near the station gate.
	Mo chit/Chatuchak park		
	Hua Lamphong		
	Mo chit/Chatuchak park	Storage	Storage corridors are located in the sub-circulation area or connection corridors. Only a few stations in Bangkok provide storage facility.
	Hua Lamphong		
	Mo chit/Chatuchak park	Toilet	Only Chatachak park station has toilet facility. It is connected between all circulation routes.
	Saphan Taksin	Security check	All the selected stations provide security check located near each station entrance.

4.2 Discussion

From the results of this study, we found that station designs should promote both the free flow of passengers through public areas and reasonable comfort in waiting areas, while promoting a feeling of security. Sufficient space should be provided for all activities, without conflict. Space designs should allow an envelope of space around each item of hardware such as a ticket machine, seat or elevator to take a value of passenger circulation.

The commercial corridor spaces design has limitation to create space, activities in this corridor should not conflict with through flows. The commercial corridor spaces are not the main function for the station, but there are the second activities to get profit from the rent of shop. In this respect design of stations differs from that of commercial areas premises, since the aim is not to tempt through flows to slow down and browse (obviously passengers can be tempted to leave the main flow). Commercial areas have basic templates for the concept such as convenience store and restaurant, and they may be superimposed on station premises. The design of the retail space needs to lead customers past the sales displays and their way from the main circulation to the booking office. For station convenience stores to be introduced successfully, quality retail space must be designed into the public area.

The area connection corridor spaces design should provide the large space for carrying a large number of passenger in rush hour or peak time. The activities in this corridor sometimes were event location, but the activities in the event should not interfere the main circulation of the station because sometimes it is an advantage to overcome the problem of users while they are using the station.

The facility corridor spaces have a limitation in the area space such as toilet, as some big station did not provide enough toilet. It has an effect on the long queues while passenger transfer from one to another transit could not get off from the station area. The toilets are mostly located in the main circulation, the queues are sometimes obstructing the main circulation while having high density in the station area.

Circulation of station designs should naturally lead passengers past facilities such as ticket selling facilities in a logical order. Routes should be obvious and direct, requiring minimal walking distances. Passengers must be able to circulate freely when moving between the different activities points, such as the entrance, ticket machine, and automatic ticket barrier. All the activities should not conflict with through flows in other activities and should not obstruct the main circulation. Also, the relationships with other activities are important to note whether or not the timings overlap, since if not certain areas may be devoted to two or more non-conflicting uses. Using one-way routes cause higher capacities, provided that flows can be managed to use the space efficiently. Where a station is operating close to capacity, it is advisable to separate small opposing flows from the main flow, indicating the adoption of a one-way system - separate entry and exit. Even small routing can disrupt the main flow, so one-way systems should only be introduced where they can be managed the passenger flows.

This paper only focused on the properties and the functions of corridor space in Bangkok mass transit node, the results could be compared with the station operated the same system or same condition. The different transportation system has a different functional requirement, different condition.

5. Conclusion

Corridor spaces performance in transit station in Bangkok identified the connection behavioral among spaces in transit stations. The identification of corridor spaces in TOD can integrate urban and transport development solutions toward a better connectivity between space usage in TOD areas and the local activities which assist passengers during their trip. Conforming to the achievement of TOD development encourages compact city concept and high-level accessibility integration. We found that the arrangement of activity in corridor space is significantly related to the priority of circulation. The main entrances were notably considered as the main circulation for accessing the particular mode of transport. As a result, this area was designed as an urban open space or semi-open space for carrying a large number of the passenger during the peak-hour. In terms of implications for transit modes, this study suggests an integration between architectural spaces, accessibility route, and needed activities for developing the connectivity in TOD. The relationship among trip purposes, time-limited and spatial structure influences users through their route-choice accessibility.

6. References

- Bansiter, D. & Thurstain-Goodwin, M. (2011). Quantification of the non-transport benefits resulting from rail investment. *Journal of Transport Geography*, 19, 212-223.
- Carlton, I. (2007). *Histories of transit-oriented development: perspectives on the development of the TOD concept*. University of California, Berkeley: California.
- Dial, R. B. & R. E. Bunyan. (1968). Public transit planning system. *Socio-Economic Planning Sciences* 1, 345-362.
- Glick, J. (2009). *The space between buildings: activating downtown's open spaces: DDLP 2009*. Denver.
- Jarzombek, M. (2010). *Critical inquiry* 36. The university of Chicaco.
- Morimoto, A. (2015). Transportation and land use. In K. Doi, *Traffic and Safety Sciences: Interdisciplinary Wisdom of IATSS* (pp. 22-30).
- Papa, E. & Bertolini, L. (2015). Accessibility and transit-oriented development in European metropolitan areas. *Journal of Transport Geography*, 47, 70-83.
- Petersen, R. (2004). *Sustainable transport: a sourcebook for policy-makers in developing cities module 2a land use planning and urban transport*. Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit (GZT) GmbH.
- Rodriguez, D.A. & Joo, J. (2004). The relationship between non-motorized mode choice and the local physical environment. *Transportation Research Part D*, 9, 151-173.
- Sanchez, T.W. (2004). Connecting mass transit and Eemployment. In D. A. Hensher, K. J. Button, K. E. Haynes, & P. R. Stopher, *Handbook of Transport Geography and Spatial Systems* (pp. 111-124).
- Sheffi, Y. (1985). *Urban transportation networks: equilibrium analysis with mathematical programming methods*. Prentice Hall, Inc.: Englewood Cliffs, New Jersey 07632.
- Singh, Y.J. et al. (2017). Measuring TOD around transit nodes - Towards TOD policy. *Transport Policy*, 56, 96-111.
- The Center for Transit-Oriented Development. (2010). *Transit corridors and TOD connecting the dots is important*. Washington DC.: Federal Transit Administration.
- Venter, C. (2016). Assessing the potential of bus rapid transit-led network restructuring for enhancing affordable access to employment e the case of Johannesburg's corridors of freedom. *Research in Transportation Economics*, 59, 441-449.
- Zimbabwe, S. & Greenberg, E. (2009). *Defining transit areas of influence*. Washington, DC: American Public Transportation Association.