Exploring Potential Impacts of Light Rail Transit (LRT) on Land Development

Case Study: Surabaya Municipality, Indonesia

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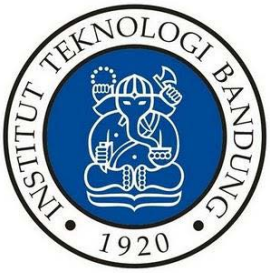

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Abstract

Mass rapid transit is a transport mean that has been developed over decades to deal with transport problems, such as road traffic congestion, and promote the use of public transport instead of private vehicles. Light Rail Transit (LRT) is a kind of mass rapid transit that has been developed in some cities across the world, such as Strasbourg-France and Calgary-Canada. As a transport mean, LRT has inter-relationship with land use described in transport-land use feedback cycle. It will inherently influence land development if it is supported by local policies. This implies transport policy and land use policy require to be integrated in order to manage the impacts of LRT on land development. However, this policy integration is not always undertaken. This condition causes the potential impacts of LRT on land development is less considered in plan-making of LRT. The LRT plan in Surabaya-Indonesia is a clear example to represent this circumstance.

The LRT plan in Surabaya mainly aims to deal with traffic congestion and promote the use of public transport. It does not explicitly consider the impacts of LRT on land development and the management of those impacts. Thus, this research aims to investigate the potential impacts of LRT on land development and the mechanism for managing land development. For this purpose, two international LRT practices, namely LRT in Strasbourg-France and Calgary-Canada, are explored and compared. In this research, the principles of transit-oriented development (TOD), consist of density, distance, diversity, design, and destination accessibility, are applied to discover the impacts of LRT on land development in LRT practices since TOD is a land use management concept describing high-density and mix-use development pattern to improve accessibility and support transit system within the proximate area of transit station.

This research reveals from the two LRT practices that LRT has affected land development in the vicinity areas of the stations. The provision of LRT system has induced high-density and mix-use development pattern within the radius of easy walking distance from the station. The LRT implementation also creates landmark of the city as well as safe and convenient environment and neighbourhood for pedestrians and cyclists. Moreover, the two LRT practices considers the external factors on land use that include level of accessibility, attractiveness of area surrounding the LRT stations and corridors, land availability and regional demand. These external factors should be taken into account since they can influence land development aside from transport system. Another feature taken from the two LRT practices is the presence of local supportive policy that integrates transport and spatial/ land use policies. This integration policy is crucial to assure land development impacts of LRT can be managed accordingly.

Furthermore, this research proposes some recommendations to be taken in the LRT plan. The government should provide a formal policy that integrates transport and spatial/ land use policy. This integration can be undertaken by incorporating TOD principles in the local spatial policy in order to manage land development within the area near LRT stations. Moreover, mobility policy should be provided to discourage the use of private vehicles in the city. Meanwhile, LRT should be interconnected with another railway (regional/ national railway) and can be operated in the same track with another train type (heavy rail) intended to reduce costs for constructing new LRT railway.

Key words: mass rapid transit, light rail transit, transport-land use feedback cycle, transit-oriented development, land development

Acknowledgement

Some cities in Indonesia have experienced difficulties to conduct new road development and road widening projects in order to provide sufficient transport infrastructure. Limited budget and land acquisition process are typical factors underlie these obstacles. This circumstance impedes the government attempts to enlarge the road network in the city that lead insufficient road capacity to deal with rapid growth of private vehicles. As consequences, there will be occur transportation problems in the city, including road traffic congestion, increase traffic accidents and emission. To cope with these problems, the national and local governments currently strive to establish a new public transport system as another mean apart from road investments. Light Rail Transit (LRT) is a transport mode that will be developed by the governments.

Currently, the governments mainly emphasise the provision of LRT for transportation purposes, whereas it inherently has ability to influence land use/ land development refers to transport theory. However, the potential impacts of LRT on land development are not explored comprehensively yet that cause these impacts less considered in the plan. This condition underlies my intention to investigate the impacts of LRT on land development as well as looking for the mechanism to manage the impacts. Moreover, I am personally interested to transport system due to my working background at the Public Works Agency of Surabaya Municipality. I realise that road investments itself will not be able to encounter transport problems in Surabaya particularly. The road investments have to be complemented by the provision of public transport that is safe, convenient, punctual and affordable in order to encourage people to use the public transport for their daily trips. Apart from the transport-related purpose of the public transport, its impacts on land development are challenging to be discovered in order to manage the land developments in the city. Therefore, this encourages me to write this thesis that aims to profoundly reveal the impacts of LRT on land development and find the concept for managing the impacts.

I realise that I cannot accomplish my thesis completely without assistance from many parties. First, I would like to dedicate my greatest gratitude to Allah SWT, the God Almighty. Furthermore, I would like present my great appreciation to my supervisors, Dr. Femke Niekerk and Dr. Iwan Pratoyo Kusumantoro, who have encouraged and guided me to finish my thesis on the right track. Moreover, I would like to give my great gratefulness to my family in Indonesia – my mother, my beloved wife, my lovely daughter, my sister and my parents in law – who always support me in any conditions for finishing my study. I also devote my special thankfulness to my colleagues – the members of Double Master Degree Programme ITB and RUG 2011-2013 – for their supports and sharing wonderful moments in Bandung and Groningen. Additionally, I dedicate my great appreciation to BAPPENAS, NESO and the Government of Surabaya Municipality that give opportunity and support for me to study at ITB and University of Groningen. Last but not least, I want to thank to Interviewees in Indonesia who give meaningful contribution for me to accomplish this thesis. I also provide opportunities for the Interviewees to discuss with me by email (andy_prihandoko@yahoo.com) if they require further clarifications relate to their statements cited in this thesis.

Groningen, August 2013

Andy Prihandoko

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CHAPTER 1
INTRODUCTION

1.1 Background

Transportation system is required to be well provided in cities since they are the centres of many and various activities, including economic and social activities. This circumstance leads the cities grow rapidly and attract investments for developments. This phenomenon also occurs in many cities in Indonesia, such as Surabaya. As the city grows, it should be complemented by providing sufficient transportation infrastructure and its facilities. The existence of high quality transportation system is obligatory to be established in cities in order to facilitate the society to mobile from one place to other places. Papacostas and Prevedouros (1993) said that a transportation system comprises the fixed facilities, the flow entities, and the control system which allow people and goods to efficiently move from a certain place to other places in order to punctual participate in some desired activities. This definition delineates the functional elements of a transportation system (the fixed facilities, the flow entities, and the control system) and indicates that transportation links social interaction.

Furthermore, Adisasmita (2010) said that fundamental elements of transportation system consist of the vehicles, the way (roads), and the cargo. The provision of these elements can serve both transporting humans and goods. The development of transportation system can result income-multiplier and promote accessibility (Banister 1995). Hence, the provision of infrastructure is required to be properly established to support transportation system working well, because it is a part of the fixed facilities of the system. Here, The World Bank has defined the term of infrastructure (1994, p.2 in Parkin and Sharma 1999) that it is facilities supporting public services in the three main sectors. Those sectors are public utilities (power, telecommunication, and piped water supply), public works (roads, dam, and drainage), and other transport sector (railways, ports, and airport). The provision of public infrastructure, such as urban transportation system, is one of the responsibilities of the government (O'Sullivan 2003).

Moreover, the rapid development in urban areas has significantly attracted a lot of people to move and live in the cities which is called urbanization. This phenomenon has enlarged the scale of the cities and considerably increased the number of urban residents. As a result, it potentially emerges critical traffic problems that include traffic congestion, traffic safety, and energy consumption of traffic (Ji-shuang and Ning 2008). These problems have become main concern from governments and societies. Moreover, traffic congestion has particularly been considered as the main hurdles to encourage economic development in urban areas (Ji-shuang and Ning 2008). Currently, governments and traffic planners have a challenge to provide comfort and rapid transportation systems for whole societies in the city. This challenge has to be seriously encountered to meet travel demands of urban dwellers. Aside from fulfilling their demands, travellers expect that urban road networks should also provide the best public service for their daily trips.

It can be noticed that urban areas have to deal with critical issues on different aspects of road-based transportation system. Some major concerns are promoted to be discussed comprise raising levels of traffic congestion, mobility degradation, and worse air quality and environment condition. Many urban areas have experienced complicated circumstances to encounter these issues due to limited resources, including financial support for the expansion of highway and transit systems, and land for new development.

Actually, there are two mechanisms promoted to address transportation problems in urban areas particularly since the early 1980s which are congestion management and travel demand management. The mechanisms aim to obtain the following purposes: reduce the number of trips, reduce the distance of trips, promote non-motorised transport, promote public transport, promote car-pooling, shift peak-hour travel, shift travel from congested locations, and reduce traffic delays (O'Flaherty 1997). Currently, there are a variety of approaches to address problems in transportation system. The approaches basically emphasise on travel demand management, more efficient use of existing and new infrastructure, and establishing sustainable transportation system (Rankin 1994).

Furthermore, in term of sustainable transportation, mass transit system has been promoted to tackle traffic problems in urban areas recently. The mass transit is defined as a large-scale system of public transport service in urban areas that is operated in high speed, transporting large number of passengers, and typically operating on an exclusive lane (Deng and Nelson 2011). A distinct characteristic of mass transit compared with other public transport is the provision of specific infrastructure separating its operation with general traffic. There are several modes of mass transit including rail-based systems (e.g. mass rapid transit (MRT), light rapid transit (LRT)) and rubber-tyre transit (bus rapid transit (BRT)). These mass transit systems provide services with high capacity and frequency.

The applications of mass transit systems can be found in many cities around the world. Many of them succeed in dealing with transportation problems. LRT is a mass transit mode that has grown rapidly in many cities in the world recently, for example LRT in Strasbourg-Alsace, France and LRT in Calgary-Alberta, Canada. LRT is difference with metro rail systems or “heavy rail”. The latter are entirely operated in exclusive rights-of-way, long trains of vehicles (6 to 10 cars per train) and have a high operating speed (approximately 45 mph [72 km/h] or higher). In the contrary, LRT can operate in shared rights-of-way, shorter trains (usually three rolling stocks per train), and slower operating speeds (10 mph [16 km/h]). Additionally, LRT can commonly be built at far lower cost than metro rail transit (Transportation Research Board 2012). Therefore, it is known LRT can be built within the existing infrastructure (roads). Thus, it may solve hurdles in providing land to construct this transportation system.

According to LRT´s proponents, it can enhance community welfare by creating new employments, spur economic development and increase property values (Castelazo and Garrett 2004). Moreover, Cervero (1984) argued that LRT potentially enable to affect urban growth and land use, stimulate redevelopment, and boost vicinity property values because it is to some extent a permanent investment along a fixed guide-way corridor. LRT will have substantial potential to influence urban development if there are local policies supporting the

LRT project (R. Cervero 1984). Aside from this, LRT aims to encourage people to change their travel behaviour from using private vehicles to use public transport that become an effort to address road traffic congestion in the city.

Moreover, the successful of LRT practices in Germany and France explains the LRT is not only offering high quality, comfort and convenient public transport for the passenger, but also incorporating urban planning integration, image and social safety in its implementation. The Dutch Ministry of Transport, Public Works and Water Management discovers the key success factors of public transport implementation in Germany and France are "high quality, organisation and long-term policy vision" (Priemus and Konings 2001). It is eminent in these countries that the development of public transport and urban revitalisation, including LRT system, can go hand in hand. The implementation of LRT in Strasbourg-France is a good example to show how the improvement of public transport can be synergised with urban development. The integration of these policies has induced revitalisation of the city as well as improving liveability and economic attractiveness of the city (Priemus and Konings 2001).

Furthermore, in general, there are several main advantages of LRT compared with bus system as follow: (Grimaldi, Laurino and Beria 2010)

- higher capacity for both vehicles and line;
- lower operating costs;
- lower noise;
- smaller loading scale (essential in city centre);
- more comfortable ride;
- higher speed, reliability and efficiency.

As a transit system, LRT has physical components that are typically classified into the following components: (Vuchic 1981)

1. Vehicles: rolling stock;
2. Transit line
3. Stations and stops: facilities at which vehicles stop to pick up and drop off passengers;
4. Fare collection;
5. Depots or rail yards: places for vehicle storage;
6. Control systems, include vehicle detection, communication and signal equipment, and central control facility;
7. Power supply systems.

It is already mentioned that LRT has potential impacts on land development, which include shaping urban growth and land use, stimulate redevelopment, and spur vicinity property values (R. Cervero 1984). These potential impacts accord with how transportation investment affects land development. According to Polzin (1999), transportation investment can influence land development by three ways, namely improving accessibility, promoting complementary policies, and creating expectations that affect land use. Polzin (1999) also classified the impacts of transportation or transit investments on land use into three categories. The first is direct transportation impact on land use, the second is indirect transportation impact on land use, and the third is secondary impacts from transit investment.

Furthermore, the evidence of the impacts of LRT on land development can be revealed by reviewing some cases of LRT implementation. Strasbourg tramway is a LRT system in the City of Strasbourg, France that is acknowledged as one of the successful LRT practices in Europe in term of integrating new light rail system in urban development and environment (Priemus and Konings 2001; HTM Consultancy 2003). It has impacts on land development by inducing redevelopment certain areas of the city to support the implementation of the LRT system. It is also the best example to show the necessity of a local policy that integrates urban planning and transport policy. Similarly, the LRT system operated in Calgary-Alberta, Canada – which is called as C-Train – is the best practice in the North America (McKendrick, et al. 2007; Marshall Macklin Monaghan Ltd. 2007). It has influenced land development in areas near LRT components. In this case, there is also a local policy that regulates development around the LRT stations towards the concept of transit oriented development. The evidence of land development impacts of LRT can be taken as lesson learns for other cities which will develop LRT system. One of the cities is Surabaya located in Indonesia.

Surabaya is the second largest city in Indonesia that has complex road network and has a large number of population and vehicles within the city that will potentially generate a lot of trips which may lead the emergence of traffic congestion. Currently, the number of Surabaya residents noted on May 27, 2013 is 3.157.357 people (Dinas Kependudukan dan Catatan Sipil Kota Surabaya 2013). Then, the number of motor vehicles in Surabaya is 6,993,413 vehicles in 2011 compared with 1,409,360 vehicles in 2008 (Bappeko Surabaya 2013). Apart from this, the existing public transports have not sufficed to serve people to commute within the city because they are not reliable and convenient for passengers that cause the passengers are reluctant to use public transports. Hence, a mass transit system is planned to be implemented in this city. LRT is preferable to be chosen considering its capabilities to provide high capacity public transport that tend to increase the number of ridership. Apart from this, LRT can also be built in the existing roads.

Unfortunately, according to the feasibility study of mass rapid transit system development in Surabaya, the LRT will be built only considering technical, financial and economic aspects. There is less attention on the impacts of LRT on land development. In my opinion, these impacts should be taken into account when making LRT's plan. Therefore, the LRT which will be operated in Surabaya can take lessons from the evidence of the impacts of LRT on land development in Strasbourg-Alsace, France and Calgary-Alberta, Canada. Then, potential impacts of LRT on land development can be explored by comparing the experiences of LRT in those cities. From this exploration, there will be questions how LRT affects land development and how to synergise public transit planning with spatial planning.

1.2 Research Objectives

This research aims to explore potential land development impacts of LRT and the management of those impacts through transit oriented development (TOD). Initially, the impacts of LRT on land development will be identified by exploring the implementation of LRT in other cities that have been already implementing LRT for years, namely LRT in Strasbourg, Alsace (France) and Calgary, Alberta (Canada). This exploration is also intended to reveal how LRT system can influence land development, and how to manage land use

development by implementing LRT. Apart from this, the exploration on land development impacts of LRT aims to understand how LRT can stimulate land use development according to the concept of transit-oriented development (TOD). Furthermore, the research will summarise potential impacts of LRT on land development that will be used to develop some key points for planning LRT. Finally, these key points will be used to develop a guideline as recommendations for plan-making process of LRT's development in Surabaya, Indonesia. The guideline will also developed by scrutinizing the development plan of LRT system in Surabaya. The guideline is expected to encourage attention among decision makers related to potential impacts of LRT on land development and how to synergise public transit planning with spatial planning by considering local conditions.

1.3 Research Questions

Light Rail Transit (LRT) is one of transport means in dealing with transportation problems in urban areas. It is intended to deal with the increase of road traffic congestion, offer another mobility option for urban residents, and enhance the level of accessibility within the city. Moreover, the implementation of LRT may lead impacts on several aspects, including ridership, capital cost effectiveness, operating cost efficiency, land development, and environmental quality. Currently, there is limited study to explore evidence of the impacts of LRT on land development, whereas theoretically transportation and land use development has relationship that may make them to affect each other. Therefore, in this research, it is necessary to explore:

1. How to use light rail transit (LRT) in managing land use development in Surabaya-Indonesia from the perspective of transit-oriented development (TOD)?

1.4 Theoretical Framework and Research Design

A framework of theories is formulated to be base for analysis in creating key factors related land development impacts to be considered in LRT planning. It is also be base to develop conceptual framework. This framework aims to provide basic notion according to theoretical view about potential impacts of LRT on land development in a city. Furthermore, there are two basic theories employed in this research. The first theory is *the principles of transit-oriented development (TOD),* and the second is *land-use transport feedback cycle*. These two theories are foundation to identify key points which will be analysed to develop the guideline.

Furthermore, those two theories are used to analyse empirical case studies of LRT in Strasbourg-Alsace, France and Calgary-Alberta, Canada as well as analysing the plan of LRT development in Surabaya, Indonesia. The empirical analysis aims to compare the case studies of LRT practices to get lessons as key points that then will be adopted or overlooked in the plan of LRT in Surabaya. The framework of research design is presented in Figure 1.1.

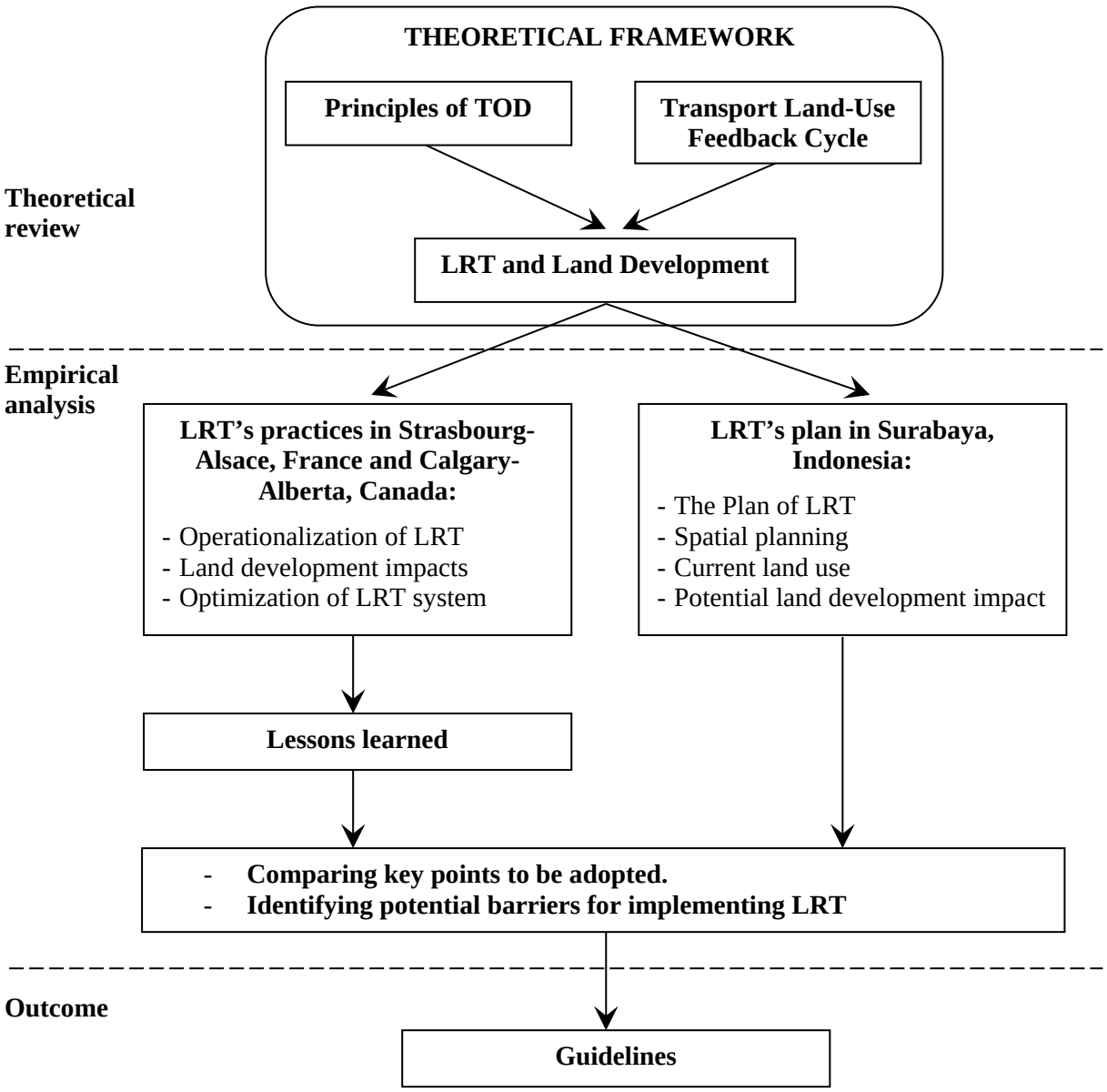


Figure 1.1 Research Design

1.5 Research Methodology

This section presents the research methodology that contains some methods which include literature review and interview. These will be applied to answer the research objectives of this research. In order to answer the research questions, first, it will be conducted literature review on some references about international experiences – in this research Strasbourg-Alsace and Calgary-Alberta are chosen – in managing impacts of light rail transit (LRT) on land development of cities. This aims to gain lesson learned from those cities that have been implementing LRT for several years. These lessons will then be considered in managing potential impacts of LRT on land development in Surabaya.

Furthermore, this research is based on qualitative analysis. For the analysis, the data used can be classified into two types of data, namely primary and secondary data. The primary data will be obtained through interviewing several stakeholders related to LRT's plan in Surabaya, who comprise representative of local authority and citizens. The method of interview undertaken in this research is unstructured interviewing method in order to reveal in-depth information. It will be complemented by visual observation to identify current condition of land use along the planned route of LRT in Surabaya. Therefore, collecting data in the field (Surabaya) is required.

1.6 Research Structure

The thesis is organised into six chapters and have been outlined as follows:

Chapter 1. Introduction

This chapter consists of background, research objectives, research questions, theoretical framework, research methodology, and research design.

Chapter 2. Theoretical Review

This chapter consists of literature review that explores some relevant theories related to the principles of transit-oriented development (TOD), and land-use transport feedback cycle. These two theories are foundations to develop key points for analysing empirical cases. This chapter also provides conceptual framework as analysis guidance of the research.

Chapter 3. Research Methodology

This chapter present the methods to be used in the research that will analyse and address the research objectives. Additionally, this will explain how the research will be undertaken that include data collection and data analysis.

Chapter 4. Light Rail Transit (LRT) Implementation in Strasbourg-Alsace, France and Calgary-Alberta, Canada

This chapter will explain LRT practices in Strasbourg-Alsace, France and Calgary-Alberta, Canada. It also present information about components built in LRT system and the impacts of LRT on land development in those cities. Discussion in this chapter aims to obtain practical knowledge of international experiences for the comparison base. At the end of this chapter, the comparison of the two cases will be presented.

Chapter 5. Developing Guideline for Light Rail Transit (LRT) Planning in Surabaya, Indonesia

This chapter will explain the plan of LRT in Surabaya, Indonesia. It also present local spatial planning in Surabaya, regulations on transportation and land use, and current condition of land use in the area along planned corridor of LRT. Moreover, the potential impacts of LRT on land development based on stakeholder´s perspectives will be presented.

Furthermore, this chapter will compare the practical experiences between the two LRT case studies (in Chapter 4) and Surabaya, Indonesia. This comparison is analysed to get lesson learned. The lesson learned consists of two points. First point reveals practical experiences

that can be adopted in Surabaya. Then, the second point indicates limitations or barriers for LRT implementation in Surabaya. Finally, this chapter will provide guidelines for plan making process of LRT.

Chapter 6. Conclusion, Reflection and Recommendation

This chapter will conclude the analysis results of the research. It will also reflect on the research and methods employed in this research. Furthermore, certain recommendations will be proposed to the Government of Surabaya Municipality and to the future research in mass transit planning, especially on LRT planning.

