Beyond the Blueprint:

A Critical View on Plans for Transit-Oriented Development (TOD) in the New Indonesian Capital

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Abstract

Indonesia is relocating its capital city from Jakarta to a new city built from scratch called IKN (Ibu Kota Negara/Nusantara). Starting with the prioritized Government Precinct, the full relocation will be completed by 2045. The master plan emphasizes Transit-oriented Development (TOD) principles to encourage walking and transit, including incorporating the 10-minute concept. Meanwhile, South Korea has been moving the administrative capital city to Sejong City since 2007 and will be finished by 2030. Both cities share similar goals and approaches to implementing TOD; however, TOD can have pros and cons. While TOD can reduce traffic congestion, improve health, spur economic benefits and foster a sense of community, it can lead to gentrification, limited parking space that discourages early dwellers and vacant districts that induces negative impacts. Moreover, walking in Indonesia is unpopular due to the lack of safe, comfortable, and reliable transit modes, motorcycle and ride-hailing service dependence, and thermal comfort issues. Therefore, this thesis aims to identify the TOD aspects in IKN walkability and transit planning that may face issues after the city is developed based on the study case of pre- and post-construction Sejong so that IKN can anticipate and prepare. The Government Precinct encourages walking and transit by providing various types of pedestrian environments, permeable edges, and multiple transit systems, including BRT. The planned walking environments and transit nodes accommodate the 15-minute radius. Still, the planners must also consider the local context for the walkable distance, provide amenities that enhance thermal comfort, support modal shift facilities, and be vibrant with activities all time of the day and week so it is not vacant after working hours. Learning from Sejong, forcing people to walk in the interconnected walkways and limiting the parking lot to encourage people to use BRT is inefficient and inconvenient. Adopting a design adaptable to unforeseen challenges is crucial to promote social interaction, active mobility by walking and transit, and reducing automobile dependency. IKN must also implement non-physical interventions by enforcing strict policies, maximizing public transport frequency, and conducting regular assessments. A successful IKN plan can be a template for other TOD megaprojects globally.

Keywords: TOD, walkability, transit, BRT, capital city, Indonesia, IKN, Nusantara, Sejong

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"I want to thank me for believing in me. I want to thank me for doing all this hard work. I want to thank me for having no days off. I want to thank me for never quitting. I want to thank me for always been a giver and trying to give more than I receive. I want to thank me for tyring to do more for right than wrong. I want to thank me for just being me at all times."

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Abbreviations

BRT	Bus Rapid Transit
CBD	Central Business District
IKN	Ibu Kota Negara/the state capital
ITDP	Institute for Transportation and Development Policy
K-IKN	Kawasan IKN/Nusantara Capital Region
KIPP	Kawasan Inti Pusat Pemerintahan/Government Core Area
KP-IKN	Kawasan Pengembangan IKN/Nusantara Expansion Region
KTX	Korean Train eXpres
LRT	Light Rail Transit
MACCA	Multifunctional Administrative City Construction Agency
MRHS	Motorcycle-based Ride Hailing Services
MRT	Mass Rapid Transit
NMT	Non-motorized Travel
ROW	Right of Way
TOD	Transit-oriented Development

1. Background

1.1 Capital City Relocation

The capital city is one of the most significant identities of a country: it is a symbol of power in terms of administrative, political, social, economic and security aspects. Therefore, relocating an established capital city requires legitimate objectives and comprehensive planning. In the last thirty years, several countries have decided to move the capital or separate the administrative city, such as Nigeria (1991), Kazakhstan (1997), Malaysia (1999), Myanmar (2005), and South Korea (2005) (Farida, 2021).

There are varying reasons to undertake such a massive project. Some countries move their city due to the geographical aspect; they move to a more strategic site at the country's centre. It may be necessary to relocate to a new site to avoid potential natural disasters and environmental issues or decrease air pollution. Another reason is to distribute the development so other areas will thrive economically. Historical and cultural background can be a background issue, where the government will move their capital city to a more neutral site to promote unity between the different ethnic or religious groups. External conflict, invasion or war are also risks that may be avoided by moving to a more easily defended area. Finally, most capital cities are densely populated, so moving out to a new area will reduce the congestion and other issues that are exacerbated by overpopulation.

Most of the new capital cities are built from scratch, requiring significant land mobilization and conversion; therefore, the existing land use and land rights in the new capitals need to be newly planned, readjusted, re-adjudicated, re-allocated and possibly re-consolidated, similar to other major land interventions (Hackbarth & de Vries, 2021). Ensuring an innovative, sustainable, and enjoyable livelihood must be emphasized. Understanding what makes a capital city and identifying the potential problems and negative impacts of such a plan are crucial for future relocations (Hackbarth & de Vries, 2021). Therefore, it is essential to look into other cases of similar issues, backgrounds, or planning in order to be aware of the shortcomings that the upcoming new capital cities will need to be aware of and ready for.

1.2 IKN: The New Indonesian Capital

Jakarta, the present-day capital of Indonesia, encounters a multitude of challenges that demand immediate attention and resolution. According to the Indonesian Population Forecast 2015-2045, around 57% of the population will be concentrated in Java. Nearly two-thirds of Indonesia's Gross Domestic Product is generated within Jakarta (van der Vuurst & Escobar, 2020). It is one of the densest cities on earth with a rate of >4000 people/km2. The high number of populations and rapid urbanization growth creates busy mobility, where the average commuting time is 2-3 hours/trip or 4-5 hours/roundtrip. Land subsidence reached 35-50 cm during 2007-2017, and the groundwater level decreased by 7,5-10 cm/year because of a common practice of extracting the water from the aquifer. Hence, the land subsidence worsened, and Jakarta sank rapidly. The water quality is worsened because 57% of the reservoir and 61% of the river are heavily polluted. Due to its position facing the Java Sea, Jakarta is also at risk of sea level rise which they predict 25-50 cm sea level rise in 2050. Natural disasters are also a significant risk that is always ongoing. Approximately 50% of the Jakarta area has a flood safety level below ten years (ideally, big cities should have a minimum of 50 years). Jakarta lies within the ring of fire, so Jakarta is threatened by nearby volcanoes such as Krakatoa and Gede Mountain and the potential earthquake and tsunami caused by the megathrust in West Java and Sunda Strait. Therefore, moving the capital city from Jakarta is deemed urgent, primarily triggered by the exponentially worsened climate change and environmental situation.

The plan to relocate the capital was formally announced by President Joko Widodo in 2019 during the annual State of the Union address at the parliament. The plan is finalized in the 2020-2024 National Medium-Term Development Plan (2020-2024 RJPM), which specifies that the development will be on the Sepaku district of North Penajam Paser Regency and Kutai Kartanegara Regency, East Kalimantan (Farida, 2021) as shown in Figure 1 below. The city is called IKN (Ibu Kota Negara/The State Capital), therefore it is the unofficial name that is widely used at the moment. On 17 January 2022, the President announced that the city's official name would be Nusantara, derived from Old Javanese which embody the national wisdom of Wawasan Nusantara (archipelagic wisdom). The name has yet to be officially established at the moment of the writing of this thesis; it will be officially inaugurated in August 2024. Therefore, this thesis will use the term IKN.

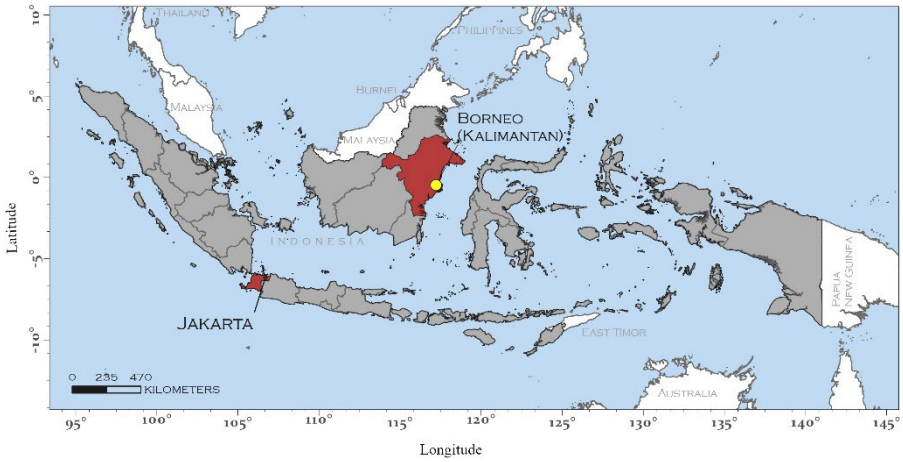


Figure 1. Location of Jakarta, the current Indonesian capital, and IKN, the new capital (van der Vuurst & Escobar, 2020)

According to the Law of the Republic of Indonesia No.3 on 2022 of The State Capital, the site is chosen for the following reasons. First, the location is strategic because it is in the middle of Indonesian territory. Metaphorically, the centre site represents justice and provides opportunities for other islands besides Java to thrive and develop. To date, Indonesia's economy has been centralized in Java and other western parts of Indonesia, so the relocation is expected to boost the investment and economic growth in the eastern part of Indonesia and reduce the regional inequality. Secondly, the surrounding area, including the adjacent cities of Samarinda and Balikpapan has relatively complete transportation and energy infrastructure, which makes the early investment efficient. Thirdly, the government already owns a total area of 180,000 hectares as an extensive permanent production forest, so the cost and conflict of buying new land can be minimized. Lastly, Kalimantan has a minimal disaster risk, be it floods, earthquakes, tsunamis, volcanoes, and landslides.

The Ministry of Public Works and Housing announced a design competition for the new capital city in 2019 to design the masterplan, then Urban+ announced the winner with their design called Nagara Rimba Nusa (Forest Archipelago). Since 2020, a Joint Operation consisting of the authorities and the winners have collaborated to create the KIPP Design Harmonization. In 2040 the construction is targeted to be finished, and 1,7-1,9 million people will move in by then.

The new capital city comprises 256,142 hectares of land and 68,189 hectares of territorial waters (Presidential Regulation No. 63 of 2022 on the Master Plan for the State Capital). Authorities planned that 75% of IKN will be a green open space, in which 65% will be a protected area and 10% will be used for food production.

The entire IKN project will be developed in five phases:

- Phase I (2022-2024): Focusing on essential infrastructure development such as main roads, public transportation, IT, electricity and water supply. By 2024, the

executive, legislative, judicial, military, and police agencies will have relocated to IKN, alongside the establishment of a BRT direct service.

- Phase II (2025-2029): Development of mixed-use areas for business, education, tourism, and advanced IT infrastructure will accommodate the target population. Approximately 1,2 million people are expected to relocate to IKN by the end of the phase.
- Phase III (2030-2034): Development of mass transportation infrastructure and waste and water infrastructure expansion.
- Phase IV (2035-2039) and Phase V (2040-2045): Final phase where the residential areas will be developed, and the smart city concept will be implemented.

The overall IKN site is divided into three zonings as shown in the Figure 2 below:

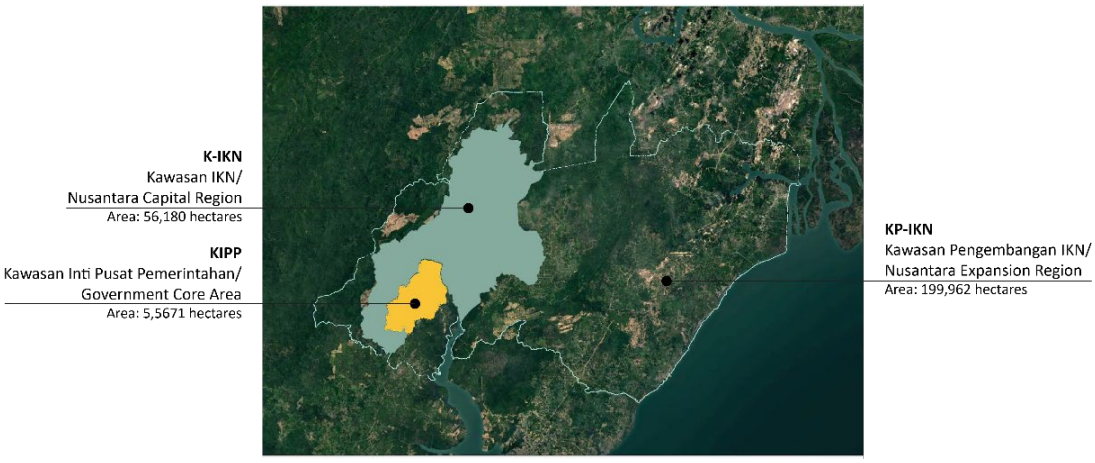


Figure 2. IKN zoning

(IKN Collaboration Team, 2021) (1)

- KP-IKN (Kawasan Pengembangan IKN/Nusantara Expansion Region) as the macro-scale planning with an area of approximately 199,962 hectares which consists of offices, business districts, talent growth centres, hotels, and MICE centre (meeting, incentives, conferences, and exhibitions).
- K-IKN (Kawasan IKN/Nusantara Capital Region) is a polycentric city with 56,180 hectares comprising offices, business districts, research and innovation centres, and academia. In total, K-IKN and KP-IKN target a population of 1,700,000—1,900,000 people.
- KIPP (Kawasan Inti Pusat Pemerintahan/Government Core Area) as the central government core with an area of 6,671 hectares and a target population of 200,000—300,000 people.

KIPP is the prioritized area to be planned and built. Based on the site analysis and review, the site is moved 4 kilometres north of the competition winner's initial location to respond to the sea level rise and coastal flood issue and preserve the sensitive Balikpapan Bay (Figure 3). The initial concept remains, and the natural topography and morphology are preserved.

Figure 3. KIPP's old and new location

(IKN Collaboration Team, 2021) (1)

KIPP is divided into three zones: 1A (Government Zone), 1B (Education Zone), and 1C (Health Zone). The primary focus for development is Zone 1A, the Government Zone where key government agencies reside, and the central transit hub from the adjacent cities and transportation infrastructure will be established. Within the Government Zone, the Government Precinct is the prioritized area with the most completed Urban Design Development so far, as shown in the bold area (number 1) in Figure 4. Covering 454 hectares, the Government Precinct houses central government agencies such as the executive, legislative and judicative bureaus, diplomatic buildings, ministries, and institutions and agencies.

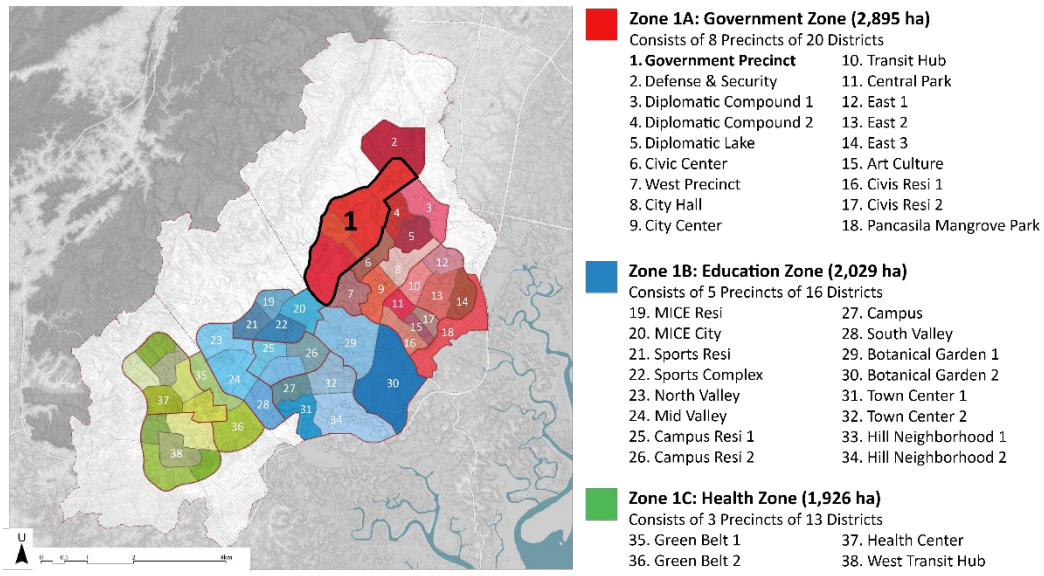


Figure 4. KIPP zoning plan

(IKN Collaboration Team, 2021) (1)

The Government Precinct site has a challenging topography, but the planners commit to preserving nature as much as possible. Therefore, using the land slopes database and considering passive fault buffers that intersect the site, a site analysis was conducted to identify areas suitable for development with minimal nature disruption (Figure 5). It was determined that slopes exceeding 60% are avoided for building development, while slopes ranging from 30-60% pose challenges.

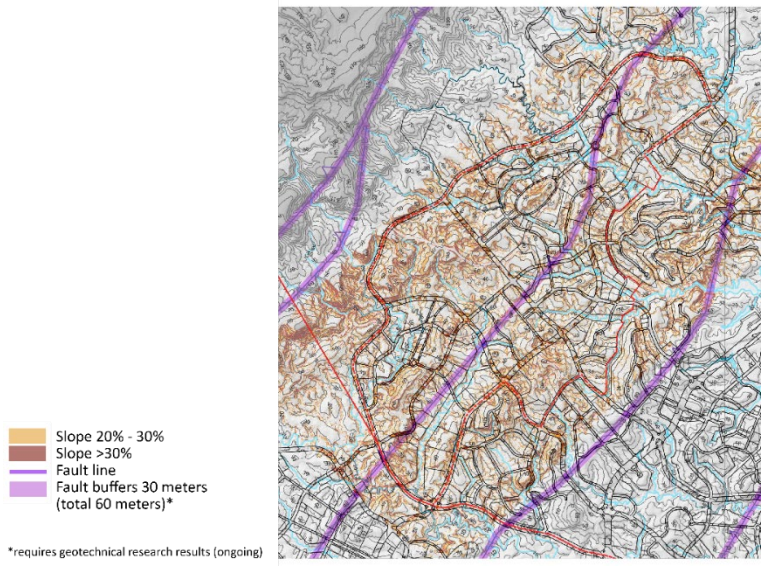


Figure 5. Developable area analysis

(Government Precinct Joint Operation, 2021)

Considering the above analysis parameters, KIPP planning area exhibits diverse topographical conditions. As a result, earthwork and land grading at various levels are necessary to maximize the efficiency of the building development (Figure 6).

