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Mixed-use Design Reform in the Jakarta Metropolitan Transit-Oriented Development Area

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Abstract: Urban sprawl in Jakarta Metropolitan area, driven by gentrification, necessitates Transit-Oriented Development (TOD) areas for mixed-use development to reduce private vehicle-dependent commuting, addressing sustainability issues. This development needs to be supported by designs that reflect the commuters' needs and preferences based on the local socio-economic context, but the existing Government's guidelines do not adequately represent this. According to this issue, Response to this issue, this study aims to propose reforms in spatial mixed-use design in the Jakarta Metropolitan TOD area using the Design Thinking method approach to address the commuters' needs and preferences. Based on this approach, data was collected through a survey of 1,697 respondents, followed by observations in four TOD zones scattered across urban and suburban regions in the Jakarta metropolitan area. These data were analyzed using multimethod, consisting of regression, weighting, descriptive and spatial analysis. The study suggests that middle-class working female commuters, with busy social roles, long travel distances, and high expenses, require mixed-use TOD housing. Design priorities include affordability, accessibility, and facility completeness, with Green Open Space as a top priority. The reform focuses to provide affordable rental housing and promote inclusive gender accessibility. These explanations conclude that major reforms are needed for TOD mixed-use design implementation and guideline, focusing on gender inclusive approaches that classified into urban and suburban areas with the largest proportions of GOS.

Keywords: mixed-use design; Transit-Oriented Development (TOD); commuters; reformation

1. Introduction

Rapid urban development has significantly accelerated global economic growth, leading to mass urbanization and impacting population concentration in urban areas (Cohen, 2006), including in developing countries (Zhang, 2016), like Indonesia. According to UNFPA (2013), >50% of Indonesia's population resided in urban areas in 2010, and is predicted to reach 64.4% by 2030. In this case, Jakarta, as the center of development and economic growth, has the highest level of urbanization, accounting for 9.54%, 8.13%, and 3.9% of Indonesia's population in 2000, 2010, and 2020, respectively (UNFPA, 2015; Central Statistics Agency, 2021). This urbanization phenomena have led to a surge in population, from 8.39 million in 2000 to 9.6 million in 2010 (Rukmana, 2014) and 10.56 million in 2020 (Central Statistics Agency, 2021). This increase has an impact on increasing land and property values, as evidenced by

increases in rental prices and property taxes, which triggers gentrification, as the reinvestment of capital in the urban center based on neoliberal economic concepts, with the goal of producing space for a more affluent class of people than those currently occupying that space (Smitt, 2000; Harris, 2008). This gentrification triggers social class segregation (Chava et al., 2018), making the inability of low-income people to face the rising property and land prices, forcing them to relocate to suburban areas (Saunders and Smith, 2014; Gu 2019) in search of a more affordable residential alternative (Liu et al., 2010). This condition is known as suburbanization, which is accelerated through the development of satellite cities, namely Bogor, Depok, Tangerang, and Bekasi (Bodetabek), including the development of affordable housing (Blackburn, 2011) and the road network connecting Jakarta, as city center, and its satellite city. Bodetabek (Henderson and Kuncoro, 1996; Winarso and Firman, 2002; Hudalah 2013).

According to The Japan International Cooperation Agency (JICA) and Central Statistics Agency reports, the number of daily commuters in Jakarta Metropolitan area increased by 10-fold in 1985-2002 (JICA, 2004), 1.5-fold in 2000-2010 (JICA 2012), 0.25-fold in 2010 -2014 (Central Bureau Statistics, 2010; 2014), 1.07-fold in 2014-2019 (Central Bureau Statistics, 2014; Central Bureau Statistics, 2019), and 3.54-fold in 2022-2023 (Central Bureau Statistics, 2024). The trend of increasing commuters is projected to continue specifically in the context of Jakarta's Vision 2042 as a global business city. Based on these numbers, more than half of them use private vehicles, which reached 78% in 2014 (Central Bureau Statistics, 2014), dipped to 72% in 2019 (Central Bureau Statistics, 2019), and then increased again to 79% in post-pandemic 2023 (Central Bureau Statistics, 2024). This condition has an influence not only on economic losses owing to wasteful fuel oil use (BBM), but also on air pollution, which causes health problems and exacerbates the effects of climate change in the capital region. Greenpeace and RDI research results (2022) show that air pollution in the Jakarta Metropolitan Area is at an alarming level, with total NOx emissions (72.4%), CO (92.36%), PM10 (57.99%), and PM2.5 (67.03%). This condition has an impact on health, particularly for children and pregnant women (Lestari et al., 2020). Moreover, the high level of emissions causes a 10 °C increase in temperature as well as an increase in rainfall intensity, as a result of extreme weather, which has the potential to create flooding (Greenpeace and RDI, 2022).

These numerous challenges inspire the government to develop a mixed-use concept at the TOD area, both at the building and regional scale, as stated in the TOD development guidelines, Spatial Planning Regulation No.16/2017. The implementation of this concept, similar to other metropolitan areas in Southeast Asia such as Bangkok (Nyunt and Wongchavalidkul, 2020) and Kuala Lumpur (Rosni et al., 2018), aims to reduce traffic congestion caused by the high frequency of commuting trips (Hasibuan et al., 2014; Hasibuan and Mulyani, 2022). In accordance with the five basic principles of TOD (5D), consisting of density, diversity, design, destination accessibility, and distance to transit (Ewing and Cervero, 2010), the application of this concept is realized through the arrangement of multiple building functions and land uses, such as housing, employment, and amenities, in close proximity and near transit stations. This attempts to promote high-density, walkable neighborhoods, as well as the integration of land use and public transit (Cervero, 1998; Shatu et al., 2022), hence improving commuters mobility efficiency, dynamicity, flexibility, and accessibility. This condition has the potential to increase commuters' interest in walking and cycling to their main daily activities, reducing dependence on private vehicles, lowering pollution, energy consumption, and travel expenditure, as well as creating an efficient and sustainable quality of life for society while improving physical health (Curtis and Scheurer, 2010; Thomas and Bertolini, 2017; Gu et al., 2019). The short mileage for daily activities, within a walking radius encourages accessible and equitable mobility, as well as efficiency in travel time and cost, hence boosting each commuters' productivity and socioeconomic well-being.