CHAPTER 2
THEORETICAL REVIEW

2.1 Introduction

This chapter presents a critical review of theoretical background relevant to the research. This chapter starts with a review of theory about relationship between transportation and land use. The theory refers to transportation land use feedback cycle that describes a simultaneous interaction between transportation and land use. This theory can explain how transportation and land use interact and mutually affect each other as well as showing factors influence the interaction. Furthermore, this chapter provides a review of the concept of transit-oriented development (TOD). This concept is used to reveal the way of mass transit, which is Light Rail Transit (LRT), can manage land use development in the city. Finally, this chapter will provide the key aspects presented in conceptual framework as the base criteria to analyse the case studies. To what extend LRT influences land use development and how the concept of TOD can manage land use development refer to key factors synthesised from the theories.

2.2 Transport Land Use Feedback Cycle

Theories on relationship between transportation and land use basically imply locational and mobility responses of private actors (households and firms, traveller) to transformations in transport system and land use at regional level (Wegener and Fürst 1999). Even though planners and public believe that transportation and land use have a close interrelationship, the impacts of transport on land use are less well known. There is a vague understanding how transport system development affects landowners, investors, firms, and households to decide location for their activities. Nevertheless, trip and location decisions are theoretically identified to influence each other, and thus transport and land-use planning have to be integrated refer to the concept of the 'land-use transport feedback cycle' (Wegener and Fürst 1999). According to Figure 2.1, the relationship of transportation and land use can be explained briefly as follow: (Wegener and Fürst 1999)

- The distribution of land uses, such as residential, industrial or commercial, spread in urban area determines the locations of human activities such as living, working, shopping, education or leisure;
- The distribution of human activities in space leads people to travel using transport system to deal with distance between the locations of activities;
- The distribution of infrastructure in the transport system creates opportunities for spatial interactions and can be measured as accessibility;
- The distribution of accessibility in space co-determines location decisions and thus results in transformations of the land-use system.

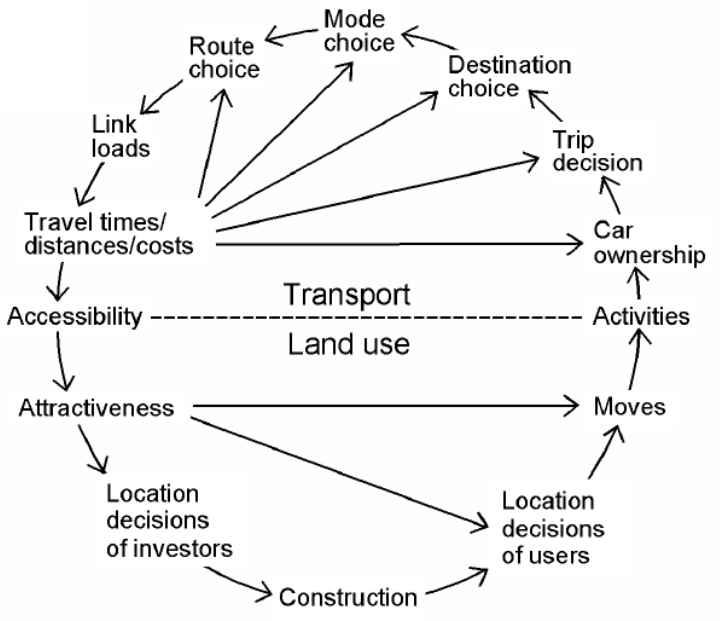


Figure 2.1 Land-use transport feedback cycle (Wegener and Fürst 1999).

Furthermore, the interaction between transportation and land use is summarised in the following tables. The following tables will present the expected impacts of transport on land use, and vice versa, based on the theories.

Table 2.1 Theoretical Perspective of Expected Impacts of Land Use on Transport (Wegener and Fürst 1999)

Factor	Impact on	Expected impacts
Residential density	Trip length	Higher residential density alone will not lead to shorter trips. A mixture of workplaces and residences can lead to shorter trips if travel costs are increased.
	Trip frequency	Little impact expected. If trips are shorter, more trips may be made.
	Mode choice	Minimum residential densities are a prerequisite for efficient public transport. More walking and cycling trips will be made only if trips become shorter.
Employment density	Trip length	Concentration of workplaces in few employment centres tends to increase average trip lengths. A balance of workplaces and residences in an area would lead to shorter work trips only if travel becomes more expensive.
	Trip frequency	Little impact expected. If trips are shorter, more trips may be made.

Factor	Impact on	Expected impacts
	Mode choice	Concentration of workplaces in few employment centres may reduce car use if supported by efficient public transport. More walking and cycling trips will be made only if trips become shorter.
Neighbourhood design	Trip length	Attractive public spaces and a variety of shops and services can induce more local trips.
	Trip frequency	If trips are shorter, more trips may be made.
	Mode choice	Street layout, pedestrian spaces and cycling lanes could lead to more walking and cycling.
Location	Trip length	More peripheral locations tend to have longer trips.
	Trip frequency	No impact expected.
	Mode choice	Locations close to public transport stations should have more public transport trips.
City size	Trip length	Trip length should be negatively correlated with city size.
	Trip frequency	No impact expected.
	Mode choice	Larger cities can support more efficient public transport systems, so more trips should be made by public transport in larger cities.

Table 2.2 Theoretical Perspective of Expected Impacts of Transport on Land Use (Wegener and Fürst 1999)

Factor	Impact on	Expected impacts
Accessibility	Residential location	Locations with better accessibility to workplaces, shops, education, and leisure facilities will be more attractive for residential development, have higher land prices and be developed faster. Improving accessibility locally will change the direction of new residential development, improving accessibility in the whole urban area will result in more dispersed residential development.
	Industrial location	Locations with better accessibility to motorways and railway freight terminals will be more attractive for industrial development and be developed faster. Improving accessibility locally will change the direction of new industrial development.
	Office location	Locations with better accessibility to airports, high-speed rail railway stations and motorways will be more attractive for office development, have higher land prices. Improving accessibility locally will change the direction of new office development.
	Retail location	Locations with better accessibility to customers and competing retail firms will be more attractive for retail development, have higher land prices and be faster developed. Improving accessibility locally will change the direction of new retail development.

In addition, Bertolini (2009) also proposed ´transport land-use feedback cycle´ to explain how the use of urban land, transport systems, and the activities of households and firms influence each other. His concept is presented in Figure 2.2. According to this figure, patterns of land use partly determine the places where people do their activities, which include places they live, work, leisure, and so on. These activities´ locations reside in different places that lead trips of people and vehicles to travel to different locations. These trips have to be considered carefully in transport system. Then, transport system developments are intended to be adapted accordingly. Otherwise, transport developments determine the accessibility of locations. The accessibility of locations is a key factor to determine attractiveness of the locations for certain activities.

However, Bertolini (2009) said that there is a risk to focus on transport land-use feedback cycle because it seems to neglect the role of people. Hence, the cycle should be seen critically and can be co-determined by other factors. According to Figure 2.2, it can be criticised that accessibility is not the only factor determining land use developments. They can be determined by land availability, attributes of the local environment, land use policy, or the economic dynamism in a region. Yet, the developments of transport systems do not only depend on the trips demand but also autonomous developments on the supply side, such as technological innovation or transport policy. Thus, it can be noticed that the transport land use feedback cycle is a complex concept. Changes in land use and transport system require longer time than changes in the patterns of activities. This may lead contradictory movements. For instance, variety in accessibility can alter patterns of activities without changing the land use first. Even though the transport land-use feedback cycle is regarded as a complex concept, it can provide a useful framework for exploring the relationship between transportation and land use developments in cities.

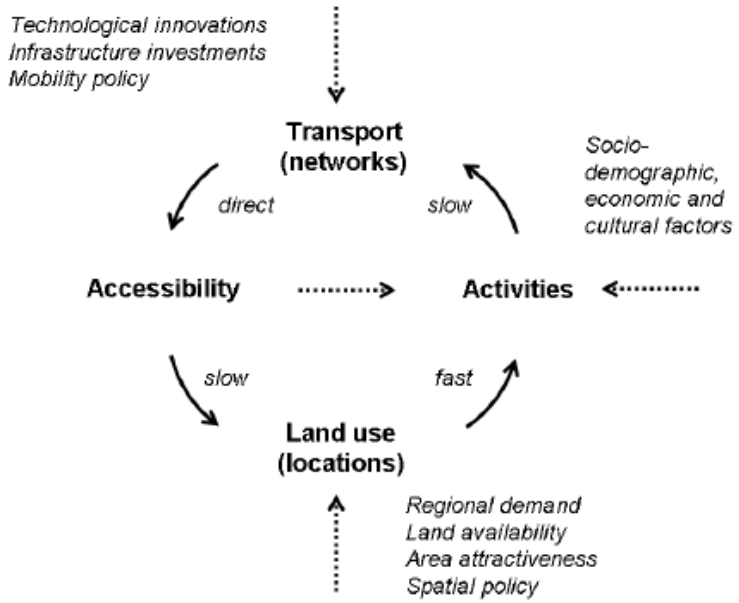


Figure 2.2 Transport land use feedback cycle (Bertolini 2009).

Remark

It can be concluded that transportation and land use have a complex relationship that cannot be simplified only considering one factor. Indeed, the development of transportation system is intended to improve accessibility in certain areas that will affect locations of human activity centres, including residential, industrial, office, and retail locations. These phenomena represent the impacts of transportation on land use development. Instead of accessibility, there are other factors, however, that have to get much attention due its influence on land use development. These factors include regional demand, availability of land, the degree of area attractiveness, and spatial or land use policy. Therefore, there should be a certain concept to be applied to deal with those factors that is able to manage land use through the development of transportation system. Thus, the concept of transit-oriented development (TOD) is promoted in this research in order to manage land use development in the city through the implementation of light rail transit (LRT).

2.3 Transit-Oriented Development (TOD)

The development surrounding transit facilities has potency to improve accessibility, support community activities, and increase life's quality in certain region. It would also contribute to achieve financial success of transit investment. The advantages of such development is often attributed to the concept of transit-oriented development (TOD) that is intended to improve air quality, preserve open space, create pedestrian-friendly environment, increase ridership and revenue, reduce urban sprawl, re-orientate urban development patterns near mass transit facilities (Cervero, et al. 2004). Therefore, there is an assumption that TOD is a proper development approach to manage areas around mass transit facilities, including bus rapid system and rail-based rapid transit system.

Furthermore, in order to understand about the concept of TOD, the following sub-sections will present definition of TOD and principles of TOD respectively.

2.3.1 Definition of TOD

Initially, the concept of TOD is proposed by Peter Calthorpe in 1993 in which TOD includes the high-density and mixed-use land development centralised on a transit station. However, there are various definitions of TOD according to some literature. It can be said that there is no a single agreed definition of TOD. Victoria Transport Policy Institute (2012) argues that TOD takes some development principles into account, including Smart Growth, New Urbanism and Location Efficient Development in which it refers to "residential and commercial centres designed to maximise access by transit and non-motorised transport modes, and with other features to encourage transit ridership". Victoria Transport Policy Institute (2012) also mentions that TOD typically consists of a rapid transit station that is functioned as the centre of the community activities. Moreover, high-density development is located around the centre, whereas lower-density development is built outwards one-quarter to one-half mile from the centre. The development promoted in TOD is a compact development that comprises various types of uses. The variety and amenities will attract people to walk and shorten distance for pedestrians to do their activities.

Apart from that, TOD is also described as "compact, mixed-use community centred around the transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more" (Bernick and Cervero 1997). Moreover, in the United Stated, several agencies have formulated their own definition of TOD as presenting in Table 2.3.

Table 2.3 Transit Agency of the United States Definitions of TOD (Cervero, et al. 2004)

Transit Agency	Definition of TOD
ATLANTA: Metropolitan Atlanta Rapid Transit Authority (MARTA)	Broad concept that includes any development that benefit from its proximity to a transit facility and that generates significant transit ridership.

Transit Agency	Definition of TOD
ASPEN: Roaring Fork Transportation Authority, Colorado	Land development pattern that provides a high level of mobility and accessibility by supporting travel by walking, bicycling, and public transit.
BALTIMORE: Maryland Transit Administration	A relatively high-density place with a mixture of residential, employment, shopping, and civic uses located within an easy walk of a bus or rail transit centre. The development design gives preference to the pedestrian and bicyclist.
CHARLOTTE: Charlotte Area Transit System	High-quality urban environments that are carefully planned and designed to attract and retain ridership. Typically, TODs provide for a pedestrian-friendly environment.
NEW JERSEY: New Jersey Transit Corporation (NJ TRANSIT)	An environment around a transit stop or station that supports pedestrian and transit use, created by providing a mix of land uses in a safe, clean, vibrant, and active place.
CHICAGO: Regional Transportation Authority of Northeast Illinois (RTA)	Development influenced by and oriented to transit service that takes advantage of the market created by transit patrons.

In brief, it can be said TOD is intended to reduce the use of private motorised vehicles and encourage citizens to use public transit by establishing a compact development that integrates transportation and land use pattern.

2.3.2 Principles of TOD

The principles of TOD are identified and formulated by the American planning communities. They argue that there are five principles called “the 5D principles of TOD”, namely *Density, Distance, Diversity, Design, and Destination Accessibility* (Chen 2010). These principles should be incorporated appropriately in any TOD projects in order to ensure the projects can be success. The principles of TOD are explained as follow:

1. **Density**

   TOD is expected to enhance land use density in the vicinity of transit station as its centre and restrain urban sprawl. Developing high residential and employment densities surrounding TOD´s centre will lead inhabitants or workers to use public transit rather than private vehicles, and enhance local economic activities as well. On the other hand, development densities will decrease in line with the increase of the distance from TOD´s centre. In this area, the use of motorised vehicles or rapid transit modes will be increasing. It can be noticed that higher land use density is required by

higher-capacity transit facility to support it. The following table will describe some examples of TOD residential densities in the United States (see Table 2.4).

Table 2.4 Example TOD Residential Densities
(Community Design + Architecture, Inc 2001)

Source	TOD Type	Residential Density
San Diego TOD Guidelines	Urban TOD (LRT served)	25 dwelling unit/acre minimum average (18 du/ac minimum)
	Neighbourhood TOD (Bus served)	18 du/ac minimum average (12 du/ac minimum)
LUTRAQ Study, Washington County, Oregon	Mixed-Use Centre (LRT served)	15 du/ac minimum average (7 to 50 du/ac range)
	Urban TOD (LRT served)	15 du/ac minimum average (7 to 40 du/ac range)
	Neighbourhood TOD (Bus served)	8 du/ac minimum average (5 to 20 du/ac range)
Portland Tri-Met, Planning and Design for Transit Handbook	LRT served TOD	Up to 1/8 mile: 30 du/ac 1/8 to 1/4 mile: 24 du/ac 1/4 to 1/2 mile: 12 du/ac
	Bus served TOD	Up to 1/8 mile: 24 du/ac 1/8 to 1/4 mile: 12 du/ac 1/4 to 1/2 mile: n.a.

According to Table 2.4, it can be seen clearly that the requirement of minimum residential density for Rail TOD is higher than Bus TOD requirement. It also has to be noted that the density of land use will be increasing close to the rapid station. The following figure describes the land development densities of a rail station.

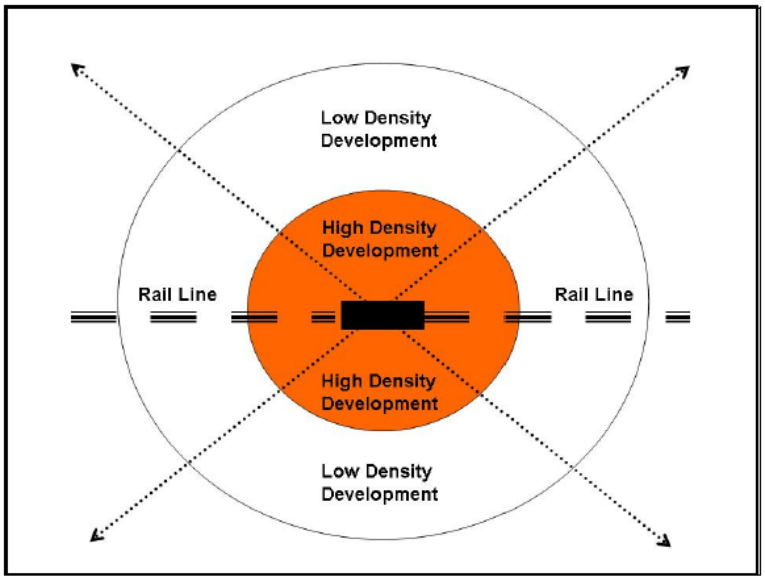


Figure 2.3 Land Development Densities surrounding a Rail Station (Chen 2010).

2. Distance

A basic requirement of this principle is TOD should ensure walking distance from a transit station to resident houses or offices not exceed 400 metres (¼ mile or travel time is approximately 5 minutes). The highest densities of development should be located within area ¼ mile from a transit station to make a distance that is affordable by walking. Thus, people can walk to the station rather than driving by motor vehicles.

3. Diversity

The diversity principle implies that TOD has to provide mixed land uses which are combining different types of land uses, such as commercial, residential, office, and other land uses, together (Chen 2010). The mixed land uses provide a place for transit users or other citizens to conduct their activities all the times. This circumstance may create more safe and secure environment as well as enhancing economic growth of the TOD area. Additionally, the mixed land uses are prone to encourage people to conduct more walking trips rather than vehicle trips. The following table presents examples of mixed-use TOD projects in the United States.

Table 2.5 Examples of Mixed-Used TOD Projects (Evans, et al. 2007).

Location	Development Mix	Situation	Travel Impact
Ballston Station Area, Arlington, VA, 1960-2002	5,914 residential units; Office: 5,721,000 sf; Retail: 840,000 sf; Hotel: 430 rooms	The Ballston area has been transformed from an automobile-oriented close-in suburb into a full-fledged TOD since the Metro Rail station opened in 1979.	The walk mode share of access/egress for the station in 2002 was 67% of about 22,000 average daily entries plus exits.
Village Green Arlington Heights, IL, 2001	250 condominiums Office: 17,000 sf Retail: 53,000 sf	A big grocery store is within walking distance. One of several downtown redevelopment projects.	17% residents report commuter rail as their primary commute mode.
Mockingbird Station, Dallas, TX, 2000	211 apartments Office: 140,000 sf Retail: 180,000 sf	A full service grocery store is within 5 minutes on foot.	Parking requirement reduction of 27% was allowed for shared use parking. About 10% of patrons are reported to arrive by transit.

Note: sf = square feet.

4. **Design**

   This principle indicate that TOD and stations as its centres should be designed properly to increase amenities, encourage more pedestrian activities, and minimise conflicts between pedestrian and motor vehicular trips (Chen 2010).

5. **Destination Accessibility**

   Destination accessibility associates to the accessibility from a transit station to its surrounding activity centres (Chen 2010). It should be noticed that accessibility is a key factor to relate transportation and land use. The relationship between transportation and land use is shown in Figure 2.2. This interaction implies that higher accessibility of a transit station tend to encourage people to use the station more frequently.

2.3.3 Light Rail Transit (LRT) and Transit-Oriented Development (TOD)

First of all, we should define what LRT is. LRT is a type of rail-based transit modes that is lighter and shorter than heavy and commuter rail transits. A definition of LRT is given by the American Public Transportation Association (APTA) as follow: (Transportation Research Board 2012)

> *"An electric railway system characterized by its ability to operate single or multiple car consists along exclusive rights-of-way at ground level, on aerial structures, in subways or in streets, able to board and discharge passengers at station platforms or at street, track, or car-floor level and normally powered by overhead electrical wires."*

Moreover, there is an expansion of LRT definition in which *"the tracks and vehicles must be capable of sharing the streets with rubber-tired vehicular"* (Transportation Research Board 2012). This means that LRT is not always operated in exclusive rights-of-way, but it is possible to operate it in shared way with other vehicles.

Cervero (1984) argued LRT is inherently able to affect urban growth and land uses, stimulate redevelopment, and enhance property values in the vicinity areas of LRT facilities since it is a permanent investment along a fixed line. Even though LRT can potentially influence for shaping urban development, it requires supportive local policies to underpin the implementation of LRT project. Transit Oriented Development (TOD) policy is a kind of land use policies that can support LRT project in order to manage land development at nearby areas of LRT components especially.

Many implementations of LRT in different cities in the world have proven that LRT system and TOD are strongly interrelated. Its characteristics may increase accessibility and attractiveness of certain area. These circumstances are likely to stimulate land use development in the area surrounding LRT system. Thus, the LRT characteristics seem to have closely relation with TOD concept that basically represents compact and mixed-use land development pattern near transit facilities (e.g. transit stations) with a high level of mobility and accessibility.

As a transit system, LRT comprises several elements, namely vehicles, transit lines, stations and stops, fare collection, depot or rail yards, control system and power supply system (Vuchic 1981). According to TOD definition, LRT station can be seen as the primary element which directly relates to TOD concept. Considering this relation, it can be said that TOD principles, including *density, distance, diversity, design and destination accessibility*, can be taken in planning LRT. The TOD principles are used to manage land use development in the areas proximate transit station especially. Therefore, it is obvious TOD principles can be incorporated in LRT planning in order to manage land use development in vicinity areas of LRT stations.

Remark

In this research, transit-oriented development (TOD) is specifically defined as a land development pattern consist of high-density and mixed-used development surrounding transit station which aims to improve level of mobility and accessibility by promoting the use of non-motorised vehicles and mass transit mode. It is a fundamental concept to manage land use development when a city implements mass transit system, including LRT system. Moreover, the principles of TOD (*density, distance, diversity, design, and destination accessibility*) are the important aspects to deal with various factors (*accessibility, regional demand, land availability, area attractiveness, and spatial policy*). Besides, LRT and TOD have a strong relationship in term of managing land use development in surrounding areas near LRT stations. Therefore, it does promise the implementation of LRT according to the perspective of TOD will be able to manage the land development impacts of mass transit system in the city.

2.4 Conceptual Framework

According to theoretical review, LRT system has potential impacts on land use development. The component of LRT system seen to largely affect land use development is its stations. Therefore, incorporating TOD principles, including *density, distance, diversity, design, and destination accessibility*, in LRT planning can be seen as proper way to manage land use development in the city when a mass transit system is implemented. They can handle several factors exist in the relationship between transportation and land use to support development in proximity area to transit nodes (stations) and corridors. The influence factors on land use development consist of accessibility, regional demand, land availability, area attractiveness, and spatial policy that refer to “transport land use feedback cycle” described by Bertolini (2009).

Furthermore, in this research, it is necessary to define TOD principles which are presented in the following table.

Table 2.6 Definition of TOD Principles for the Research

No	TOD Principle	Definition
1	Density	This principle indicates high residential and employment densities in which enormous residents and workers occupy proximate areas of transit stations. It is commonly presented in dwelling units per acre (du/ac)
2	Distance	This principle represents walking distance from a transit station to residential area or offices less than 400 metres or 5 minutes walking time.
3	Diversity	This principle implies mixed-use land development is provided near a transit station which is combining variety of land uses, such as residential, offices, retails and open space.
4	Design	This principles shows the development of transit station and activity centres nearby creates safe and convenient area as well as stimulating more pedestrian activities.
5	Destination accessibility	This principle relates to the accessibility for the people to commute from a transit station to the surrounding activity centres.

Additionally, the influence factors on land use development based on Bertolini (2009) will be managed through the concept of TOD principles that will be explained in the following sub-sections.

1. **Level of accessibility**

   The level of accessibility is a fundamental factor influencing land development pattern in the city. It implies the degree of easiness for residents to approach their destinations, including public transport facilities. In order to adjust this factor, some TOD principles, which are density, distance, diversity, and destination accessibility, are the most suitable concept, because these principles are basically intended to provide a certain area contains high-density and mixed-used land use which will improve accessibility of the area.

2. **Regional demand**

   This factor represents an economic dynamism in a certain region. This factor can be managed by the agglomeration of urban activity centres, especially industrial and commercial areas. The main purpose of the agglomeration is to provide a place where various industries and retails can conduct their economic activities closer. It can be

said that the agglomeration may trigger economic development in the region. The agglomeration phenomenon seems to be closely linked with the principles of density, distance, and diversity since these principles basically relate to the provision of area with high-density and mixed-used land use.

3. **Area attractiveness**

   The principle of design is the most appropriate concept to enhance the attractiveness value of certain area surrounding transit facilities. This principle aims to provide greater amenity for urban residents that will attract them to concentrate their activities in the given area proximate to transit facilities. Thus, this circumstance can be utilised to manage land use development through the implementation of a mass transit system.

4. **Land availability**

   This factor strongly affects the space can be used for land development. Considering this circumstance, the principles of density and diversity in the TOD concept are suitable to deal with the availability of land in the city. These principles indicate that various urban activity centres, such as residential, office, and retail areas, are placed into one area that will reduce the need of larger space of land to develop those activity centres. In other words, the implementation of TOD principles will enable to exploit the urban land efficiently.