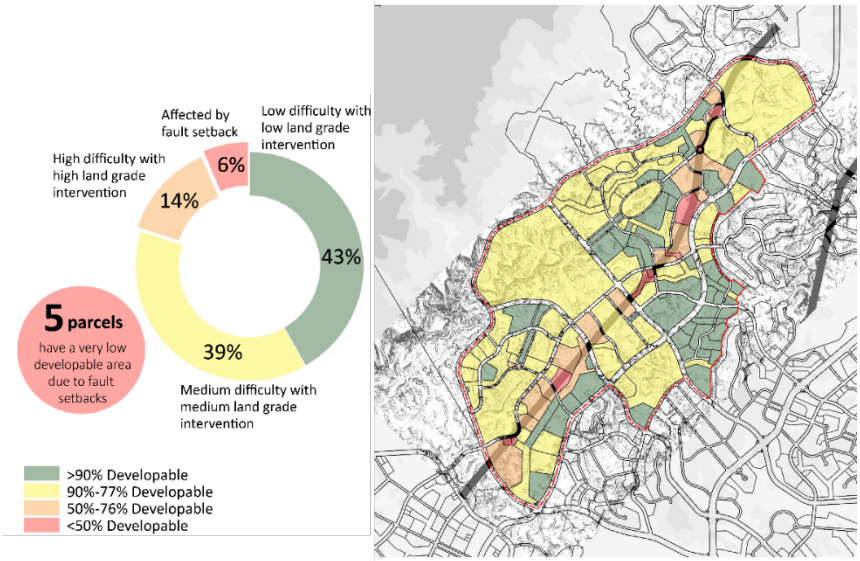


Figure 6. Developable area result

(Government Precinct Joint Operation, 2021)

Based on the developable site result, the Government Precinct is divided into eight precincts comprising 20 urban blocks and 141 parcels based on function, topography, and morphology, as shown in Figure 7. Government offices make up the most function (48,8%), followed by public green open spaces (20,4%), vertical residence (2,8%), commercial and financial (1,5%), public facilities (1,2%), and mixed-use (1%).

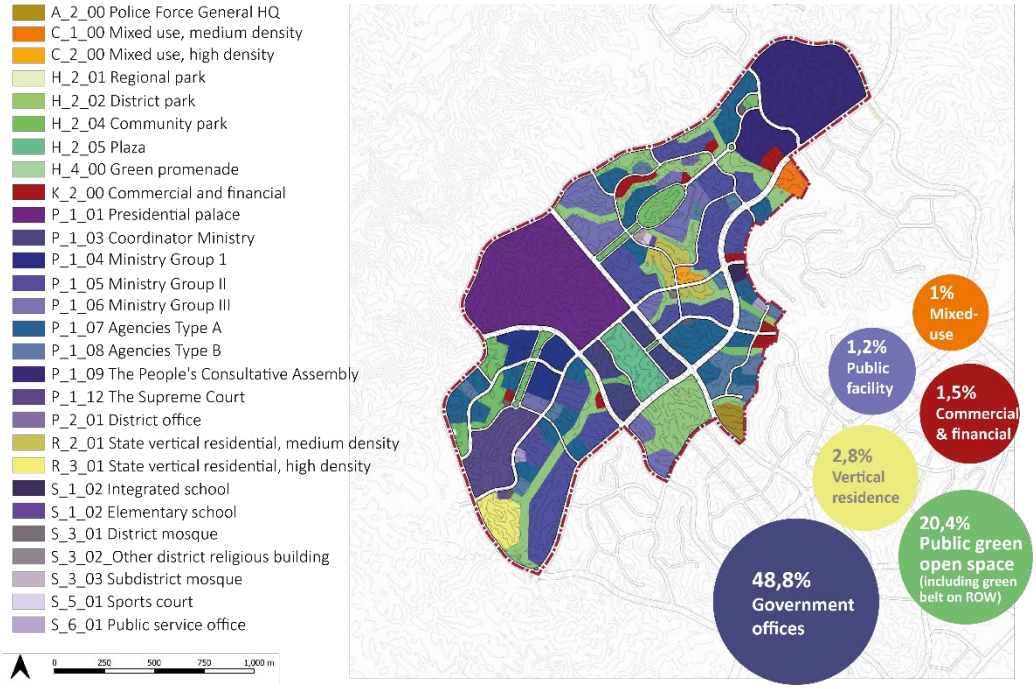


Figure 7. Government Precinct zoning plan

(IKN Collaboration Team, 2021) (1)

The goal of the IKN plan is to create a future city that does not depend on private vehicles by applying the Transit-oriented Development (TOD) concept (Law of the Republic of Indonesia No. 3 of 2022 on The State Capital). TOD has been implemented in the legal foundation of the IKN masterplan, which shows that Indonesia manifests the concept of sustainable mobility in the capital that will be the example for the development in other cities and other countries. The TOD principles that IKN must possess are written in Table 1:

Table 1. TOD principles of IKN

(Law of the Republic of Indonesia No. 3 of 2022 on The State Capital)

	Transit-Oriented Development Principles	**Concept Plan Illustration**
1	Develop an environment that encourages walking	
2	Prioritize active mobility network	
3	Create a dense road or lane network	
4	Develop a site near high-quality public transport	
5	Plan multi-functional land use, income level, and demographics	
6	Optimize the density & adjust the transit capacity	

7	Create zones with short transit travel time	
8	Enhance mobility by managing parking & road usage	

Law no.3 mandates a sustainable mobility network with key principles: high-quality public transportation, hierarchical transit options for strategic corridors, 80% public transportation usage (90% in high-density nodes), 10-minute walkable access to public transit, emission-free public transit and vehicles, and establishment of mobility hubs. There are also non-infrastructure policies such as public transit subsidies, integrated payment, and comprehensive framework for transportation planning and management. Figure 8 shows the shared street concept.

Figure 8. Shared street concept illustration

(Zerlina, Azriani, & Tsarina, 2022)

1.3 Sejong: South Korean New Administrative Capital

Another country that has been constructing a similar megaproject of relocating the capital that is still ongoing right now is South Korea. As one of his campaign's main agendas, the then-presidential candidate Roh Moo-hyun proposed to relocate the capital from Seoul to a new city, later named Sejong City, in the west-central Hoseo Region, 120 km to the south (Figure 9). There are various reasons for this relocation, such as to balance the national development, relieve the congestion and overcrowded Seoul, and encourage more investment in the central region.

Figure 9. Seoul and Sejong location

(MACCA, 2017)

Sejong was granted the status of a Special Self-Governing City in 2012. Since then, South Korea has had a two-capital model. Seoul remains the official capital and the economic and cultural centre, and Sejong is the de-facto administrative capital where many of the government's most important agencies are located (de Vries, 2021). Although most ministries and agencies have been relocated to Sejong, the most influential agencies—including the National Assembly and other bodies remain to be residing in Seoul.

Sejong city is located in the central part of the country, bordering South Chungcheong to the west, Daejeon Metropolitan City to the south, and North Chungcheong to the east. The total area of Sejong is 73 km2 (28 square miles), surrounded by a peripheral area of 223 km2. The city is expected to house a total of 500.000 people by 2030, and the density will be approximately 68 people/ha. The master plan was developed in 2007 based on the competition winning design with the main concept of a ring-shaped city. The city comprises dispersed towns and six major functional zones that are connected with a looping ring-shaped central axis that acts as the primary public transportation network (Figure 10). Together with the existing Geum River, a vast green area in the ring's core is proposed to create access to green space from any zone in the city.

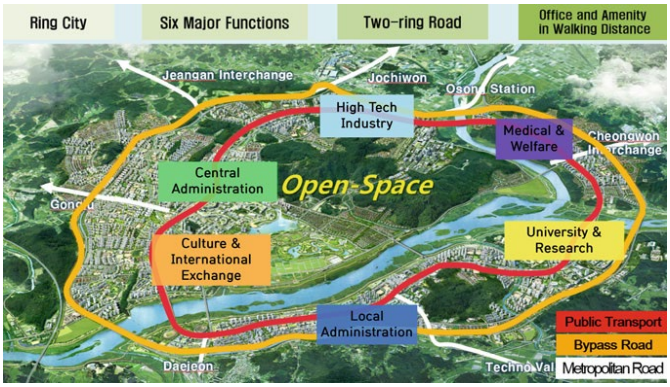


Figure 10. Sejong urban structure

(NAACC, 2017)

Construction started with completing the master plan in 2006 and relocating significant government facilities from the Seoul Metropolitan Area in 2012 (Kwon, 2015). The construction is divided into several phases:

- 1st phase (2007-2015). The first residential area completed in 2011, with 90% of home buyers moving in by March 2012.
- 2nd phase (2016-2020). It is targeted that 300,000 people will move in already.
- 3rd phase (2021-2030). It is targeted that the population will reach 500,000.

Sejong locates the government agencies in a cluster of continuously connected buildings called the Government Complex Sejong in a total area of 213,000 km2 that is located in the northwestern part of the city. As shown in Figure 11, the U-shaped six-stories government buildings complex with 36 ministries and agencies are connected by sky bridges and a continuous undulating rooftop garden to foster collaborative work and service between agencies. Moreover, the open winding rooftop garden will create additional green space in the urban area and provide a place to enjoy a scenic panorama of the city from above (Park, 2019)

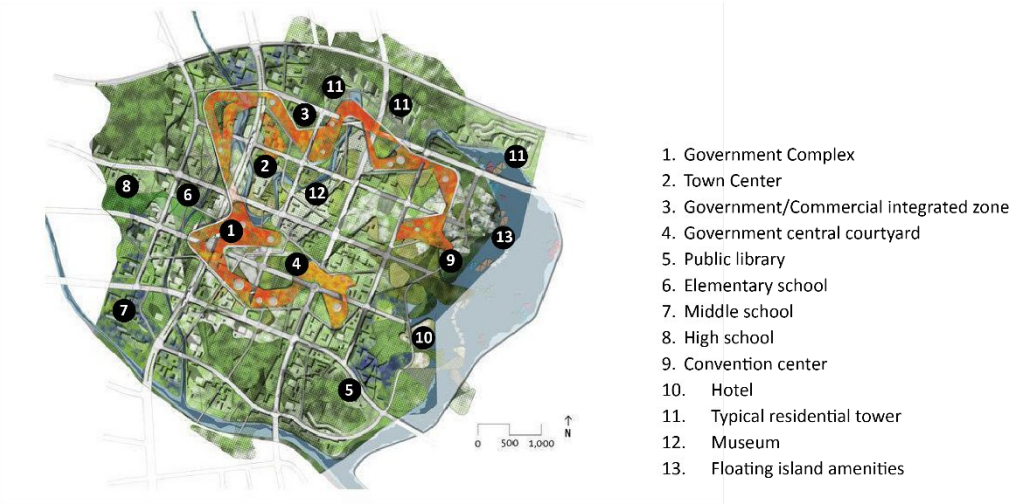


Figure 11. Government Complex Sejong and its surrounding area

(https://www.architectmagazine.com/design/buildings/master-plan-for-the-public-administrative-town-designed-by-the-team-of-balmori-associates-h-architecture-and-haeahn-architecture_o)

More than a decade has gone by since the first construction. Although it boasts a smart and sustainable city concept with a circular network and massive blue-green space in the core, the city still gains mixed opinions regarding its liveability. The constant challenge that the new city is facing is the low rate of permanent residents' migration in the new city because of its difficult access and limited facilities. Its proximity to Seoul and other developed cities creates less urgency in migrating to the city. The need for more facilities and lifestyle amenities is a severe drawback to attracting young families and government workers.

1.4 Mutual Things in Common

From the list of the established and ongoing capital city relocations globally, Sejong bears many similarities and relevancy with what IKN is planning. Both cities are constructed following a competition for the master plan of the city. They are planned as an answer to relieve the overpopulated and congested current capital city, to balance out the national development, and both cities implement sustainable mobility concept (de Vries, 2021). Most importantly, Sejong is the latest capital city relocation case that has been developed for at least a decade and people have been settling down in the city, so the changes and growth from the pre- and post-construction phase can be observed. Both IKN and Sejong apply TOD principles in their master planning. Continuous pedestrian paths and reliable public transportation networks are planned to connect people to the functions seamlessly without relying on private vehicles. IKN planned different types of walkable streets to encourage walking in all environments, and Sejong also planned the human-scale walkable environment and linked Government Complex. For the mass transit system, BRT is chosen as its primary mode of transportation that runs through the exclusive lane, a central axis of the city in Sejong. In IKN, the BRT is also supported by other modes of transit that run locally in the Government Precinct.

2. Literature Study

2.1 TOD Principles

The concept of accessible development is not a new idea, but the TOD term was coined by Peter Calthorpe in 1993 to describe a walkable community that accommodates a specific density and mixed land use (Jamme, Rodriguez, Bahl, & Banerjee, 2019). TOD can also be defined as a planning strategy that focuses on integrating urban places that bring together people, activities, buildings, and public space, with easy walking and cycling connections and near-excellent transit services to the rest of the city. TOD integrates land use, transportation, and people in a proper density and diversity ratio that creates healthy, profitable, and liveable communities. However, assessing if a specific area applies TOD is complicated because what is considered a dense, pedestrian-friendly, and transit-supportive area in one area might be different from another (National Academies of Sciences, 2004). The flexibility and plurality of the TOD definition can be both a strength and a liability because of the different perspectives on assessing TOD. Therefore, the pros and cons of TOD will be explored in the following sub-chapters.

TOD concept originated in the USA to address the problems in U.S. cities because of growing automobile dominance, transit disinvestment, highway expansion, and suburbanization that started at the end of World War II (Xu, Guthrie, Fan, & Li, 2017). Auto dependency creates a domino effect of pollution, traffic congestion, rising economic costs, burdened health facilities, and lack of social space. Since then, the TOD concept has gained more recognition globally as cities become increasingly crowded and congested, which creates a dire need for a transformation of city planning that tackles the major urban issues.

Interestingly, studies show that although the majority of TOD concepts were introduced by the Western countries or the Global North, the developing countries in the Global South are interested in applying TOD principles in their city planning due to the more urgent issues of overpopulation and congestion. That being the case, most lessons learned from a North American and European TOD are learned from the practices in the Global South case studies (Hasibuan & Permana, 2022).

Although she does not explicitly state the TOD definition, Jacobs (Jacobs J., 1961) emphasized the importance of the human factor in comprehensive city planning, especially the values of the community to create a safe and integral urban vitality that aligns with the fundamental TOD principles. A safe city street for all must have a clear demarcation between the public and private space, clear orientation to the street to invite eyes upon the street, and users on the sidewalk fairly continuously both to add effective eyes on the street and induce the people in the buildings to keep an eye on the surroundings. For a district to have an exuberant diversity, it must meet four conditions, including serving more than one primary function and facilities for people who go outdoors in different schedules and purposes, having short blocks with frequent streets and opportunities to turn corners, mingling buildings that vary in age and condition in a fairly close-grained manner, and having a sufficiently dense concentration of people, including residents, for whatever purposes they may be there.

The fundamental mobility principle underlying TOD is based on promoting walking as a primary mode of transportation. Walking is the healthiest option to travel because it encourages fitness and reduces the dependency on private vehicles, leading to less air pollution. It provides affordable and primary transport, especially for the physically, economically, and socially disadvantaged people who often do not have alternatives (Litman, 2023). It can also support the existing or upcoming public transit system and provide an option for short-distance trips (Leather, Fabian, Gota, & Mejia, 2011). Due to its direct appeal to pedestrians, walkable neighbourhoods can promote economic activity, social interaction, community networks, and social capital, which are the key drivers of community resilience (Logan, et al., 2022). Therefore, pedestrian facilities must reflect a universal design that is inclusive for all road users and people in general (Litman, 2015).

Since TOD necessitates walkability and accessibility to public transportation, it is essential to have a pleasant, walkable environment to access transit stations. Many metropolitan cities implement the BRT system as the primary public transportation mode, especially in high-density cities in developing countries. BRT, or Bus Rapid Transit, is a bus-based mass rapid transit system that runs through the street in a dedicated lane; therefore, it is on par in speed, comfort, and reliability with rail-based transit systems (Angelina, Vallée, & Louen, 2017). Compared to Light Rail Transit (LRT) and Mass Rapid Transit (MRT), the BRT system is cheaper and can transport almost as many passengers as LRT per hour. Using the same budget required for constructing 1 km of the metro, one can construct either 18 km of BRT, 35 km of two-lane urban road, 235 km of bicycle lane, or 350 km of footpaths (Leather, Fabian, Gota, & Mejia, 2011). Since it does not require rail infrastructure, it is relatively quicker to establish and cheaper in investment, which appeals to most developing countries.

Despite its origin in North America and Europe, the BRT system has been effectively adopted in developing countries, particularly in South America, since the late 1980s. Curitiba, Brazil, has been integrating bus-only public transportation into the urban planning system since 1974 because it is deemed more affordable than building a rail or subway system (Goodman et al., 2006, as cited in Kang, 2012). Bogota, Colombia, launched the TransMilenio BRT system in 1998 by Mayor Penalosa, who determined that the BRT system and other supporting amenities such as road infrastructure, pedestrian zones, bicycle lanes, and revitalization of parks are efficient and economical to develop an equitable and accessible city (Kang, 2012). Both cities successfully attract people to use public transportation; therefore, it shows that establishing TOD in developing countries at a low cost is possible.

2.2 TOD Benefits

Increased walkability and transit ridership can spur many benefits, such as less traffic congestion, reduced air and noise pollution and accident damage. Improving active travel—walking and cycling—can enhance public transit because both mobility types complement each other, so communities with high transit use tend to have a high active travel rate. In urban areas, 10-30% of motorized vehicle use is done in short trips; therefore, a walkable environment can encourage the shift to active travel. The dedicated lanes that the BRT has can ease the traffic because the mass number of people moves seamlessly in the particular lane. Moreover, an integrated walkable environment with public transportation significantly increases the transit rate, thus reducing the dependency on private vehicles and drastically reducing traffic congestion in the city (Litman, 2023).

As mentioned in the TOD principles, TOD can improve fitness and health by walking or cycling. The reduced pollution benefits the health of humans and the surrounding nature in the city. In addition, with improved air quality and reduced emissions, a town that fosters TOD will enhance its citizens' healthy environment and lifestyle. Active transport provides basic mobility, especially for people who cannot access or operate private vehicles. Therefore, TOD provides an inclusive, healthy and accessible network that will contribute to social justice.

Litman (Litman, 2023) suggests that TOD can spur many economic benefits for citizens, businesses, or the government. Improved walking, cycling, and transit infrastructure with affordable systems can expand education and employment opportunities, benefiting laborers and enterprises. A vibrant walking environment and accessible transit nodes can increase the local property and businesses’ value and invite patrons, which will support regional economic activity. The compact multi-modal development provides agglomeration efficiencies and resource cost

savings. Substituting short urban trips with walking or cycling can result in significant energy savings and reduced fuel consumption.

TOD highlights placemaking to create human-scale environments that are visually appealing and memorable, foster a sense of community, enhance vibrant activities, and encourage social interaction (National Academies of Sciences, 2004). According to Litman (Litman, 2023), streetscaping, road diets prioritizing bicycle lanes and wider sidewalks, traffic calming, and speed control programs will result in a safe, aesthetically pleasing, comfortable pedestrian-oriented realm. An accessible and inclusive mix of public spaces and amenities will create a welcoming built environment that revitalizes neighbourhoods and enhance liveability. The more people who walk on the sidewalks, the safer the streets are due to increased security patrols, trimming landscaping, and increased passive surveillance by pedestrians to invite more 'eyes on the street' (Litman, 2023; Jacobs J., 1961).

2.3 TOD Caveats

TOD necessitates a development that revolves around a transit hub. However, tagging an area as a "TOD area" may be misleading. Some argue that buildings erected near the transit nodes do not necessarily mean that it is transit-oriented since many have single-use development patterns with conventional parking requirements (National Academies of Sciences, 2004). It is more a TAD (Transit-adjacent Development) than TOD since the transit-served areas need to be integrated into the network (Padeiro, Louro, & da Costa, 2019).