However, the ideal conditions for this goal can be achieved if daily commuters in the Jakarta Metropolitan Area utilized TOD mixed-use optimally. This optimization can be realized through providing designs that reflect their needs and preferences based on local context. This argument aligns with an architectural design theory which emphasises the critical importance of an appropriate design for any developments should reflect users' needs, local context, and the characteristics and value of a dwelling space (Goldman, 1970; Rapoport, 1980; Mangunwijaya, 2009). Commuters' socio-demography background and mobility patterns influence their preferences in the design of spatial development, often attributed to different psychological considerations, social roles, and physical body shape (Lowe and Stevens, 2010; Nurhijrah, 2018). These factors also influence individuals' experience of space and sets their behaviour (Zou and Ergan, 2019; Justin et al, 2020). However, the existing approach in Spatial Planning Regulation No. 16/2017, as the TOD guidelines basis, remains general and insufficiently specific to represent the needs and preferences of users from various communities, including commuters, as evidenced by the direction of development objectives (article 4) and technical guidelines design (articles 6-8). In this case, the aim of developing TOD mixed-use areas in article 4 solely relates to promote the sustainable mobility generally, without addressing commuting mobility activities, which

play an important part in the issue of sustainable mobility in Indonesia. Furthermore, the technical design guidelines in articles 6–8 solely depend on the readiness state of supporting facilities and infrastructure, land carrying capacity (vulnerability and disaster risk), land status and permits, and socioeconomic conditions of the community, which determine the type of activity that dominates. Meanwhile, the community needs and preferences aspects are not included as one of the design considerations in this technical guideline. Based on this policy gap, this study aims to propose design reformation of TOD mixed-use in the Jakarta Metropolitan area into more-inclusive based on the specific needs and preferences of daily commuters in order to support the optimization of its function and value.

2. Material and Methods

Data collection through questionnaire surveys based on research ethics and observation was conducted for two months in 1st August until 30 September 2023. Questionnaire surveys were distributed to 1,697 respondents, which the number was obtained using Slovin calculations from a total population of 4,410,400 commuters, with a 3% error rate (Central Statistics Agency, 2024). Respondents were selected randomly using a purposive sampling method with several criteria. First, daily commuters who work/studying and live in the Jakarta metropolitan area with the differences in administrative areas, that are divided into six regions: Jakarta, Bogor, Depok, Tangerang, South Tangerang, and Bekasi. Second, daily commuters were $\geq$ 18 years old, which this age limitation indicates a person's independence, capacity, and authority to make decision and act, as stipulated in Indonesian civil and criminal law (Supreme Court, 2011). Third, daily commuters who have carried out daily commuting trips for $\geq$ 2 years when this research survey was conducted in 2023. This criteria aims to select respondents based on their amount of familiarity with commuting activities, including the dynamics of changes in mobility patterns prior, during, and following the Covid pandemic.

This survey activity aims to collect data that will be utilized as a reference base for reforming the existing design of TOD mixed-use in the Jakarta Metropolitan Area. The data was grouped into four categories, which were ordered according to the context of the inquiry, from most general/basic to most specific. This structuring also represents the interrelationship of each question variable. In this case, the commuters' characteristics questions, both socio-economic and mobility, were placed in the initial position as opening questions with closed questions (multiple choice). At the next level, the closed question was directed at determining the main trigger factors for TOD mixed-use needs, priority needs, and design preferences, as described in more detail in Table 1.

The information of each question variable was specifically described using sub-variable questions (Table 1). In this study, the sub-variable questions in the commuters' characteristics variable correspond to the description of the characteristics of Jakarta metropolitan commuters presented in various Central Statistic Agency reports, while the sub-variable questions in the main trigger factors and priority needs variables were adapted from several previous TOD studies regarding commuters' preference in choosing housing and workplace location (Hasibuan and Mulyani, 2022) as well as socio-cultural characteristics in the residential and land use dimensions (Hasibuan and Permana, 2022).

Table 1. Variables and Sub-variables.

Variables	Sub-variables
Commuters Characteristics	Gender
	Marital Status
	Domestic Role Busyness
	Type of Daily Activity
	Income
	Social Role Busyness
	Daily Activity System
	Weekly Mobility
	Origin/Destination (OD)
	Travel Distance
	Travel Time
Main Trigger Factor	Travel Distance
	Travel Time
	Travel Cost
	Physical Condition
	Domestic Role Busyness

	Social Role Busyness
	Family Proximity
Priority Need	Ease of Access
	Price Affordability
	Public Facilities Completeness
	Social Facilities Completeness
	Family Proximity
Design Preference	Rental Price Affordability
	Purchasing Price Affordability
	Facility Need

(Source: Central Statistic Agency, 2014; Central Statistic Agency, 2019; Central Statistic Agency, 2024; Hasibuan and Mulyani, 2022; Hasibuan and Permana, 2022).