It can be seen incorporating the principles of TOD in LRT system can be used to manage the influence factors of transportation on land use development. The interaction between the principles of TOD and the influence factors of land use development is utilised to manage land use development in the city. Therefore, the conceptual framework of the research is shown in the following figure.

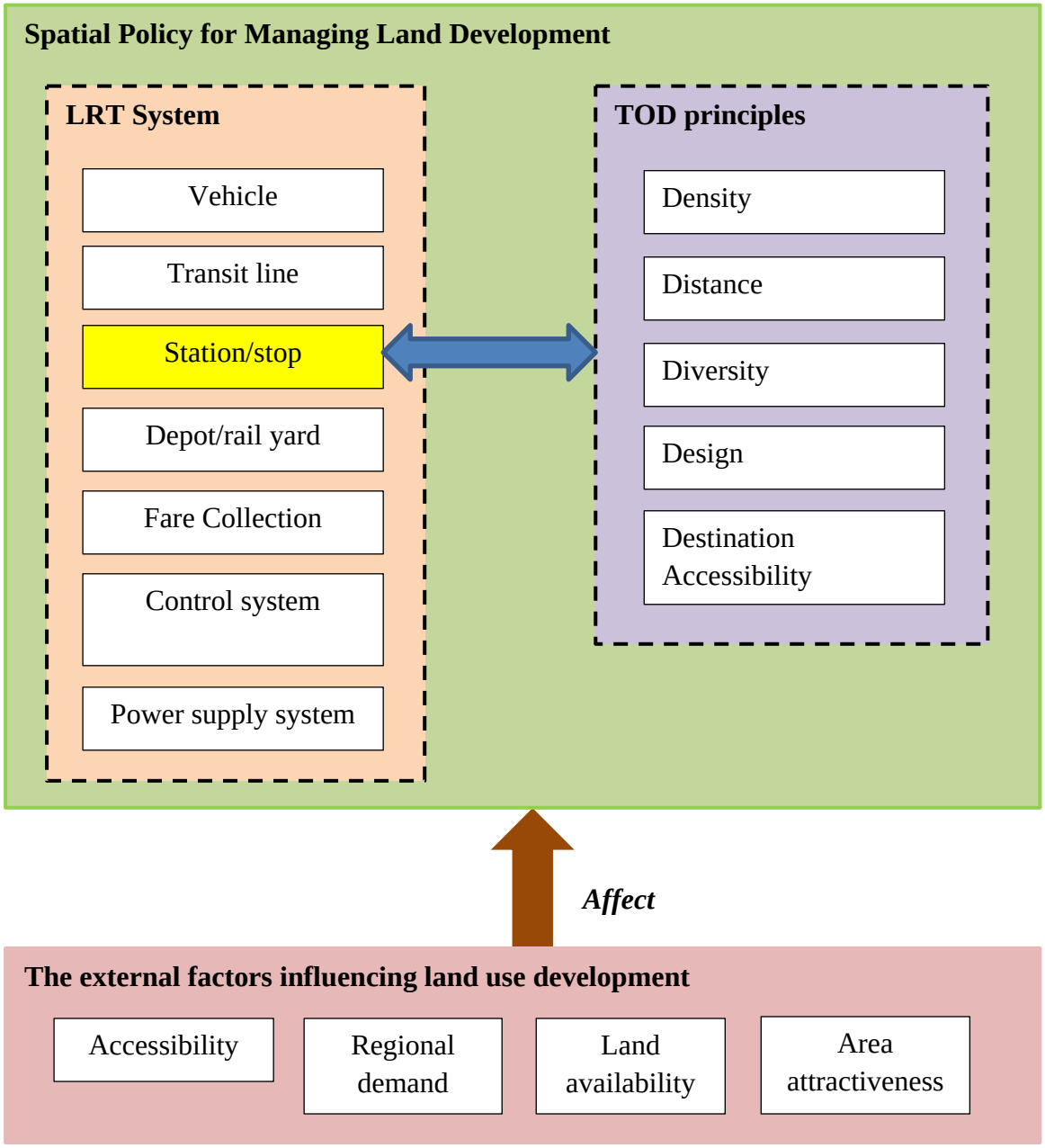


Figure 2.4 Conceptual Framework of the Research

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents in detail the research methodology implemented in the research. The basic aim in determining the research methodology is to address the main research question. For this purpose, case study approach will be employed in this research. This research will explore three cities, namely Strasbourg-Alsace, France; Calgary-Alberta, Canada; and Surabaya, Indonesia, as case studies. Then, two of those cities, which are Strasbourg-Alsace, France and Calgary-Alberta, Canada, will be compared to identify the impacts of LRT on land development that will be lesson learned to be taken in developing guideline for plan-making process of LRT in Surabaya-Indonesia. This step will apply comparative analysis approach to reveal similarities and differences of the land development impacts due to LRT implementation in different cities. Furthermore, this chapter also discusses types of data are required in this research as well as how to obtain and analyse the data.

3.2 Case Study Research

This research employs case study approach as the methodology in order to analyse a complex issue profoundly that is intended to reveal the facts of causal effect in a certain event. This method is chosen to be the most appropriate approach to answer the main research question of this research because it is mainly used to answer the questions “how” or ”why”. Hence, the research can identify, understand, and explain how to utilise LRT in managing land use development in a city refers to the perspective transit-oriented development (TOD) by implementing case study approach.

Apart from that, there are some considerations why this method is chosen in this research. First, it should be noticed that the researcher cannot interfere the process how LRT affect land development in the cities. This circumstance accord to attribute of case study method that it can be undertaken by a researcher who is unable or less able to adjust particular events (Yin 1994). Secondly, it can be noted that the relationship between LRT and land development is a complex phenomenon that may stimulate various opinions from different stakeholders that should be considered in plan-making process of LRT in the city. This reason again leads case study method to be applied in this research due to its appropriateness for understanding a complex phenomenon (Yin 1994). Thirdly, this method is proper to recognise and observe the research empirically by profound study to specific scope of study object. It means that the result of case study research cannot be generalised to another broader study object. This characteristic of the method seems to be suitable to be applied in this research since it specifies to explore land development impacts of LRT only in the city.

Furthermore, the case study method applied in this research will include various sources of data that discuss the impacts of LRT on land development in the cities. The sources of data can be journal articles, reports, documents, other publications from reliable sources, and the interview result of relevant stakeholders of LRT planning in Surabaya-Indonesia.

Additionally, this research selects three different case studies, which are Strasbourg-Alsace, France; Calgary-Alberta, Canada; and Surabaya, Indonesia. Strasbourg-Alsace, France is selected as a case study because it is one of the best LRT practices in Europe (Priemus and Konings 2001; HTM Consultancy 2003). It has been an essential tool for the City of Strasbourg in inducing urban redevelopment to support the LRT implementation in the city. In this case, there is also a local policy that favours the operation of LRT and integrates the LRT in urban development and environment. On the other hand, Calgary-Alberta, Canada is chosen considering its fast growth, especially in transportation system, that make Calgary-Alberta is appropriate to be a good example for the LRT implementation (McKendrick, et al. 2007; Marshall Macklin Monaghan Ltd. 2007). This city also has sufficient experiences in managing land use development by issuing a local policy that regulates development around transit stations to accord with the concept of TOD. Meanwhile, Surabaya-Indonesia is chosen as a case study because it is the second largest city in Indonesia that has experienced transportation problems and lack management of land development. Unfortunately, the city still does not implement mass transit system, which is LRT, to solve the problem, although the local government has a plan to develop LRT in the city. Therefore, it is interested to get lessons from other cities experiences, which are Strasbourg-Alsace, France and Calgary-Alberta, Canada, to use LRT in managing land use development in the city according to the perspective of TOD that will be useful to be considered in plan-making process of LRT in Surabaya-Indonesia.

3.3 Types of the Required Data

There are two types of data used in this research that comprise primary data and secondary data. These data will be explained in following section.

3.3.1. Primary Data

The primary data will be collected by the researcher by conducting visual observation in the study area (Surabaya) and interviewing relevant parties in term of LRT planning. The visual or field observation is required to be conducted in order to capture current condition of land use in the area along the planned corridor of LRT in Surabaya. The interview aims to get general description about LRT's plan in Surabaya. Aside from this, the purpose of the interview is to understand stakeholder's perspectives related to potential impacts of LRT on land development in Surabaya. In this case, the interviewees comprise representative of several local government institutions, who are responsible in local transport planning, representative of local public transport association, and property developer. These interviews are undertaken in Surabaya which has a plan to implement LRT system in the city.

3.3.2. Secondary Data

The secondary data is collected by conducting literature review and collecting data from government reports, publications in transport planning issues, especially for LRT cases, and documents form international organizations that have attention on LRT issues. In term of secondary data from government institution, it will be obtained by directly visiting to certain institution, such as Development Planning Board and Transportation Agency of Surabaya Government.

3.4 Data Collection Methods

This section explains several methods implemented in this research which include interview, observation, and literature review.

3.4.1 Interview

The interview is a prominent method to collect qualitative data. In this research, it is essential to collect and understand opinions from various stakeholders (government, and citizens) regarding with the government plan to operate Light Rail Transit (LRT) in Surabaya-Indonesia. The result of interview will provide general overview about perspectives of the relevant stakeholders about potential impacts of LRT on land development in the city and how to deal with those impacts. Furthermore, this overview will be used to generate some key points that will be considered in developing guideline for planning LRT in Surabaya that will offer recommendations to manage land development in the city.

Furthermore, the method of interview conducted in this research is unstructured interviewing method. This method is selected considering its ability to provide more detail and broader data than other interview methods in qualitative research. Neumann (2006) illustrate this method as an interview session in which the interviewer refers to some basic questions that will be modified during the session considering the interview circumstance in order to gain more profound information. The basic questions asked to interviewees are presented in Table 3.1. Moreover, this method suits to create certain condition that make the interview can be more relax, gain better understanding about the informant views, and create trust between the interviewer and the informant.

Table 3.1 List of Key Questions for Interviewees

No	Interviewee	Key question
1	Local government	1) What are considerations used by policy makers in plan making of LRT system? 2) What are supports provided by government for implementing LRT system? 3) Does the LRT´s plan consider the land development impacts of LRT? 4) Does the LRT´s plan integrate in Spatial Policy of the city? 5) Is the design of LRT components (e.g. stations) deliberately intended to be a landmark of the city in order to attract investments for developing the land in the vicinity areas of LRT? 6) Are there strategies from government dealing with potential impacts of LRT on land use development? 7) What do you think about integrating Transit Oriented

No	Interviewee	Key question
		Development (TOD) principles (i.e. density, diversity, distance, design, and destination accessibility) in LRT planning in order to manage land use development? 8) Are TOD principles integrated in Spatial Policy of the city? How to integrate TOD principles and LRT planning in spatial policy? 9) To what extend accessibility, land availability, regional demand and area attractiveness of the city will be considered in formulating spatial policy for managing the land development? 10) What kinds of barriers faced to implement LRT´s plan?
2	Public transportation company and Property developer	1) What is your opinion about government´s plan to implementing LRT? 2) What is your expectation to government related to upcoming LRT implementation? 3) Do you think LRT will influence land use pattern of the areas surrounding LRT facilities, especially area near LRT station? If so, could you mention what kinds of potential impacts of LRT on land use development? 4) What is your opinion about the way of government to deal with potential land development impacts of LRT? 5) Do you think LRT planning has to be integrated in spatial policy?

Additionally, it is obvious that interview method requires specific interviewees or informants as a data source. Considering this research is mainly based on qualitative analysis, the interviewees can be determined through purposive sampling method that chooses cases with particular aim in mind (Neumann 2006). This indicates that the interviewees are chosen based on their relevancy to the research objectives. They should have strong knowledge and experience related to study object of the research. They understand the problems faced in managing land use development due to LRT implementation. In this research, the interviewees are especially actors involved in decision-making of the plan of LRT in Surabaya-Indonesia. Therefore, several interviewees are selected to obtain specific information to be analysed in this research. The interviewees are stakeholders who are relevant in LRT planning of Surabaya, including government officials of Surabaya Government and existing public transportation company. They are presented in table 3.2.

Table 3.2 List of Interviewees in the Research

No.	Interviewee	The Number of Interviewee (person)
1.	Local government:	
	a. Development Planning Board	2
	b. Transportation Agency	2
	c. Public Works Agency	1
2.	Public transportation company	1
3	Property developer	1
	Total	**7**

3.4.2 Observation

As the interview, the observation is also one of methods to gather qualitative data. It is intended to observe selected data in a specific object. This method is helpful for the researcher to understand and analyse any phenomena related to object study which occur in the reality. In this research, observation only focusses on capturing the real and current conditions of land use in certain areas along the planned route of LRT in Surabaya-Indonesia. This will be presented visually to recognise the potencies of those areas to be managed through LRT implementation.

3.4.3 Literature Review

Literature review is chosen to collect the secondary data because it can be used to accumulate knowledge; to learn from other studies; and to formulate based on other people done (Neumann 2006). The sources of data, including books, journal articles, proceeding, reports, governmental documents, and other relevant information from reliable sources will be reviewed to gather relevant information that are required for the analysis of the research.

3.5 Method of Analysis

This research basically employs comparative approach as a part of qualitative analysis. Collier (1993) argues that "comparison is a fundamental tool of analysis" because it strengthens the case description, and has an important role in creating the concept by focussing on similarities and differences among cases (Mills, Bunt and Bruijn 2006). It can be said that comparative can be applied to explore and understand the implementations of a specific policy in which it aims to formulate a new policy for solving certain problems. Therefore, exploring the land use development impacts of LRT in the city through comparing implementation of LRT in Strasbourg-Alsace, France and Calgary-Alberta, Canada can result lesson learned that will be adopted in plan-making process of LRT in Surabaya. However, it is also necessary to carefully consider whether the lessons can be adopted or not by taking local conditions of Surabaya-Indonesia into account.

3.6 Operationalization of Data Collection Methods

This section explains how to operate the methods used in this research to collect the required data. The operationalization of the methods is depending on the context of each case study. The detail explanation of the operationalization of the methods is presented in the Table 3.3.

3.7 Steps of the Research

The following steps are conducted to obtain the objectives of the research.

1. **Literature review of theoretical background and the chosen method for analysis.**

   This explores the theories related to transport planning, land use planning, urban transit, and bus transit and land development planning to understand these concepts and then reveal the potential impacts of LRT on land development. Thus, this can help to identify factors influence land development due to LRT implementation. This step will also lead to select appropriate methods to analyse issues in this research.

2. **Selecting, describing and comparing the case studies.**

   This step explains the reasons of selecting particular areas to be compared. The implementation of LRT in Strasbourg-Alsace, France and Calgary-Alberta, Canada is chosen because it represents the best practices of LRT that have impacts on land development in those cities. Then, Surabaya is chosen as study area because it has a LRT's plan that is less considering potential land development impacts of LRT. Furthermore, the relevant information about Surabaya will be presented in detail refers to several literatures, such official documents, reports and other references.

3. **Collecting the primary and secondary data**

   The primary data will be collected by conducting visual observation on planned corridor in Surabaya and interviewing several relevant stakeholders. On the other hands, the secondary data will be collected by conducting literature review and surveying relevant secondary data.

4. **Analysing the data collected**

   The data collected are analysed using comparative analysis method. This method is a part of qualitative analysis that is chosen in this research in order to compare current practices of LRT system in different cities of different countries. This method focuses on discovering the similarity and difference between case studies, and then finds the gap of those practices. This can recognise lessons that can be learned from others´ practices how LRT stimulate land use development and how to use LRT in managing land use development in cities. Finally, those lessons from comparing practices of LRT in other cities are used in formulating the guidelines for planning LRT system in Surabaya.

5. Conclusions, Reflection and Recommendations

The results of analysis are concluded in this part. From the analysis, the research will present the potential impacts of LRT on land development and propose guideline for LRT planning. Besides, the limitations that are experienced by this research will be presented in reflection sub section. Finally, recommendations for local government and further research will be proposed.

Table 3.3 Operationalization of Data Collection Methods

Research Objectives	Case Study	Method for Collecting Data	Source of Data	Operationalization
Identifying the way of LRT in stimulating land use development refers to the perspective of transit-oriented development (TOD)	Strasbourg-Alsace, France and Calgary-Alberta, Canada	Literature Review	- International journal articles. - Documents and reports. - Publications in internet.	The sources of data are reviewed to collect information according to conceptual framework of the research as follows: - To what extend LRT system implemented in Strasbourg-Alsace, France and Calgary-Alberta, Canada relate to TOD principles. - How TOD principles included in LRT systems of Strasbourg-Alsace, France and Calgary-Alberta, Canada manage land use development surrounding LRT stations.
	Surabaya-Indonesia	Literature review	- Governmental documents and reports of the Surabaya Government, including Local Spatial Planning and LRT Planning. - Publications in internet.	The sources of data are reviewed to gain information relate to conceptual framework of the research as follows: - Considerations in LRT planning of Surabaya whether it is integrated with land use policy or not. - How LRT system planned in Surabaya relate to TOD principles.
		Interview	- Governmental agencies within the Surabaya Government.	The in-depth interview will be conducted to gain thorough information needed in this research from the stakeholders in Surabaya.

Research Objectives	Case Study	Method for Collecting Data	Source of Data	Operationalization
			- Public Transportation Company in Surabaya. - Property developer in Surabaya.	The key questions of interview are used to reveal information from the stakeholders.
		Field observation	Area surrounding planned LRT corridor in Surabaya	Current land developments in areas near planned LRT corridor in Surabaya are captured and then presented in visual description to show real conditions of the areas which will be affected by the implementation of LRT.
Developing a guideline for LRT planning in order to manage land use development in a city.	Strasbourg-Alsace, France and Calgary-Alberta, Canada	Literature review	- International journal articles. - Documents and reports. - Publications in internet.	The sources of data are reviewed to get information as follows: - How land use policy and LRT planning are integrated from the perspective of TOD in order to manage land use development within the cities.
	Surabaya-Indonesia	Literature review	- Governmental documents and reports of the Surabaya Government, including Local Spatial Planning and LRT Planning.	The sources of data are reviewed to collect information as follows: - How plan making process of LRT is currently conducted in Surabaya. - What are strategies planned by the government to cope with potential impacts

Research Objectives	Case Study	Method for Collecting Data	Source of Data	Operationalization
			- Publications in internet.	of LRT on land use development? - Whether LRT planning in Surabaya is integrated to land use policy to manage land development in the city from the perspective of TOD.
		Interview	- Governmental agencies within the Surabaya Government. - Public Transportation Company in Surabaya. - Property developer in Surabaya.	The relevant stakeholders, namely government officials, public transportation company and property developer will be interviewed according to the key questions of interview for collecting information required of the research.

CHAPTER 4
LRT Implementations in Strasbourg-Alsace, France and Calgary-Alberta, Canada, and Their Impacts on Land Development

4.1 Introduction

This chapter discusses the comparison between LRT practices in two foreign cities, which are Strasbourg-Alsace, France and Calgary-Alberta, Canada. In the following section, the typology of LRT system will be presented. It then presents the impacts of the two LRT practices on land development in each city and reveals how TOD principles are adopted to deal with those impacts as well. In the next sub-sections, the LRT implementations and their impacts on land development in Strasbourg-Alsace, France and Calgary-Alberta, Canada will be explained separately as well as presenting the comparison between those practices.

4.2 Case Selection of International LRT Practices

This section describes the criteria behind the selection of the two international LRT practices in this research. In principle, there are two basic criteria underlie the case selection in this research, namely: 1) Long-time experience in operating LRT system; and 2) Local policy support. The explanations of the criteria in each LRT practices are presented as follow:

1. Long-time experience in operating LRT system

- ***LRT practice in Strasbourg-Alsace, France***

  LRT system in Strasbourg is acknowledged as one of the best LRT practices in term of integrating the LRT in urban development and environment (HTM Consultancy 2003). It has been run for 19 years until 2013. Hence, it is a proper model to show the success of LRT system to serve urban community for many years.

- ***LRT practice in Calgary-Alberta, Canada***

  The implementation of LRT system in Calgary is considered as one of the successful LRT practice in the North America (McKendrick, et al. 2007; Marshall Macklin Monaghan Ltd. 2007; Wikipedia 2013). This transport system has been operated since 1981. Therefore, it has quite long experience that will give lesson how to retain LRT implementation for serving people to commute within the city for decades.

2. Local policy support

Local policy support is a fundamental factor to assure the implementation of LRT affects land development and manages such development. Cervero (1984) argued LRT implementation will substantially influence urban development if supportive local policies are provided. Thus, the existence of supportive local policies in each LRT practice is explained as follows:

- ***LRT practice in Strasbourg-Alsace, France***

  A local policy was issued in 1991 which aims to improve urban quality of living (la qualité de la vie) by integrating town planning and transport policy (LiRa 2000). The

LRT in Strasbourg is implemented by the local government to deal with increasing traffic and pollution, as well as promoting public transport ridership and urban redevelopment (LiRa 2000). The presence of this supportive local policy is a powerful mean to manage impacts of LRT on land development. Therefore, LRT practice in Strasbourg offers a lesson how to integrate LRT and land use/spatial policy.

- ***LRT practice in Calgary-Alberta, Canada***

  The local government of the City of Calgary has provided several policies to support the implementation of LRT. The government has developed a solid framework that promotes transit use and transit-supportive land uses (Marshall Macklin Monaghan Ltd. 2007). The supportive local policies issued by the government are presented as follows: (Marshall Macklin Monaghan Ltd. 2007)

  - *Calgary Transportation Plan in 1995*. This policy emphasises the role of public transit and the reduction of vehicle trips.
  - *Sustainable Suburbs Study in 1995*. This study provides a guidance to create sustainable development in suburban areas.
  - *Transit Friendly Design Guide in 1995*. This policy aims to develop new street design standards in order to induce transit-supportive development.
  - *Transit Oriented Development Policy Guidelines in 2004*. This policy provides guidelines for development of areas specifically 600 meters of a transit station that should accord with the concept of transit oriented development (TOD).

Based on the explanation of the case selection criteria in this research above, the LRT practices in Strasbourg and Calgary are comparable and selected to give lessons for the upcoming implementation of LRT in Surabaya, Indonesia. Furthermore, the two LRT practices will be analysed deeply in the following sections according to the conceptual model of this research.

4.3 Typology of LRT System

LRT known as tramway (APTA 1994) is defined by the Union Internationale de Transports Publics (UITP) as *"a public transport permanently guided at least by one rail, operated in urban, suburban and regional environment with self-propelled vehicles and operated segregated or not segregated from general road and pedestrian traffic"* (ERRAC and UITP 2009). It can be seen LRT has a broad definition that includes a classical tram (not segregated) and a metro (fully segregated) (ERRAC and UITP 2009). In other words, its broad definition encompasses a broad continuum from single train units operating in mixed traffic within city streets at low speed (40 km/hour or slower) to multiple train units operating on an exclusive right-of-way at high speed (100 km/hour or faster) (Transportation Research Board 2012). Moreover, the technologies of LRT and tram have more similarities than differences. These two terms are commonly differentiated by the speed and the length of the corridor. The term of LRT is used to indicate a train system towards a rapid transit, fast serving long trip and serving wide-spaced stations/stops (Walker 2010). Therefore, in this research, tramway can be put in wide spectrum of LRT definition that implies it is also classified as LRT.

Furthermore, LRT system can be distinguished considering two features, namely the area scale of the LRT network and the interoperability of the LRT in using different types of railways, such as operational combination with heavy train and tram infrastructure (Priemus and Konings 2001). According to those features, The Dutch Ministry of Transport, Public Works and Water Management is classified the LRT system into four types as follow: (Priemus and Konings 2001; Zuiderveen 2009)

1. *Urban regional light rail on its own (new) track, with the possibility of additional shared use of railway tracks*

   This LRT type is characterized by the possibility of shared use existing railway with other train technologies, such as metro and express tram. This type provides direct connection between important commuter areas and the city centre. Examples of this type are metro/express tram Rotterdam and express tram Utrecht-Nieuwegein/IJsselstein.

2. *Urban regional light rail on the existing railway net*

   In this type, the LRT is (almost) only operated in the existing railways mixed with other train technologies. This LRT will serve the passenger 4-6 times per hour approximately. This system provides direct connection between important commuter areas and the railway station in the city centre. Randstadspoor in the Utrecht is an example of this LRT type.