Uneven amenities distribution that is only concentrated around the transit hub and ignoring other areas may cause an imbalance in land values, leading to worse social issues. Padeiro et al. (Padeiro, Louro, & da Costa, 2019) hypothesize that gentrification may occur in an area with high-quality pedestrian environments and accessible transit that leads to increasing property value, which can only be affordable to affluent households and tend to engender the displacement of the low-income group, leading to social injustice. However, they conclude that the result is not clear-cut and conclusive because the gentrification impact is varied according to the existing local dynamics, built environment attributes, and accompanying policies. Therefore, further investigation is necessary to implement a suitable policy. In connection with this thesis, the focus project is an office precinct, so there will only be a few residential areas except for the presidential palace and its supporting residences. The gentrification impact may not emerge as prominent in this non-commercial zone as in other zones with residential and mixed-use functions for citizens. Nevertheless, it is crucial to consider this potential issue for the adjacent or upcoming zones.

The specific zoning of the administrative area creates a certain scheduled usage by a particular group of people, which will leave the area in a vacuum in other periods. It potentially discourages vibrant activities and even induces a form of blight since the monotony use of the environment is only used by a dominant type of users in a limited schedule (Jacobs J., 1961). On the other hand, a nodal development around a transit station may increase localized congestion, a phenomenon called the "congestion conundrum" (National Academies of Sciences, 2004). When a considerable influx of office workers walking and using public transportation use the transit stations at once during rush hours, they will potentially create traffic congestion because they will occupy the pedestrian space and obstruct the flow of pedestrians or cyclists who share the right of way. If the BRT stops are in the middle of the street, a wave of riders will cross the crosswalks at once and spill out to the streets, disrupting the vehicular flow.

One way to force people to use the transit system is by limiting the parking lots, so people will be forced to walk or take public transportation instead. However, enforcing such a policy can be difficult and instead lure away the dwellers during the early construction phase when only some part of the transit systems is established. The logistical dilemma is another issue; parking facilities must be carefully calculated to avoid the lack or abundance of lots. Providing parking facilities to accommodate multi-modal access needs can also impact the street design and layouts when the operators insist on code-standard parking, which may detract from the quality of walking (National Academies of Sciences, 2004). On the other hand, separating the exclusive pedestrian streets from the vehicular streets can only be practical if the planners presuppose a spectacular decline in the automobile numbers and much greater dependence on public transportation; otherwise, parking facilities around the pedestrian environment can take a massive proportion of the land and encourage area disintegration instead of saving (Jacobs J., 1961).

Apart from the cons of TOD, Litman (Litman, 2023) argues that objections have been made regarding the assertions of benefits associated with active mobility that can be refuted or invalidated. Firstly, critics argue that walking and cycling are costly because they are slow and inefficient, but they are the most efficient modes for shorter trips. Walking and cycling can be deemed efficient under favourable conditions and costly under unfavourable conditions depending on the users' conditions and preferences. Secondly, walking and cycling infrastructure may seem costly compared to the roadway costs per automobile passenger, but such analysis often underestimates the actual costs and subsidies of the automobile. Thirdly, the motorists argue that it is unfair that the taxes they pay also go to non-motorized travel infrastructure instead of roadway facilities, but this argument only reflects the 'get what they pay for' and ignores the 'pay for what you get' argument. Moreover, motorists are responsible for compensating for the risks and pollution they produce; therefore, it is necessary to support sustainable mobility. Lastly, the

active travel investment is exaggerated by wishful thinking, but the appropriate physical program design and support can have significant impacts that exceed expectations.

2.4 TOD Frameworks

Due to the lack of a standardized or clear definition for TOD, disagreements may arise regarding what constitutes good TOD. There is no universally accepted approach to ensure that the projects deliver the intended TOD outcomes (National Academies of Sciences, 2004). But, since Indonesia has declared the 10-minute city and TOD concept in the form of walkability and transit in the master plan brief, there are two frameworks that can be used to analyze the TOD factors in IKN:

2.4.1 X-minute City Concept

In recent years, there has been a surge in popularity for the idea of creating an "x-minute city," which involves designing a community or neighbourhood that allows inhabitants to access basic needs and services within hyper proximity, typically ranging from 10 to 20 minutes. The idea is based on the chrono-urbanism concept that “the quality of urban life is inversely proportional to the amount of time invested in transportation, more so through the use of automobiles” (Moreno, Allam, Chabaud, Gall, & Pratlong, 2021). Locating the essential livelihood needs within a 15-minute radius can reduce commuting time and allow for multimodal use of basic infrastructures.

This concept has been successfully implemented in major cities globally. Melbourne implemented a 20-minute program based on the research that 20 minutes is the maximum time that people are willing to walk to meet their needs; Portland implemented 20-minute neighbourhoods for healthy connected centres, Milan improved the open squares and polycentric city to be accessible within 15-minutes, and Buenos Aires develop mixed-use development within 15-minutes access (C40 Cities; City of Buenos Aires, 2022). Shanghai introduced the 15-minute community-life circle, and Copenhagen even established a 5-minute walk to all amenities and public transportation. Recently, Paris successfully applied the 15-minute city concept, making it an example of turning an established major capital city into a walkable one (Moreno, Allam, Chabaud, Gall, & Pratlong, 2021).

The concept was introduced to tackle the challenge of the shared urban lifestyle because a city is, in fact, polyrhythmic (individuals have different social and personal spaces) and polychronic (the use of their places varies according to the time)” (Moreno, 2021). However, there are still concerns about measuring the effectivity of the x-minute concept precisely because of its subjectivity and

contextuality. Some cities using the isochrone approach need help to measure the benefits or issues for residents who live beyond the time threshold. In the worse case, inequalities might be ignored because the calculations are based only on the average walkshed, ignoring the magnitude of the lack of access (Logan, et al., 2022). The same study also says about measuring the x-minute city in the USA and New Zealand that any arbitrary goal set by planners is unlikely aligned with what people accept or consider feasible. It proves that more studies and surveys need to be conducted on citizens who will inhabit the city to identify their preferences.

2.4.2 ITDP TOD Standard

ITDP (Institute for Transportation and Development Policy) is an organization that publishes standards about TOD and BRT. Many developing countries have been working with ITDP and using their standard metrics to evaluate the TOD implementation in their metropolitan cities. Jakarta has been working with ITDP since 2002 to improve its BRT system, TransJakarta, with technical assistance. The work has been successful because, since 2015, the ridership has kept increasing, finally reaching one million a day in 2020. ITDP has conducted BRT feasibility studies in other big cities in Indonesia, such as Medan and Semarang. The ITDP system and standardization work well to be implemented in Indonesia so that IKN could apply the same system in their current planning (ITDP, n.d.).

ITDP issued the TOD Standard as an assessment tool to evaluate the TOD implementation post-construction (ITDP, 2017). It outlines eight urban design and land use indicators, each supported by specific performance objectives and metrics that promote safe and vibrant neighborhoods, pedestrian and cycling networks, public transport, and minimal car traffic. The indicators are as follows in Table 2:

Table 2. ITDP TOD principles

(ITDP, 2017)

No	Indicator	Description	Parameter(s)
1	Walking	Continuous and inclusive walkway networks and crosswalks must be maintained. Safe and convenient street amenities, such as lighting, shade, or landscape furniture, must be provided. Visual attractiveness and transparency along the path must be promoted by designing a permeable building frontage that blends seamlessly with the walkway to encourage enjoyment in walking and vibrant activity. Walkways must be inclusive by accommodating the users with walking or carrying aids.	1.A The pedestrian realm is safe, complete, and accessible to all. 1.B The pedestrian realm is active and vibrant. 1.C The pedestrian realm is temperate and comfortable.

2	Cycling	Promoting safe street conditions for cyclists and providing secure parking is important because cyclists are among the road users most vulnerable to crashes with vehicular traffic.	2.A The cycling network is safe and complete. 2.B Cycle parking and storage is ample and secure.
3	Connect	Short, direct walking and cycling require a dense, well-connected network of paths and streets around short city blocks. A variety of paths and streets for pedestrians and cyclists that permeates seamlessly with the urban fabric must be promoted. A proper size of city blocks better connected and accessed by walking or cycling instead of motor vehicles will reward the connectivity point.	3.A Walking and cycling routes are short, direct, and varied. 3.B Walking and cycling routes are shorter than motor vehicle routes.
4	Transit	Walkable access to transit is a prerequisite for TOD standard recognition. Rapid transit service connects and integrates pedestrians with the city beyond walkable and cycling ranges. The transfer station should be designed for short, convenient and all-accessible connections with the rapid transit service.	4.A High-quality transit is accessible by foot.
5	Mix	When a balanced mix of complementary uses and activities within a local area (i.e., a mix of residences, workplaces, and local retail commerce), many daily trips can remain short and walkable. People of all ages, genders, income levels, and demographic characteristics can safely interact in public places.	5.A. Opportunities and services are within a short walking distance of where people live, and work and the public space is activated over extended hours. 5.B Diverse demographics and income ranges are included among local residents.
6	Densify	A dense development model is essential to serving future cities with transit that is sufficiently rapid, frequent, well-connected, and reliable at most hours to ensure a good life free of dependence on cars and motorcycles.	6.A High residential and job densities support high-quality transit, local services, and public space activity.
7	Compact	Compactness means having all necessary components and features fitted close together, conveniently and space-efficiently. Compact neighbourhoods or cities require less time and energy to travel from one activity to another and require less extensive and costly infrastructure	7.A The development is in, or next to, an existing urban area. 7.B Traveling through the city is convenient.

8	Shift	The focus is on minimizing the space given to motor vehicles, on which urban development practices and policies have specific leverage.	8.A The land occupied by motor vehicles is minimized.

From the above TOD principles, walkability is the fundamental factor that must be achieved in order to establish the sustainable mobility. A developing neighbourhood is considered a thriving and inclusive TOD if it promotes walking regarding local regulations or international standards.

2.5 Challenges of Walk and Transit in Indonesia

Despite its many benefits and firm goals, applying walkability in Indonesian cities takes time and effort. Indonesians have the lowest walking steps count by pedestrians (Althoff as cited in Hasibuan & Mulyani, 2022), and walkability is not the primary concern in switching to public transportation from private vehicles. The acceptable walking distance is contextual because it depends on the built environment, such as the proximity to the destinations and social features, safety or the presence of other walkers (Pongprasert & Kubota, 2017). Hence, the 10-minute city concept needs to be enhanced with activities.

Thermal comfort also significantly affects walkability, especially in countries with hot and humid climates, such as the Middle East, Southeast Asia, South America, and Northern Africa (Lee & Park, 2023). The microclimate is also affected by the urban form, space configuration, and anthropogenic factors such as human activities and psychological emotions that affect subjective comfort perceptions (Zou & Zhang, 2021). Hot and humid cities may be one of the reasons that discourage people from walking even shorter distances. The microclimate of the outdoor environment is influenced by the 'urban shape and geometry, urban density, vegetation, surface properties, city size, geographic location, population and density, land use, road width, and building mass' (Raya, Hasibuan, & Sodri, 2022). Based on the study cases of the landscape design in The Park in Las Vegas, Darling Quarter in Sydney, and Gubei Gold Street in Shanghai, it is concluded that the shade from the vegetation and artificial shading, as well as water feature settings, can improve the thermal comfort and mitigate the urban heat island (Zou & Zhang, 2021). Makati Business District in Manila improved the pedestrian walkway by providing covered walkways, elevated walkways, and underpasses, which effectively increased the pedestrian traffic volume by 200,000 on weekdays and increased the walking distance covered by pedestrians from 400 meters to 700 meters (Tan, 2005 as cited in Leather et al., 2011).

Another factor that discourages walking is the safety factor because pedestrians, cyclists, and motorcyclists are vulnerable to accidents and fatalities due to the lack

of safe infrastructure and policies on safe riding (World Health Organization, 2009). Pedestrians constitute a higher share of total fatalities where the facilities do not meet demand, such as New Delhi, Bangalore, and Kolkata, have pedestrian fatality shares more significant than 40%, Ulaanbaatar with 80%, and Indonesia in general with pedestrian fatality share of 15% of the road accidents.

Unlike in North America, where the dependency on cars is the issue, in many cities in Asia, the prevalent issue is the dependency on motorcycles and other paratransit modes. The use of motorcycles is widespread in Southeast Asia because of their price, size, fuel and maintenance cost, and ability to reach difficult areas, narrow streets and in-between cars in a traffic jam. In many cities in the global south, most of the land-use zoning is mixed and densely packed, which organically creates a 15-minute city, but poor infrastructure forces people to use motorized vehicles instead of walking or cycling. In Hanoi, many trips could be made by walking or cycling because the average trip lengths are low, but people choose to use motorcycles instead (Schipper L et al., 2008, as cited in Leather et al., 2011). Nearly 35% of destinations in Manila are within a 15-minute walk or cycle, but people use paratransit modes and even cars (Metro Manila Urban Transport Integration Study as cited in Leather et al., 2011). In Bangkok, motorcycle taxi is the most used access mode, even in a TOD area with a transit station within a 1 km radius (Pongprasert & Kubota, 2017). In Surabaya, the second biggest city in Indonesia, motorized vehicles are the most popular mode, although over 60% of trips are under 3 km (Hook, 2003 as cited in Leather, 2011).

Indonesia's motorcycle-based ride-hailing service (MRHS) has been rising in use and popularity since 2015, both for private uses and as a feeder to the public transit service. A total of 24% of commuter train users and 3% of BRT users ride a motorcycle-based taxi or MRHS as their access/egress mode to and from the bus or transit stations because of poor public transit service coverage in Jakarta (Medeiros et al. as cited in Irawan et al., 2020). Individuals use MRHS for short travel distances and as a feeder or first- and last-mile mode to reach distant BRT and MRT stations, which complements public transit (Irawan, Belgiawan, Tarigan, & Wijanarko, 2020). However, an increase in public transit also implies an increase in MRHS usage; MRHS only substitute conventional motorcycle taxi. The same study also suggests that the highest percentage of MRHS users' trip purpose (32,4%) is the trip to the workplace.

The first BRT corridor in Indonesia was introduced in 2004 in Jakarta with the name of TransJakarta as a solution to combat the massive traffic congestion in the densely populated capital. Although the initial construction was met with public outcry due to the road capacity reduction coupled with the Three-in-One policy (three passengers per car during rush hours), slowly, the BRT system gained favourable public opinion (Ernst, 2005). Over time, BRT has gained popularity as

a privileged transportation mode that can bypass traffic jams in their dedicated lanes, especially during rush hours. More buses, routes, and systems are developed in the following years. A similar BRT system is replicated in other cities, including Bandung with Trans Metro Bandung and Yogyakarta with Trans-Jogja. However, regarding the walkability aspect, there are areas for improvement in the TransJakarta BRT system. Some stations were designed to fit the available median width, resulting in narrow stations far from key transfer nodes (Ernst, 2005). The long path to reach the stations, especially with the elevated bridge, discourage people from accessing BRT and instead choosing a taxi or MRHS that meets and collects the passengers at any point.

3. Objectives

This thesis aims to identify the TOD aspects in IKN planning that may face issues after the city is developed so that IKN can anticipate and prepare. By analysing what has been (or has not been) planned in IKN and looking at the differences between the planning with the post-construction results in Sejong, what are the TOD issues that IKN might face in the future? Sejong is not the only city planned to establish a sustainable city, but it is the only city that adopted the TOD program and BRT system from the design level at that moment (Kang, 2012). In connection with IKN, Sejong City planning and construction share goals and approaches. Evaluating the 15 years of progress can mean reflecting on the sake of the next 50 years of progress in IKN. Indonesia can learn, avoid, implement, or improve from the evident-based post-construction of Sejong.

4. Delimitation

Currently, the area that is prioritized and already has a concrete urban design development (UDD) approved and in the urban design guideline stage is the KIPP area Zone 1A, especially the Government Precinct. This area comprises the executive, legislative, judicial bureau, ministries, and state-owned and private-owned agencies. Therefore, this thesis will only discuss the Government Precinct of KIPP of IKN, which from this point onward will be called Government Precinct.

From the eight principles of TOD, the Walk aspect aligns with the 10-minute city concept following Law No.3; therefore, the Walk principle will be analysed as the primary concern. At the current stage, stemming from the walkability principle, a transit plan has also been launched in various road-based modes in Government Precinct. Therefore, this thesis will focus on Walkability and Transit as critical aspects of the TOD city.

TOD implementation can only be fully measured when the project is complete. IKN is still in the early planning phase, so the measurement will not be conducted on a metric scale. Instead, whether the plan has included the TOD principle will be explored qualitatively. The current planning phase is in the early stage of the regional development plan, so there has yet to be a detailed design development plan. Although the existing available masterplan cannot be appropriately analysed with the ITDP indicators at the moment, it can be a way for IKN to prepare for future assessment once the infrastructure is built and operated and day-to-day life has commenced; therefore, this indicator is chosen.

Limited sources can be found in English for the TOD evaluation in Sejong City. The available articles and studies mention some parts of a selected site but not all pedestrian networks in general. Therefore, this study will be treated as an example of the construction result and does not represent a general outcome of the master plan. Summaries from websites, blogs, and news are also cited because of the lack of other articles and studies in English that can be found.

5. Method

This thesis will analyse the Walkability and Transit aspects that the IKN planners implemented in the Government Precinct according to the ITDP's TOD standard and compare it with the reality during the construction in Sejong. In analysing the current design progress of KIPP based on the x-minute concept and the ITDP's TOD Standard, there are two mutual indicators that this thesis will focus on, which are Walkability and Transit. ITDP has provided specific objectives of the Walk and transit indicators objectives that must be met to fulfill the TOD concept in Table 3.

Table 3. ITDP TOD indicators

(ITDP, 2017)

TOD indicators	**Parameters**
Walkability	*Objective A. The pedestrian realm is safe, complete, and accessible to all.* It is measured by the existence of a complete, continuous, accessible for all, and safe walkway network including safe crossings.
	Objective B. The pedestrian realm is active and vibrant. Walkways must be attractive visually, both the walkway itself and the adjacent buildings frontage to promote activity. There must be a permeable frontage as well to measure the physical connection via entrances and exits of the buildings.
	Objective C. The pedestrian realm is temperate and comfortable. Shades and shelter must be provided to protect from the climates. Landscape furniture are also recommended.
Transit	*Objective A. High-quality transit is accessible by foot.* The maximum accessible walking distance to the nearest rapid transit station is defined as 1000 m and 500 m for a frequent local bus service that connects to a rapid transit network within less than 5 kilometres.

Literature studies of the pros and cons of TOD and the challenges of its implementation in Indonesia are used to determine the strengths and weaknesses in the TOD implementation in the Government Precinct masterplan. The aspects will be compared with the case of pre- and post-construction of Sejong to extract the changes and issues during the development. The pre-construction analysis is essential due to the fact that it has yet to be constructed, so there is time to revisit the plan and make some changes or adjustments.