All survey data obtained was analyzed using descriptive analysis methods including crosstabulation and frequency analysis, regression, and weighting method. The frequency analysis method (Fisher and Marshall, 2009) was employed to describe the characteristics pattern (i.e., sociodemographic and mobility aspects) of commuters who need TOD mixed-use. This wa followed by identifying the main trigger factors though the weighting method (Ahn, 2011) as depicted in Formula 1 with the following explanation: the values W, k, and i denote the weight size, amount of data, and priority level. In our study weight value (W) at each priority level was different: priority 1 (0.46), priority 2 (0.26), priority 3 (0.16), priority 4 (0.09), and priority 5 (0.04). After this step regression analysis (Sarstedt & Mooi, 2019) was conducted to measure the significance of the main trigger factors that influence priority needs. To complement the analysis of the priority needs, the frequency analysis and cross-tabulation (Wildemuth, 2009) were conducted on the variables of design preference related to rental, purchasing price affordability, and facility need:

$$W_k = \frac{1}{k}\sum_{i=k}^{k}\left(\frac{1}{i}\right) \tag{1}$$

The results of these analyses were compared with the results of the spatial and descriptive analysis. Spatial analysis was conducted using overlay method on data (1) Buildings from Google Eart Engine open buildings, (2) Roads from Open Street Map, (3) Indonesian Landforms from BIG, and (4) land use from Jakartasatu to identify land use arrangements and existing distribution patterns in the four TOD areas were selected as observation locations, including Dukuh Atas, Rawa Buntu, Jaticempaka, and Pondok Cina (see Figure 1). Meanwhile, a descriptive analysis was conducted to further investigate the suitability of the Government's policy document, i.e., TOD mixed-use technical design guideline for commuters' needs.

Figure 1. Four observed TOD areas of Dukuh Atas, Rawa Buntu, Jaticempaka, and Pondok Cina, in the Jakarta Metropolitan area through map overlay method (2023).

Findings from the entire analytical processes were used as a reference basis to propose reform of the existing TOD mixed-use design. Figure 2, the Design Thinking Method, represents all the research steps within our methodology. Design Thinking (Lockwood, 2010; Chou, 2018) is a method to produce quickly an architectural design, design product, branding, and information system through a process of investigating spatial problems by applying intuition and logic, concept and execution, control, and balance empowerment (Robbins, 2018). It has six stages: four initial stages consist of understand, observe, interpret, and ideate, together representing the concept structuring; the last two stages represent the design structuring.
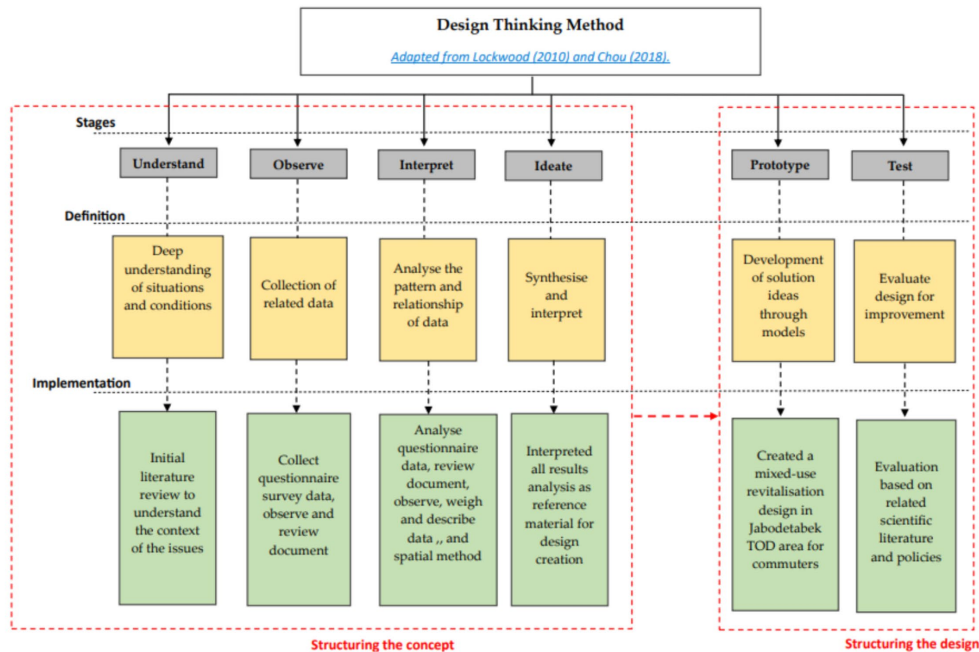

Figure 2. Design Thinking Method adapted from Lockwood (2010) and Chou (2018).

3. Results and Discussion

3.1. Commuters' Needs for TOD Mixed-Use Design

Our frequency analysis showed that 65.94% of respondents required a TOD mixed-use with female commuters accounting for 62.56% of the total respondents. They were mostly unmarried (76.14%), not busy domestically (80.43%) but are busy socially (89.19%) (Table 2). The majority of our respondents were workers (56.39%) with a monthly income of 1.5 to 6 million IDR (51.02%), followed by >6–18.5 million IDR (33.93%), <1.5 million IDR (10.84%), and >18.5 million IDR (4.21%). On monthly basis, 44.63% of them allocated >0.5–1 million IDR or 17–33% of their income for travel costs, while those who allocated >1 million IDR accounted for only 24.87%. This shows that only a small percentage of commuters allocated more that 33% of their monthly income for travel expense.

In terms of mobility characteristics (i.e., Daily Activity System) 45.66% respondents who required TOD mixed-use conducted their daily activities through offline method or in-person; hybrid (39.95%) and online (14.39%). The pattern of mobility can also be seen from the frequency of our respondents travelling to work on a weekly basis dominated by 5 days/week (45.66%), followed by > 5 days/week (15.46%), 4 days/week (11.35%), 3 days/week (10.81%), and <3 days/week (9.56%). This pattern of mobility suggested that those who need TOD mixed-use were those who are required to commute more often. Average daily travel time was >2–4 hours or >1–2 hours per trip (50%), with >25–40 km being the most common travel distance (35.06%). The sequence of travel distance also revealed that those with longer travel distances, except for > 40 km, were more interested in residing in mixed-use TOD areas, coming from the suburbs and conducting their daily activities in urban areas (see Table 2).

Table 2. The characteristics of commuters who need TOD mixed-use.