3. *Connection to (medium) big cities with shared use of the national railway network (Karlsruhe model)*

   This LRT type is characterised by the use of the national railway network and the existing or the new tram track. The operation of LRT is mixed with other train at the national railway network. Meanwhile, the operation of LRT at the city might be mixed with the local trams. The LRT is designed to serve the passengers about 4 times per an hour. The main feature of this type is free transfer between settlements and the regional city centres. Examples of this type are LRT in Karlsruhe, Cologne/Bonn, Manchester, Newcastle, Salzburg, Bern, Kassel and Saarbrucken.

4. *Regional subsidiary lines (Durener model)*

   This LRT type is run at connections in rural areas using the existing railway exclusively. Its operation is not mixed with other train types. This type basically aims to salvage the unattractive regional railways. The level of service is improved by increasing the number of stops, the speed and frequencies. This LRT is planned to serve around 1-4 times per hour. The LRT in Duren (Germany) is an example of this type.

It can be noticed the type 1 and 2 above typically provide high-level of service and are built in the largest urban areas. Their lines are mostly separated with other transport modes, excluding other train types, by constructing grade connections. In this research, the LRT system in Strasbourg-France and Calgary-Canada seem to be included in type 1 since they are operated in their own tracks and these systems connect the city centre and its hinterlands or sub-urban areas.

4.4 LRT Implementation and Its Impacts on Land Development in Strasbourg-Alsace, France

Strasbourg located in eastern France proximate to the border with Germany. It is a capital and principal city of the Alsace region. The city of Strasbourg lies on a territory of around 78 square kilometres. It is located in the metropolitan region or Urban Community of Strasbourg (CUS) that covers an area of 305.97 km2, which extends 28 km north-south and 16 km east-west. Currently, the number of population in Strasbourg is 468,724 residents (City and Urban Community of Strasbourg 2013). The pattern of population distribution within the CUS, like other European cities, is characterised by a high-density city centre and a mixed density inner ring, surrounded by lower density suburban villages spread in the city's hinterlands (Thomas n.d.). The Strasbourg is an important business city in CUS. The employment distribution is mainly centralised in the city centre which approximately accommodates 100,000 workers (Thomas n.d.).

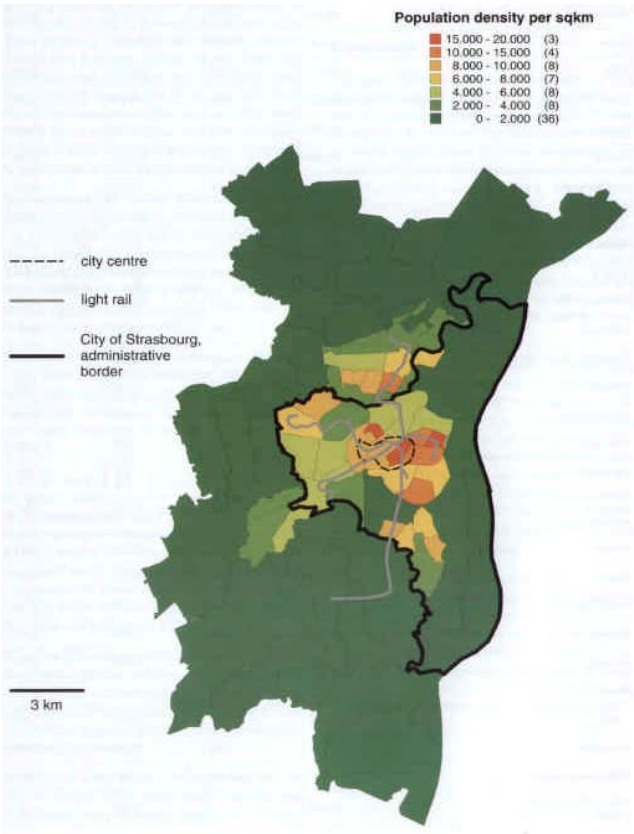


Figure 4.1 Map of the City of Strasbourg. (HTM Consultancy 2003).

4.3.1 Overview of Strasbourg Light Rail in Strasbourg-Alsace, France

The Strasbourg tramway is a light rail system in Strasbourg operated by the Compagnie des Transports Strasbourgeois (CTS) or Strasbourg Transport Company (in English). This company has a task to provide comprehensive public transport network of the Urban Community of Strasbourg (CUS). The tramway system consists of six corridors, namely A, B, C, D, E, and F corridors. The tramway has been operated since 1994. The A and D corridors were firstly opened in 1994. Then, the B and C corridors were opened in 2000. Meanwhile, the E corridor was opened in 2007 and the F corridor was opened in 2010. The total length of tramway corridors is currently 55.8 km comprises two tracks. However, the length of the physical track is only 38.7 km due to many corridors overlap with each other. There are 67 stations along the corridors (Wikipedia 2013).

Figure 4.2 Map of Strasbourg tramway corridors (Wikipedia 2013).

The Strasbourg tramway is a mean taken by the CUS to deal with increasing traffic and pollution. It also aims to promote the use of public transport and to assist urban redevelopment (LiRa 2000). In term of guiding urban redevelopment, especially in the city centre, the municipality in 1991 favours with integrating town planning and transport policy. This policy had guideline to improve the urban quality of life (la qualité de la vie). There were six types of action to integrate town planning and transport policy as follow: (European Academy of the Urban Environment 1996; LRTA 2003)

1. Builds a new tramway system as the backbone of public transport;
2. Links the tramway and the bus network;
3. Encourages bicycle use and improves pedestrian facilities;
4. Alleviates automobile use;
5. Re-planning urban spaces in accordance with the public transport system;
6. Public participation and information of local residents.

Moreover, HTM Consultancy (2004) classified the Strasbourg tramway as one of the best practices of integration new light rail and urban development and environment.

4.3.2 The Impacts of Strasbourg Light Rail on Land Development

The Strasbourg light rail as a backbone of public transports of the city is an innovative mean of urban transport that simultaneously promotes the concept of improving public transport infrastructure and town planning (LRTA 2003). The LRT system supported by the local policy that integrates town planning and transport policy has played an important role in inducing urban redevelopment in the city. A clear example is redevelopment of the main squares of the city that supports the LRT station and provides pedestrian facilities. This evidence implies the implementation of the Strasbourg light rail can affect land development in surrounding area of the LRT station in particular. Furthermore, the impacts of Strasbourg Light Rail on land development are presented in the following sub-sections based on transit oriented development (TOD) principles.

1. **Density**

   The Strasbourg tramway has been serving dense areas, especially in its city centre. In 2003, the A and Lines had to serve an urban area occupied by 427,200 residents. The tramway in A and B Lines also had to serve 176,800 workers in the urban area (egis Semaly Ltd and Faber Munsel 2003). Besides, it is noted that the operation of the LRT system has affected land use mainly in the growth of retail services in the downtown of Strasbourg. Meanwhile, it has not significantly influenced on office/ commercial land use.

   Even though the implementation of LRT system in Strasbourg seems to induce land development in the areas near the stations or corridors, there is no clear guidance about the rate of area density should be achieved in certain areas near LRT system. For instance, there is no regulation how many dwelling units are allowed to occupy surrounding area of LRT stations and corridors. Without clearly defining the rate of area density, it may cause less manageable land development in the areas near the LRT system.

Figure 4.3 The Tramway serve a high-density area consists of diverse types of land use, namely residential and retail services (Cheney 2010).

2. Distance

The proximity to LRT system has attracted development of areas nearby. The construction of LRT line B induced shopping-structure in the city centre and office development in Plaine des Bouchers. The development of tramway lines had abandoned existing roadways and it had been replaced by railway and pedestrian path. The stops are also located along this new railway. This indicates the LRT system in Strasbourg is built within walking distance in which people can reach the station by walking. Furthermore, population catchments around LRT stops in the Line A are 58,000 inhabitants (within radius 400 m) and 113,000 inhabitants (within radius 800 m). On the other hand, in Line B, the population catchments in the vicinity of the stops are 60,700 inhabitants (within radius 400 m) and 106,500 inhabitants (within radius 800 m) (egis Semaly Ltd and Faber Munsel 2003). However, there is no clear definition in the local policy about the radius of area that should refer to the concept of transit oriented development.

Figure 4.4 Transformation of road function due to LRT operation in Strasbourg. (Thomas n.d.)

3. Diversity

There is no sufficient information whether the implementation of LRT system in Strasbourg has been stimulating mix-use development due to the fact that the city of Strasbourg has been occupied by high-density land use with various uses, including residential and commercial uses, even before the LRT system was operated in the city (Freemark 2010). However, the operation of LRT system plays a role in stimulating the growth of retail services in the city centre. Therefore, it is still questionable the extent of the LRT system influences the mix-use development in the areas near the LRT stations and corridors.

4. Design

The development of LRT station and corridor had induced redevelopment of main squares in the city center (the Place Kléber and the Place de la Gare) as landmark of the city. The exiting roadway was abandoned and replaced by railway as well as providing ways for cyclists and pedestrians. Moreover, 1,700 trees were planted along the corridors and around the stations to create convenient areas for the LRT´s users

and contribute in reducing air pollution within the city. Thus, the design accommodates the concept of environmental-friendly development.

Figure 4.5 Redevelopment of the Place de la Gare to accommodate LRT and preserve larger space for pedestrians (Thomas n.d.).

Figure 4.6 Trees are planted along the LRT line in Strasbourg to create it convenient for people (Strasbourg.eu and Urban Community n.d.).

5. Destination Accessibility

The LRT system is connected to bus system and long distance or regional trains. There are also some Park and Ride lots in several stations. Apart from this, there are biking sheds in several stations and complemented cycling path to ease people to access the LRT stations.

However, the provision of Park and Ride sites may trigger residents to live far away from the LRT system. It also stimulates people to still depend on the use of private vehicles for their journey. Eventually, this may reduce the attractiveness of areas near the LRT stations which is potentially deterring land development in those areas.

Figure 4.7 Park and Ride facility at the station of Strasbourg tramway. (Strasbourg.eu and Urban Community n.d.)

Furthermore, this section also describes the extent of LRT system in Strasbourg considers the external factors influencing land use. It is presented as follow:

1. **Accessibility**

   The LRT system in Strasbourg definitely considers the connection with other public transport networks. Before the LRT operated, there are regional and long distance railways as well as bus-based public transport that have been serving people in Strasbourg. The LRT system has been linked to those public transports to enhance accessibility for people.

2. **Regional Demand**

   It is known that the LRT system passes the city centre which is a place for offices and commercial areas that accommodate 100,000 workers. Thus, it can be said that the LRT system offers another mobility options for workers and will enhance accessibility to economic centres of the city. It implies the LRT system in Strasbourg is taken economic reasons into its implementation.

3. **Land Availability**

   In certain parts of the LRT lines in Strasbourg, the railway is constructed by replacing the function of the existing roadways. This replacement also preserves ways for cyclists and pedestrians. This indicates that the implementation of the LRT system considers the availability of land authorised by the government.

4. **Area Attractiveness**

   The LRT system in Strasbourg has passed attractive places of the city, such as main squares of the city. It is noticed that the main squares of the city have become attractive places that gives opportunity for high ridership regard with the operation of LRT. Therefore, it can be seen that the LRT implementation also considers the attractive of particular areas within the city.

4.5 LRT Implementation and Its Impacts on Land Development in Calgary-Alberta, Canada

Calgary is a city in the province of Alberta Canada which is situated in the Rocky Mountain foothills of southern Alberta (McKendrick, et al. 2007). The total area of the city is 825.29 km^2. In 2011, the number of residents in Calgary was 1,096,833 and the population density was 1,329.0/km^2. This demographic condition is making the city become the largest city in Alberta (Wikipedia 2013). The city of Calgary has constantly grown since it was established in 1876 which is proven by doubling of population in the last 30 years. This city has massively developed in the surrounding area of downtown core in which there are 112,000 jobs and 12,000 residents existed within 3.5 km^2 area (Campbell, Reuter and Epp 2010). This area contains 32 million square feet of office, hotels and retail spaces (Hubbell and Colquhoun 2007).

Besides, residential growth seems to continue around the city which will cause urban sprawl. The current trends show that residential development intensively grows in the western area and industrial growth is rapidly developed in the eastern area. The phenomena cause urban expansion that requires the improvements on infrastructure and transportation system in order to provide connectivity throughout the city. To respond this circumstance, two transportation projects are currently undertaken, namely the west extension of LRT system and the completion of the Calgary Ring Road (Campbell, Reuter and Epp 2010). The expansion of Calgary LRT system, which is called C-Train, to the west aims to provide a sufficient public transport for people to traverse throughout the vast city, to reduce travel time, and to relieve inner city congestion. On the other hand, the Calgary Ring Road is designed to meet the need for high capacity collector road system around the city linking to main roads connected to the city core.

Furthermore, the LRT system is chosen as a backbone of public transportation system in Calgary because it offers several benefits compare with other modes (e.g. bus rapid transit), namely higher speed and service reliability, reduced operating costs, impact on the downtown road system and urban environment, and ability to achieve a more compact urban form (Hubbell and Colquhoun 2007). In the following sub-sections, the C-Train as the LRT system in Calgary will be described as well as its impacts on land development refers to TOD principles.

4.4.1 Overview of C-Train

C-Train is the light rail transit (LRT) system in Calgary-Alberta, Canada which has been operating since May 25, 1981 with the 12.9 km South LRT line (McKendrick, et al. 2007). The operator of this system is Calgary Transit that is a part of the Calgary municipal government's transportation department. Up to day, the length of the C-Train line is 56 kilometres (Wikipedia 2013), in which the network is illustrated in Figure 4.8. The C-Train system comprises four sections built in difference principle. The first section is the downtown section in which the C-Train operates in a transit mall with its lines built in the road. The transit mall is shared line in which it can be passed by LRT, buses, and official vehicles. By contrast, the Northeast Line was constructed in the median of arterial road ways. The South Line operates on the exclusive rights-of-way tracks or railways. Additionally, two-thirds of

the Northwest Line operates on residential areas, and the rest passes through the median of an arterial roadway. The C-Train system also comprises 25 suburban stations and 11 downtown platforms which are spaced approximately every 1.6 km in the suburban area (McKendrick, et al. 2007). The structure types of the stations are varying from simple in-community platforms (see Figure 4.9) to large structures (see Figure 4.10).

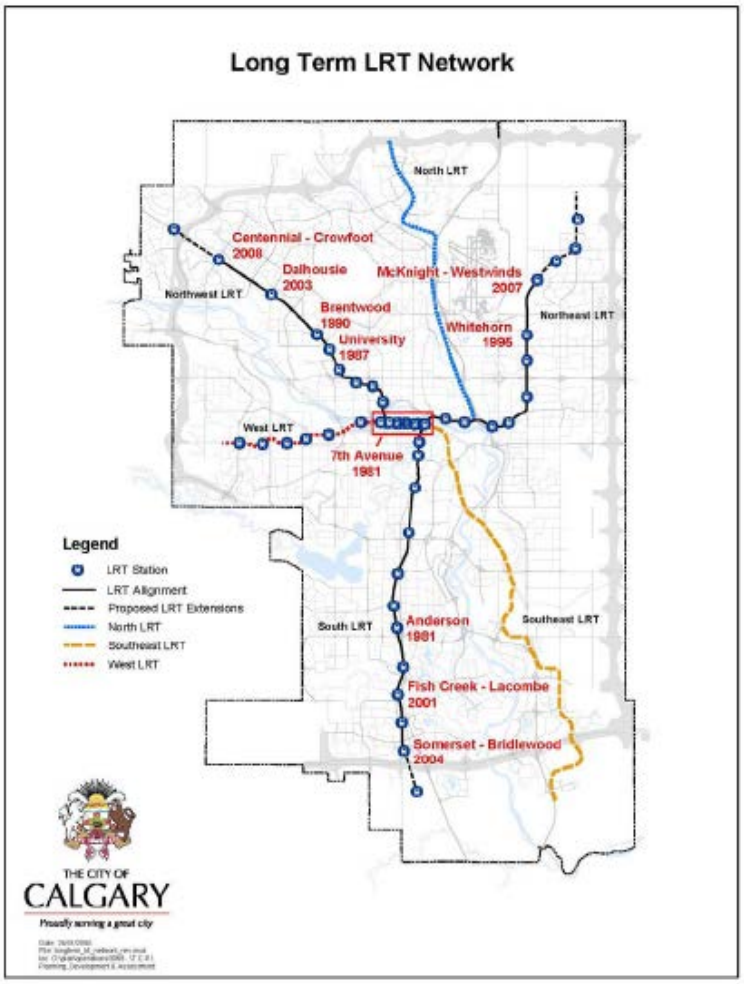


Figure 4.8
Long Term LRT Network in Calgary-Alberta, Canada (Hubbell and Colquhoun 2007).

Figure 4.9 Community station at Banff Trail Northwest line (McKendrick, et al. 2007).

Figure 4.10 Brentwood Station with park-and-ride in expressway median.
(McKendrick, et al. 2007)

Furthermore, the C-Train not only operates at exclusive rights-of-way tracks. In downtown area, which is at 7th Avenue, it operates on the 7th Avenue transit mall that is shared with buses and emergency vehicles (McKendrick, et al. 2007). The portions of rights-of-way track of the C-Train is shown as follow:

- 82% at-grade surface operation in a protected right of way,
- 8% in tunnel,
- 5% on bridges, and
- 5% within the downtown transit mall.

Additionally, the implementation of C-Train is also supported by a local policy that regulates the development around the station to refer the concept of transit oriented development (TOD). This policy is TOD Policy Guidelines approved by the City Council of Calgary in 2004. This policy provides guidelines for development of areas specifically 600 meters of a transit station (LRT or BRT station). This policy has six objectives: (The City of Calgary 2004)

1. Ensure transit supportive land uses;
2. Increase density around Transit Stations;
3. Create pedestrian-oriented design;
4. Make each station area a “place”;
5. Manage parking, bus and vehicular traffic;
6. Plan in context with local communities.

4.4.2 The Impacts of C-Train on Land Development

It is inevitable that the implementation of the C-Train has influenced land development along its corridor and surrounding area near the C-Train stations. A high quality transport service provided by the C-Train can largely improve the accessibility by shortening travel time. Therefore, vicinity areas of the C-Train stations are prone to be desirable for new development or redevelopment due to their high level of accessibility to a rapid transit system. Moreover, the Government of the City of Calgary provide land use and transportation policies that support the implementation of LRT system. One of the policies is Transit Oriented Development (TOD) Policy Guidelines. This policy basically provides direction for the development in areas within 600 metres from a transit station. The type of development promoted by this policy is a higher density, walkable, mixed-use environment within station areas in order to optimise use of transit system (The City of Calgary 2004). This policy implies that LRT system inherently has ability to influence land development in the areas near transit stations and transit lines in particular. Therefore, TOD is required to manage land development within the transit station areas.

Furthermore, the impacts of C-Train on land development in the City of Calgary will be explained in the following sub-sections according to TOD principles.

1. **Density**

   The extension of C-Train network, which is West Line, is a trigger to redevelop Westbrook Village. This redevelopment project includes the development of Westbrook station as a new C-Train station. The concept of Westbrook Village redevelopment is a high-density mixed-use development, including residential, retail and office uses. In particular, the redevelopment of Westbrook station is located in 13.0 gross acres in which 9.0 acres is developable consist of four parcels of land. The strategic location of the Westbrook station due its proximity to public transit and two major arterial roadways stimulates the considerable demand for office, retail and residential uses (The City of Calgary n.d.). The parcel description shown in Figure 4.11 is presented in the following Table 4.1. According to the parcel description, it can be argued that the provision of Light Rail Transit (LRT) system will affect development density in the vicinity area of the station. Moreover, it should be noticed the redevelopment of Westbrook Village is a TOD project in Calgary, Canada that clearly articulate the level of density within the area. The target of density in Westbrook Village is represented in Floor Area Ratio (FAR) which is “a density measure indicating the ratio between a building's total floor area and its site coverage” (Lincoln Institute of Land Policy 2013). The density target in this area is described in Figure 4.12.

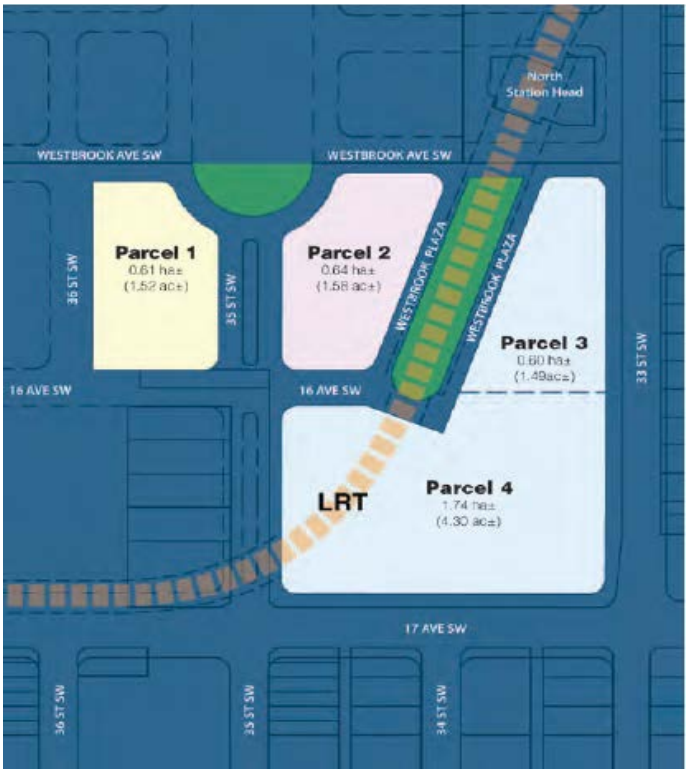
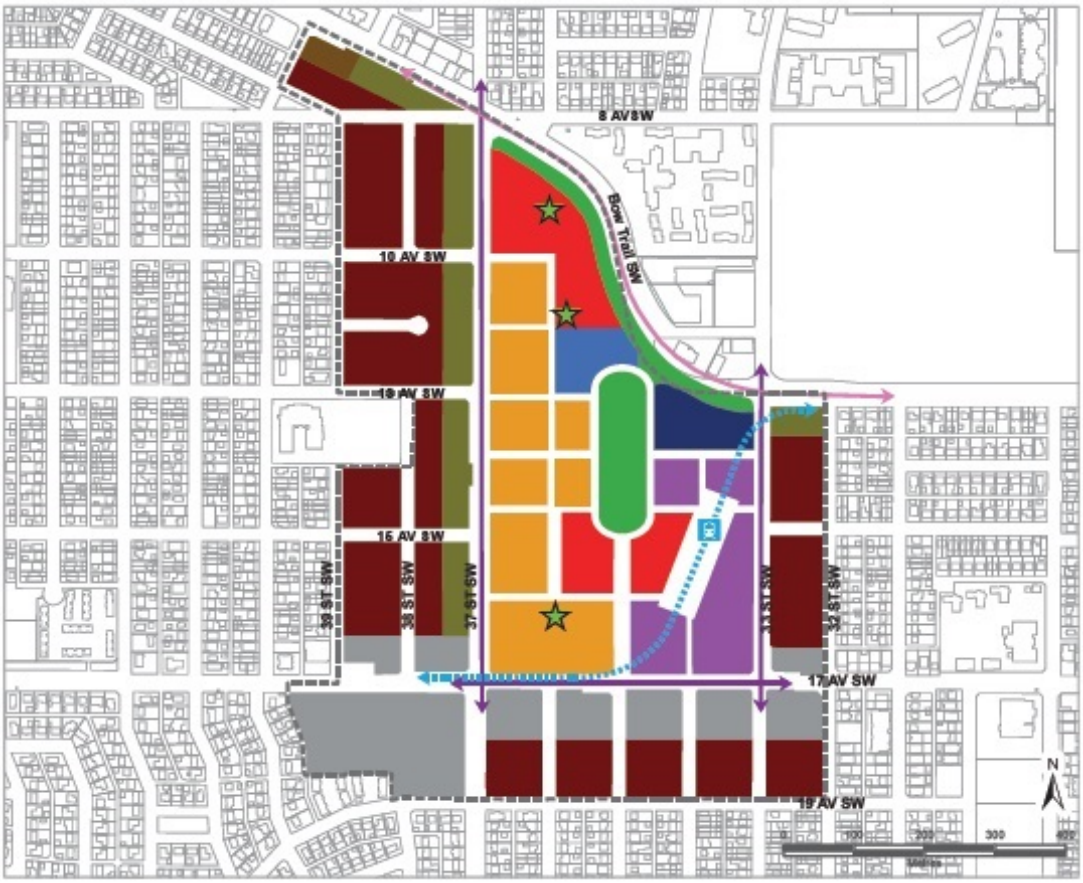


Figure 4.11 The Westbrook Station redevelopment site (The City of Calgary n.d.).

Table 4.1 Parcel Description in the Westbrook Station redevelopment site. (The City of Calgary n.d.)