The ongoing planning documents obtained from the IKN planners are identified in identifying and analysing IKN's Walk and Transit value. An informal interview with the IKN planners is conducted to get more explanation on the background and current progress of the project. The design will be analysed in a qualitative approach since the drawing documents are still in the tentative general drawing stage, so the details are not fixed, or the detailed dimensions are not precise at the moment.

The Sejong data are based on the available articles in English, websites, news, and design guidelines. Due to time and resource constraints, a qualitative approach is utilized to analyse the findings of the desktop study. Ideally, the design guidelines that are only written in Korean are translated by native speakers, but due to the limited time and resources, Google Translate and Papago (a Korean translation service) are used instead.

6. Analysis

6.1 General Master Plan

6.1.1 IKN Government Precinct General Master Plan

As shown in Figure 12, the Government Precinct is designed to be a vibrant precinct by interconnecting the bureaus, commercial and mixed-use nodes, and public facilities through unbroken connection networks to create collaborative works and synergy on-ground and on the elevated levels. The buildings' edges are connected to the pedestrian path and public green spaces, which makes active edges that enhance the practicality and convenience of public service.

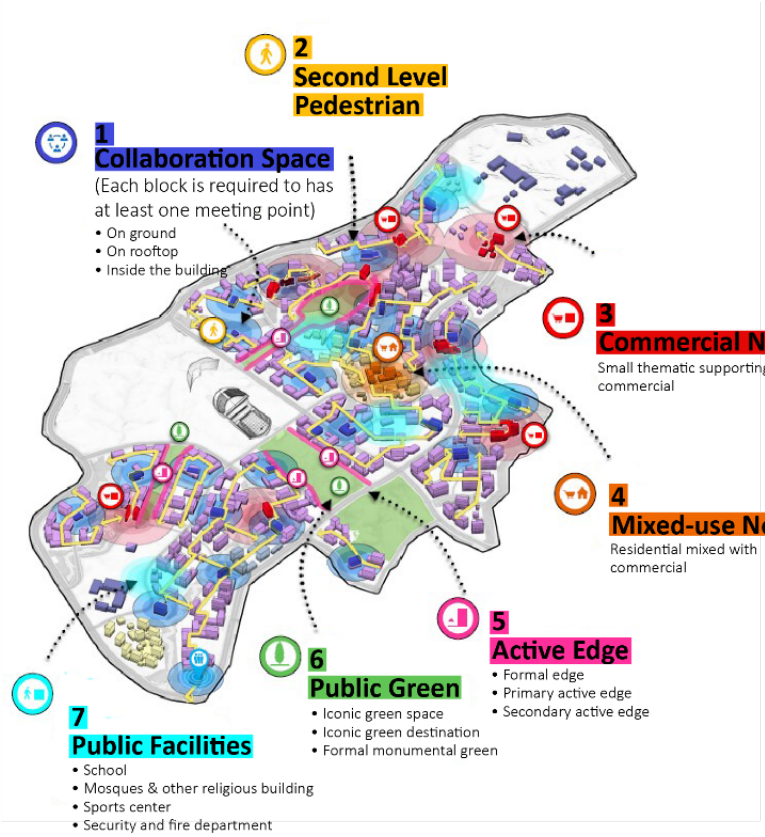


Figure 12. Government Precinct zoning concept and strategy

(Government Precinct Joint Operation, 2021)

The connectivity concept in the Government Precinct promotes collaboration and productivity among government officials. As shown in Figure 13, each ministry parcel of 3-4 hectares is connected to public transportation nodes, shared streets with all road users, and pedestrian-friendly access such as sidewalks and river bridges. The other side of the parcel is linked to additional ministry parcels, green open areas as shared spaces, and second-level pedestrian walkways to connect buildings on different levels. The institutions' and agencies' blocks are also adjacent in continuous connectivity to support collaborations.

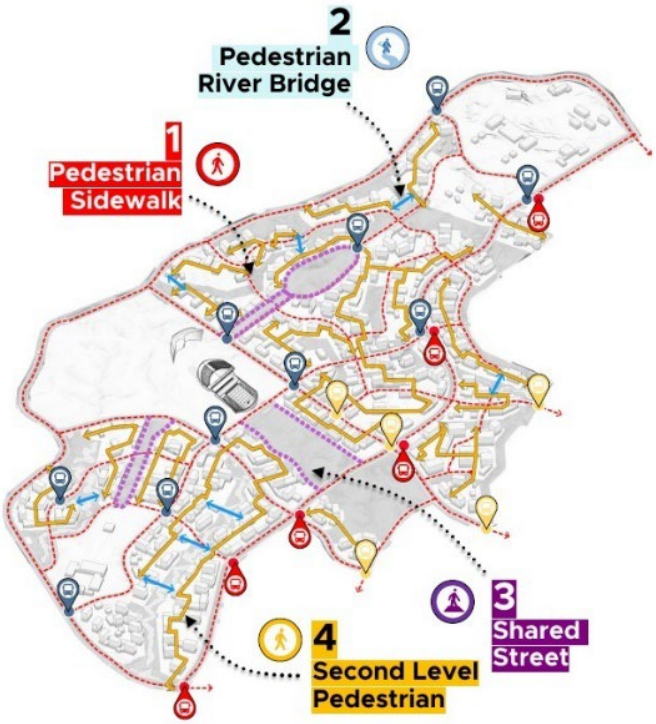


Figure 13. Circulation concept and BRT shelter location

(Government Precinct Joint Operation, 2021)

The Government Precinct's transportation system performance will be assessed through the accessibility and connectivity of the city's transportation network infrastructure. Some of the Key Performance Indicators of Transportation that are applicable in the Government Precinct are:

- Urban transportation nodes have pedestrian and bicycle lanes and park-and-ride facilities with less than 500 meters of transfer distance.
- Each area in KIPP has a feeder car integrated with the BRT nodes.
- A maximum of 2 times modal transfers in 1 trip, both origin and destination
- 80% of people's mobility uses public transportation within the KIPP area.
- Walking time to and from transit nodes and public facilities within 10 minutes.
- Airport train travel time from KIPP to the airport is less than 50 minutes.
- Walkways to and from public transportation are a maximum of 500 meters.
- Public transport services coverage is 80% of the length of the roads in KIPP.

6.1.2 Sejong General Master Plan

Sejong applies decentralized city planning where the main functions of central and local administration, cultural and international exchange, central park, medical service, university and research and high-tech industry are not placed in a unique, central zone. Instead, they are dispersed across the city and connected with the ring-shaped inner-city road prioritizing public transportation lanes (Figure 14). The city's core is allocated for the blue-green infrastructure of parks, forested areas, and a lake instead of a city centre that can be accessed by walking, cycling, and BRT. The outer ring road is placed in the outer part of the city to serve the private cars and connection to the neighbouring cities.

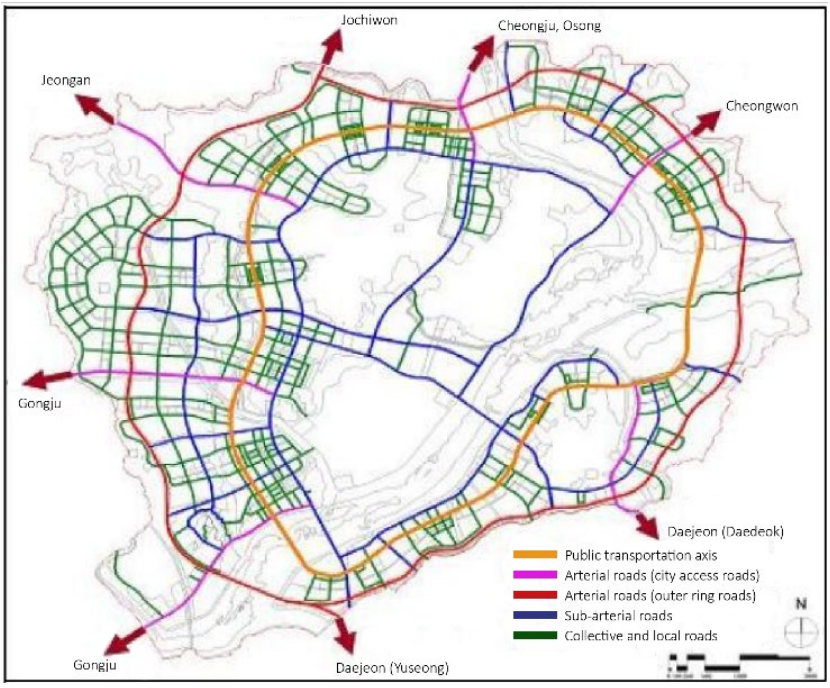


Figure 14. Sejong road network hierarchy

(MACCA, 2016)

As shown in Figure 15, the city comprises six towns with a population of 50,000-130,000, each containing four to five mixed-use neighbourhoods with a population size of 230,000, having residential, commercial, and business areas (Lee & Park, 2023). The planners established regulation zones along the ring axis with design standards comprising eight components: building placement, land uses, building form, frontage types, facades, materials and colours, building signage, and sidewalk (Lee & Park, 2023).

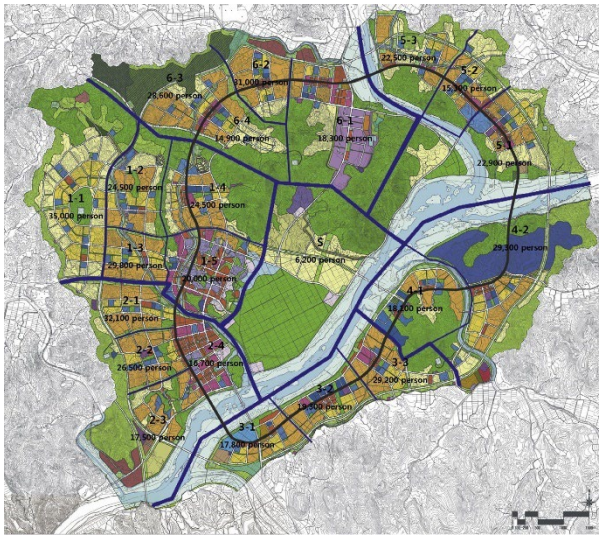


Figure 15. Neighborhood unit plan including areas and population in connection with the main transit road. (Kwon, 2015)

However, the development and growth in Sejong 15 years after its first construction stage could have been faster. It has attracted fewer residents to relocate from Seoul than what was expected; instead, people choose to live in the adjacent cities or even stay in Seoul and only commute to Sejong for work, despite the long hour of commute. As of 2020, 351,007 people reside in a 465,23 km2 area, making it the least populous and most minor administrative division in South Korea (de Vries, 2021). Regardless, it should be noted that it is normal for a new city to grow slowly as the construction and development are done in stages.

Many reasons factor into the reluctance of the immediate departure in the early days. The tower of buildings and crane jungles paint the city's landscape, creating a sense of emptiness and incompleteness. People need more infrastructure and daily life amenities to permanently start a family in the new city. The city's primary function is to act as the governance area, which creates a lack of a vibrant activity that supports the non-formal family living facilities since most families there are ‘forced’ to move from Seoul (van der Heijden, 2016). The proximity to adjacent developed cities makes people prefer commuting from those cities, including Seoul. Moreover, many important government agencies still reside in Seoul, so many people do not see the urgency to move to Sejong permanently.

Most of the necessary infrastructure and facilities have been established; thus, the population is also growing. The average age of its residents is under 40, making it the youngest region in the nation. It is one of the fastest-growing cities in South Korea, and the vicinity of the Government Complex is also filled with retailers and well-known apartment brand names (The Korea Herald, 2019). However, the issue of commuting civil servants from Seoul still lingers, which prompts debates in planning a KTX station in the heart of the city, close to the Government Complex.

6.2 Walkability Indicator

6.2.1 Walkability Concept in the Government Precinct

The planner analyses the SWOT (Strengths, Weaknesses, Opportunities, and Threats) aspects of the site to determine the area's potential and challenges. Upon closer investigation of the selected Government Precinct location and road layout, it is concluded that sticking to the 10-minute city concept is challenging because of the contour. The micro-undulating topography is a strength because it is a unique identity that allows different variations in design, zoning, and site characteristics. On the other hand, the variety of levels can also be a disadvantage because it requires various degrees of intervention, such as extensive earthwork, retention work, or bridge structure (Figure 16). It also hinders pedestrians, especially people with disabilities, from accessing the pedestrian path smoothly. Arterial road corridor that connects the main functions are separated quite far from each other, which cuts the direct pedestrian access intra-block. Consequently, some areas have small developable sites due to the significant setback.

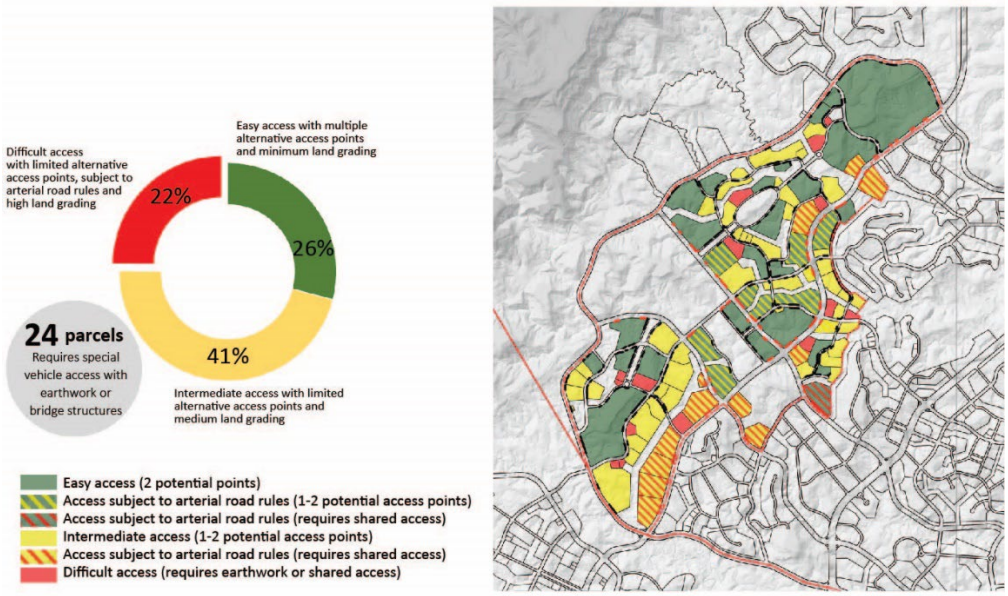


Figure 16. Circulation concept and BRT shelter location

(Government Precinct Joint Operation, 2021)

The difference between the highest and lowest points is almost 20 m on average, making the average land slope 20%. However, flattening all the contours is not preferable because it will have a considerable impact, especially environmental damage. Therefore, one of the key development strategies is to develop a design that follows the contextual contour, including the pedestrian path. To reach the goals within the available contours, adjustment of the walkable urban system is made by interlacing the walkability studies of 1) Slope and walking pace; 2) The 15-minute city's mobility shed; 3) Indonesian comfortable pedestrian ramp slopes

standard with maximum slope percentage of 7%; and 4) TOD mobility radius standard (Zerlina, Azriani, & Tsarina, 2022).

Ultimately, the pedestrian path planning is based on contour levels with three slope classifications: gentle (0-5%), moderate (5-10%), and extreme slope (>10%):

- On gentle slopes (0-5%), pedestrians can move effortlessly at 5 km/h via a ramp that accommodates wheelchair users without assistance.
- On moderate slopes (5-10%), pedestrians can move at 4-2 km/h with landings every 9 meters, but wheelchair users require assistance to move around.
- On extreme slopes (>10%), pedestrians move at <2km/h, which requires additional access for wheelchair users, such as ramps or elevators. The stairs are designed with landings every 15 steps.

Objective A: The pedestrian realm is safe, complete, and accessible to all.

IKN prioritizes pedestrians as the primary user of the urban mobility concept. Continuous and complete walkways must be maintained from the start to the destination and the transit nodes. Figure 17 shows the layout and diagram of the pedestrian circulation. Pedestrian paths interconnect buildings at the parcel level through an easement connection. To serve the need for accessibility between different contours and different buildings in a different level, elevated pedestrian connections are also planned on the elevated levels. Each network will meet at nodes and connect with transit points, public service, and urban parks.

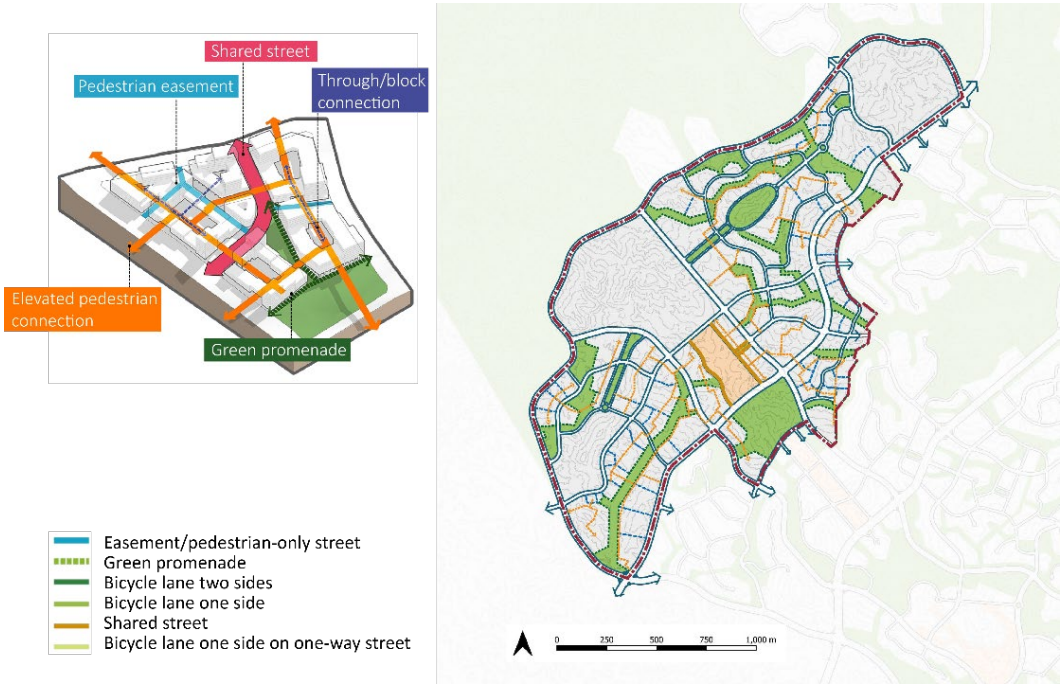
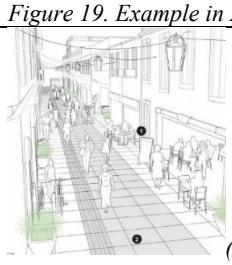
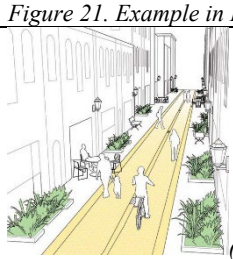
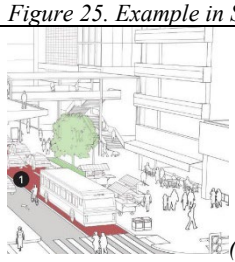


Figure 17. Pedestrian circulation layout and diagram

(Government Precinct Joint Operation, 2021)

There are different types of pedestrian environments as written in Table 4:

Table 4. Pedestrian environment types

<u>Shared street:</u> Spaces that accommodate all road users including pedestrians, cyclists and motorized vehicles. It will create a lively and accessible corridor that still prioritizes pedestrians.	 (18)  (19) *Figure 18. Shared street concept* *Figure 19. Example in Auckland, New Zealand*
<u>Pedestrian easement:</u> A medium-width pedestrian-only street with active and semi-active buildings	 (20)  (21) *Figure 20. Pedestrian easement concept* *Figure 21. Example in Barcelona, Spain*
<u>Through block connection:</u> This connection provide direct paths for pedestrians through large building blocks, enhances ground-level permeability and promotes better pedestrian connectivity.	 (22)  (23) *Figure 22. Through block connection concept* *Figure 23. Example in Berlin, Germany*
<u>Green promenade:</u> A pedestrian path that intersects with green open spaces. This promenade character will be adapted to create continuity with the character of surrounding green open spaces.	 (24)  (25) *Figure 24. Green promenade* *Figure 25. Example in Sydney, Australia*
<u>Elevated pedestrian connection:</u> Elevated connection that is situated above street level to connect buildings that are built on uneven topography and varying elevations.	 (26)  (27) *Figure 26. Elevated pedestrian connection concept* *Figure 27. Example in Hongkong*

(18, 20, 22, 26) https://nacto.org/, (19) https://www.boffamiskell.co.nz/news-and-insights/article.php?v=roading-excellence-awards-2012, (21) https://staybarcelonaapartments.com/blog/shopping-malls-Barcelona, (23) https://www.berlin.de/sen/sbw/, (24) https://www.levittbernstein.co.uk/sketchbook-ideas/, (25) https://landezine-award.com/darling-harbour-transformation/, (27) https://www.yuantalks.com/

Buildings on the same floor elevation will be connected through sky bridge connection, eliminating the need to descend to the ground level to access adjacent

buildings (Figure 28). Buildings are not arranged in a long, horizontal stretch; instead, it will be arranged in a grid-like layout, allowing for multiple sky bridges and providing users with path options. This floating access encourages people to walk on the upper floors instead of taking private vehicles on the street floor, so there will be less road traffic. Moreover, the semi-indoor bridges offer a third space for commercial use.