Characteristics	Indicators	Total n	Total %
Gender	Male	419	37.44
	Female	**700**	**62.56**
Marital status	Married	267	23.86
	Unmarried	**852**	**76.14**
Domestic Role Busyness	Busy	219	19.57
	Not Busy	**900**	**80.43**
Type of Daily Activity	Working	**631**	**56.39**
	Studying	340	30.38
	Working and studying	148	13.23
Income	<1.5 million/month	85	10.84
	1.5-6 million/month	**400**	**51.02**
	>6-18.5 million/month	266	33.93
	>18.5 million/month	33	4.21
Social Role Busyness	Busy	**998**	**89.19**
	Not Busy	121	10.81
Daily Activity System	Hybrid	447	39.95
	Online	161	14.39
	Offline	**511**	**45.66**
Weekly Mobility	<3 days/week	107	9.56
	3 days/week	121	10.81
	4 days/weeks	127	11.35
	5 days/weeks	**591**	**52.82**
	>5 days/weeks	173	15.46
Origin/Destination (O/D)	Suburban/Urban	**917**	**81.95**
	Urban/Suburban	98	8.76
	Suburban/Suburban	104	9.29
Travel Distance	0-15 km	298	26.62
	>15-25 km	312	27.92
	>25-40 km	**392**	**35.06**
	>40 km	117	10.4
Travel Time	30-45 minutes	479	42.77
	>45 minutes-1 hours	34	3.01
	>1-2 hours	**560**	**50.00**
	>2 hours	46	4.22
Travel Cost	0-0.5 million/month	341	30.50
	>0.5-1 million/month	**499**	**44.63**
	>1-2 million/month	164	14.69
	>2 million/month	115	10.18

Notes: Income is in IDR (Indonesian Rupiah), 1 US$ is equivalent to 16,249 IDR.

The demand for TOD mixed-use was mostly driven by three main trigger factors, i.e., travel distance, travel time, and travel cost (Table 3) implying that respondents' needs for TOD mixed-use were driven by mobility factors. The next attributing factors were physical condition, social role busyness, domestic role busyness, and family proximity (Table 3).

Table 3. The main trigger factors of respondents' need for TOD mixed-use.

Point	Travel Distance	Travel Time	Travel cost	Physical condition	Social Role Busyness	Domestic Role Busyness	Family Proximity
1st place	4,208	1,560	1,280	952	232	192	360
2nd place	1,638	3,976	917	462	287	420	231
3rd place	1,152	1,026	3,018	768	432	198	120
4th place	310	490	700	2,405	960	425	265
5th place	116	140	300	556	1,924	692	588
6th place	39	81	258	213	426	1,392	777

7th place	92	28	24	190	210	478	1,064
Total	7,555	7,301	6,497	5,546	4,471	3,797	3,405
Priority	**1**	**2**	**3**	**4**	**5**	**6**	**7**

The overall results show that to reduce travel distance the majority of our respondents need to live within TOD mixed-use areas which aligns with the finding that respondents who require TOD mixed-use live in a longer distance from urban areas. This finding indicates that accelerating the suburban growth by creating a road network connecting urban and suburban areas (Henderson and Kuncoro, 1996; Winarso and Firman, 2002; Hudalah 2013) is no longer necessary. Currently, acceleration is dictated by distance and time, therefore future mixed-use TOD development in suburban regions must incorporate these two factors. In our case study frequency analysis revealed that more than half of commuters' travel distance was longer (i.e., 15–40 km) than those found in 99 metropolitan areas across 25 countries whose maximum commuters' travel distance was 13.63 km (Moovit, 2020). This circumstance in our study affects travel time which typically exceeds the threshold of ≤ 40 minutes (Sorokin and Kastornova, 2004). Moreover, the long duration of mobility is exacerbated by the offline daily activity system (or in-person as opposed to on-line) and the requirement for 5 days or more of weekly mobility. The long duration of travel can result in transport fatigue (Mikhailov, 2003) affecting commuters' psychological and physiological state as they experienced uncomfortable travel conditions (Kopytkov et al., 2018). This fatigue led to decreased productivity, lower work quality, higher psychological distress, and household instability (Ilina, 2016) which may explain the phenomenon of busy social role held by almost 90% of our respondents (Table 2). Reducing distance and mobility duration through the provision of TOD mixed-use can affect the appropriate balance of social role busyness and hence support productivity. However, they will not affect the domestic roles busyness since only a small proportion of respondents with unbusy domestic roles (i.e., 19.57%) may require TOD mixed-use (Table 2). Our finding on social role business (i.e., 89.19%) correlates with the high proportion of unmarried status (i.e., 76.14) amongst our respondents. However, our data does not align with the proportion of commuters in the Jakarta metropolitan area in general which according to Government's data is dominated by married status at 54.5% (Central Statistics Agency, 2024). With regards to gender distribution patterns our respondents requiring TOD mixed-use with unmarried status and unbusy domestic role were dominated by females. Traditionally, domestic role responsibilities are held mostly by married women which in turn influenced their mobility preferences which typically required time and distance efficiency (Nisic and Kley, 2019). With regards to domestic roles, female commuters in the Jakarta metropolitan region prioritise family proximity when deciding where to live (Hasibuan and Mulyani, 2022).

To this end, the relative commuters high need for TOD mixed-use triggered by the factors of travel distance and travel time (Table 3) is primarily attributed to the heavy social role of unmarried female commuters. The cultural transformation and economic demands in recent time have driven unmarried urban females to compete in various professional sectors (Wei and Acker, 2018). The high percentage of respondents within the low and middle-income groups (Table 2) also illustrates that heavy social roles are of a consequence in the quest for economic prosperity. The low and middle-income society groups as defined by the World Bank consist of people earning between 2 and 20 US$ per day, equivalent to between 0.96 and 9.6 million IDR per month. Our respondents' limited monthly income affects the travel costs they can afford (Table 2) with minimising travel spending a strategy to reduce monthly expenses. This factor ranked third in determining commuters' reason for living within TOD mixed-use areas (Table 3). Table 4 outlines the relationship between the trigger factors (Table 3) and commuters' priority needs with regards to TOD mixed-use, beginning with price affordability, followed by ease of access, public facility completeness, and social facility completeness. The regression results suggest that price affordability is the key component that must be addressed to meet mixed-use TOD development goals (Curtis and Scheurer, 2010; Thomas and Bertolini, 2017; Gu et al., 2019) in the Jakarta metropolitan area.