Parcel	Description	Development Potential
Parcel 1	Medium to high density residential, primarily mid-rise, street-oriented buildings.	Approximately 530,000 square feet.
Parcel 2	High density, mixed-use development in pedestrian friendly blocks fronting onto the transit plaza.	Approximately 550,000 square feet.
Parcel 3	High density, mixed-use development in pedestrian friendly blocks fronting onto the transit plaza.	Approximately 325,000 square feet.
Parcel 4	High density, mixed-use development with retail at grade options fronting onto 17th Avenue.	Approximately 935,000 square feet.



Legend

- Westbrook LRT Station
- Plan Area Boundary
- West LRT Line
- Arterial Street
- Neighbourhood Boulevard
- Park and Open Space
- Urban Plaza

Minimum and Maximum Densities

	Area	Minimum FAR	Maximum FAR	Maximum Bonus FAR
	A	N/A	2.5	N/A
	B	1.0	3.0	N/A
	C	2.0	4.0	N/A
	D	2.0	4.0	5.0
	E	2.0	5.0	N/A
	F	2.0	5.0	6.0
	G	2.0	6.0	8.0
	H	2.0	8.0	9.0
	I	2.0	10.0	12.0

Figure 4.12 Density Target in Westbrook Village Area (The City of Calgary 2009).

2. Distance

It is noticed that the C-Train lines are located to serve large residential communities and business districts. Its stations are placed in certain area in order to meet travel patterns within main transportation routes. They are also integrated with adjacent land use (McKendrick, et al. 2007). This indicates that the distance between activity centres and the C-Train station is relatively close and within tolerably walking distance. The Downtown West-Kerby station on 7th Avenue corridor is an example to show the close distance of the activity centre to the C-Train station. It can be seen in Figure 4.13 that the Downtown West-Kerby station on 7th Avenue corridor is located near high-density area within the city centre of the City of Calgary.

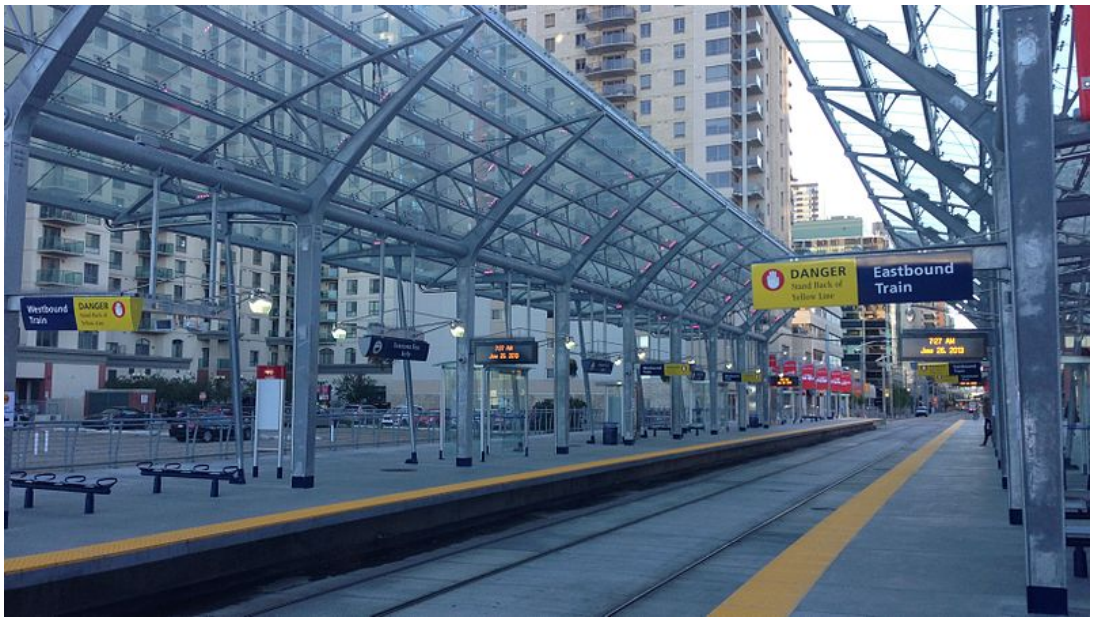


Figure 4.13 Downtown West-Kerby station on 7th Avenue corridor (Wikipedia 2013).

Another example is the redevelopment of Westbrook Village. In this area, there will be a Westbrook station in the West Line as the extension line of C-Train network (see Appendix 1). In the plan of the redevelopment of Westbrook Village, the radius of the TOD is obviously determined. The TOD project covers the area situated within 400 meters to 600 meters from the Westbrook LRT station (see Figure 4.14). The radius This redevelopment aims to transform present uses as auto-oriented, low-density, shopping centre and high school site to be a pedestrian-oriented community with mixed-used development (i.e. residential, retail and office) proximate to public transit (The City of Calgary n.d.). It can be seen clearly that the proximity to public transit is a consideration for redeveloping Westbrook Village. It means the area near the C-Train station will be more developed.

However, in this case, it is still questionable whether the LRT system influence land development or vice versa. The LRT station on 7th Avenue Calgary in Calgary downtown indicates that the transit station is placed to serve the existing of high-density area. This reflects the LRT does not affect land development, but serves it potential riders.

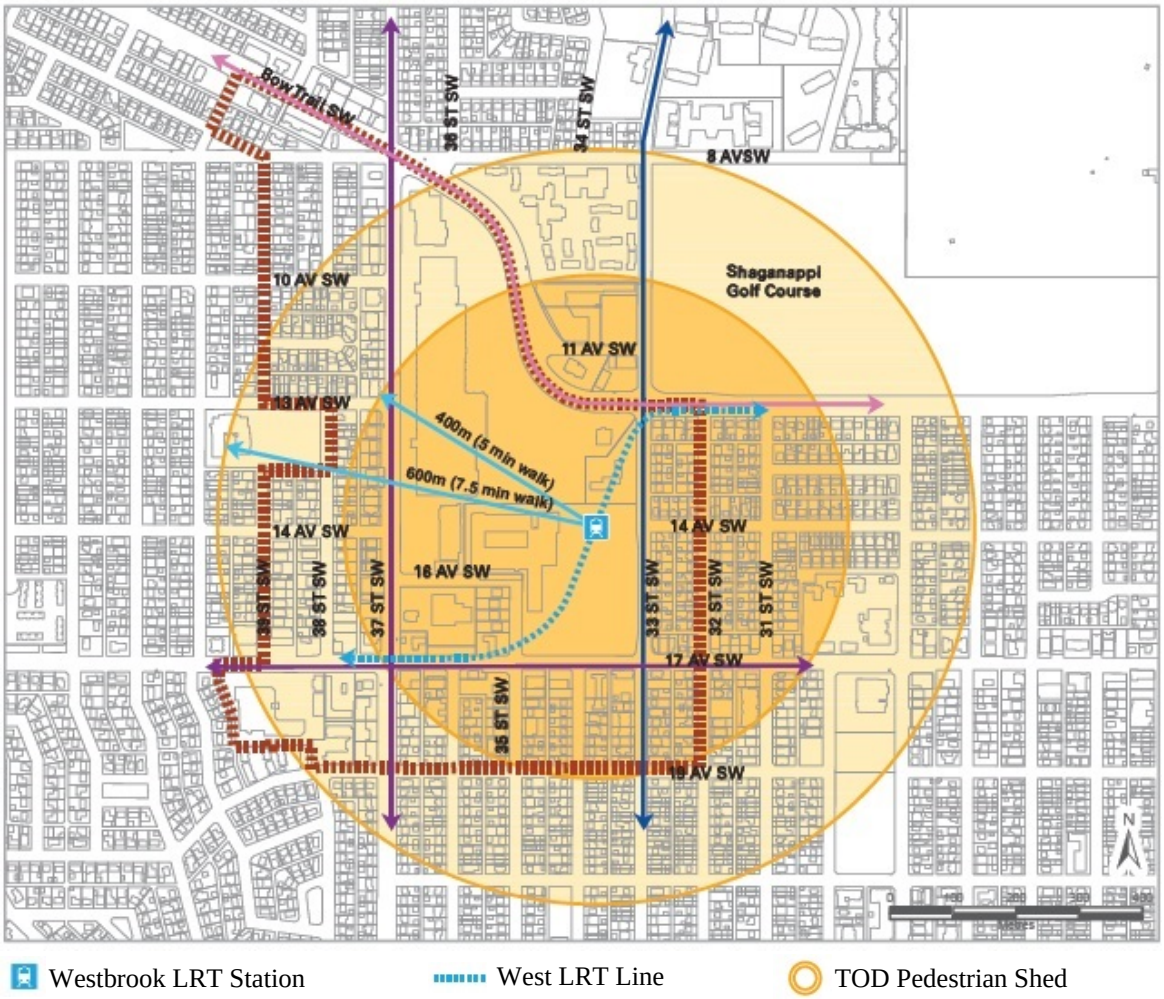


Figure 4.14 TOD Coverage Area in Westbrook Village (The City of Calgary 2009).

3. Diversity

The operation of C-Train system has stimulated the various development types in the vicinity areas of the C-Train stations. There is evidence that some high density residential, office and retail development has built adjacent to existing LRT stations at Lions Park (Northwest Line), Stampede/Elton (South Line), Southland (South Line) and Franklin (Northeast). The development of "The Bridges" is a clear example of TOD (see Figure 4.15). This project is developed at the site near Bridgeland/Memorial Station that occupies a 15-hectare area. It is a mixed-use development in which it provides up to 1,500 new residential units as well as new retail and office uses (Hubbell and Colquhoun 2007). This situation reflects that the implementation of the C-Train system has stimulated development diversity and mixed-use development within station areas.

Figure 4.15 The Bridges is an example of Transit Oriented Development (TOD) in Calgary, Canada (The City of Calgary 2013).

Furthermore, the Westbrook Village redevelopment is a distinct evidence to indicate how the existence of Westbrook LRT station induces mix-use development within the vicinity area of the station. This TOD project provides mixed-use facility to ease access to the LRT station as well as featuring a new civic library and community arts centre, retail, office and residential units in which all of these facilities proximate to a pedestrian/cycling-to-transit interface. This redevelopment area will be occupied by 10,000 inhabitants living in various types of compact/dense houses that are pointed to a central park (IBI Group 2011). The types of buildings within the redevelopment area are specified clearly in the plan (see Figure 4.16).

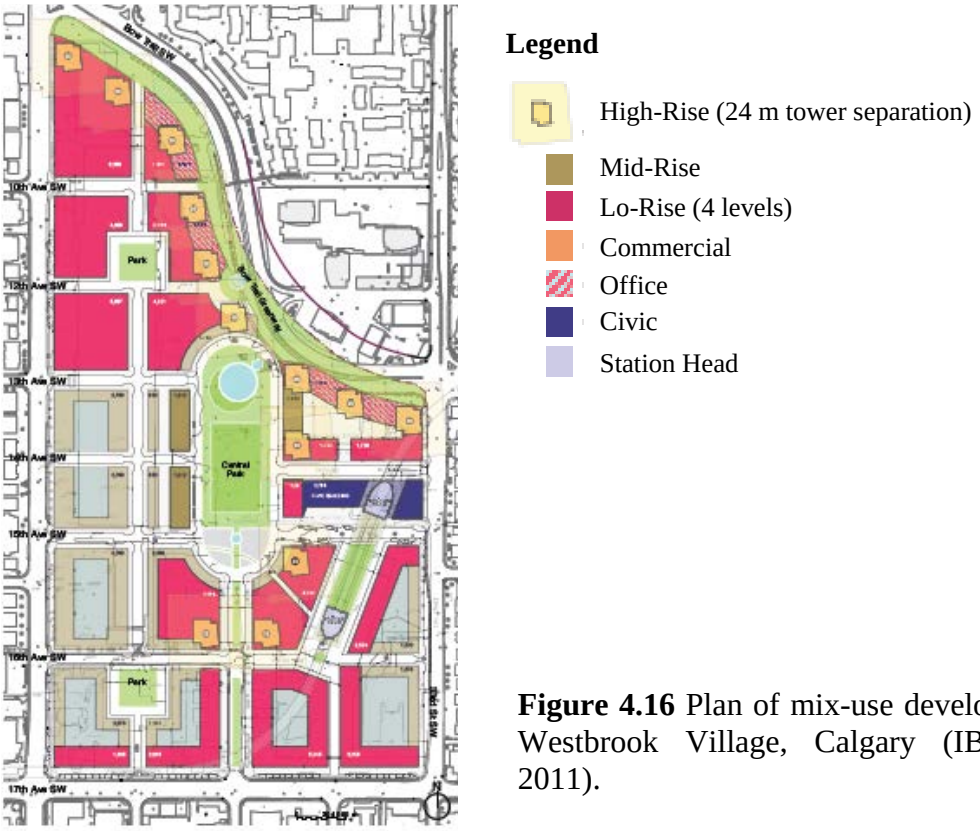


Figure 4.16 Plan of mix-use development in Westbrook Village, Calgary (IBI Group 2011).

However, the presence of LRT stations in Calgary does not always stimulate mix-use development in the area nearby. In certain cases, the C-Train stations are located in dense and mix-use areas already, such as the stations along the 7th Avenue corridor that are situated in the downtown of Calgary.

4. Design

It is noticed that the C-Train lines are designed to traverse residential communities and business district. This design offers opportunity to increase in the areas near the C-Train system (i.e. nearby the stations and the lines). The improved accessibility reduces commuting time for residents that will attract them to live near the C-Train station in particular. Moreover, the design of stations reflects the local condition and the expected number of passengers (McKendrick, et al. 2007). For instance, the station in median of arterial roadways, such as the Bridgeland/Memorial station, is designed by providing overhead pedestrian bridges which can be accessed by stairways and ramps (Hubbell and Colquhoun 2007). Another station design is modest shelters applied in the downtown. These simple side-loading platforms are used by considering no requirement to protect passengers from an adjacent railway or major road (McKendrick, et al. 2007).

Moreover, the TOD Policy Guidelines has regulated to make each station area to be a landmark, a community gateway and a connector for mixed-use activities. The redevelopment of Westbrook Village is a distinct example to prove this criterion. The Plan of Westbrook Village redevelopment aims to create "a lively, walkable and attractive district" (The City of Calgary 2009). Moreover, the design of Westbrook Village emphasises the creation of place-making and pedestrian-friendly area as well as providing safe, secure and convenient neighbourhoods and environments (see Appendix 2).

5. Destination Accessibility

The C-Train is a backbone of public transit in the City of Calgary. It has long routes, which is 56 kilometres, connecting suburban areas and downtown of the city. Its stations also link to feeder buses in order to ease the passengers to continue their trips to end destination. Park and Ride areas are also provided at suburban stations, although, by policy, the amount of park and ride is limited around 15% to 20% of peak hour and peak direction transit trips leaving a community (McKendrick, et al. 2007). There are currently 11,200 park and ride stalls in total at 17 stations of the C-Train system (Hubbell and Colquhoun 2007). Therefore, it can be seen that the operation of the C-Train system in the City of Calgary will improve accessibility for residents to travel within the city. However, the provision of parking sites for private automobiles may lead people to live fragmented and spread in sub-urban areas or far from the LRT system.

Moreover, the redevelopment of Westbrook Village as a TOD project is a good example to show how pedestrian and cyclist facilities are provided to ease access to the LRT station. In this redevelopment plan, the pedestrian and cycling paths are well-

linked to the Westbrook LRT station in order to encourage pedestrian and cycling activities (see Appendix 3).

Furthermore, this section also illustrates how far LRT system in Calgary takes the external factors influencing land use into account. It is explained as follow:

1. **Accessibility**

   Some parts of the LRT line are operated along the existing railways (e.g. South line) that connect certain areas within the City of Calgary. The LRT network is also linked to the bus network that has been operating before the implementation of the LRT system. This implies the implementation of LRT in Calgary considers connectivity between LRT system and another public transport that will enhance accessibility for passengers. The redevelopment of Westbrook Village is obvious evidence to describe how LRT system is well connected to road network and other public transit (see Appendix 4).

2. **Regional Demand**

   In 2005, there were 112,000 workers in the downtown of Calgary that required to be served by transit system. The LRT had a significant role to carry 42% of those workers (McKendrick et al 2005). This indicates the LRT considers the economic activities within the city, especially in the city centre.

3. **Land Availability**

   In some parts of the LRT line utilised the existing railways before the LRT was operated. This may reduce costs for providing the land in order to construct new railways. Moreover, the land use of certain areas was re-functioned to provide room for developing a LRT station. The development of the Westbrook station is a clear example to describe this case. This station was built on the area that was formerly occupied by Ernest Manning High School, which closed in June 2011, and a former Petro-Canada service station (Wikipedia 2013). These buildings were demolished to provide land for constructing the Westbrook station. Hence, it can be seen clearly that the availability of land is one of considerations in implementing the LRT.

4. **Area Attractiveness**

   The downtown of Calgary is a dense business district which offers high ridership rate for LRT implementation. Therefore, the LRT has been operated to serve this area. This implies the LRT system is passed through the area that has high attractiveness to be visited.

4.6 Comparison of LRT Implementation in Strasbourg-France and Calgary-Canada

This section will compare the implementation of LRT system in Strasbourg-France and Calgary-Canada according to the literature review that is presented in Table 4.2. This comparison is basically based on three groups of criteria as follow:

1. The existence of supportive local policy that integrates land use and transport policy;
2. The LRT impacts on land development refer to TOD principles;
3. The external factors influencing land use.

Table 4.2 Comparison between LRT system in Strasbourg-France and Calgary-Canada

No.	Criteria	LRT system in Strasbourg-France	LRT system in Calgary-Canada
1.	**The existence of supportive local policy**	There is a local policy issued in 1991 which aims to improve urban quality of living (*la qualité de la vie*) by integrating town planning and transport policy. This policy was issued before the implementation of Strasbourg tramway.	There is Transit Oriented Development Policy Guidelines issued in 2004 which provides guidance for development of areas specifically 600 meters of a transit station (LRT or BRT station). This policy was issued after the C-Train has been operating since 1981.
2.	**The LRT impacts on land development refer to TOD principles**		
	a. Density	There is no clear evidence whether the implementation of LRT in Strasbourg induces high-density and mix-use land development due to the fact the city of Strasbourg has been occupied by high-density land use with various uses, including residential and commercial uses, even before the LRT system was operated in the city.	The extension of the LRT line induces redevelopment towards TOD project in a certain area nearby, for example the redevelopment of Westbrook Village. This project will increase density in the area surrounding Westbrook station as a LRT station by providing high-density and mixed-use development. The density target (expressed in FAR) in this area is clearly defined in the plan.
	b. Distance	The proximity to LRT system has attracted development of areas nearby. The construction of LRT line B induced shopping-structure in the city centre and office development in Plaine des Bouchers.	The TOD Policy Guidelines regulates area development typically 600 meters of a transit station. It implies the LRT system will affect the land development around 600 meters of its station. However, in this case, it is questionable whether the LRT system influence land development or vice versa. The LRT stops on 7th Avenue corridor in Calgary downtown indicates that the transit station is placed to serve the existing of high-density area. This reflects the LRT does not affect land development, but serves it potential riders.

No.	Criteria	LRT system in Strasbourg-France	LRT system in Calgary-Canada
	c. Diversity	There is no sufficient information available to prove the LRT implementation stimulating mix-use land development in the city of Strasbourg because diverse land use has been exist in the city before LRT was operated.	The TOD Policy Guidelines directs the mix of land use, both horizontally and vertically, in the area around 600 meters of a transit station. The Westbrook Village project obviously explains how the development of the LRT station stimulates redevelopment of the area to be mixed-use land development, including residential, commercial and retail. However, there is evidence that the transit station serves the area which has already grown as a mixed-used area. Thus, the station does not always affect land development in the area nearby.
	d. Design	The development of LRT station and corridor induced redevelopment main squares in the city centre (the Place Kléber and the Place de la Gare) as landmark of the city. The exiting roadway was abandoned and replaced by railway as well as providing ways for cyclists and pedestrians.	The TOD Policy Guidelines has regulated to make each station area to be a landmark, a community gateway and a connector for mixed-use activities. The redevelopment of Westbrook Village is a distinct example to prove this criterion.
	e. Destination accessibility	The LRT system is connected to bus system and long distance or regional trains. There are also some Park and Ride lots in several stations. Apart from this, there are biking sheds in several stations and complemented cycling path to ease people to access the LRT stations. However, the provision of Park and Ride sites may trigger residents to live far away from the LRT system. This may reduce property values near the stations which eventually deters land development.	The LRT system is linked to the bus system in its stations. There are some Park and Ride sites in several stations to accommodate private cars. Besides, bike parking sites are also provided for bikers. These facilities enhance accessibility for people to reach the stations as well as arriving at their end destination. However, the provision of parking sites for private automobiles may lead people to live fragmented and spread in sub-urban areas or far from the LRT system.

No.	Criteria	LRT system in Strasbourg-France	LRT system in Calgary-Canada
3.	**External factors influencing land use**		
	a. Accessibility	There are regional and long distance railways as well as bus-based public transport that can be linked with the LRT line to enhance accessibility for people.	Some parts of the LRT line are operated along the existing railways (e.g. South line) that connect certain areas within the City of Calgary. Also, the bus system has been operating before the implementation of the LRT system.
	b. Regional demand	The LRT system serves the city centre occupied by offices and commercial areas that accommodate 100,000 workers. This implies the LRT system assists to deliver economic activities in the city.	In 2005, there were 112,000 downtown workers who required to be served by transit system. The LRT had a significant role to carry 42% of those workers (McKendrick et al 2005).
	c. Land availability	The function of some existing roadways was replaced to be the new railways and the paths of cyclists and pedestrians.	The LRT line in some parts utilizes the existing railways which reduce costs for providing the land. The development of the Westbrook station is an example of re-functioning existed land use in order to provide space for the station.
	d. Area attractiveness	The main square of the city has become an attractive place that gives opportunity for high ridership regard with the operation of LRT.	The Calgary is a dense business district in its downtown which offers high ridership rate for LRT implementation.

Based on Table 4.2, check list of comparison criteria will be presented in the Table 4.3 in order to summarise the implementation of LRT system in Strasbourg, France and Calgary, Canada.

Table 4.3 Check list of comparison between two LRT practices.

No.	Criteria	LRT system in Strasbourg-France	LRT system in Calgary-Canada
1.	**The existence of supportive local policy**	√	√
2.	**The LRT impacts on land development refer to TOD principles**		
	a. Density	-	√
	b. Distance	√	√
	c. Diversity	-	√
	d. Design	√	√
	e. Destination accessibility	√	√
3.	**External factors influencing land use**		
	a. Accessibility	√	√
	b. Regional demand	√	√
	c. Land availability	√	√
	d. Area attractiveness	√	√

Remark

According to Table 4.2 and Table 4.3, the comparison between the two international practices of LRT system can be summarised as follow:

1. The local policy that integrates land use and transport policy is essential to support the implementation of LRT system in order to manage land development in the vicinity areas of LRT stations and corridors.
2. Integrating LRT system in land use policy or urban planning seems to induce redevelopment in certain areas along the LRT corridors and around the LRT stations.
3. The TOD principles can be suitable measures to identify the impacts of LRT on land development, although those impacts cannot be revealed completely in the LRT practices.
4. The TOD principles seem to be preferable criteria to be taken into spatial policy in order to manage the impacts of LRT on land development.
5. The LRT system should take the external factors into its plan owing to the fact those factors have important role in affecting land development within the city.

CHAPTER 5
Developing Guideline for Light Rail Transit (LRT) Planning in Surabaya, Indonesia

5.1 Introduction

This chapter presents the overview of Surabaya Municipality and the LRT planning in Surabaya-Indonesia, including to what extend the plan considers the potential impacts of LRT on land development according to transit oriented development (TOD) principles. It also discusses whether the external factors influencing land use is taken into account. At the end of this chapter, the guideline for LRT planning will be developed based on lessons obtained from international LRT practices (presented in Chapter 4) compared with current LRT planning in Surabaya-Surabaya.

5.2 Overview of Surabaya Municipality, Indonesia

To begin with, it is noticed Surabaya is the second largest city in Indonesia. It is a capital city of Jawa Timur Province located in the eastern part of Jawa Island which has a strategic location (see Figure 5.1). This leads the city to be a centre of land transportation links it with surrounding regencies. The rapid growth of economy in the city has stimulated higher mobility of residents. As a city's centre of trade and service, Surabaya can attract inhabitants who live in outside regions to conduct various activities in the city, such as working, trading, education, so forth. This leads an increase of traffic volume that exceeds the capacity of roads in the city. As a consequence, traffic congestion in many road networks is an inevitable problem. Moreover, traffic congestion is also triggered by the rapid growth of private vehicles, both motorcycles and cars, whereas there are almost no change in road capacity and mass transportation to solve this problem. Apart from this, the poor condition of present public transport in Surabaya also discourages people to shift their behaviour from using private vehicles to public transport.