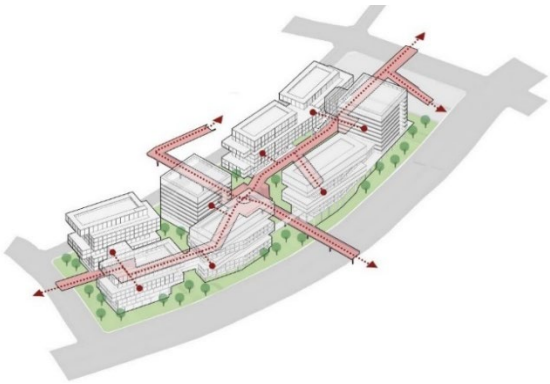


Figure 28. Sky bridge connection diagram

(IKN Collaboration Team, 2021) (3)

Crosswalks have already been conceptualized in the design brief, which states that the crosswalks must be safe, accessible and inclusive. To ease the access to the BRT in the street median, pelican crossings with signalling system are preferred instead of overpasses (Figure 29). At the current conceptual design phase, there has yet to be further design detail on how the crosswalks and their amenities will look on each road type. The lighting plan is already thought of, but since the planning stage is still very general, the lighting concept still needs to be drawn.

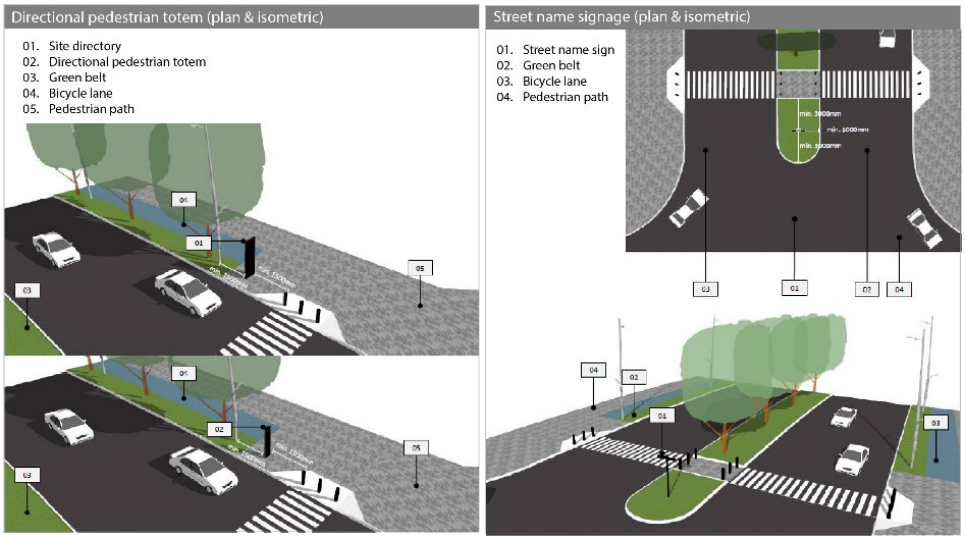


Figure 29. Crosswalk, directional pedestrian totem, and street name signage concept

(Government Precinct Joint Operation, 2021)

Objective B: The pedestrian realm is active and vibrant.

Based on the circulation strategy and the land use, more specific streetscape character and functions are elaborated to create a robust landscape identity and foster an easy orientation and sequence according to the street hierarchy. The pedestrian is the favoured road user; therefore, the supporting amenities such as trees, signage, wayfinding, material and street furniture are planned accordingly. Green open space is planned to accommodate social needs and preserve the site's unique character and biodiversity. There are different types of parks to accommodate different events and scales, as shown in Figure 30.

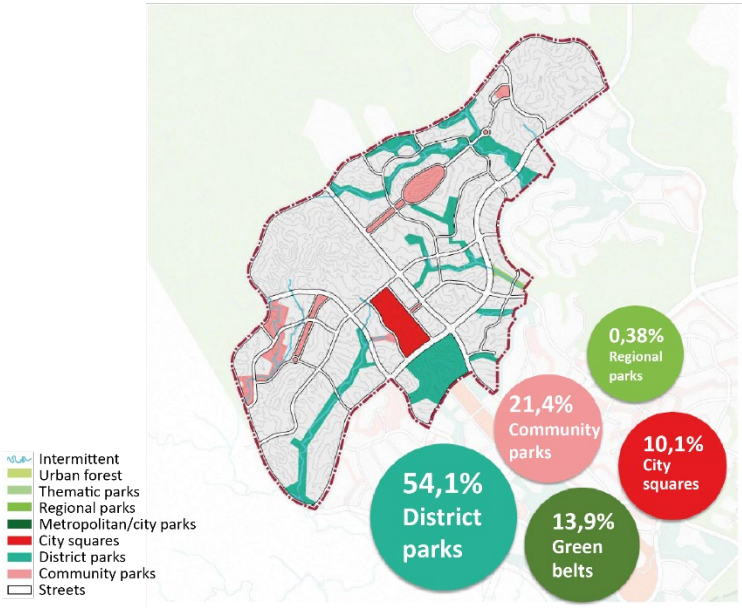


Figure 30. Green open space plan

(Government Precinct Joint Operation, 2021)

The space permeability and human scale are mentioned as one aspect of the urban character (IKN Collaboration Team, 2021). The building blocks will not be designed as massive blocks that block natural light and air circulation. Instead, shared open areas between building blocks are proposed to create natural spatial qualities, maintain natural plants, and good air quality. Some buildings may need to be constructed on a stilted structure to answer the need to adjust with the contour. This terraced landscape will create an open space on the ground that can be converted into a social space, service area, or parking space. Instead of parking lots at the front area of public buildings, the space will be prioritized for pedestrians, public transportation and drop-off for private vehicles. To maximize the shared spaces on the landscape, different front edge designs are proposed following the building functions and the contour: the government edge, special front edge, public easement, and green front edge (Figure 31).

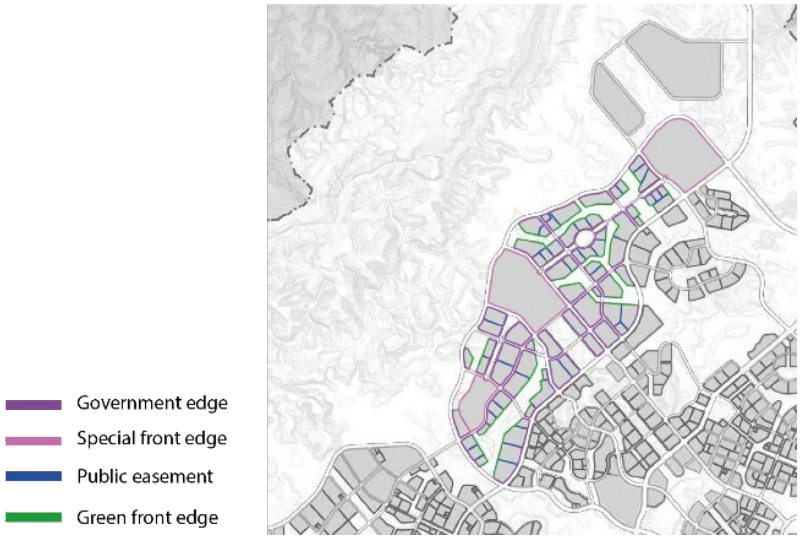


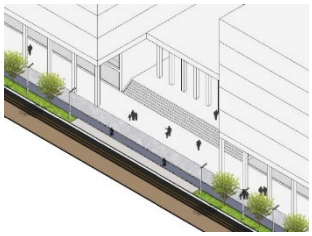
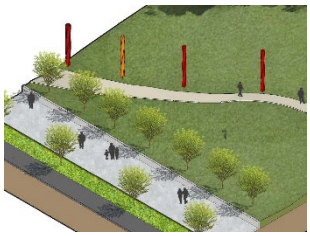
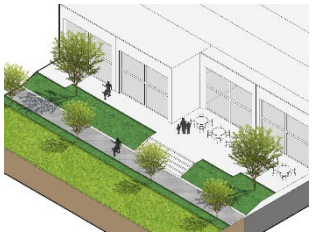
Figure 31. Front edge map

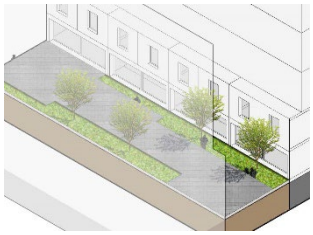
(IKN Collaboration Team, 2021) (1)

The permeable ground floor is expected to enhance social interaction and activities between the indoor and outdoor areas, making the pedestrian flow vibrant and dynamic. The different designs of the front edges are described in Table 5 below:

Table 5. Front edge design types

(IKN Collaboration Team, 2021) (1)

Government edge: The perimeter type that meets the building façade with road area with a setback range of 8-10 meters. The building has a permeable façade character that actively encourages pedestrian interactions.	
Special front edge: The edge types that are located in special areas, such as presidential palace and other special areas in another KIPP zone. The facade setback dimension varies based on building typology.	
Green front edge: Located in the central area/district/block area with a dynamic facade facing a green open space. It has a varied setback and can a serve as an activity centre with big openings that can be combined with residential areas with limited openings into small commercial facilities.	

Public easement: Located in the easement space between building blocks at the regional block community level. It features a dynamic facade with varied openings and a shopping area that directly connects with the pedestrian area, with setbacks ranging from 8-20 meters.	

The accessibility of the building must be carefully considered to keep the buildings safe while being permeable at the same time. The ITDP Standard mentions that the façade needs to have different entrances and exits, especially if the buildings have multiple facades and entry, and openings that are too long distance might not be attractive to walk along. However, while this is efficient for most commercial and public service buildings, the buildings that house high-ranking officials might have extra security measures which prevent people from entering freely.

Scattered open green spaces connected by the pedestrian paths must be created as a catchment area for people to stop, not just walk along the edges. Design-wise, the frontages of the buildings must be designed attractively so that people enjoy walking along the path. The guideline mentions the dynamic façade, so a standard guideline should be used to determine the general façade design.

Objective C. The pedestrian realm is temperate and comfortable.

Figure 32 shows the streetscape character and hierarchy with different widths, layouts, and elements. The streets are named based on the zone and the character of the street. Traditional vistas are designed and shaped with various types of vegetations and access paths for a human-scale streetscape.

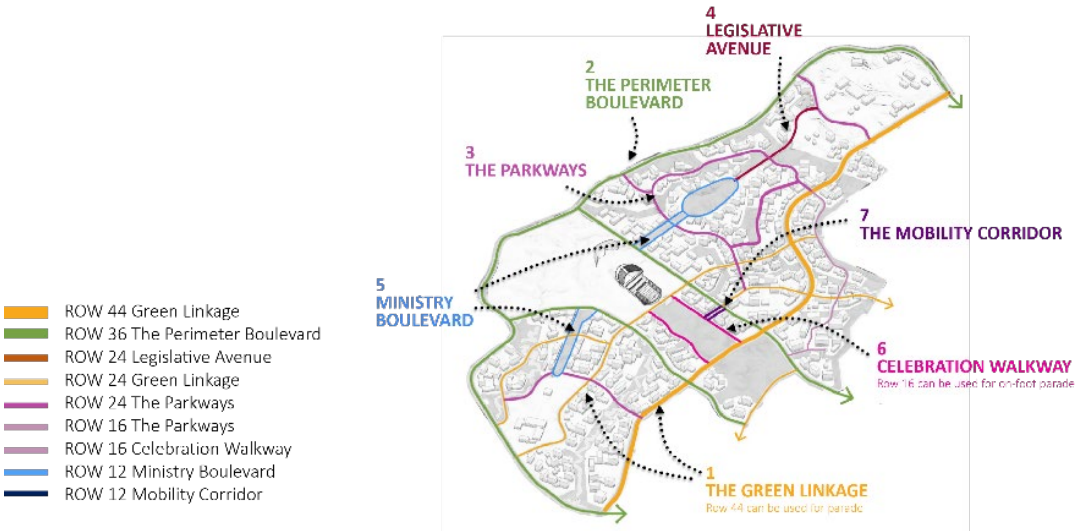


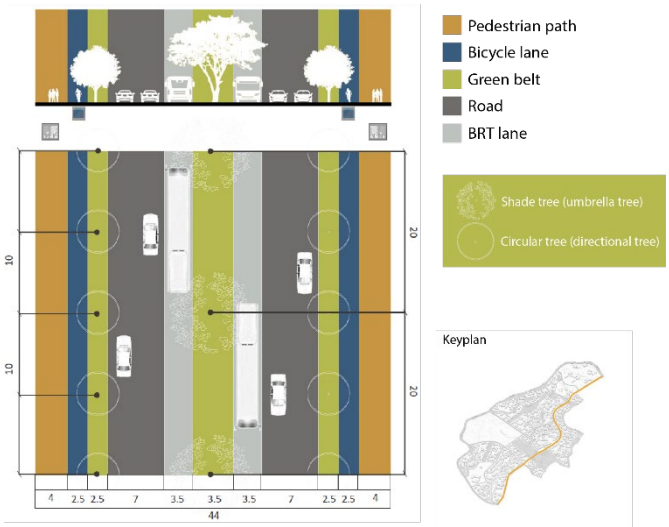
Figure 32. Streetscape character and hierarchy

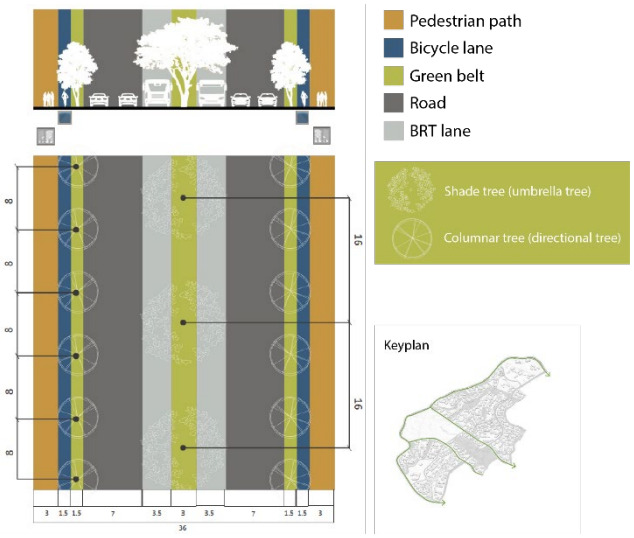
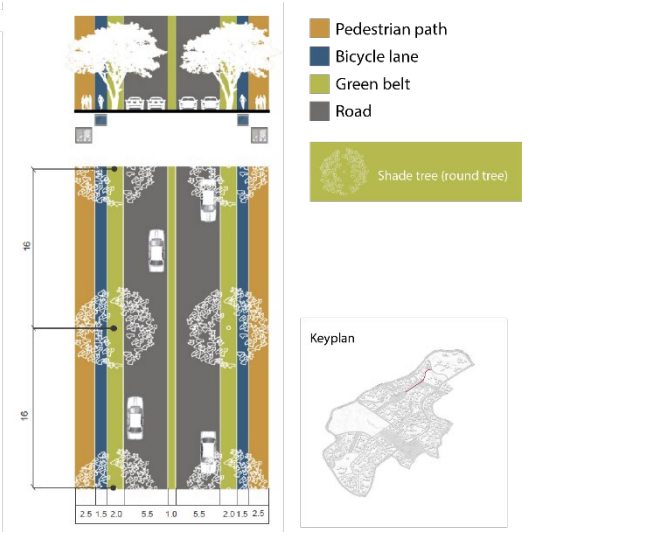
(IKN Collaboration Team, 2021)

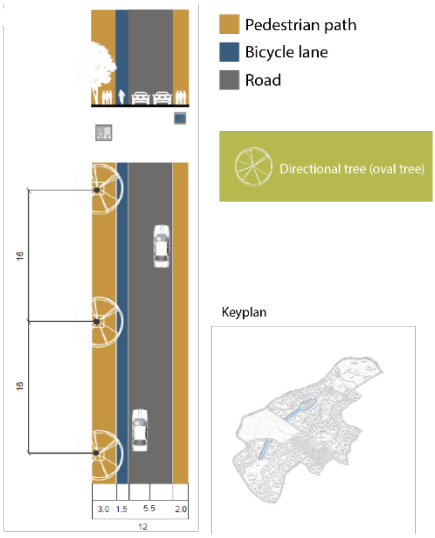
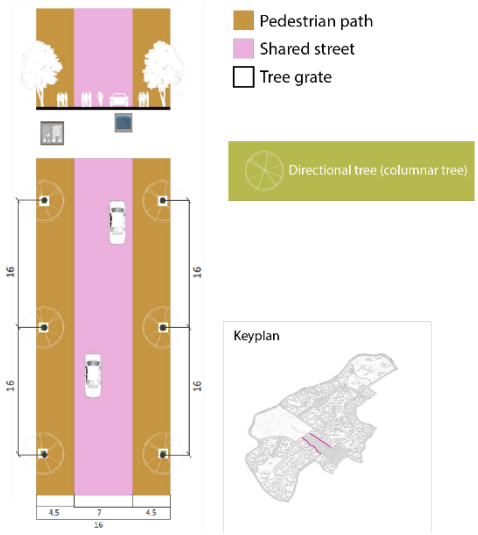
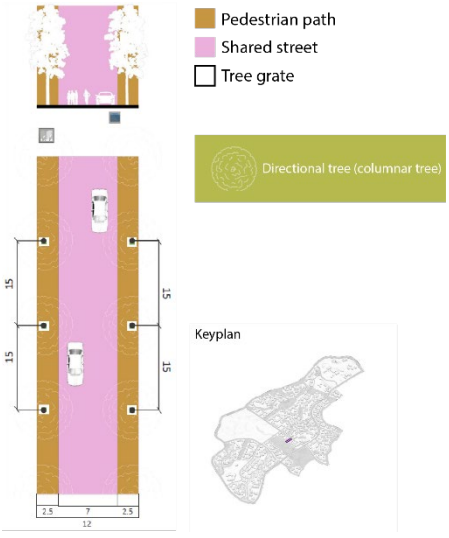
The Right of Way (ROW) is classified into different types according to width and character in the Table 6.