Table 4. The significant influence of the main trigger factors on the priority needs in TOD mixed-use areas.

Main Trigger Factors	Priority Needs									
	Ease of Access		Price Affordability		Public Facility Completeness		Social Facility Completeness		Family Proximity	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Travel Distance	0.155	0.000	**0.231**	0.000	0.150	0.000	0.055	0.007	0.013	0.538
Travel Time	0.157	0.000	0.132	0.000	0.080	0.000	0.048	0.044	0.119	0.000
Travel Costs	0.186	0.000	0.168	0.000	0.114	0.000	0.076	0.000	0.033	0.085

Physical Condition	0.092	0.000	**0.093**	0.000	0.105	0.000	0.184	0.000	0.101	0.000
Social Role Busyness	0.101	0.000	**0.158**	0.000	0.107	0.000	0.100	0.000	0.029	0.150
Domestic Role Busyness	0.111	0.000	0.055	0.008	0.101	0.000	0.110	0.000	0.091	0.000
Family Proximity	0.056	0.003	**0.092**	0.000	0.104	0.000	0.113	0.000	0.225	0.000

Notes: Coef (coefficient value), **Sig. (**significance value).

The findings from the regression analysis (Table 4) explain in detail the position of price affordability as the main priority influencing commuters' need for TOD mixed-use, caused by its highest coefficient value. The positive coefficient value also illustrates the linearity of the relationship between main trigger factors and priority needs. In this case, the magnitude of the influence was represented by the significance of a value lower than the limit of 0.05. As shown in Table 4 most of the relationship had a p-value of 0.000, indicating high influence. Family proximity has the smallest impact on the priority needs of TOD mixed-use in relation to ease of access (0.003). However, it outweighed the considerable effect of domestic role busyness on price affordability (0.008), as well as the travel distance and travel time on social facility completeness. The regression analysis also showed that travel distance did not exhibit a significant relationship with family proximity because its p-value was 0.538, greater than the insignificant value of travel costs and social role busyness factors in relations to family proximity of 0.085 and 0.150.

In addition to these key findings, the analysis reveals the significant role that factors like travel costs, physical condition, and social role busyness play in shaping the priority needs for TOD areas. Travel costs and physical condition consistently demonstrate positive effects on ease of access and price affordability, reinforcing the notion that lower travel costs and well-maintained infrastructure are crucial for enhancing the appeal of TOD areas. Similarly, social role busyness was found to influence the need for social facilities and public amenities, highlighting how commuter lifestyles and responsibilities impact their preferences for TOD environments. Ultimately, these insights suggest that TOD developments must address a combination of accessibility, affordability, and livability factors to meet the diverse needs of commuters effectively.

The results of the our regression analysis highlight that the development of mixed-use design of TOD areas in the Jakarta metropolitan area must also consider price affordability in addition to ease of access which has become Government's primary focus as outlined in the Spatial Planning Policy of 2017 (SP Ministry, 2017). In this context, the high significance value of affordability implies that the high number of commuting mobility in the Jakarta Metropolitan area is closely related to the phenomenon of gentrification of the urban center, which is characterized by increasing land and property prices (Harris, 2008). As a results, the provision of TOD mixed use to minimize commuting mobility must be supported by an affordable marketing system, which, in accordance with the TOD principle (Ewing and Cervero, 2010), must be classified based on the differences of commuters' financial ability. The results of our cross-tabulation (Table 5) revealed that commuters' financial ability depends on their monthly income. Respondents with higher monthly income were more likely to be able to rent or purchase residences within TOD mixed-use areas.Those with a monthly income of <1.5–6 million IDR can afford rental and purchasing prices of <1 million IDR/month and <200 million IDR. Meanwhile, those with a monthly income of <6–18.5 million IDR can afford rental and purchasing prices of <2–4 million IDR/month and <400–600 million IDR indicating that most respondents can afford to pay 30% of their monthly income for rent. In our study, those who chose the rental system constituted 53.53% of the total number of respondents, outnumbering those who chose ownership system (46.47%). This pattern suggests that TOD mixed-use was perceived only as transit spaces and was not intended for permanent residency. Considering the income distribution shown in Table 2 and findings shown in Table 5 the development of TOD mixed-use with a rental system and prices of <1 million IDR/month needs to be prioritised and pursued further to suit commuters' needs and affordability.

Table 5. Respondents' price affordability of TOD mixed-use based on their income level.

Price Affordability	Income Level/Month (%)			
	<1.5 Million IDR	1.5–6 Million IDR	>6–18.5 Million IDR	>18.5 Million IDR
Rental Price (Million IDR/Month)				
<1	**18.60%**	**59.30%**	20.93%	1.16%
1–2	8.94%	54.89%	34.47%	1.70%
>2–4	10.81%	33.78%	**51.35%**	4.05%
>4–6	0.00%	30.00%	50.00%	**20.00%**
>6	0.00%	10.00%	10.00%	0.00%
Purchase Price (Million IDR/Month)				
<200	**13.48%**	**63.12%**	21.28%	2.13%
200–400	5.81%	50.32%	38.06%	5.81%
>400–600	6.12%	18.37%	**59.18%**	16.33%
>600	8.33%	33.33%	33.33%	**25.00%**

Notes: 1 US$ is equivalent to 16,241 IDR (Indonesian Rupiah).

In terms of accessibility the design and development of TOD mixed-use areas must consider the completeness of facilities, in addition to the importance of the integration of a mass public transportation system. Ewing and Cervero (2010) assert that facility completeness is crucial for achieving destination accessibility in TOD mixed-use implementation following the diversity principle. The facility's completeness can minimise distance traveled resulting in easy and equitable access.