Furthermore, Surabaya also has a large number of residents. This circumstance will potentially generate a lot of trips which lead the emergence of traffic congestion. The number of Surabaya residents is currently 3.157.357 people (Dinas Kependudukan dan Catatan Sipil Kota Surabaya 2013). The number of motor vehicles in Surabaya is 6.993.413 vehicles in 2011 compared with 1.409.360 vehicles in 2008 (Bappeko Surabaya 2013). Currently, the rapid growth of vehicles in the city exceeds the capacity of the existing road network because there are a few projects of constructing new roads and widening existed roads. The difficulties for providing the land are a major obstacle to run those projects. The growth of motor vehicles and the length of road in Surabaya-Indonesia are presented in the following tables.

Table 5.1 Number of Motor Vehicles in Surabaya-Indonesia (Bappeko Surabaya 2013).

Type of Motor Vehicle	Year			
	2008	**2009**	**2010**	**2011**
Heavy vehicle	154	361	397	547
Motor cycle	1,028,686	3,007,739	4,465,144	5,726,514
Truck	135,308	205,885	226,474	280,388
Bus	776	6,690	8,944	11,698
Car	244,435	526,837	823,849	974,266
Total	**1,409,360**	**3,747,512**	**5,524,808**	**6,993,413**

Table 5.2 Length of Roads in Surabaya-Indonesia (Bappeko Surabaya 2013)

Criteria	Year			
	2008	**2009**	**2010**	**2011**
The length of the road (km)	1,400	1,421.52	1,426.152	1,426.647

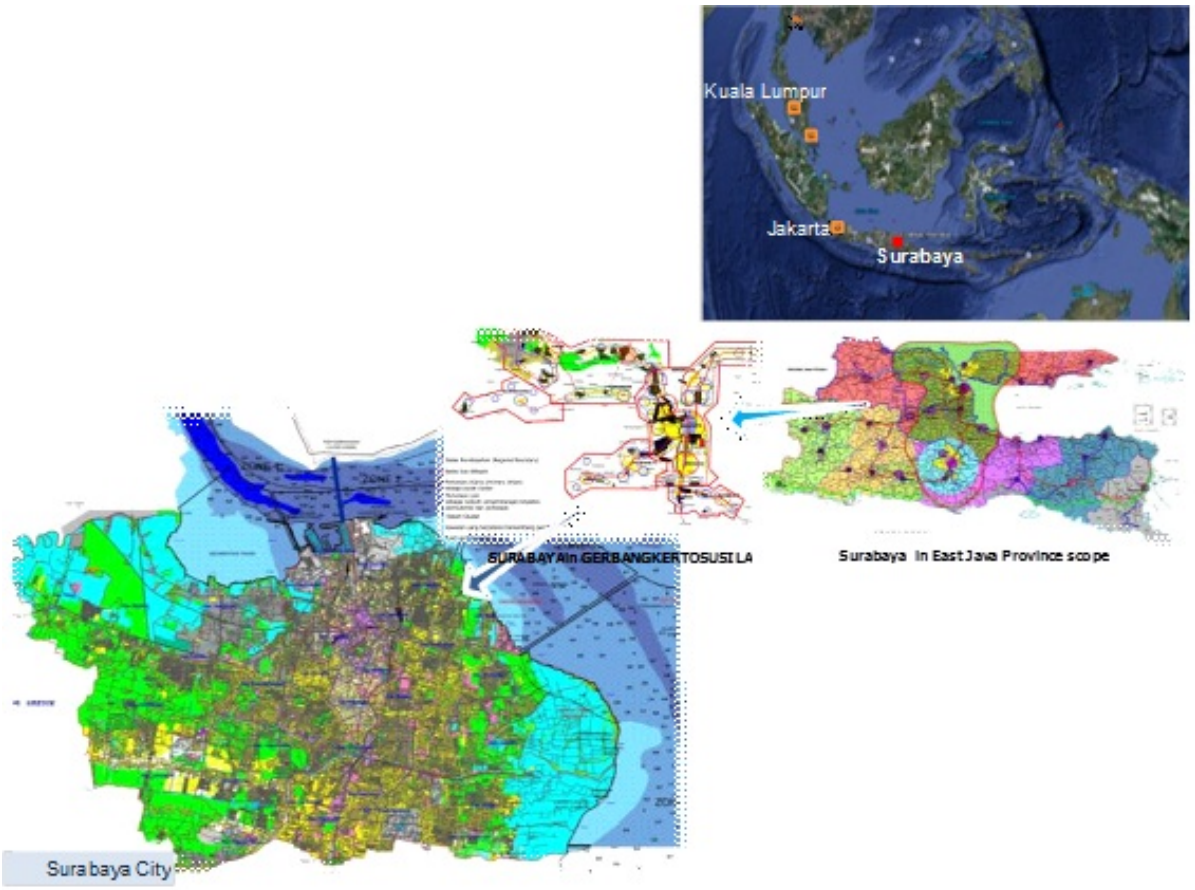


Figure 5.1 Map of Surabaya, Indonesia (Bappeko Surabaya 2007).

5.3 LRT Planning in Surabaya, Indonesia

LRT is a new public transport mode that will be provided in Surabaya. The Government of Surabaya Municipality has prepared a plan of the public transportation system for several considerations. An official of the Transportation Agency of Surabaya Municipality said *"LRT is planned to cope with rapid growth of private vehicles that exceeds road capacity in the city. It is expected to improve volume-to-capacity ratio of the major roads. Besides, the local government is obligated to provide mass transit mode refers to Act of Republic of Indonesia No. 22/2009 on Traffic and Road Transportation"*. Another official also mentioned the reason behind the LRT Plan in Surabaya that *"The LRT is provided to improve trip efficiency in term of travel time and travel cost. The plan of LRT system is a part of public transportation system in Surabaya that will integrate LRT with the trunk and feeder system to create a complete connection of transportation network within the city"*.

Furthermore, the official of the Development Planning Board of Surabaya Municipality explained that *"The city requires a new public transport that is convenient, safe and punctual in order to encourage people to use public transport that will solve road traffic congestion. Therefore, the LRT aims to be a mean to improve the performance of the public transport and promote the use of it. The LRT plan is also intended to create Surabaya a smart, compact and green city"*. According to the perspectives of the local government officials, it seems LRT is not only intended to deal with road traffic congestion but also offering another mobility option for residents to travel within the city.

Additionally, the LRT Plan in Surabaya is a mandate from national and local regulations. In the national regulation, Act of Republic of Indonesia No. 22/2009 on Traffic and Road Transportation mentions that "*the local government must provide public transport for passengers and freight in the regency or municipality"*. It also declares that "*the public transport should be safe, convenient and affordable"*. Meanwhile, in the local regulations of Surabaya, such as Local Regulation of Surabaya Municipality No. 17/2012 on The Long-term Development Plan of Surabaya from 2005-2025; Local Regulation of Surabaya Municipality No. 18/2012 on The Middle-term Development Plan of Surabaya from 2010-2015; and Review of Local Spatial Plan 2007 of Surabaya Municipality, they state the Government of Surabaya Municipality will "*provide a mass rapid transit system that is affordable, safe, convenient, efficient, effective and reliable supported by implementing non-motorised vehicle paths"* (e.g. cycling and pedestrian paths). Even though there are several regulations underlie the LRT plan in Surabaya, there is no local policy that integrates transport policy and spatial policy in order to support the implementation of LRT.

Aside from the government's perspectives, the Surabaya society has their own views on the plan of LRT development in Surabaya. The public transportation company thinks the plan of LRT is a good effort from the government to provide better public transport considering current public transport condition in the city. He describes the current condition of public transport in Surabaya as follow:

> *"Currently, there are 5,400 fleets of public transports serving people in Surabaya that consist of 79 routes. Unfortunately, it is only around 70% of them can be said feasible to*

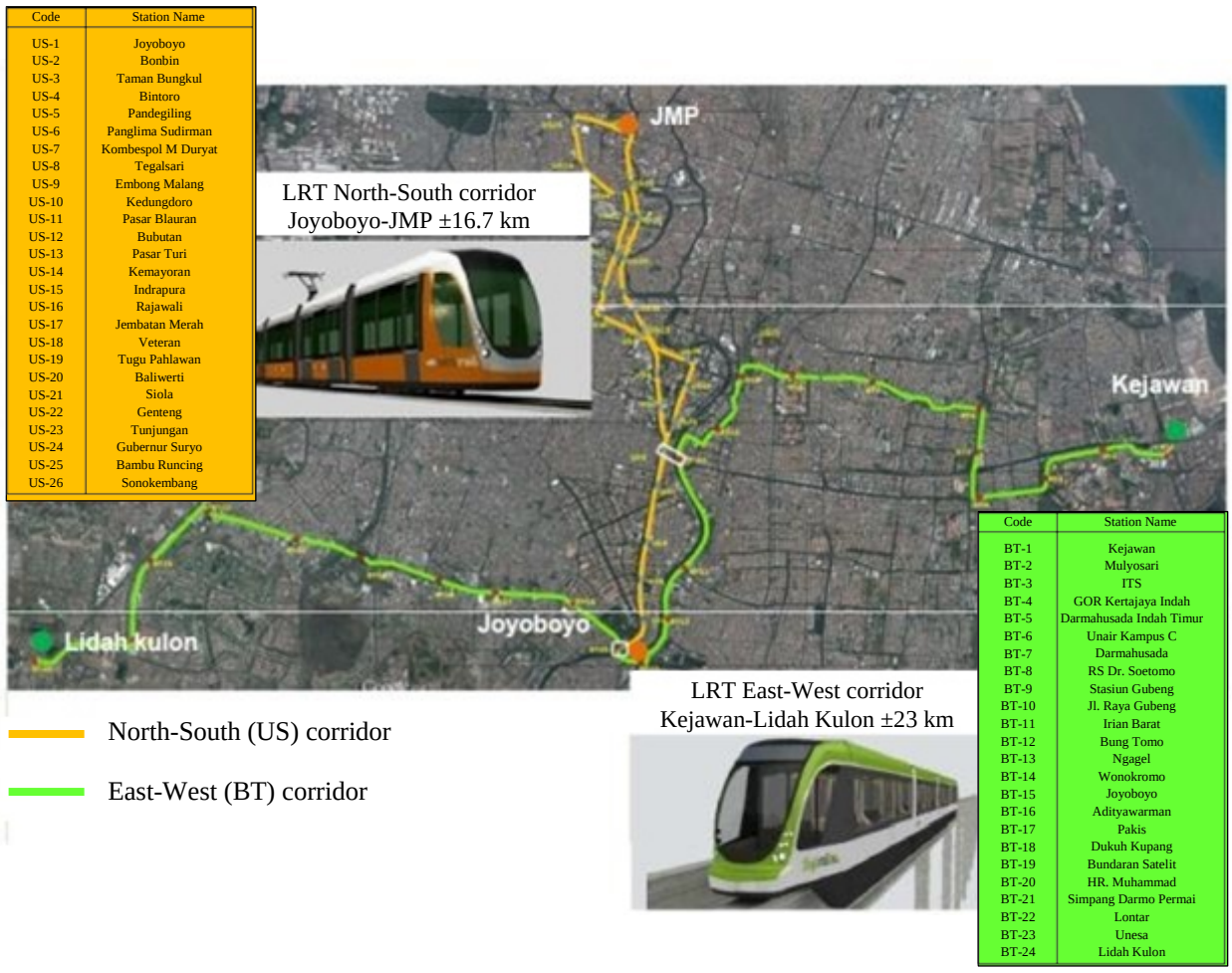
be operated due to the age of vehicles. This circumstance is being worse by preference of residents to use motor-bikes for their daily trips".

The opinion of the public transport company accords with the perspective of property developer who argues that *"The provision LRT is a good plan for the city in order to provide better public transport and deal with traffic congestion in many roads within the city"*.

In brief, the plan of LRT seems to only consider the transportation purposes. It merely aims to deal with road traffic congestion, promote the use of public transport and offer another mobility option by providing the new transport mode that is affordable, safe, convenient, efficient, effective and reliable. The provision of LRT in Surabaya is not explicitly exploited to induce and manage land development, especially in the area near the LRT stations. Therefore, it can be noticed that the LRT plan and spatial/land use policy are not comprehensively integrated in Surabaya case.

5.3.1 Description of the Plan of LRT in Surabaya, Indonesia

The LRT system in Surabaya is planned to consist of two corridors, namely North-South (US) corridor and East-West (BT) corridor. In the US corridor, there will be 26 stations to be built, whereas 24 stations will be provided in the BT corridor. The description of LRT system in Surabaya is shown in Figure 5.2 and Table 5.4.



Code	Station Name
US-1	Joyoboyo
US-2	Bonbin
US-3	Taman Bungkul
US-4	Bintoro
US-5	Pandegiling
US-6	Panglima Sudirman
US-7	Kombespol M Duryat
US-8	Tegalsari
US-9	Embong Malang
US-10	Kedungdoro
US-11	Pasar Blauran
US-12	Bubutan
US-13	Pasar Turi
US-14	Kemayoran
US-15	Indrapura
US-16	Rajawali
US-17	Jembatan Merah
US-18	Veteran
US-19	Tugu Pahlawan
US-20	Baliwerti
US-21	Siola
US-22	Genteng
US-23	Tunjungan
US-24	Gubernur Suryo
US-25	Bambu Runcing
US-26	Sonokembang

Code	Station Name
BT-1	Kejawan
BT-2	Mulyosari
BT-3	ITS
BT-4	GOR Kertajaya Indah
BT-5	Darmahusada Indah Timur
BT-6	Unair Kampus C
BT-7	Darmahusada
BT-8	RS Dr. Soetomo
BT-9	Stasiun Gubeng
BT-10	Jl. Raya Gubeng
BT-11	Irian Barat
BT-12	Bung Tomo
BT-13	Ngagel
BT-14	Wonokromo
BT-15	Joyoboyo
BT-16	Adityawarman
BT-17	Pakis
BT-18	Dukuh Kupang
BT-19	Bundaran Satelit
BT-20	HR. Muhammad
BT-21	Simpang Darmo Permai
BT-22	Lontar
BT-23	Unesa
BT-24	Lidah Kulon

Figure 5.2 The Plan of LRT System in Surabaya, Indonesia.
(Dinas Perhubungan Kota Surabaya 2012)

Table 5.3 List of the planned LRT stations in Surabaya, Indonesia (Bappeko Surabaya 2013).

North-South (US) Corridor		**East-West (BT) Corridor**	
Code	**Station Name**	**Code**	**Station Name**
US-1	Joyoboyo	BT-1	Kejawan
US-2	Bonbin	BT-2	Mulyosari
US-3	Taman Bungkul	BT-3	ITS
US-4	Bintoro	BT-4	GOR Kertajaya Indah
US-5	Pandegiling	BT-5	Darmahusada Indah Timur
US-6	Panglima Sudirman	BT-6	Unair Kampus C
US-7	Kombespol Duryat	BT-7	Darmahusada
US-8	Tegalsari	BT-8	RS Dr. Soetomo
US-9	Embong Malang	BT-9	Stasiun Gubeng
US-10	Kedungdoro	BT-10	Jl. Raya Gubeng
US-11	Pasar Blauran	BT-11	Irian Barat
US-12	Bubutan	BT-12	Bung Tomo
US-13	Pasar Turi	BT-13	Ngagel
US-14	Kemayoran	BT-14	Wonokromo
US-15	Indrapura	BT-15	Joyoboyo
US-16	Rajawali	BT-16	Adityawarman
US-17	Jembatan Merah	BT-17	Pakis
US-18	Veteran	BT-18	Dukuh Kupang
US-19	Tugu Pahlawan	BT-19	Bundaran Satelit
US-20	Baliwerti	BT-20	HR. Muhammad
US-21	Siola	BT-21	Simpang Darmo Permai
US-22	Genteng	BT-22	Lontar
US-23	Tunjungan	BT-23	Unesa
US-24	Gubernur Suryo	BT-24	Lidah Kulon
US-25	Bambu Runcing		
US-26	Sonokembang		

Table 5.4 Description of the Plan of LRT System in Surabaya, Indonesia

Criteria	**US Corridor**	**BT Corridor**
Number of stations	26 stations	24 stations
Length of corridor	16.7 km	23 km
Type of railway	At ground railway	Elevated railway
Existing land use along the corridor	Residential, trade and service, and public facilities. *Note: There are several heritage buildings.*	Residential, offices, trade, hospital, and education.

(Source: adopted from Dinas Perhubungan Kota Surabaya 2012)

Furthermore, it should also be known that the US corridor will pass old central business district (CBD) of the city. Moreover, there are several heritage buildings along this corridor which has existed there since the Dutch colonialism era. On the other hand, the BT corridor will serve relatively new developed areas of the city, such as in the eastern and western parts of the city that has been experiencing rapid development in recent years.

Moreover, it is noted that the main factor in determining the LRT corridor in Surabaya is travel demand (Dinas Perhubungan Kota Surabaya 2012). According to Transportation Modelling Study in Surabaya, the US corridor has high demand for trips (Dinas Perhubungan Kota Surabaya 2012). The high demand for travel in the selected corridors indicates these corridors offers high potential ridership for upcoming LRT. As it is expressed by the official of the Development Planning Board of Surabaya who said,

> *"The decision in selecting the corridor routes and the stations is basically determined by the current travel pattern within the city. The lines which show high travel demand are more preferable to be chosen as the LRT corridors since these lines will provide high potential ridership for LRT. The same reason also underlies why the selected corridors will pass the developed areas in the city because these areas offer high ridership for LRT implementation".*

Therefore, it can be seen that the areas which have high travel demand are prioritised to be served by the future LRT in Surabaya. In my opinion, for the next phase of LRT development in Surabaya, it should extend its network to less developed areas within the city since LRT as a transportation system has ability to stimulate land development. This opinion is in line with the property developer who argued,

> *"There are three main factors as motors to drive land development in a city, namely water provision, electricity and transportation. It is clear that the provision of LRT as a high quality of public transport system will attract many investments for land development".*

5.3.2 The Plan of LRT in Surabaya and TOD Principles

According to the previous sections in this chapter, it is revealed that the LRT is planned only for transportation purposes, which are dealing with road traffic congestion and providing mobility alternative for residents to travel within the city. The potential impacts of LRT on land development are not considered in advance in plan-making process. To deal with the impacts of LRT on land development, TOD principles can be suitable development concepts for managing those impacts. As it is stated by the official of the Development Planning Board of Surabaya who argued,

> *"TOD principles are necessary to be included in LRT planning if the government aims to manage and control land development in the areas near the station/stop of LRT in particular".*

Apart from this, the TOD principles are an appropriate mean to induce development/redevelopment in the vicinity areas of the LRT stations. The official of Transportation Agency of Surabaya said,

"By integrating TOD principles, it can give opportunity to develop various types of activity centres in the area surrounding stations/stops".

Even though the TOD principles are proper tools to manage land development near the transit stations, they are not explicitly taken into the LRT plan in Surabaya. As it is expressed by the official of the Public Works Agency of Surabaya who stated,

"It is quite difficult to integrate TOD principles into the LRT plan considering Surabaya is not a new city. This city has developed for long years in which various types of land development have been established in many areas of the city. Thus, it will require complex schemes and huge budget by the government to manage land use development by incorporating TOD principles in Spatial Policy related to the LRT plan".

Indeed, the implementation of LRT might need redevelopment in the proximate areas of the stations that will transform current land use in those areas. This process to some extend might relocate buildings and/or inhabitants occupy those areas that will potentially lead social resistance for LRT implementation. However, in my view, the Government of Surabaya Municipality should consistently realise the inherent nature of LRT in spurring land development in the areas near the stations requires to be managed in order to support the implementation of LRT. For this reason, TOD principles can be adopted to control and manage land development in the areas surrounding the stations.

Furthermore, the extend of the LRT plan in Surabaya considering the potential impacts of LRT on land development according to TOD principles is examined in this section based on documents related to the plan, interview with the government officials, and field observation. This can be explained as follow:

1. Density

Density indicates densely residential and employment areas in which enormous people live or undertake their daily activities in the vicinity areas of transit stations. According to the plan, the LRT stations and corridors will be built in locations which are occupied by relatively dense residential and employment in which these areas are densely populated. The distribution of population density in Surabaya is shown in Appendix 5. Based on this figure, the LRT system will lie on the areas which have high population density range from 4,392 to 83,663 inhabitants per km^2. As it is raised by the official of the Development Planning Board of Surabaya who explained,

"LRT is developed to provide a safe, convenient, punctual and affordable public transport that will generally serve densely areas in which various land uses occupy those areas ".

For example, the station at Tunjungan is located at the central business district in which many employment places and trade centres are exist there. However, the location of the stations is not selected to manage land development in the vicinity area of the station. It is chosen to serve the areas that have high potential ridership for the LRT which are near activity centres of the city, such as residential areas, offices, trade centres, education centres and hospitals. This accord with the official of the Development Planning Board of Surabaya, who stated,

"The decision in selecting the corridor routes and the stations is basically determined by the current travel pattern within the city. The lines which show high travel demand are more preferable to be chosen as the LRT corridors since these lines will provide high potential ridership for LRT. The same reason also underlies why the selected corridors will pass the developed areas in the city because these areas offer high ridership for LRT implementation".

Moreover, there is no specific target of density rate in the areas surrounding the stations in the plan. This condition implies the LRT in Surabaya is indeed not prepared to manage the density of land development within the areas near the stations.

2. Distance

This principle indicates the mix-use development with high density, including residential, employment, retail, open space and public uses, is located in the convenient walking distance to access the transit station. In Calgary, the preferable distance for TOD is 400 m to 600 m (The City of Calgary 2009). This seems to be applicable for Surabaya case due to tropical climate of the city. Even though the LRT plan in Surabaya does not explicitly take TOD principles into the plan, the distance from the planned LRT stations to activity centres is likely within the range of the easy walking distance. As it is signified by the official of the Development Planning Board who said,

"The government also considers the convenient distance for pedestrians to access the LRT stations and their destination. For Surabaya case, the distance of the station is made close to the activity centre considering the natural climate of Surabaya which has high temperature in order to ease people to reach their destination".

For instance, the planned station at Wonokromo is proximate to Darmo Trade Centre (DTC) and the Wonokromo heavy rail station. This close distance seems to ease people to access the LRT station. Nevertheless, there is no guidance in the plan about the specific distance of the activity centre and the LRT station. Thus, it is not clear the periphery of area around the station that will be managed its land development.

3. Diversity

The diversity demonstrates high-density mix-use developments, including residential, employment, retail, open space and public uses, are resided in the proximate areas to the transit stations. This kind of development provides diverse communities that may offer high ridership for LRT. Based on the plan document and field observation (see Table 5.5 and Table 5.6), it is found that the planned corridors of LRT will pass various type of existing land use. The field observation in this research was conducted along the planned corridors of LRT in Surabaya, both the North-South (US) corridor and the East-West (BT) corridor, which cover ± 40 km of length. It mainly aims to discover the current land use in the areas near the planned stations and corridors. The visual condition of current land use along the planned corridors of LRT in Surabaya is shown in Appendix 6.

Table 5.5 Existing Land Use along The North-South corridor of LRT in Surabaya

No	Name of Street	Existing Land Use
1.	Raya Darmo	Residential, Trade and service, and Public facility
2.	Urip Sumoharjo	Trade and service
3.	Jenderal Basuki Rachmad	Trade and service
4.	Embong Malang	Trade and service
5.	Blauran	Trade and service
6.	Bubutan	Trade and service, and Public facility
7.	Indrapura	Trade and service, and Public facility
8.	Rajawali	Trade and service
9.	Perak Barat	Trade and service, and Public facility
10.	Perak Timur	Trade and service
11.	Jembatan Merah, Veteran	Trade and service
12.	Pahlawan	Service and Public facility
13.	Gemblongan	Trade and service
14.	Tunjungan	Trade and service
15.	Gubernur Suryo	Trade and service, and Public facility
16.	Panglima Sudirman	Trade and service

(Source: Dinas Perhubungan Kota Surabaya 2012 and Field observation 2013)

Table 5.6 Existing Land Use along The East-West corridor of LRT in Surabaya

No	Name of Street	Existing Land Use
1.	Raya ITS	Residential and Education
2.	Raya Kertajaya Indah	Residential, Trade and service
3.	Dharmahusada Indah Timur	Residential, Trade and service
4.	Dharmahusada	Residential, Trade and service, and Education
5.	Prof. Dr. Moestopo	Hospital, Trade and service
6.	Stasiun Gubeng	Trade and service
7.	Gubeng	Hospital, Trade and service
8.	Irian Barat	Trade and service
9.	Ngagel	Trade and service
10.	Wonokromo	Trade and service, and Public facility
11.	Joyoboyo	Trade and service
12.	Adityawarman	Trade and service
13.	Mayjend. Sungkono	Residential, Trade and service
14.	HR. Muhammad	Residential, Trade and service
15.	Bukit Darmo Boulevard	Residential, Trade and service, and Education
16.	Lidah Kulon	Residential

(Source: Field observation 2012)

Those diverse types of land use are spread along the planned corridors of LRT which occupy dense areas already in which there is almost no vacant land available for future development. As it is conveyed by the official of the Development Planning Board of Surabaya who said,

"The future LRT corridors in Surabaya are located along the developed areas that are dense and occupied by diverse land uses already".