Table 6. ROW Characters

(IKN Collaboration Team, 2021)

<u>The Green Linkage:</u> The character is shaded and lush with greeneries and diverse textures. This type of street is applied at ROW 44 and ROW 24	 

<u>The perimeter boulevard:</u> The character is formal, serene, and cozy so the trees that will be planted will provide a certain degree of shade, but they will not block the governmental building facade.	
<u>The parkways:</u> The path will surround commercial and residential area, so the vegetation types are a combination of directional palm trees and accent trees	
<u>Legislative avenue:</u> Located at the end of the central government axis, this avenue is surrounded by governmental buildings and offices, so the trees selection will be shade trees and accent trees in between.	

<u>Ministry boulevard:</u> The streetscape character is formally arranged vegetation with neat spacing, monumental but not-so massive tree canopy.	
<u>Celebration walkway:</u> The character is an open street with wide-spacing trees that do not cover the facade to give more space for pedestrian and cyclist mobility.	
<u>The mobility corridor:</u> The most notable character is thin and columnar trees, because the road is narrow, and the building frontage is directly adjacent to the street	

While the various types of trees are planned, some selections are based on the characteristics of the ROW and the buildings, prioritizing form over function. Columnar trees might not provide as much shade as trees with wider canopies, so additional shading features should be provided, for example, pergola, shelter, or awnings at the frontages. Spacing between the trees must also be considered to achieve the desired effect, whether as a visual line or a canopy of intertwining branches. The timing of the planting is also important: the big trees must be planted as soon as possible, so when the streets are ready, the trees will already have wide canopies and provide shade. Security measures, such as CCTV or emergency buttons, need to be installed to ensure safety even at night.

6.2.2 Walkability Comparison with Sejong

Sejong Walkability Plan

Korea Planning Association has established guidelines to regulate streetscape design, including safety, comfort, and visual aspects to improve pedestrian walkability. The guidelines are also implemented in Sejong city planning, but since it is a new administrative capital city, the planners took extra steps by implementing the most up-to-date version that has been improved over the previous guidelines. As shown in Figure 33, Sejong established regulations zones along the ring-shaped axis, and urban planners developed design guidelines for eight components in the zone: building placement, land uses, building form, frontage types, facades, materials and colours, and building signage, and sidewalk (Lee & Park, 2023).

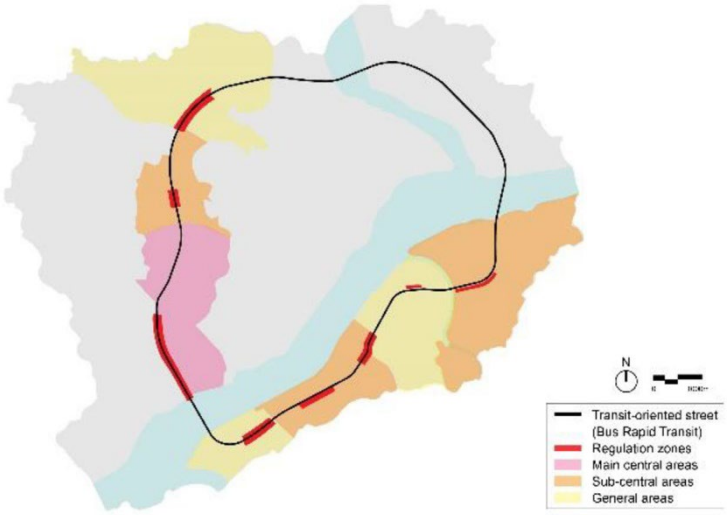


Figure 33. Three planning areas for the regulation zones in Sejong (Lee & Park, 2023)

Not only on-ground pedestrian walkways, Sejong also has a continuous sky bridge that connects the administrative buildings. The Government Complex Sejong houses ministries and agencies and connects them with elevated sky bridges and a 3,6 km continuous rooftop garden that the public can access in some parts (Figure 34). The concept of an overhead crossing is familiar; it has been built in North American cities, e.g., Minneapolis and Alberta. In Asia, a sky bridge is typical in Hongkong as a solution to create more pedestrian space that is safe from heavy vehicular traffic and direct connections between densely located buildings. A ground-level pedestrian path is difficult to build due to the limited space to be shared with other vehicles. Thousands of people use it daily to walk between central business districts (CBD) because walking through skywalks takes less time than walking on ground-level walkways. The elevated bridge also added commercial value because the indoor routes create multi-layered vitality (Wan, 2007).

Figure 34. Government Complex Sejong (https://www.gbmo.go.kr/)

Sejong Development Shortcomings

Kim et al. (Kim, Oh, & Park, 2016) diagnosed the walking environment of the completed area from 2007-2016 to propose future directions for the rest of the locations that improve the walkability experience. Based on the study, there are four critical issues in the pedestrian environment in Sejong, which are:

- *Ensuring the safety of the sidewalk.* In 2009, it was decided that bicycle lanes should be separated from motorized vehicle roads but within the same level as the pedestrian path, only separated by various types of boundaries and different materials. In the city area, green spaces, and parks, the paths are separated using obstacles such as vegetation. However, in 2010, obstacles were implemented to separate the pedestrian path and bicycle lanes.
- *Ensuring safety and convenience when crossing.* In 2007, 31 pedestrian overpasses were planned above the roads and BRT lanes. Then, in 2010 it was decided that the overpasses shall be removed, leaving only four overpasses remaining due to the underpasses in the BRT roads. The reason for eliminating them is to provide more inclusive crosswalks on a flat surface.
- *Enhancing the attractiveness and vitality of the streets.* There are multiple discussions and workshops to enhance vibrant areas by improving the urban wall and providing more functional space on the street. In 2012, the Design Guidelines for Public Facilities in MACCA were enacted, discussing the sidewalk design and materials and the arrangement of street furniture and facilities. Other strategies are building a commercial street-side parklet,

improving the building facade and the design of the street in general, and encouraging programs on the road that invite people to come and walk.

- *Reinforcement of travel speed limit regulation and road diet.* There are discussions about the road diet and reducing lane widths to regulate speed. However, since 2016, the maximum speed limit for vehicles in the city has been reduced from 60 km/h to 50 km/h, which sparks discussions about the possibility of reducing the lane width in the future.

In the same study, 169 residents in Sejong were surveyed about the pedestrian's level of satisfaction in the regulated and unregulated zones regarding safety, comfort, and attractiveness. Sufficient sidewalk widths, suitable surfaces, and pedestrian safety indicate safety. The convenience and continuity of paths and the ease of finding them indicate connectivity. The architectural coherence, aesthetics, and visual variety indicate the attractiveness indicator. The result shows that although the satisfactory level in the safety aspect is higher in the regulated zones, the overall pedestrian satisfaction level is higher in the unregulated zones due to the attractiveness level. This finding is in line with the study by Lim and Byun (Lim & Byun, 2017 as cited in Lee & Park, 2023) that reviews the design guidelines, compares the study sites' physical features and the design guidelines, and surveying the pedestrian satisfaction. The result shows that Sejong implemented the streetscape design guidelines strictly, but pedestrian satisfaction is low in aesthetics due to the limiting and unclear guidelines that hinder the visual variety in regulated zones. Lee & Park (Lee & Park, 2023) also empirically examined the implementation of the streetscape guidelines, especially the visual variety aspect, in the regulated zones in Sejong to determine what might have been missed or not functioned correctly in the design guidelines, especially the aesthetics value. The result shows that the same design standard and rigid guidelines limit, mislead or even hinder the creative explorations and visually appealing streetscape design.

The sky bridge in the Government Complex, envisioned to promote collaboration, sparked dissatisfaction instead. The main problem lies in the building form itself. Unlike Hongkong, where buildings rose vertically and are located close to each other, the buildings in Government Complex are stretched horizontally, which creates a long journey between offices. Moving from the end to end takes 20 minutes if people go through the external passage and about 40-60 minutes using the internal passageway between the buildings (Namu Wiki, 2023). Corridors are winding and bifurcated or blocked. There are many complaints that people get lost inside the almost-never ending passage as they move from floor to floor, but if people choose to access the adjacent building from outside, people have to cross the road and go around the fence-protected government buildings, so it takes about 10 minutes longer than walking through indoors (Herald Corporation, 2013). The painstaking walking journey prompted many people to use private cars to reach

another part of the building, which scrapped the walk accessibility concept that the building envisioned.

Figure 35. Government Complex Sejong sky bridge

(https://commons.wikimedia.org/wiki/File:Hannuridaero_and_Bangchukcheon.jpg)

The 79,194 km2 roof garden is a popular tourist site because the site offers a panoramic view of the city from above. There are 1,17 million plants of 218 species, including fruit trees, herbs, and medicinal plants (Sejong Sori, 2018). However, similar to the case with the sky bridge, many staff across departments expressed their inconvenience rather than effectiveness in using the connected roof to reach other buildings (Park, 2019). This world-record longest roof garden is also expensive to maintain, which can be another financial burden for the authority (Namu Wiki, 2023).

6.3 Transit Indicator

6.3.1 Transit Concept in Government Precinct

The transit system concept has two goals: to promote the citizens' rapid movement based on public transit and to develop an environmentally friendly city that contributes to reducing emissions from motorized vehicles. It should be noted that the central transit hub that connects the BRT, LRT, MRT and airport train that link to the outer part of KIPP will not be planned in the Government Precinct. Instead, it will be located in the adjacent area of the upcoming Civic Core.

Figure 36 below shows the overlapping map of the transit system and the pedestrian network. The transit stops locations are planned based on the proximity of the functions, road hierarchy, and walkable distance to the next stops. Then, to justify the distance between the stops, the planners conduct the parametric analysis using the Urban Network Analysis tool, which analyses the walkability speed and preference for the transit stops. The result shows that the planned locations still follow the targeted Key Performance Indicators walkability sheds, which are a 5-

minute walking distance within a 220 m radius for a bus stop transit hub and a 10-minute walking distance within a 440 m radius for a city scale transit hub (Zerlina, Azriani, & Tsarina, 2022).

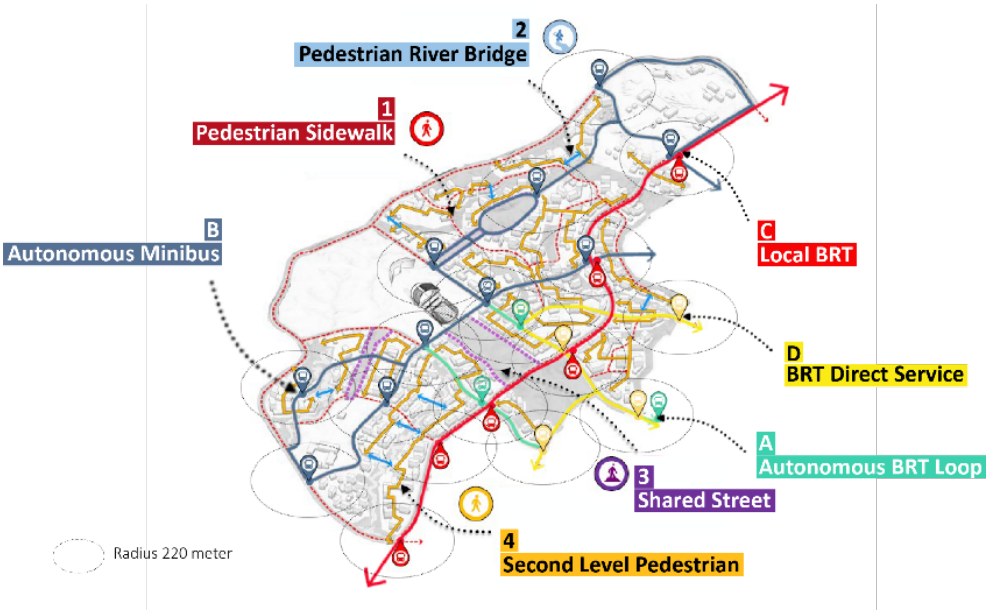


Figure 36. Pedestrian path and transit plan

(Government Precinct Joint Operation, 2021)

Pedestrian walkways and bicycle lanes are the highest priority in the road network service. The modes are decided based on the passenger's demand, cost, and ease of construction. The spatial need of each mode is adjusted with the ROW on the KIPP road hierarchy plan. There are different types of transit according to the functions, which are described in the Table 7:

Table 7. Types of transit system

Autonomous BRT: An environmentally friendly driverless BRT as a feeder in the capital's centre that will run through a dedicated lane.	 *Figure 37. Autonomous BRT*
Autonomous Minibus: An environmentally friendly driverless shuttle that runs solely within the Government Precinct on non-steep roads. It is a climate-friendly way to shorten the travel time because the travel will not be mixed with BRT and other general vehicles.	 *Figure 38. Autonomous Minibus*

Local BRT: The common BRT system serves most of the KIPP. It will operate in a dedicated lane along the collector arterial corridor with other vehicles in the mixed traffic.	 *Figure 39. Local BRT*
BRT Direct Service: The BRT system that connects to the outer part of Government Precinct. In a contoured site, the local road network will only be served with direct service BRT because autonomous BRT requires a certain degree of contour, so it cannot be implemented in this area.	 *Figure 40. BRT Direct Service*

(37) https://sgtransportcritic.wordpress.com/2021/01/14/the-arrt-of-hybrid-diversity/, (38) https://www.sustainable-bus.com/news/keolis-downer-driverless-shuttle-pilot-newcastle-australia-navya/, (39) https://thinksustainabilityblog.com/2017/06/14/sustainable-cities-bogota-colombia/, (40) https://cebucity.news/2022/08/27/cuenco-wants-brt-phases-done-at-the-same-time/

The BRT system will be planned from 2022 to 2045, while the Autonomous BRT along the government axis will begin from 2031 to 2045. The Autonomous Minibus connecting the judicial, legislative, and presidential palace is planned to from 2035 to 2045. The routes and stops are designed based on predicting transportation demand and spatial transit coverage in a particular area. The public transportation and mode-sharing analysis have been conducted by analysing the travel time and mode options during rush hour. The initial result shows that the mobility network will reach the Key Performance Indicators of 80% public transportation usage. It is essential to analyse the timeframe as the ridership tends to jump drastically during rush hour, so efficient, fast and high-capacity public transportation can answer the high demand. The transit stops scheme is shown in Figure 41.

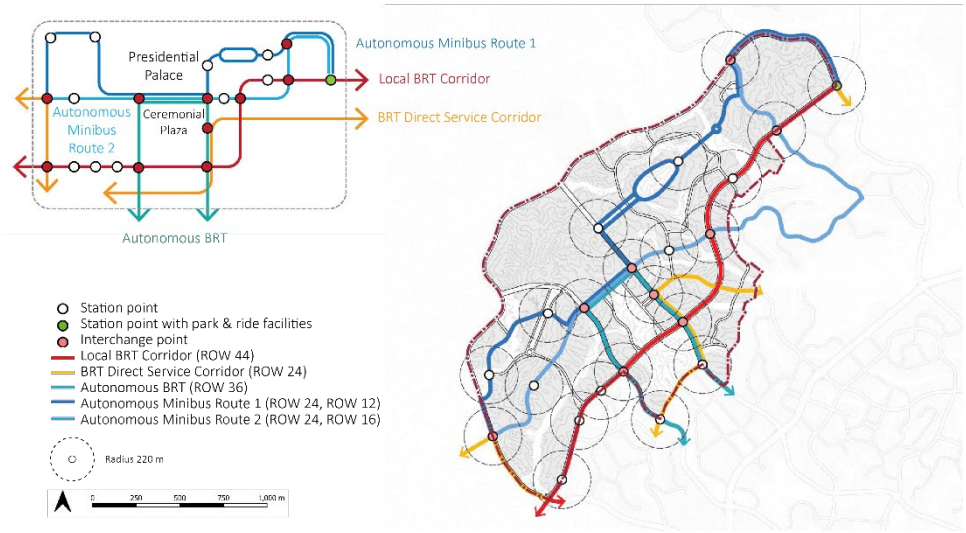


Figure 41. Transit stops scheme.

(Government Precinct Joint Operation, 2021)

The primary collector road, the secondary arterial road and the local road network will be served with autonomous BRT and direct service BRT, completed with pedestrian walkways and bicycle lanes. Medium-sized transfer points along the roads will aid in shifting between walking, cycling, and BRT. Park-and-ride facilities will be built in several nodes to ease modal sharing to pedestrian paths and public transit (Figure 42). NMT lanes will connect transportation nodes with bicycle parking. Bike-sharing facilities will be provided to facilitate shorter trips.