Our frequency analysis (Table 6) found that 46.47% of respondents required Green Open Space (GOS) facilities within TOD mixed-use designs followed by public facilities (27.17%), commercial areas (9.38%), recreation areas (6.97%), social facilities (5.09%), and others (4.47%). GOS as the most prioritised or preferred facility was cited by our respondents across all characteristics, followed by public facilities, commercial areas, and recreation areas. These four types of facilities cited as the top four most needed facilities by commuters thus needs to be prioritised in the future design of TOD mixed-use areas. In contrast, social facility ranked as a low priority and within some groups of respondents it ranked last or was not mentioned. These results demonstrated changes in the types of TOD mixed-use facilities needed or preferred commuters. Data collected in 2013 and 2020 (Hasibuan and Mulyani, 2022) showed that commuters in the Jakarta metropolitan area, especially in the west suburbs, required more public facilities than GOS. Moreover, Hasibuan and Permana (2022)'s earlier research also showed that public and social facilities were the top two priorities of TOD facilities needed by commuters with GOS in third or fourth place, followed by commercial area then recreation area. These changes mean that commuters' need for GOS, commercial areas, and recreation areas has increased, whereas the need for social facilities has decreased. In our present study, commercial areas include not only shopping centres but also workplaces. Public facilities and amenities include commuter line, Light Rapid Transit (LRT), and Mass Rapid Transit (MRT) stations, as well as Bus Rapid Transit. (BRT/TransJakarta) stops, while social facilities include education, health, and religious facilities.

Table 6. TOD mixed-use facilities required by commuters.

Characteristics	Facility Function (%)					
	GOS	Recreation Area	Commercial Area	Public Facility	Social Facility	Others
Gender						
Male	46.06	8.11	9.07	25.54	4.30	6.44
Female	46.71	6.29	9.57	28.14	5.43	3.29
Marital Status						
Married	44.57	7.87	10.47	30.71	2.62	3.75
Unmarried	47.07	6.69	9.04	26.06	5.87	4.69
Domestic Role Busyness						
Busy	44.75	9.13	10.50	29.68	2.28	3.65
Not Busy	46.89	6.44	9.11	26.56	5.78	4.67
Social Role Busyness						
Busy	46.39	6.91	9.42	27.35	5.01	4.61
Not Busy	47.11	7.44	9.09	25.62	5.79	3.31

Type of Daily Activity						
Working	43.11	7.77	9.35	30.11	4.60	4.60
Studying	48.53	5.88	8.53	25.29	6.47	4.71
Working and Studying	56.08	6.08	11.49	18.92	4.05	3.38
Weekly Mobility						
<3 days/week	53.27	8.41	8.41	22.43	4.67	2.80
3 days/week	47.11	6.61	6.61	25.62	7.44	5.79
4 days/weeks	44.88	7.09	12.60	25.20	4.72	4.72
5 days/weeks	44.33	7.61	7.95	30.12	4.91	4.74
>5 days/weeks	50.29	4.05	14.45	22.54	4.62	3.47

3.2. The Current TOD Mixed-use Design

Results of our spatial analysis of the four observed TOD locations (Table 7) revealed that the existing land-use function within urban and suburban TOD zones was dominated by residential areas. The distribution percentage of land-use in each zone showed that the TOD zone in urban areas had a smaller residential area coverage compared to those in the suburbs. For example, Jaticempaka, located within a suburban TOD zone, had the highest residential area coverage (69.55%), followed by Rawa Buntu (40%) and Pondok Cina (31%). However, the coverage of residential areas in Jaticempaka exceeded the TOD technical guidelines standard as outlined within the Spatial Planning Regulation No.16/2017. This Regulation governs that the residential area coverage within urban TOD zones should be between 20% and 60% of the total area and 30%-60% in the suburban. This Regulation also specifies a 20% coverage limit for GOS in both urban and suburban TOD zones. This means that the GOS area coverage in our three observed locations did not conform with the Regulation: while the GOS area in Rawa Buntu (suburban) only just meet the 30% minimum requirement, with the other three zones far below the minimum requirement (Table 7).

Table 7. The existing land and building use in the four observed TOD locations.

TOD Location	Existing Land and Building Use (%)						
	GOS	Recreation Area	Commercial Area	Public Facility	Social Facility	Residential	Other
Dukuh Atas	10	0	21	3	5	**29**	31
Rawa Buntu	31	0	2	0	1	40	25
Jaticempaka	9.79	0	0.12	0.10	0.68	69.55	19.75
Pondok Cina	7	0	4	0	31	31	26

Notes: Duku Atas (urban), Rawa Buntu (suburban), Jaticempaka (suburban), Pondok Cina (suburban).

Moreover, the non-existence of a recreation area in all TOD observed locations and specifically in Dukuh Atas (an urban TOD zone) further emphasised that the TOD technical guidelines had not been fulfilled. The Regulation asserts that recreation areas must be provided alongside mixed-use residential, commercial areas, offices, and public facilities (Spatial-Planning-Ministry, 2017). The coverage area of public facilities in Dukuh Atas only reached 3% of the total area and social facilities (5%). The commercial area had a larger coverage of 21% and the residential area of 29%, a coverage distribution which can be attributed to the function of Dukuh Atas as a business centre and commercial district, in addition to being the primary transit zone of all TOD locations in the Jakarta metropolitan area. The land-use proportion in Pondok Cina TOD zone was also influenced by the regional function. Serving as an education centre, Pondok Cina has resulted in the massive development of social facility accounting for 31% of the total area with the same percentage as the residential area (Table 7). In this TOD zone other land-use functions were either extremely limited or nonexistent: commercial (4%), recreational areas (0%), and public facility (0%). A similar condition was also found in Rawa Buntu TOD zone: commercial areas (2%), public facility (0%), and recreation areas (0%). These data demonstrate that both Rawa Buntu and Pondok Cina TOD zones (within the suburbs) also did not comply with the Government's land-use requirements through which public facilities must be provided alongside other facilities (Spatial-Planning-Ministry, 2017). The Jaticempaka TOD zone, whilst meeting the land-use requirements for public facilities (0.10%), commercial area (0.12%), and social facility (0.68%), did not meet the requirement standard for recreation area (0%) and GOS (9.79%).