If the operation of LRT will induce land development near its stations and corridors, it requires redevelopment projects toward high-density and mixed-used development in the area nearby which is not anticipated in the plan.

4. Design

This principle expresses the development of LRT components, such as the station, and land development near the station creates an area that is safe, convenient and has high accessibility to transit facilities as well as encouraging more pedestrian activities. The LRT in Surabaya is designed to be an environmental-friendly transport system. It can be seen in its station design which is some vegetation will be planted there. As it is explained by the official of the Development Planning Board of Surabaya who stated,

"The LRT components in Surabaya are designed to be in line with the attempt of the government to create Surabaya as a green city. The vegetation will be planted in the stations and along the corridors to reduce emission. Apart from this, the future LRT is designed to be a new landmark of the city that offers a safe, convenient, punctual and affordable public transport in order to encourage people to use the public transport rather than private vehicles".

Figure 5.3 Design of LRT Station in Surabaya (Bappeko Surabaya 2013).

The LRT system will also connected to cycling path and pedestrian way to provide large opportunity for cyclists and pedestrians to access the LRT stations. This is intended to increase accessibility of LRT system and stimulate people to use non-motorised vehicles. As it is explained by the official of the Development Planning Board of Surabaya who stated,

"Before LRT is planned, the government has already built several pedestrian ways and cycling paths, especially in the city centre. This aims to provide better infrastructure for pedestrians and cyclists as well as encouraging people to travel using non-motorised

vehicle. Aside from this, the provision of pedestrian and cycling ways is also intended to be connected to the upcoming LRT system in order to succeed its implementation".

Figure 5.4 Cycling path (left) and Pedestrian way (right) (Bappeko Surabaya 2013).

However, the pedestrian and cycling facilities is not evenly provided in entire city which means the upcoming LRT system are not completely connected to those infrastructure.

5. Destination Accessibility

This principle indicates the areas near the LRT stations are supported by integrated transportation networks that make those areas have high level accessibility to ease people to reach their destination. The LRT plan is a part of the plan of public transportation system in Surabaya by which the LRT system is supported and integrated with the trunk and feeder buses system. As it is expressed by the official of the Transportation Agency of Surabaya who explained,

"The Government of Surabaya Municipality has a plan of public transportation system that consists of LRT system. The LRT network will be linked and integrated with the trunk and feeder buses networks to serve people to travel across the city".

Besides, the pedestrian and cycling has been started to be connected with the LRT network. As it is stated by the official of the Development Planning Board who said,

"…the provision of pedestrian and cycling ways is also intended to be connected to the upcoming LRT system in order to succeed its implementation".

The connection and integration of LRT system with other transport networks will enhance accessibility in the city. Therefore, it can be seen the plan of LRT in Surabaya considers accessibility for people to access the LRT system and go to their end destinations.

5.3.3 The Plan of LRT in Surabaya and the External Factors Influencing Land Use

This section illustrates the extent of the plan of LRT system in Surabaya relates to the external factors influencing land use. This relationship is presented as follow:

1. Accessibility

This factor relates to the extent of LRT system connected and integrated with other transport infrastructure and other transport modes. As mentioned in the previous section, the LRT system is planned to be linked and supported by the trunk and feeder buses system. It will also be connected to pedestrian and cycling paths. Moreover, the corridors

of LRT in Surabaya pass main roads of the city that are linked to collector roads. As it is mentioned by the official of the Transportation Agency of Surabaya who said,

"The LRT corridors is planned to traverse major roads in the city due to most trips are undertaken in those roads".

By locating the LRT corridors in the major roads of the city, it implies that the LRT system is supported by large road network which will offer wider opportunity for people to access the LRT easily, especially reaching its stations. According to the LRT plan, the corridors are also passed by current public transport. There are ten routes of public transports exist in the North-South corridor (Dinas Perhubungan Kota Surabaya 2012). Meanwhile, twelve routes of public transport have served people in the East-West corridor (Dinas Perhubungan Kota Surabaya 2012). Besides, the LRT system is planned to be integrated with the plan of the extension regional railway network that will connect Surabaya with other Regencies and Municipalities. Therefore, the integration and connection of LRT system, transport infrastructure and other transport modes indicate the Government considers the accessibility of upcoming LRT system to serve people to commute within the city.

2. Area Attractiveness

This factor indicates the attractiveness degree of certain area has influenced land use apart from the existence of transport network. According to the LRT plan of Surabaya, the attractiveness of areas is a consideration in locating the LRT corridors and stations. As it is mentioned by the official of the Development Planning Board of Surabaya who expressed,

"LRT stations and corridors in Surabaya are located in attractive places within the city. For example, the North-South corridor will be built passing several heritage buildings that have been tourism objects of the city for years. In this corridor, there will be a Bonbin station located near the Surabaya Zoo that is well-known tourism object of the city".

It can be clearly seen that the LRT plan takes area attractiveness into determining the location of the stations and corridors. The LRT will pass heritage buildings in the North-South corridor that are attractive objects to be managed as history tourism of Surabaya. There is also the Surabaya Zoo that has been visited by a lot of visitors. In the east-west corridor, there are two famous universities, namely Institute of Technology Sepuluh November (in eastern part of Surabaya) and University of Surabaya (in western part of Surabaya), that has attracted many students coming from various regions of Indonesia. Besides, the two corridors also pass several large trade centres, such as Jembatan Merah Plaza and Tunjungan Plaza (in the north-south corridor), Galaxy Mall, Pakuwon Trade Center and Lenmarc (in the east-west corridor), that are attractive places for people to come there. Therefore, this circumstance implies that the plan of LRT is affected by the attractiveness of certain areas in the city.

3. Regional Demand

Regional demand relates to an economic dynamism in a specific area that inherently has ability to influence land use. Even though the plan of LRT does not explicitly aim to

generate economic activities or accelerate economic growth of Surabaya, this plan seems to consider economic dynamic of the city. It can be shown that the LRT system will serve some central business districts where various economic activities are conducted. As it is described by the official of the Development Planning Board who said,

"The LRT corridors are planned to traverse the Central Business Districts (CBDs) of the city in order to serve a lot of trips that pass those areas".

Therefore, the LRT system is likely offering another mobility option for people in Surabaya to conduct their economic activities.

4. Availability of Land

The availability of land is one of decisive factors to undertake a development programme. In an urban area, this factor is more crucial due to lack of vacant land. The plan of LRT in Surabaya also considers this factor by locating almost all LRT components (e.g. corridors, stations, depot, and park and ride site) in the land owned the government. As it is signified by the official of the Development Planning Board of Surabaya who stated,

"The infrastructure of LRT including railways, stations, depot and park and ride site is planned to be built mostly on the land owned by the government".

This strategy is taken to avoid project cancellation or delay due to no land available for constructing the infrastructure of LRT. For instance, the railway will be built in the area within right-of-way of the existing roads. It will be built in a lane of the road or in median road. Another example is the plan for changing the land use of the local government asset at Mayjend. Sungkono street (± 1.109.5 m^2) to be park and ride for supporting the upcoming LRT. Therefore, the government does not need to acquire land from private owners that is usually difficult to be attained.

5.4 Developing Guidelines for LRT Planning in Surabaya, Indonesia

To begin with, the plan of LRT in Surabaya is compared with the LRT practices, both the LRT in Strasbourg, France and Calgary, Canada based on three criteria as follow:

1. The existence of supportive local policy that integrates land use and transport policy;
2. The LRT impacts on land development refer to TOD principles;
3. The external factors influencing land use.

Before comparing those three LRT cases, there are several points can be taken to describe the LRT plan in Surabaya. First, the LRT plan in Surabaya is indeed based on some regulations or policies. However, there is no single policy that integrates transportation and land use/spatial policies. As it is raised by the official of the Transportation Agency of Surabaya who mentioned,

"Currently, transportation planning and spatial planning in Surabaya Municipality are two separate policies that are not integrated yet. There is still no a policy that comprehensively promotes the integration of transportation and spatial planning".

Second, the provision of LRT in Surabaya is mainly intended for complying transportation purposes. It aims to deal with road traffic congestion and improve the services of public transport in order to encourage people to use public transport rather than private vehicles. Thus, the LRT plan in Surabaya less considers the potential impacts of LRT on land

development. In other words, the concept of TOD as a mean to manage land development is not definitely incorporated in the plan. As it is raised by the official of the Development Planning Board of Surabaya who argued,

"I think TOD concept is a suitable tool to control and manage land development in the areas near the LRT stations. However, it is not included into the plan since the provision of LRT basically aims to deal with traffic congestion and provide a better public transport".

Third, the external factors influencing land use, including *accessibility, regional demand, land availability and area attractiveness*, seems to be considered in the LRT plan in Surabaya. Furthermore, the summary of the LRT plan in Surabaya is presented in Table 5.7 refers to literature review on related documents of the LRT plan in Surabaya and the interview results with several stakeholders in Surabaya.

Table 5.7 Description of the LRT Plan in Surabaya refer to three criteria

No.	Criteria	LRT Plan in Surabaya-Indonesia
1.	**The existence of supportive local policy**	There is no local policy to promote integration between spatial and transport policies.
2.	**The potential impacts LRT on land development refer to TOD principles**	
	a. Density	LRT is planned only for transportation purpose (to meet travel demand), not taken its potential impacts on land development into account. Thus, TOD principles are not incorporated in the plan explicitly.
	b. Distance	
	c. Diversity	
	d. Design	
	e. Destination accessibility	
3.	**External factors influencing land use**	
	a. Accessibility	The LRT system will be built considering connectivity with current public transport and road networks.
	b. Regional demand	The LRT stations and corridors are located to pass CBD that will induce economic activities.
	c. Land availability	The LRT track will be constructed on the existing roadways. Moreover, some parcels of land owned by the government will be re-functioned to be *Park and Ride* site as a component for supporting LRT.
	d. Area attractiveness	The LRT stations and corridors will be located in and pass through CBD, heritage buildings, education and residential areas.

The three LRT cases are then compared to discover similarities and differences of those LRT systems refer to the three criteria above. The comparison result is obtained by comparing information in Table 4.4 (see Chapter 4) and Table 5.8. This comparison is shown in the following table.

Table 5.8 Comparison of three LRT cases.

No.	Criteria	LRT practice in Strasbourg-France	LRT practice in Calgary-Canada	LRT plan in Surabaya-Indonesia
1.	**The existence of supportive local policy**	√	√	-
2.	**The LRT impacts on land development refer to TOD principles**			
	a. Density	-	√	-
	b. Distance	√	√	-
	c. Diversity	-	√	-
	d. Design	√	√	-
	e. Destination accessibility	√	√	-
3.	**External factors influencing land use**			
	a. Accessibility	√	√	√
	b. Regional demand	√	√	√
	c. Land availability	√	√	√
	d. Area attractiveness	√	√	√

According the comparison result in Table 5.6, several lessons can be learned from the two LRT practices (Strasbourg-France and Calgary-Canada) to be taken into the LRT planning in Surabaya-Indonesia. The lesson learned is presented as follow:

1. The implementation of LRT is prone to lure land development in the areas near its stations. It requires a local policy that integrates land use and transport policy in order to stimulate and manage land development in those areas especially. Therefore, the Government of Surabaya Municipality should formulate such policy to regulate land development around the LRT stations.
2. The integration of LRT system in land use or spatial policy may stimulate urban redevelopment in certain areas in the city which requires strong political will, financial support and community acceptability.
3. The TOD principles will be decisive measures to recognise and manage the impacts of LRT on land development, if the parameters of each principle are defined clearly. For instance, the City of Calgary, Canada was issued the TOD Policy Guideline in 2004 which provides guidance for development of areas specifically 600 meters of a transit station (LRT or BRT station). Thus, it is clear the land development within radius 600 meters from transit station has to accord with the concept of transit oriented development.

4. The LRT system is not the only factor influencing land development. There are also external factors – which are accessibility, regional demand, land availability and area attractiveness – that have an important role in affecting land development. Hence, they need to be considered in the plan making of LRT system in Surabaya-Indonesia.

Additionally, it is necessary to identify potential barriers that will hinder the implementation of the future LRT in Surabaya. According the interviewees' perspectives, there are several barriers that have to be dealt with by the local government in order to assure the LRT can be implemented successfully. The potential barriers are presented as follow:

1. Social condition

   This barrier relates to the perspectives of society on LRT, especially from the perspectives of current public transport companies and drivers. They may deem the LRT implementation will threat the existence of the current public transport in the city. Moreover, the implementation of LRT will require route changes (re-routing) of current public transport network in the city. This policy will potentially trigger a protest from the public transport operators. As it is raised by the official of the Transportation Agency of Surabaya who argued,

   "Potential barrier will come from the existing public transport operators. The plan of LRT will require re-routing of current public transport network. This policy will lead a social conflict that can postpone the implementation of LRT".

2. Political condition

   This barrier relates to the extent of political The LRT development project is a huge project that requires many years to accomplish the system completely. As the city mayor in Surabaya is elected every five years, there is no guarantee the next mayor will continue the policy of the former mayor to develop LRT system. In other words, the political condition is prone to be a barrier in implementing LRT in Surabaya. As it is expressed by the official of the Development Planning Board of Surabaya who mentioned,

   "LRT project is long-term project in which there is no guarantee the next mayor will continue the policy of current mayor to build LRT system in the city".

3. Financial and organisational/ institutional conditions

   These barriers relate to the limited budget to finance the development of the LRT system as well as the form of organisation/ institution will be built to manage the LRT. It is noted the development of LRT system require a huge amount of budget. To deal with this circumstance, the LRT project in Surabaya is planned as a *public-private-partnership* project in which the private companies are invited to invest their capital and cooperate with the government to develop and operate the LRT system. However, the cooperation scheme between the local government and the private company is not defined completely yet that may cause the project to be postponed. As it is described by the official of the Development Planning Board who said,

"LRT project is planned as a public-private-partnership project. However, it is still not decided yet how the cooperation scheme will be agreed between the government and the investors".

Furthermore, guidelines for LRT planning in Surabaya-Indonesia will be developed considering lesson learned from the two LRT practices – both in Strasbourg-France and Calgary-Canada – and potential barriers on upcoming LRT implementation in Surabaya. These guidelines are intended to assist decision makers and planners to consider several factors in plan making of LRT system. The guidelines mainly aim to identify potential impacts of LRT on land development and to manage those impacts. It should be noticed the guidelines are context dependent meaning adjustable to deal with different local attributes. Therefore, based on lesson learned from the two international LRT practices and the potential implementation barriers, the guidelines are formulated as follow:

1. **Guideline 1:** *Involving wide range of various stakeholders*
   At the early step of plan making process of LRT system, this process should engage wide range of stakeholders, including government, politicians, transport companies/operators, property developers, experts, NGOs, and the society. This is crucial stage to raise awareness and understanding among stakeholders as well as building commitment and gaining acceptance. The stakeholder acceptance may avoid social and political barriers threatening the implementation of LRT. This step can be a starting point for institutional building in order to improve former organisation/ institution or establish a new organisation/ institution.

2. **Guideline 2:** *Formulating a vision of upcoming LRT system*
   The long-term vision is necessary to be developed in order to define a desirable LRT system in the future and its relationship to urban development. This vision can adopt development motto of the city of Strasbourg "improving life quality of the city". It implies the LRT system should integrate with urban development in order to improve liveability of the city.

3. **Guideline 3:** *Defining development objectives of LRT system*
   Clear objectives need to be determined in order to ensure the desirable LRT system. Several objectives can be defined as follow:
   a. Relieving road traffic congestion;
   b. Reducing pollution level;
   c. Offering another mobility option for urban society;
   d. Enhancing accessibility of the city;
   e. Providing environmentally friendly public transportation;
   f. Stimulating and managing land development within the city.

4. **Guideline 4:** *Defining development criteria of LRT system*
   Certain criteria require to be set up to clarify the objectives of the LRT system. Since this research emphasises the LRT impacts on land

development, the criteria should enable the LRT system to deal with those impacts and manage land development in the city. Based on the comparative analysis, the three criteria can be taken into LRT planning as follow:

a. The presence of a supportive/ flanking policy that integrates land use and transport policy;
b. Transit Oriented Development (TOD) principles, namely *density, diversity, distance, design,* and *destination accessibility,* as measures to identify and manage land development in the areas around the LRT stations;
c. External factors influencing land use, which are *accessibility, regional demand, area attractiveness,* and *land availability.*

5. Guideline 5: *Defining clear parameters of development criteria*

Parameters of development criteria should be defined clearly in order to ensure those criteria can be executed precisely in its implementation. For instance, certain parameters should be articulated in each TOD principle. The parameters can be presented as follow, for example:

a. Density

A parameter, such as dwelling unit per acre (DUA), can be put in this criterion. It needs to determine how many DUA of areas near LRT stations. This parameter can help stakeholders to understand the level of DUA should be achieved in areas around the stations.

b. Diversity

The types of land use should be defined clearly as parameter in this criterion. What types of land use, such as residential, commercial, education and open space, should be provided in areas proximate to LRT stations.

c. Distance

The radius of area around LRT station has to be defined as the parameter of this criterion. The radius should be articulated clearly, for example 600 meters from the station, in order to give guidance where areas have to refer to the concept of TOD.

d. Design

As this criterion expresses to make attractive and unique places as well as encouraging walking and cycling activities, some parameters below can be considered:

1. Availability of facilities for cyclists and pedestrians, such as pedestrian and cycling paths, and bike shed;
2. Availability of green open space, such as garden around LRT station and plantation along LRT corridor;

3. The extent of station design accommodates and reflects the identity of the city or the community around the station particularly.

e. Destination accessibility

Some parameters can be defined as follow:

1. The level of connectivity the LRT station with other public transports, such as feeder bus.
2. The level of connectivity the LRT station with cycling and pedestrian facilities.

6. Guideline 6: *Developing action strategies to achieve the vision and objectives of LRT system*

These strategies are essential to obtain the vision and objectives of the LRT system. These strategies will be translated into actions to pursue those agenda. The strategies for integrating land use and transport policy can adopt the actions made by the city of Strasbourg-France as a reference, as follow: (LRTA 2003)

1. Providing LRT system as the main public transport;
2. Links the LRT and other public transports, such heavy rail trains and buses;
3. Encourages cycling and walking activities by improving pedestrian and cycling facilities;
4. Restricts the use of private motorised vehicles;
5. Regenerates urban spaces to accord with the public transport system;
6. Encourages public participation and provides sufficient information for public.

7. Guideline 7: *Assessing implications of the implementation of LRT system to optimise its implementation*

This step is crucial to ensure that the vision and objectives of the LRT system are still supported by the stakeholders and feasible to be run continuously. Therefore, an assessment of the LRT implementation should be conducted comprehensively in order to optimise the implementation of the LRT system.

8. Guideline 8: *Setting up monitoring and reporting scheme of LRT implementation*

There should be developed certain monitoring framework to assure the LRT system operating in accordance with its vision and objectives. It is also required a reporting scheme in order to deliver complete information about the performance and implications of the LRT implementation for all stakeholders.

CHAPTER 6
Conclusions, Reflections and Recommendations

6.1 Introduction

This chapter mainly presents three points, namely conclusion, reflection, and recommendations, based on the analysis results in the previous chapters. The conclusion basically emphasises the important points about how the LRT system manages land development refers to the concept of transit oriented development (TOD). The reflection section mainly illustrates difficulties in conducting the research. At the end of this chapter, the recommendations will be offered to the Government of Surabaya Municipality and for future research. The recommendations for the local government are mainly intended to improve the plan of LRT system in Surabaya, Indonesia. Meanwhile, the recommendation for future research aims to stimulate other researchers to profoundly investigate specific theme based on the finding of this research.

6.2 Conclusion

This section presents conclusion of this research by answering the research question mentioned in Chapter 1. This answer is based on criteria using in the whole analysis of this research. The research question is presented as follow:

> *How to use light rail transit (LRT) in managing land use development in Surabaya-Indonesia from the perspective of transit-oriented development (TOD)?*

This research question is addressed using the result of comparative analysis in this research. According to the comparison of two LRT practices in Strasbourg-France and Calgary-Canada, it is discovered that the implementation of LRT has influenced land development in the vicinity areas of the stations. However, it must be noticed the LRT system requires a flanking policy to manage such land development. This policy has supported the implementation of LRT by integrating the land use or urban development policy and transport policy. In Strasbourg, there is a municipal policy that integrates town planning and transport policy aims to improve the living quality of the city. Meanwhile, the city of Calgary has issued the TOD Policy Guidelines that provides guidance for development pattern in the areas within 600 meters from transit stations. Hence, it can be concluded the presence of such local policy is fundamental to enable the LRT system in managing land development.

Furthermore, the implementation of LRT system has proven to have impacts on land development. The provision of LRT system may induce land development/ redevelopment in the areas near the stations. According the comparative analysis, it is revealed the TOD principles are able to explain the impacts of LRT implementation on land development. The density principle can identify how the LRT system can stimulate high-density development around the LRT station. In Calgary-Canada, the extension of C-Train line and the development of the Westbrook station induced redevelopment in Westbrook Village, an area around the LRT station. This redevelopment creates a high-density area which consists of diverse types of land uses, including residential, commercial and retails. However, it is noticed the LRT system does not always stimulate high-density development; instead it serves

the areas, such as downtown in Strasbourg-France and Calgary-Canada that have been already densely populated and occupied by various uses. The evidence also indicates that the implementation of LRT may induce mixed use development but not always. Moreover, the distance principle shows the implementation of LRT can lure land development in the areas within walking distance or 600 meters from the station. For example, the redevelopment of Westbrook Village in Calgary-Canada and the redevelopment of main squares in the city centre of Strasbourg. Then, the design principle can be used to identify how the LRT system influences the provision of convenience and safe area as well as creating a landmark of the city around the station. This area has been designed to encourage pedestrian and cycling activities by providing facilities for pedestrians and cyclists. Finally, the destination accessibility is able to recognise the impacts of LRT system in improving connectivity with other public transports, pedestrian and cycling facilities.

Moreover, the result of comparative analysis discovers the two LRT practices and the LRT plan in Surabaya-Indonesia also consider the external factors influencing land use. These factors are accessibility, regional demand, area attractiveness and land availability. In term of accessibility, the LRT system considers the connectivity of the LRT network with the existing road network and other public transports (e.g. heavy rail train and bus). Apart from this, the LRT system considers the need of increasing mobility for economic activities. Thus, the LRT system serves the economic activity centres within the city, such as in the city centre and CBDs. The LRT system also serves attractive places in the city, such as zoo and heritage buildings in Surabaya, in order to make those places to be more attractive and accessible. The availability of urban land is also a consideration in developing the LRT system.

Furthermore, it should be noticed there are actually other external factors influencing in the transport-land use feedback cycle (see Figure 2.2 in Chapter 2) which are not discussed in this research. These factors should be considered in the LRT plan since it will also affect land use. The other external factors are, (Bertolini 2009)

1. The external factors on transport (network): technology innovations, infrastructure investments, and mobility policy;
2. The external factors on activities: socio-demographic, economic and cultural factors.

To sum up, the LRT has potential impacts on land development, but it cannot manage those impacts alone. It requires a formal policy that integrates land use and transport policy. The TOD principles can be included in this formal policy since they can identify the impacts of LRT on land development. Thus, these principles can be used to manage the land development in the areas around the LRT station particularly. Moreover, the plan of LRT system should also consider the external factors influencing land use that are exist already. Therefore, the integration LRT system and the supportive local policy that includes TOD principle as well as considering the external factors can be a way to use the LRT implementation to manage land development in Surabaya-Indonesia.

6.3 Reflection

This research applies a comparative analysis approach which requires abundant information to be compared between three case selected studies. In order to be compared

comprehensively, there should be adequate data available in those three cases. However, for collecting the data about the impacts of the two international LRT practices on land development, some information is not accessible or less sufficient to explain those impacts. Since this research refers to TOD principles to reveal the impacts of LRT on land development, the data is quite difficult to be found in the case of the LRT in Strasbourg-France due to the fact its practice has not implemented the concept of TOD explicitly. The difficulties in obtaining the relevant information might affect the result of comparative analysis.