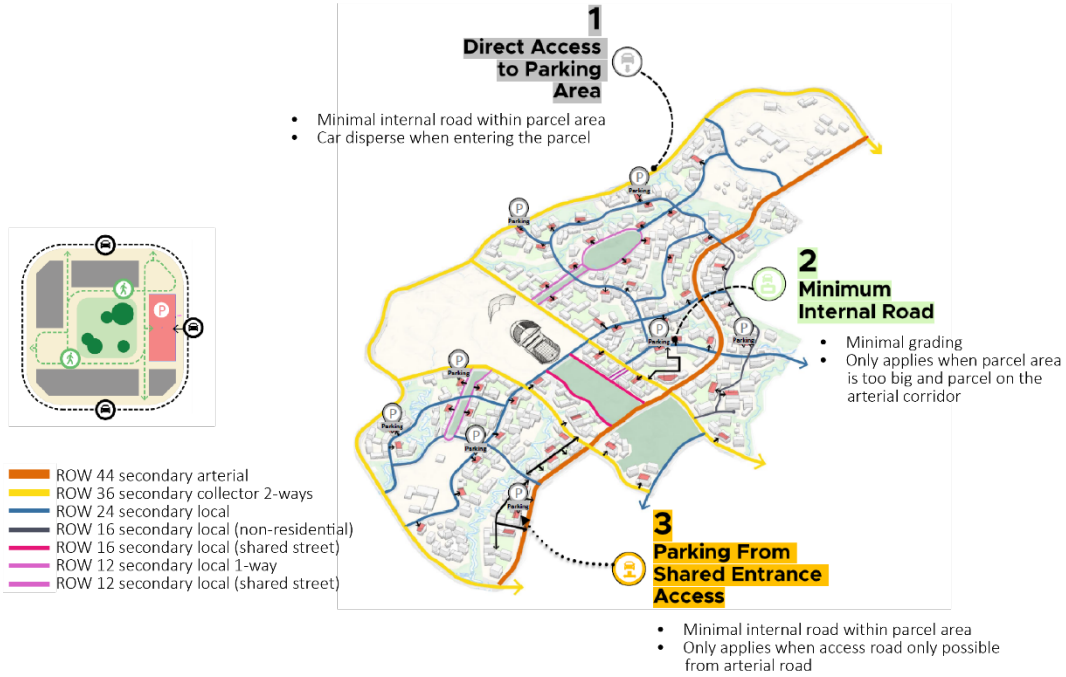


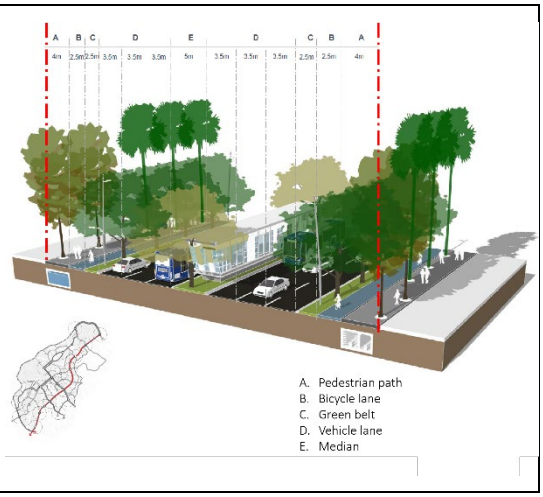
Figure 42. Parking accessibility concept

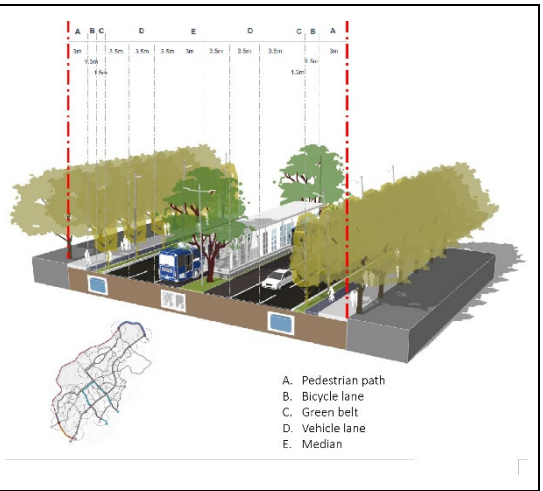
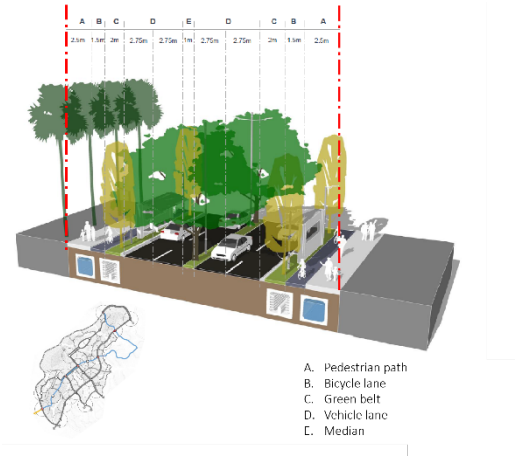
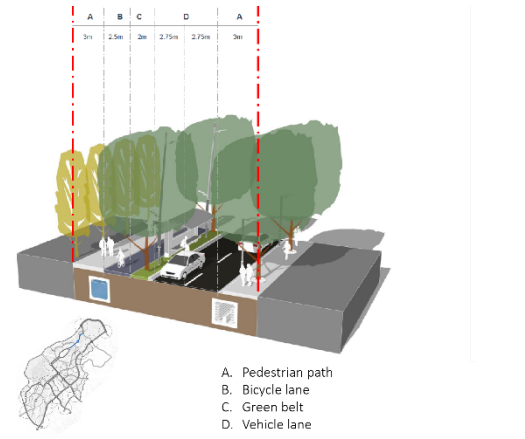
(Government Precinct Joint Operation, 2021)

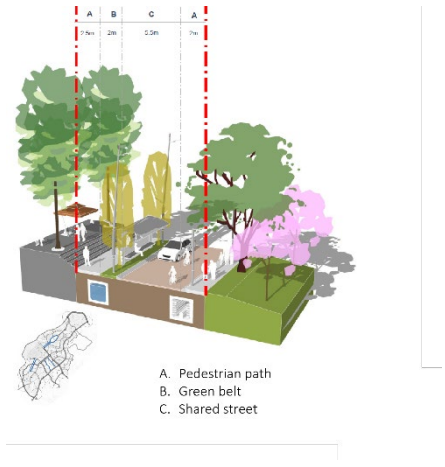
Table 8 presents the various types of ROW found within the Government Precinct, encompassing pedestrian walkways, bicycle lane, vehicle roads, and BRT lanes:

Table 8. Right of Way (ROW) types

(IKN Collaboration Team, 2021) (1)

<u>ROW 44 – Secondary Arterial with Local BRT Corridor</u> Consists of 6 lanes of 2-way roads with two lanes dedicated to BRT exclusive lanes in both directions. Median green belt of 5 meters with a row of trees to increase thermal comfort and green open space. Exclusive lanes for cyclists and pedestrians for safe and comfortable movement. The bicycle lanes are planned on both sides. The green open space that separates motorized vehicles, cyclists and pedestrians.	

ROW 36 – Secondary Collector 2-ways Consists of 6 lanes with two dedicated lanes for a 2-way BRT. Rows of trees along the median of 3 m for thermal comfort and green open space. Exclusive lanes for cyclists and pedestrians. Bike path on two sides. Green buffer separates the movement of motorized vehicles, cyclists and pedestrians	
ROW 24 – Secondary Local Consists of 4 lanes of a 2-way road. Rows of trees along the median of 1 m for thermal comfort and green open space. Exclusive lanes for cyclists and pedestrians. Bicycle lane on two sides. Green buffer separates the vehicles and pedestrians. There are Autonomous Minibus stops on the green belt.	
ROW 16 – Secondary Local Consists of 2 lanes of a 2-way road. Exclusive lanes for cyclists and pedestrians. The cyclists' lanes are concentrated on one side. A line of trees with a tree grate on one side to separates the vehicles and pedestrians. Green open space as a green buffer on one side that separates vehicles and cyclists. There are Autonomous Minibus stops on the green belt.	

ROW 12 – Secondary Local (Shared Street) Consists of 2 lanes that cyclists and pedestrians share. Rows of trees along the green belt for thermal comfort and green open space. There are Autonomous Minibus stops on the green belt.	

The BRT runs on a dedicated lane with a physical barrier, so other vehicles cannot access it directly. The Autonomous Minibus also runs on a dedicated lane without a physical barrier so private cars can access the lane. Some transit stops are placed on the pedestrian path or green belt with limited or no extra space for stationary uses of pedestrian environments, such as standing on walkways or sitting on the bench, thus may hinder some people who need to navigate along the path. In some transit stops with higher capacity, the pedestrian path can be full of users, especially during peak hours. Different stations and catchments must be planned to avoid obstructing other pedestrians.

The design concept provides the layout between the vehicle, bicycle, pedestrian, and median lanes with the transit stations. However, there is no planned bay in the lane because the BRT and the Minibus will stop on the lane to collect or discharge the passengers. Referring to the typical case in Southeast Asia where MRHS is a common first- or last-mile mode to the stations, a bay can be helpful to drop off or collect the passengers of MRHS, but the planners choose to prioritize an exclusive lane without a bay and exclude other transportation modes to achieve the standard design and disregard the future profit or business opportunities.

Bicycle parking, either for personal bicycles or bike-sharing modes, must be provided sufficiently according to the functions of the building or zone. Park-and-ride facilities are built at some points in the Government Precinct to encourage the modal shift from private vehicles to public transit. However, in the current design stage, there is no detailed plan yet regarding the bicycle parking rack around the transit stops. The bicycle (or other two-wheelers non-motorized vehicle) parking must be conceptualized in the next detailed design drawing to ensure the transit station is integrated with other transportation modes.

6.3.2 Transit Comparison with Sejong

Sejong Transit Plan

As shown in Figure 43, Sejong planned a public transportation axis of 22,9 km long and built it in the main ring-shaped axis as the primary travel mode in an exclusive lane that connects each city district (Kwon, 2015). The BRT system is considered the most suitable public transport system in Sejong, which is supposed to accommodate 500,000 people in the future since the construction and operation costs for BRT are a tenth of that of a subway system (Goodman et al., 2006, as cited in Kang, 2012). Frequent rapid buses will loop around the city in 40 minutes, thus allowing residents to go anywhere in the city in 20 minutes without using a car (Cowley, 2014). The BRT system serves the inner city through most residential and commercial areas and connects with neighbouring cities such as Osong, Cheongwon, Daejeon, Gongju, and Jeongan. An outer ring road is constructed to move the users of private cars to go through the other side of the city, so the inner transport axis is highly prioritized for public transportation (Kang, 2012).

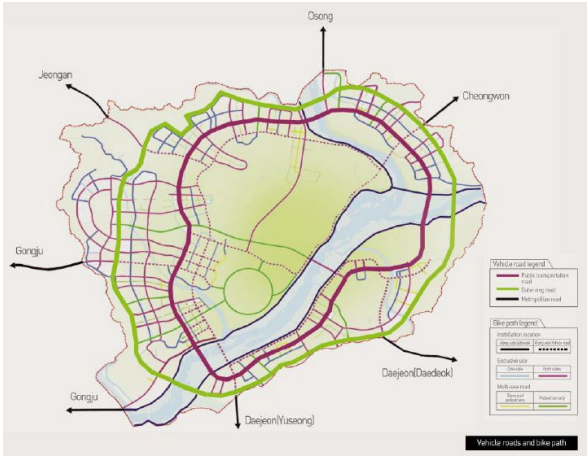


Figure 43. Main circulation in Sejong city and the neighboring cities (MACCA, 2012)

In connection with the walkability aspect, it is planned that citizens from any district will be able to access a BRT stop within 20 minutes on foot or by green transport modes. In Figure 44, the red colour shows the 10-minute radius from the transit axis, which covers about 74,2% of the commercial district. About 86,9% of the commercial district can be reached by walking 15 minutes from the transit stations (Kwon, 2015). To maximize the reach, community buses will be operated along local distribution roads for dwellers living in certain zones far more than 500 m from BRT stops. Private cars and bicycle parking lots will be adjacent to the BRT stops so people can conveniently park and ride the bus instead (Kang, 2012).

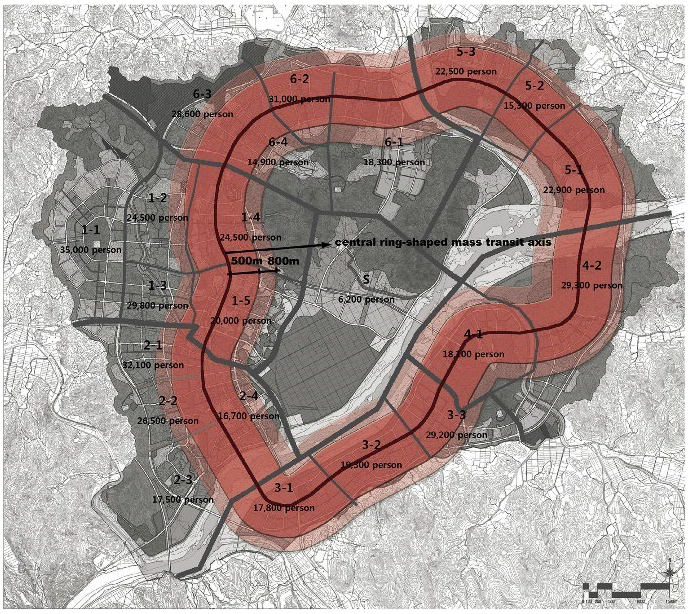


Figure 44. Sejong commercial district 10-minutes walkability shed from the public transit nodes.

(Kwon, 2015)

The BRT stops are located in the middle of the road, so users must cross through crosswalks to access them Figure 45. There are three types of stops: Type 1 is in the road section, Type 2 is before the crosswalk, and Type 3 is in a two-way parallel road section. The average distance between each BRT stop is 0,99 km: the closest distance is 0,42 km, and the furthest is 2,4 km (Bae, Lee, & Jeon, 2008).

Figure 45. BRT stop's bird eye view

(Bae, Lee, & Jeon, 2008)

The network and BRT plan is executed in phases following the estimated occupancy time in the area. From 2012-2015 when only some living areas are occupied, a sizeable transportation-only district will be established as a walking plaza. From 2016-2019, the public transportation-only district concept will be introduced on holidays or weekends. After 2020 when the development is starting to be completed, a full-time public transportation-only district will be reviewed and promoted according to the result of the pilot project (Bae, Lee, & Jeon, 2008).

Sejong Transit Shortcomings

Surveys of the citizen in some part of the residential neighbourhood was conducted o evaluate the BRT stops along the pedestrian path (Kim, Oh, & Park, 2016). The questions are mainly about the pedestrian path's safety, convenience, and aesthetics. The survey concluded that many people are reluctant to access the BRT because the paths are inconvenient and uninteresting due to the noise from the traffic, lack of shade provided by trees, absence of traffic lights at the north-south crosswalks, inappropriate location and shape of the bus shelter area, and the lack of space and diversity in use. There are suggestions such as incorporating commercial areas along the path to revitalize the area, providing canopies, implementing traffic calming, expanding the walkways at intersections, adjusting the bus stop location and its access, and managing the street-level activities.

Challenges in implementing BRT in Sejong are mainly political constraints. The low-investment BRT makes it seem insignificant and even vulnerable; for example, the lanes are always at risk of being deleted permanently to make way for other transportation. External pressures from private car users can also be a threat to the extent of the abolishment of the BRT lane altogether.

A unique case in Sejong BRT lane is that other vehicles use the lane from time to time, both legally and illegally. Legally, ambulances and technical vehicles are permitted to use the lane. However, some private vehicles illegally use the lane because, in the early days, there were not many cameras installed yet. Although they cannot use it due to the blocking rods, delivery motorcycles can still access it if they run through the pedestrian lane and escape through the crosswalks. It usually happens late at night because the bus frequency is less than during the day (Namu Wiki, 2023).

Sejong City built a few parking lots and a smaller road capacity to encourage people to commute sustainably by walking, cycling, and BRT. Unfortunately, the BRT service could not serve about one-third of ministry workers who commute between Sejong and other adjacent cities, including Seoul. At the beginning of the construction, the roads were congested with private cars, while the BRT lanes were mostly empty, and only a few people were using them because of the limited frequency and number of buses (Korea Joongang Daily, 2023).

Figure 46. Vehicles parked along the road outside the Government Building Sejong (The Korea Times, 2018)

Finding a parking spot took work. The initial plan was to force people to use public transportation; therefore, few parking facilities are provided. The Government Complex Sejong, which contains 14,000 employees, only has one basement floor dedicated to a parking lot, which needed to be improved to serve thousands of vehicles. In 2018, to enforce the shift to public transit and limit the use of private vehicles, the Government rolled out the vehicle ban that instructs government employees to leave their cars behind if the last digit on their license plate matches that of the calendar date. The strict ban prompted a backlash because almost all employees claimed that the only public transit available, the BRT, could not accommodate everyone since the number of buses is too few and interval times between buses are pretty long. Many people turned to the street and illegal parking on the empty lots instead of taking the BRT (The Korea Times, 2018). To fix the issue, newer buildings are planned with more basement parking lots, and the unbuilt development sites are turned into temporary parking facilities. Illegal parking lots with no cost at undeveloped building sites were popping up around the main road; the authorities even permitted it by putting temporary parking signs at those sites. Ultimately, using a private car is still more advantageous than taking BRT, discouraging the modal shift to BRT.

7. Discussion

7.1 General Issues

The Indonesian Government has embedded the TOD concept into the foundation, and the IKN planners implement it in the master plan. Interestingly, through an informal interview with the planners, they do not identify Government Precinct as a TOD area because it does not have a central transit hub. They define TOD as a centralized transportation hub that serves various modes and connects to adjacent cities. The main hub connecting BRT, LRT, MRT, and airport trains will be placed on the Civic Precinct next to the Government Precinct; therefore, this is the area where they define a TOD zone. Although, in a broader sense, TOD can be interpreted as principles (e.g., sustainable development), planners interpret TOD on a narrower scale in the form of a stand-alone entity of a building. From one angle, this humble acknowledgment proves that the planners comprehend the TOD critical principle: it should not be simply a physical term; it must have a sense of community and neighbourhoods (National Academies of Sciences, 2004). These plural definitions are expected and accepted since the TOD concept is loose and contextual; however, they share the same framework: reducing automobile dependence and improving the urban quality of life (Jamme, Rodriguez, Bahl, & Banerjee, 2019). It also aligns with what Cervero et al. (National Academies of Sciences, 2004) argue that there are many perspectives to define TOD, so it should be left to the local stakeholders to identify what they consider TOD.

Before discussing each point from the TOD's pros and cons, the land use must be addressed first because the zoning and the road hierarchy impact the walkability and transit aspects. There are numerous trade-offs to concentrating the Government Area in a particular zone and not dispersing it. The precinct is planned for one primary purpose: offices. Only very few commercial and residential areas exist, including the presidential palace. Referring back to one of TOD's caveats, it is unlikely that gentrification will occur in this Government Precinct since this zone is exclusively built for administrative purposes. However, this spatial strategy could create sprawl because the city's central office district is concentrated in one place. It lacks the diversity of building functions and acts as a reservoir for a specific category of users: the office workers who occupy the precinct on the same daily

schedule and at once. During non-working hours, weekends, and holidays, the Government Precinct may become inactive, empty, and underutilized, which according to Jacobs (Jacobs J., 1961), could lead to a still area and even induce blights. During weekday rush hours, employees who reside in other precincts will flock to and from the Government Precinct at once. The transit system may be inefficient because it will be too crowded during rush hours and become unused or idle outside working days. More mixed-use facilities or attractive events should be infused in the Government Precinct to draw more diverse users at various times of the day and the weekends, even for leisure purposes, to liven up the precinct and avoid detrimental effects.

In theory, the 10-minute city concept is meant to diversify the livelihood areas so that people can access the basic needs and amenities within 10 minutes of their residential area, thus reducing the need to use private vehicles. However, IKN planners define the 10-minute concept as a walkable distance between the buildings (primarily offices) and the transit stops. It does not necessarily follow the original definition due to the lack of the mixed-use (especially in residential areas), but the variations of access networks and transportation modes with sporadic stations location still implement the 10-minute and 15-minute framework.