To this end, our research findings and discussion highlight the following key interrelated points. The

function and conditions of the socio-economic and urbanisation growth in the (sub)urban areas surrounding each of the TOD zones determined the dominant patterns of the existing land use types: while urban TOD was dominated by residential and commercial areas, the suburban was generally dominated by residential areas. Other land-use functions only exhibited a small percentage of the total land area or were non-existent within some TOD zones. This means that the development of mixed-use design in the four observed TOD zones has not been implemented optimally in relation to the five TOD principles (5D). The main shortfall includes the lack of the development of diverse land use that can accommodate the dwelling needs to achieve smooth destination accessibility. The concept of dwelling becomes key as it includes the entire sequence of human activities to preserve human existence, not only manifested through fulfilling physiological needs but also psychological, spiritual, economic, and other needs (Wolford, 2008). In the context of spatial planning, the fulfillment of dwelling needs is also influenced by the design composition including the proportion and arrangement of all spatial elements (Wolford, 2008; Elizandri et al., 2017). In our study, these elements can be interpreted as the types of land-use. The composition of land-use design in the Jakarta metropolitan' TOD zones followed the Government's policy on the TOD Spatial Structure Guideline (Figure 3).
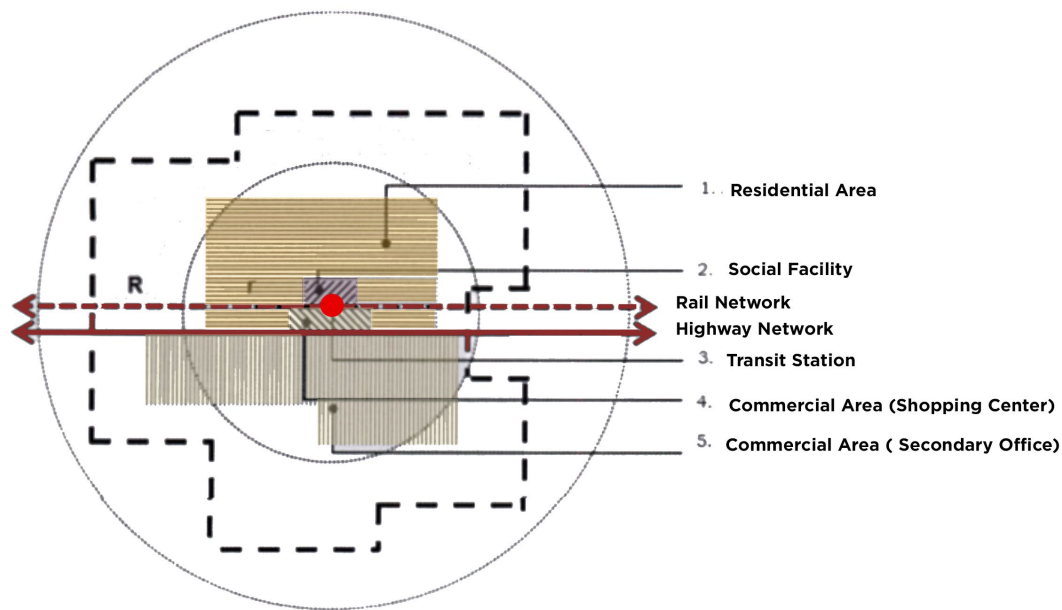

Figure 3. TOD spatial structure guideline in the Jakarta metropolitan area. Source: The Spatial Planning Ministry (2017) with some modifications by the author 2024.

Following the Government's Guideline as depicted in Figure 3, transit areas which include the stations of Commuter Lines of MRT, LRT, and BRT stops are located at the centre of the spatial structure surrounded by various land uses including commercial areas, social facilities, and residential areas. Commercial areas consisting of retail, offices, restaurants and recreation areas are located 400 m from the transit centre and are equipped with GOS facilities. Social facilities, also located within this radius, are accompanied by plaza and park facilities to support the residential and office areas. Residential neighborhoods with diverse housing types, prices and densities are located within 800 m from the transit centre. This Government's Guideline was implemented in the spatial structure of Dukuh Atas TOD zone where the transit stations were integrated with social facilities and commercial areas within a 400 m radius. They were also connected with GOS in the form of parks, vacant land, and green belts along arterial and protocol roads, and with riverbanks in the zone centre (Figure 4). Several commercial areas, specifically shopping centres, were directly integrated with residential areas in the mixed-use high-rise buildings located at the core of the transit hubs. Unique findings which seem to be in contradiction with the TOD 5D principles are as follows; the single-use residential area was located behind the commercial area and had access to a variety of social and GOS facilities; planned settlements were within 800 m radius from the core spatial structure; unplanned settlements were >800 m or in the outermost layer of the structure (Figure 4); the planned settlements were inhabited by upper middle-class residents while the unplanned settlements were mostly inhabited by mass public transportation users from the lower-middle income class.