Furthermore, for collecting data through interviewing several stakeholders in Surabaya-Indonesia, each stakeholder has slightly different interpretation about the concept of TOD, although a brief overview about the TOD concept was given before conducting the interview. This might bring difficulties for the researcher to synthesise perspectives among interviewees on TOD concept. This may result bias information from the interviews.

As a qualitative research, the analysis approach applied in this research has strength and weakness. The qualitative approach may benefit the researcher because it allows the researcher to conduct profound and detail analysis. Besides, this approach is also flexible in dealing with unpredictable conditions during the research. Nevertheless, the qualitative research is a time-consuming research because detail and profound information have to be gathered. Moreover, it is not an easy task to synthesise various perspectives of interviewees in certain condition. As a consequence, the analysis result of the research relies on the skill and experience of the researcher.

Additionally, this research only focusses on the external factors affecting land use, whereas there are other external factors that also influence relationship between transportation and land use (Bertolini 2009). The Figure 2.2 explicitly shows that the external factors on transport (networks) and activities have important roles in influencing such relationship that are not discussed in this research.

6.4 Recommendation

The recommendations are offered to the Government of Surabaya Municipality and for further research. The recommendations to the local government are intended to offer several points that should be taken in plan making of LRT system in Surabaya-Indonesia. On the other hand, the recommendation for further research aims to stimulate other researchers to deeply discuss an essential point discovering by this research that is not comprehensively explored yet.

6.4.1 Recommendation for local government

This section offers several recommendations for the Government of Surabaya Municipality in developing plan of LRT system in Surabaya-Indonesia. These recommendations are presented as follow:

1. The Government of Surabaya Municipality has to provide a formal policy that integrates land use or spatial policy and transport policy due to the fact the local spatial planning and the transportation planning are two separated products. Currently, there is no integration between the two planning products which may cause the local

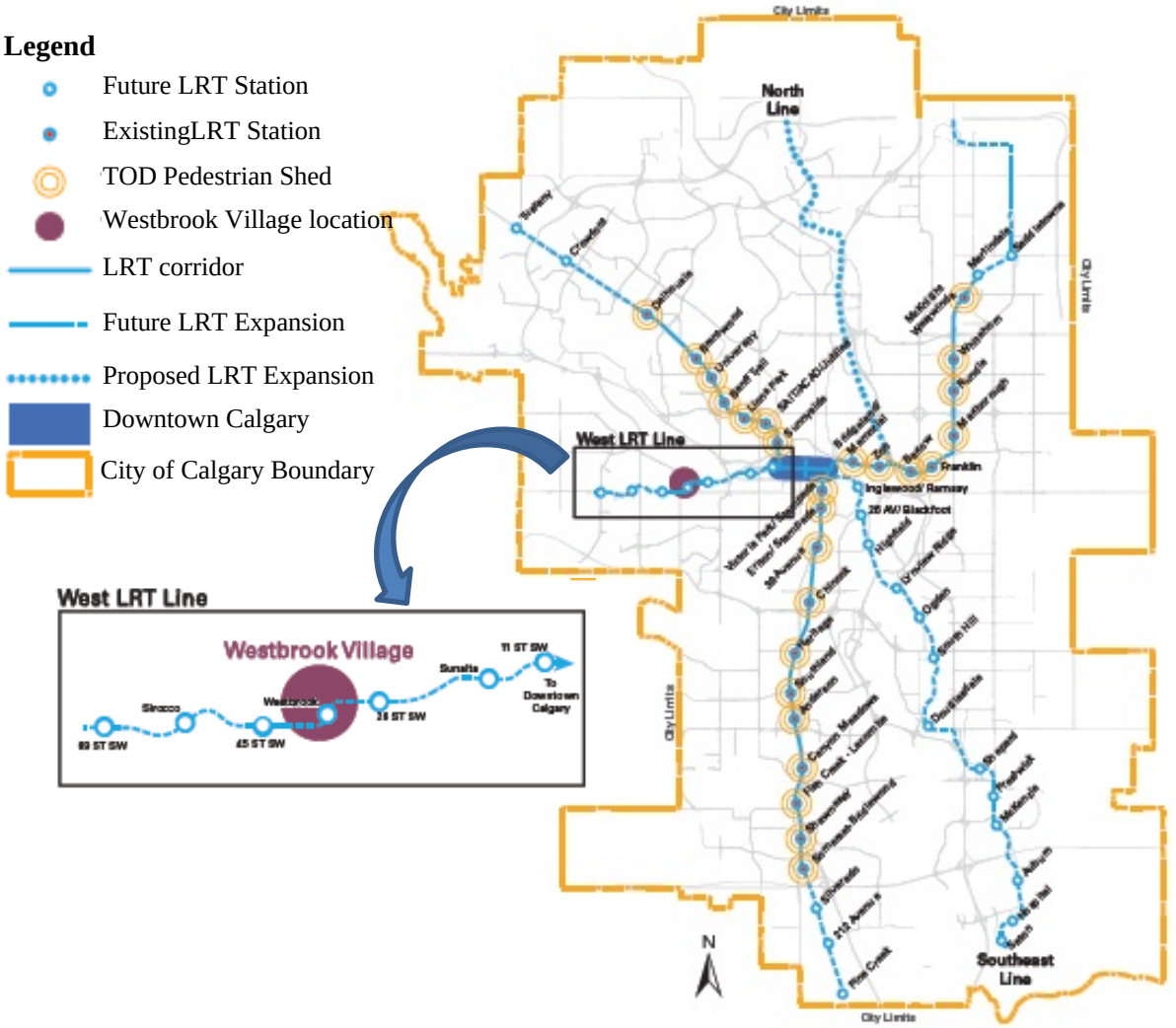
government is less powerful to manage the potential impacts of LRT system on land developments in the city.

2. TOD principles should be incorporated in the local spatial policy in order to manage land development pattern in the areas around LRT station to be transit oriented development.
3. It is noted mobility policy is one of decisive factors which influences the relationship of transport and land use presented in transport-cycle feedback cycle by Bertolini (2009). Hence, there should be mobility policy in Surabaya aims to discourage the use of private vehicles in the city. For example, the mobility policy includes road tax and parking policy that will depress the private vehicle owners especially.
4. The Government of Surabaya Municipality should plan for integrating the LRT network and another railway network (heavy rail or regional rail). This plan is intended to utilise another type of railway to be shared use with LRT. Therefore, it can reduce the burden of the local government to provide additional budget for constructing new railways for LRT. For this reason, the next LRT in Surabaya can adopt the Karlsruhe model in which the LRT is operated on its own track and heavy railway (Priemus and Konings 2001; Zuiderveen 2009).

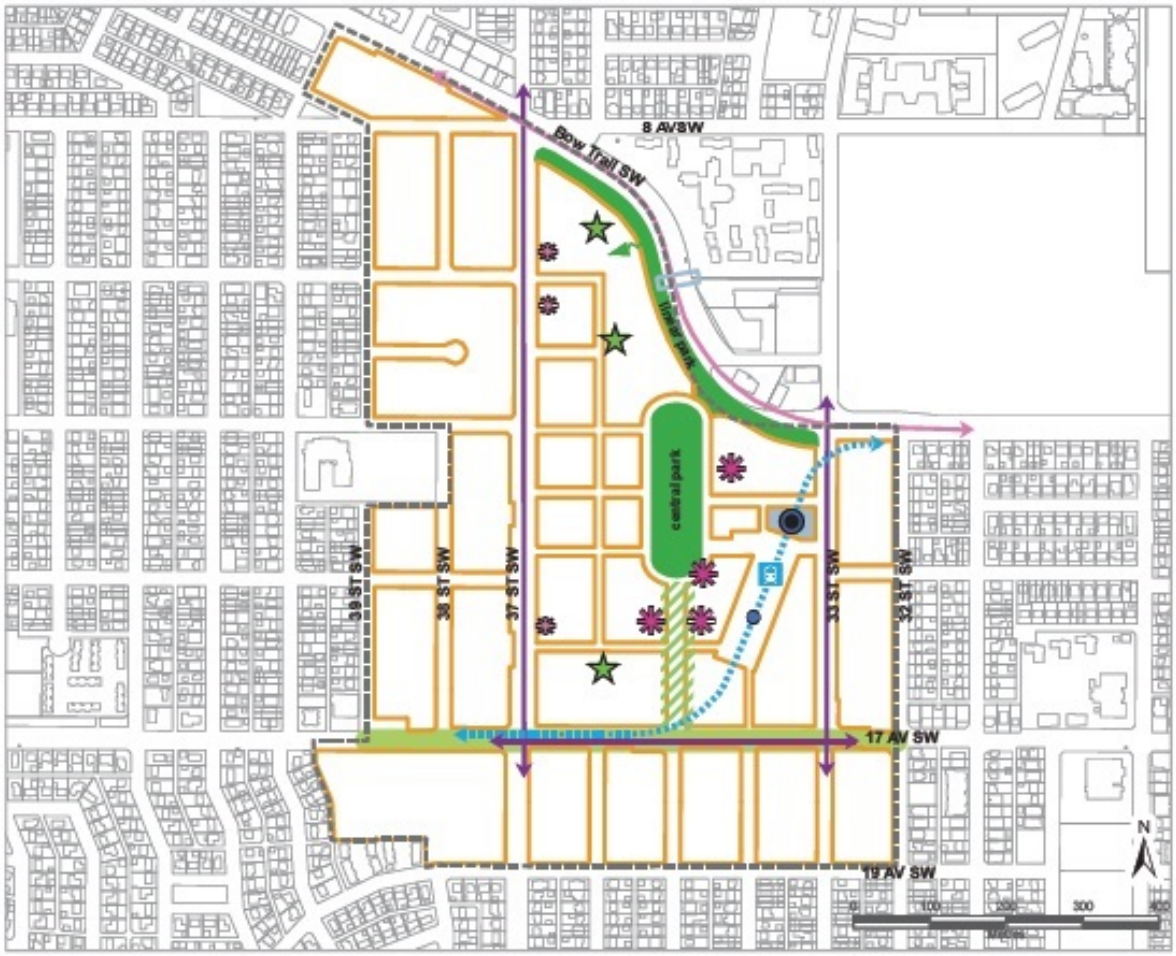
6.4.2 Recommendation for future research

This research reveals the important role of a local policy that integrates land use and transport policy in managing land development within the city. However, this research does not intensively discuss how to develop such policy. Therefore, in my view, it is important to conduct further research that aims to develop a policy that integrates land use and transport policy in order to manage land development as supportive mean for the implementation of transit system. This policy should be formulated comprehensively that considers interrelationship between public transport system and land use dealing with potential impacts of transit system on land development in the city.

Appendix 1
Location of Westbrook station as new C-Train station within Westbrook Village redevelopment area (The City of Calgary 2009)



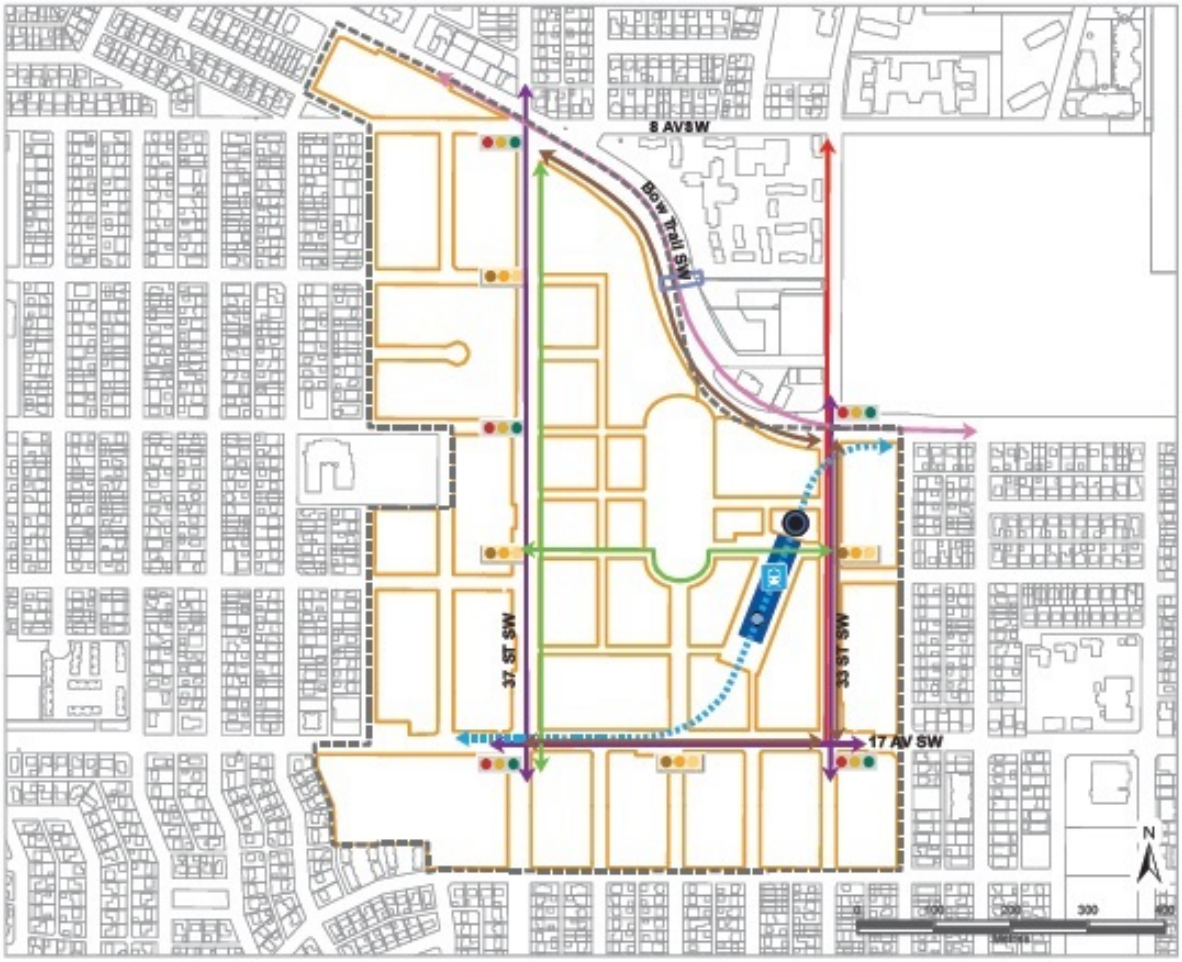
Appendix 2
Urban Design and Public Realm within the Westbrook Village, Calgary-Canada



Legend

- Westbrook LRT Station
- Plan Area Boundary
- West LRT Line
- Arterial Street
- Neighbourhood Boulevard
- Pedestrian Linkage
- Existing Pedestrian/ Bicyle Overpass
- Transit and Civiv Amenity
- Transit Station Access
- Multi-Modal Transit Hub
- Major Landmark
- Minor Landmark
- Special Character Zone
- Park and Open Space
- Possible Green Mews
- Formal Boulevard
- Urban Plaza

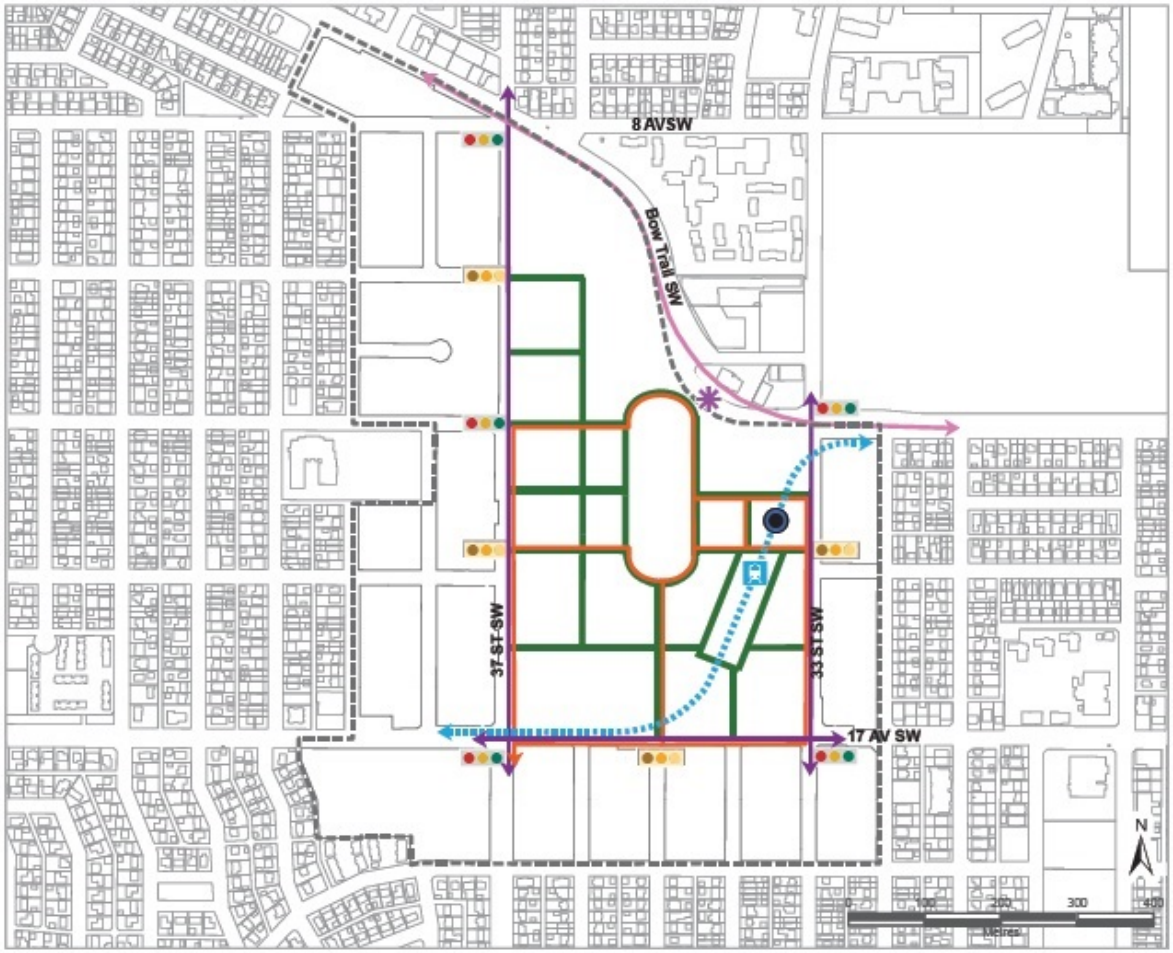
Appendix 3
Plan of Pedestrian and Cycling Network Linked to the Westbrook LRT Station in Calgary, Canada (The City of Calgary 2009)



Legend

- Westbrook LRT Station
- Plan Area Boundary
- West LRT Line
- Arterial Street
- Neighbourhood Boulevard
- Transit Station Access
- Multi-Modal Transit Hub
- Possible Regional Pathway Connection
- On-Street Bycycle Linkage
- Multi-use Pathway
- Pedestrian Linkage
- Existing Pedestrian/ Bicyle Overpass
- Transit Station Area (Underground)

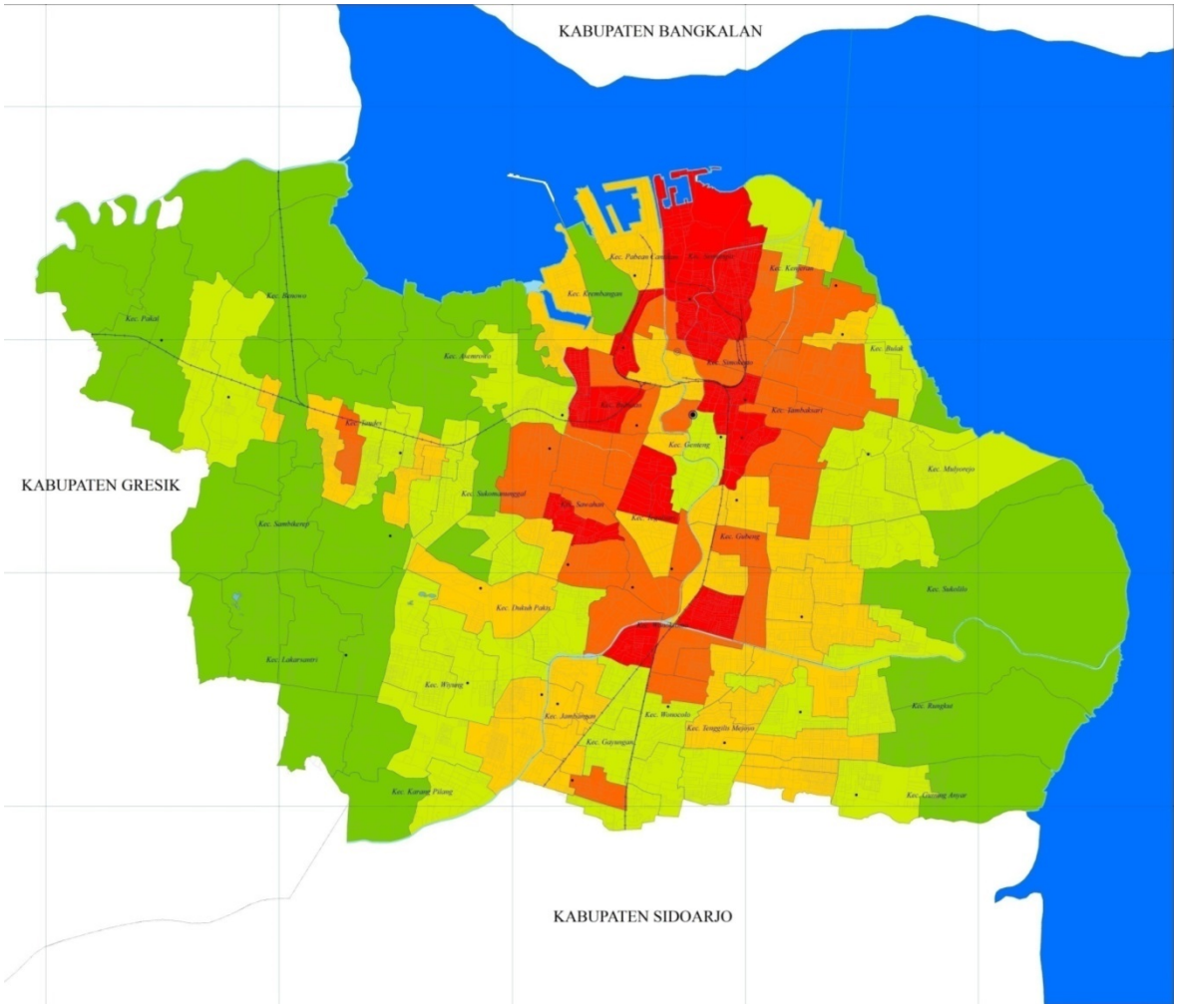
Appendix 4
Plan of Road and Public Transit Network Linked to the Westbrook LRT Station in Calgary, Canada (The City of Calgary 2009)



Legend

- Westbrook LRT Station
- Plan Area Boundary
- West LRT Line
- Arterial Street
- Neighbourhood Boulevard
- Multi-Modal Transit Hub
- Potential Bus Route
- Future Road Network
- Formal Boulevard

Appendix 5
Map of Distribution of Population Density in Surabaya
(Bappeko Surabaya 2012)



LEGEND:

Distribution of population density (inhabitants/km^2)

287 – 4391
4392 – 9613
9614 – 17477
17478 – 33413
33414 – 83663

Appendix 6
Visualisation of Current Land Use along the Planned Corridors of LRT in Surabaya, Indonesia (Field Observation 2013)

A. North-South (US) Corridor


Trade (Jembatan Merah Plaza)


Heritage Building (Tugu Pahlawan)

Trade (Tunjungan Centre) at Tunjungan

Office (BRI Tower) at Basuki Rachmad


The Office of East Java Governor at Gubernur Suryo

Office (Intiland) at Panglima Sudirman


City Park (Taman Bungkul) at Raya Darmo


Surabaya Zoo at Raya Darmo

B. East-West (BT) Corridor

Residential (Pakuwon City) near ITS


Education (ITS) at Raya ITS


Residential at Raya Kertajaya Indah


Trade (Galaxy Mall) at Dharmahusada Indah Timur

Siloam Hospital at Raya Gubeng


Darmo Trade Center ata Wonokromo


Trade and Residential (Lenmarc) at Bukit Darmo Boulevard


Education (UNESA) and Residential (Citraland) at Bukit Darmo Boulevard

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