In Sejong's case, creating a single ring-shaped road and leaving the inner core for mostly the green spaces symbolizes a linear city. While the green core is planned to be the open space that ties the districts together, it may take too long to access the opposite area because vehicle users must go through the loop. The ring shape can act as a distributor that exudes a centrifugal force moving away from the centre. It does not serve direct access; shortcuts across the core are faster to access the other end than around the loop (Jacobs A., 1995).

Initially, it was difficult to attract settlers to permanently move to Sejong due to the difficulties in access and the lack of facilities that support basic lifestyle needs and communities. The government workers were forced to move there to become early settlers, even calling the city "Seberia," a portmanteau of Sejong and Siberia (The Korea Times, 2021). The negative stigma of Sejong in the early days of construction due to the lack of facilities and entertainment must be a concern for IKN to ensure that the necessities are built and provided simultaneously with the currently developed Government Precinct, so new inhabitants will feel comfortable living in the new city.

Since the first groundbreaking until now, there have been many changes, adjustments, and modifications to fix the TOD infrastructure in Sejong. The city is young, so there is plenty of room for improvement. More facilities and amenities that attract people to move permanently have been established, so the city's population has multiplied rapidly.

7.2 Prospects

Walkability became the critical aspect in IKN, which the planners refer to the 10-minute city and even 15-minute city to access the primary functions of the city. The two timeframes of 10-minute walkability and, later, 15-minute walkability are applied in planning the transit stops in a 220 meters radius. The different pedestrian networks have been laid out, in which some of the paths are shared with vehicles and bicycles, and some are pedestrian-only to ensure the safety and convenience of the pedestrian. Lastly, the Urban Network Analysis that the planners have conducted is an excellent quantitative strategy to justify the planning decision.

The elevated sky bridge is an answer to maximize the x-minute concept in the challenging contours. Modifications from the initial plan of on-ground walkways must be appreciated because it shows that the planners respect the existing contour by adjusting the design instead of doing a practical cut-and-fill to make everything flat. By creating secondary access on the contoured land, the 10-minute concept will be applicable. The bridge serves as a symbol of collaboration between the ministries and agencies. It helps to provide secondary access to the adjacent buildings without needing to go to the ground floor and be exposed to the scorching equatorial sun to maintain thermal comfort. The additional space can also act as a small commercial area, which will be necessary to answer the demand of the thousands of workers in the Government Precinct. The decision to create crosswalks with signalling systems instead of overpasses with elevators or ramps is inclusive because it eased the mobility of people with disabilities or walking and serves the social justice aspect.

Active travel supplements the transit system. Integrating the active NMT, transit stops, and park-and-ride facilities in the strategic nodes will potentially increase the transit rate. The ROW design in Government Precinct provides an appropriate composition of pedestrian walkways and bicycle lanes. The different types of pedestrian walkways, street character, permeable edges, and safe crosswalks encourage people to walk more in a convenient environment.

There are advantages to implementing BRT instead of a conventional bus. It is easy to be integrated with other transportation modes, the emission can be controlled by selecting the appropriate technology and system, and the routing flexibility is high. Although it may be slower than MRT or LRT, the constant and uninterrupted speed ensures the BRT goes smoothly. The dedicated lane allows the BRT to run freely without being stuck in the same traffic as the cars; thus, it is a viable alternative to driving that can reduce traffic congestion.

7.3 Challenges

However, according to the literature study, the walkshed does not necessarily mean that people will find it convenient; many factors influence people's preference or decision to walk, such as weather or sociocultural belief. The time threshold has challenges in measuring accessibility levels. Litman (Litman, 2023) found that people may be willing to sacrifice time to walk under favourable conditions, but it is different everywhere. Referring to the study cases in some big cities in Southeast Asia, even though they have walkable distance within 15 minutes, it does not mean people are eager to walk to their destinations because different people, environments, and cultures have different perspectives on what they call 'walkable distance' (Pongprasert & Kubota, 2017; Leather et al., 2011). Once the area is active, the authorities must conduct evaluations and surveys of the IKN residents. Compared with Sejong, although it placed the transit stops in the neighbourhood within a walkable distance of 20 minutes, finding the source that assesses whether citizens find the distance walkable in any circumstances is difficult. Studies are needed to investigate the x-minute concept implementation in Sejong.

The plan is still in a very general masterplan; therefore, there is yet to be a detailed drawing with precise dimensions regarding the supporting amenities such as bicycle parking (and other nonmotorized two-wheelers mode parking), lighting, bollard, tactile pavement, or even trash bins. It is crucial to facilitate the pathways with safety and comfort elements for inclusive walkways that are safe every hour. But, referring to the case in Sejong, a too-strict guideline will limit creative exploration and improvisation. Design guidelines are still needed to achieve the end goal of creating bustling activities and communities along the walkways. Still, it must be flexible enough to fit the surrounding areas' aesthetics and design mood.

The sky bridge must be designed carefully since the interconnected buildings will be built in stages because not all facilities will be constructed simultaneously. It must not end up as an overpass crossing the busy street and junctions that replaces the crosswalk. Studies show that these conventional crossing bridges are unpopular; people prefer to travel on the ground despite the risks and barriers (Leather, Fabian, Gota, & Mejia, 2011). They also tend to ignore people with disabilities or older people who cannot cross the street quickly, as many do not have a working elevator or ramp. This is why Sejong decided to dismantle the overpasses, except for some necessary overpasses over the BRT underpasses, so that IKN can learn from this.

The plan to continuously connect the buildings in Government Complex Sejong backfired when the horizontal walkway needed to be shorter and created a hassle to walk and reach the other building, which prompted people to go back to using their cars eventually. It differs from the case in Hongkong, where the sky bridges are the most efficient route to access the adjacent buildings seamlessly. However, it must be noted that the success of the sky bridges in Hongkong has been largely attributed

to the dense urbanscape and lack of space for pedestrian walkways in the city (Wan, 2007). Although the total length of the connected walkways is more than 4,4 km, it connects nearly 60 buildings which are way more buildings and functions than Sejong has. The distance might be long, but the density and mix values determine the effectivity of the sky bridge. Therefore, the locations of the interconnected buildings in the Government Precinct must be placed strategically.

Sejong also uses BRT as its primary public transportation by dedicating the inner ring, the city's central axis, for public transit. It will be seen as the primary mode to access the city, effectively pushing people to choose public transportation. The main roads have exclusive lanes for BRT to promote the smooth ride of the BRT. However, the lack of options aside from BRT to access the nearby cities and Seoul discouraged people from shifting to public transit. The non-existent mode alternatives to the outer terminal or station other than BRT push people to choose from two bad options: a long journey with BRT or a quick car trip. Even though riding the BRT in the inner city is fast, if accessing the transit hub on the outskirt by private cars is more immediate and efficient, people will choose their private vehicles instead. The BRT system is also busy during rush hours, which creates more hassle than driving through the wide street with a private car.

IKN plans park-and-ride facilities near the transit nodes to support modal shifts. During the early construction phase in Sejong, parking facilities were limited to force people to ride the BRT, but the infrequent and insufficient service cannot meet the demand for a quicker and more frequent mode, which prompts people to park illegally on the street or empty lots instead. Eventually, the authorities compromised by allowing users to park their cars on the vacant unbuilt lot. Indeed, parking can be a double-edged sword; it is essential to lure modal shift, but the existence of it spoils car owners and deters the pedestrian-oriented atmosphere, separates transit from the community, and limits the potential for other spaces that should be used for other TOD purposes (National Academies of Sciences, 2004). The same study indicates that successful TOD is created by the rapid growth of mixed-use developments around transit nodes combined with bad and worsening traffic conditions. People will still prefer to be stuck in the traffic inside their private vehicles rather than inside the BRT, so only when the BRT that uses an exclusive lane is proven to pierce through the congestion faster than private vehicles, then people will shift to take the BRT. There has to be a plan to simultaneously discourage private vehicles and encourage walking or transit in phases to avoid imbalance and abrupt interventions. An equilibrium should be achieved between developing the BRT to meet the increasing demand and providing necessary parking spaces without spoiling car users so that no commuters are sacrificed, and the authorities will have the traffic problem in hand. Later during the development, when the BRT ridership numbers increase, some parking spaces can be eliminated

and turned into parklets, just like Sejong citizens suggested in the post-occupancy evaluation.

Other alternatives than BRT are provided in the Government Precinct, which is good for transporting fewer passengers in the smaller fleet that runs as a shuttle inside the Government Precinct only. However, the high investment and maintenance cost to operate the smart mobility services that run through the dedicated line, e.g., Autonomous Minibus service, is not as efficient in such a sprawled territory because it will be mostly idle and unused outside on the weekends and holidays. It will only help promote walkability and reduce pollution as other types of activities in the mixed-use area. As mentioned in Chapter 7.1, by adding more mixed-use facilities or events, the precinct will be livened up all the time to make the vehicle investment worthwhile.

7.4 Recommendations

The different types of pedestrian paths are essential to differentiate functions and dimensions and give a different ambiance of comfort and visual aesthetics. However, the shared street must be designed carefully since the study shows that the full benefits of shared space are most likely to be achieved if the pedestrian feels comfortable walking in the path. Also, the limited space in the transit stops may create congestion in the walkways during rush hours, so more landbanks must be provided as a catchment area for the users waiting for public transportation. The bicycle and other nonmotorized two-wheeler parking modes have yet to be planned in the drawing, so more amenities must be installed in the upcoming detailed plan.

It is an immense challenge to establish open but comfortable pedestrian walkways in IKN since the site is located in the most humid and hottest part of Indonesia, the equator. In the various ROW design concept, the tree types along the walkways and median have been selected, but the species must be chosen carefully to provide shade. Shaded walkways must be prioritized to be constructed so the tree canopies are already big enough when the Government Precinct starts to be active. The spacing between the trees must also be considered to ensure that the distance between the trees will spur intertwining branches. The trees that are planted along the median must be carefully located as well since they are seldom effective due to the limiting space requirements that resulted in fewer trees and great distances at intersections for a clear turning view that often resulted in significant gaps in between the trees (Jacobs A., 1995). Aside from canopied trees, other tree types are planned in some areas with strong characters, which might not provide enough shade since the functions are the area's symbol or aesthetic purpose, e.g., columnar trees. Therefore, these areas must be supported with additional canopies to ensure comfortable walkways. Additionally, studies show that the appropriate planting of

vegetation can be combined with water features to produce a synergistic effect to cool down the area and increase comfort, especially in a sun-exposed area (Zou & Zhang, 2021). Artificial shadings, such as pergolas or awnings, can also be introduced to cool down the space in areas not protected by trees or towering buildings' shade. Based on the literature study, in most urban areas in Indonesia, walking is not preferable due to the weather, lack of infrastructure, et cetera. (Hasibuan & Mulyani, 2022; Leather, 2011). Therefore, the appropriate trees and supporting elements must be designed to help cool down the area, thus creating a comfortable outdoor environment that invites pedestrians to walk. However, it must be noted that certain trees with big canopies can damage the streets due to the spreading roots; therefore, the distance between the trees to the structure must be maintained, or the roots must be protected with a particular layer.

In the Government Precinct transit stops design, there is no bay area to drop off passengers from MRHS or other modes of transportation. Based on the informal interview with the planners, the design intentionally excludes the drop-off; they want to create an ideal plan that acts as a model or template that promotes walking and cycling and forces people to use public transport; hence they only design for the transit stops and lanes. By doing so, they are excluding the commercial lens of transportation by MRHS, which is a common practice at the moment. While this deliberate decision to not accommodate vehicles other than the transit may be good enforcement, based on the literature about the reality in Indonesia, MRHS is still popular as a first- and last-mile mode to reach the transit stations. Also, looking back at the case in Sejong, since there was no schedule or system at the beginning of the development, people will still use private vehicles to commute to the central transit hub. It is still being determined whether they will open their service in IKN, but the adjacent cities of Balikpapan and Samarinda have had their services running for years. It is up to those businesses to open their service in IKN, but the planners may need to consider them in the accessibility design in the long run.

Concerning the motorcycle issue, the case with the delivery motorcycles that often run through the BRT lane in Sejong relates to what Indonesia experienced. Unlike in Sejong, where motorcycles are mostly only for delivery services, in most major cities in Indonesia, motorcycles are the most popular mode of transportation, both as a private vehicle, delivery services, and the MRHS. There are many instances where private vehicles, both cars and two-wheelers, enter the BRT lane because the lane acts like a highway in the congested road. The BRT authority must install a barrier or gate that uses a sensor to open exclusively for BRT to prevent other vehicles from entering the lane.

Participatory forums, dialogues, and workshops with the authorities, designers, and citizens must be performed regularly to evaluate the development progress, to avoid an image of a city that is only built for one particular institution, and to create

a shared sense of belonging and responsibility between the citizens and the Government. The Government must make sure to include the citizen in the development by updating the progress of the project in the media and incorporating citizens to monitor the progress of the implementation of the plan and the policy. As the national motto suggests, *Bhinneka Tunggal Ika,* which means Unity in Diversity, everyone is welcome to involve in building the country to achieve a developed and prosperous state.

7.5 General Lessons from Sejong

Throughout its development, Sejong faces problems both in physical aspects, e.g., infrastructure and parking issues, and non-physical elements, e.g., working together with different authorities. Sejong regularly evaluates and updates the guideline and policies to accommodate the city's growing population, such as rebranding the BRT system and adding more routes and frequencies.

The political circumstance is one of the critical factors in the optimal operation of the BRT in Sejong. First and foremost, the split of the government agencies in Seoul and Sejong creates a tiresome commute between the cities, discouraging people from moving sustainably with public transit. About one-third of the employees commute daily from Seoul and other adjacent cities. The long travel time and shift with the BRT—then KTX is not more attractive than taking private vehicles, no matter how jammed the road and difficult to find the parking lot. Driving a private car is much faster than taking the BRT to the intercity terminal or Osong Station and then transferring to another bus or KTX to Seoul. Many commuters think it does not make sense that it only takes 50 minutes from Seoul to Osong Station by KTX, but it takes at least 40 minutes by BRT from Osong Station to the complex, or even an hour (The Korea Times, 2023). However, if Sejong builds the KTX, paradoxically, it would create even less urgency in migrating into the city since people can commute much easier now.

Secondly, the overall BRT system ownership, planning, operation and maintenance are done by different authorities, especially the fields that overlap with other municipalities and interests. This differs from Bogota, in which the department under the City Hall is a single authority overseeing all the BRT planning, construction, and maintenance (ITDP BRT Planning Guide). This complicated management resulted in difficulties compromising opinions, complications, disputes, or neglect in vehicle selection and purchase, infrastructure, faring and profit, and maintenance. The methods to answer the problems are the de-integration of one party by agreement in exchange for extensive long-term funding, integration by collaboration between the public and private organizations, and reintegration by intervention from a third party that overviews the negotiation

process (Paulsson, 2020). It is important to address the different stakeholders and foster discussion to decide the best management and approach to operate the public transportation and the overall TOD.

There need to be more studies about the effectiveness of the BRT system in Sejong and how walkability affects the ridership of BRT. However, this is the first time an advanced BRT system has been introduced in South Korea, so many studies, discussions, and revisions are happening along the way. It can be a model for implementing advanced BRT in other cities in South Korea or other countries.

8. Conclusion

Indonesia has made a strong political statement to stand with sustainable urban planning and mobility by incorporating TOD principles into the master plan for the new capital city. However, it should be noted that TOD can have positive and negative effects because it can be a cause or a consequence. While a well-intentioned Government Precinct plan with a one-stop administrative facility with a pedestrian-friendly environment and transit options can reduce traffic congestion, improve health and well-being, and foster vibrant activities, it may also induce gentrification and a vacuum district during non-working hours, which risks detrimental impacts. On the other hand, the new capital that flourishes with smart growth and active mobility is a consequence of a carefully planned TOD. Therefore, planning must be flexible and adjustable to upcoming challenges and open to new solutions or technology that may not exist yet during the beginning of the project. Social values must be considered when designing the built environment to realize its goals and avoid social issues. Local characteristics, culture, and potential must be examined to tailor the design decision to fit the context and avoid a rigid and one-size-fits-all approach.

The keys to the modal shift effectivity are synergy and integration, both between the motorized and non-motorized mobility and between the design elements. IKN has initiatives to implement the walking and transit aspects with the ideal dimensions and facilities despite the challenges of the topography and climate, which shows that IKN is committed to weaving the functions and the temporality into a walkable urban fabric. However, from Sejong, we learn that the integrated Government Complex, infrastructure within walkable distance, and exclusive public BRT network do not necessarily generate an immediate result of a thriving TOD capital: it takes time, constant evaluation, countless adjustments and compromises to invite settlers and encourage them to walk and use the transit. Political issues and conflicts of interest also challenge BRT management. Learning from Sejong's shortcomings, a harmonious integration between time, space, and sociability values between different stakeholders will promote the prosperous multi-service city with high proximity as the authorities envisioned.

In addition to physical intervention, non-physical measures must be incorporated to ensure a successful TOD vision. The stricter policy that discourages private automobiles must be enforced, such as adding incentives or subsidies for public

transport, maximizing the public transport frequency, integrating a multi-modal urban design incorporating the busiest nodes, and charging private vehicles when they access particular areas or expensive and limited parking facilities. Traffic and social impact assessments must be performed regularly to determine what works and what does not and how to solve unforeseen issues, improve them to maximize their full potential and amplify them to the upcoming zones that will be developed. Streamlining the multiple institutions and stakeholders is crucial to coordinate the operational, management, and decision-making.

As one of the world's most extensive and most populated countries, moving and building the new capital from scratch is Indonesia's grandest project, especially during the post-pandemic era. With the sustainability and smart city in mind and implemented into a TOD-based city, the success of the TOD implementation in IKN can be a template for future cities that respond to the mobility needs sustainably, especially in highly populated developing countries. When the most influential figures in the country can change the norm by shifting from unnecessary private vehicle travel to embracing sustainable mobility of walking, cycling, or riding public transit, it will hopefully create a ripple effect that can influence citizens to do so. It can shift from the private motorized dependency mindset towards a more sustainable perspective and lifestyle for future generations.

9. Methodological Reflection

Conducting an ex-ante analysis is crucial to provide a forecast before the commencement of the construction, which can help avoid the potential issues that may arise during or after the project is done. It should be noted that the design development progress in Government Core is still ongoing, meaning that the attached images in this thesis are still tentative, and more detailed and precise drawings will be issued in the subsequent design phase. Should there be more time for more research on the fixed and completed masterplan, further analysis could extend to the comparative evaluation of the whole aspects of TOD parameters, not just limited to the Walk and Transit aspects.

Due to the massive context of the project, this thesis does not discuss land use and design from different perspectives, such as the social lens from the local indigenous community, environmental and ecological impact, gender preference in the walkability and transit aspects, et cetera. Future researchers may explore and investigate crucial topics and potential issues from interesting perspectives in further studies.

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