Figure 4 illustrates differences in the implementation of the spatial structures within the suburban

TOD zones. In Pondok Cina the Commuter Line Station that serves as a transit centre was directly integrated with various social facilities, commercial and residential areas within a 400 m radius without a particular socio-economic classification. It lacked sufficient GOS facilities, existed only along the riverbank and vacant land within dense settlements which differs from other suburban TOD zoneswhere transit centres were surrounded by green spaces. The GOS surrounding the Jaticempaka transit centre mostly existed within vacant land, homeowners' gardens existed within unplanned residential neighborhoods, and parks existed within planned residential districts. These types of residential neighborhoods were dominated by landed housings, whereas vertical housing existed within a 400m radius from the LRT stations as transit centres. This vertical housing was integrated with commercial areas in a mixed-use high-rise building (Figure 4).
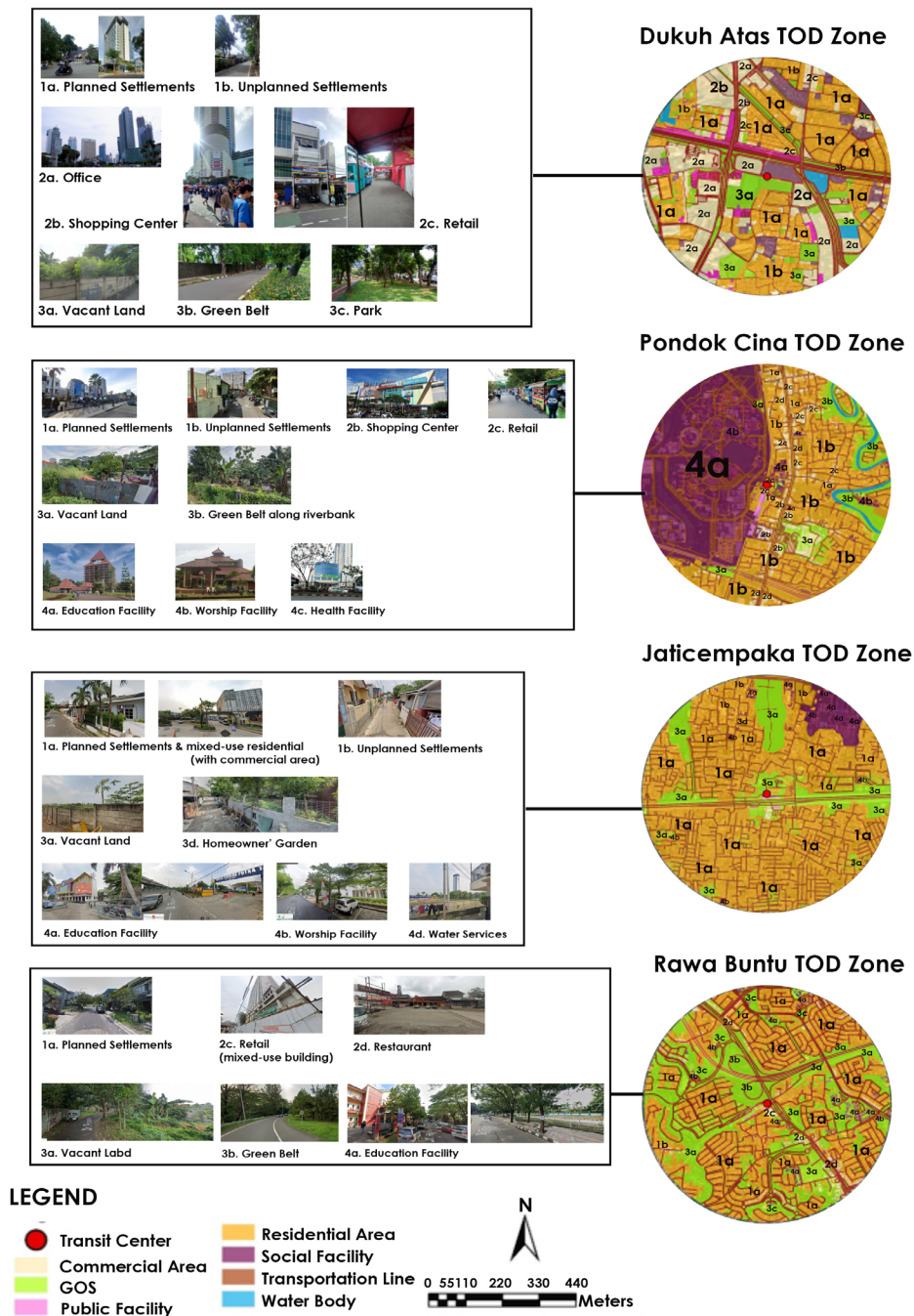
Figure 4. The implementation of the spatial structure in the four observed TOD zones in the Jakarta Metropolitan area i.e., Dukuh Atas, Pondok Cina, Jaticempaka, and Rawa Buntu (authors observed 2023 and 2024).

Social facilities, specifically educational, worship, and water services, were concentrated in the outermost of the spatial structure. A similar spatial structure was also observed in Rawa Buntu which was dominated by planned settlements with GOS facilities, green belts and parks, as opposed to unplanned settlements concentrated around Commuter Line stationscentre. Social facilities, such as education, worship, and health facilities, as well as commercial areas specifically retail and restaurants, were also concentrated within the planned settlements. These conditions were influenced by the rapid growth of 'Kota Mandiri' (i.e., independent city) surrounding the Rawa Buntu TOD zone. To this end it can be inferred that the implementation of the spatial structure guidelines within each of the TOD zones was largely influenced by development trends within the areas where TOD zones exist. Consequently, TOD mixed-use designs must be reformed according to the current progress in local urban and suburban development.

3.3. Recommendation: TOD Mixed-Use Design Reform

Our research findings and analysis provide the following insights; reform in TOD mixed-use designs for its future implementation in the Jakarta metropolitan area is paramount to suit the needs and preferences of its commuters. The reformed designs should include the classification of ownership systems and price range of residences including a rental pricing system. Following our findings 9.8% of the residential space within TOD mixed-use areas must be allocated to commuters with > 50%provided through a rental system. Rental prices should be classified according to the proportion of commuters' affordability, i.e., for 51.02% of residences the price should be set between 1 and 2 million IDR/month, a price level that suits commuters with an income of between 1 and 5-6 million IDR/month. Rental prices between 2 and 4 million IDR/month should be provided for those with an income of >6-18.5 million IDR/month (Figure 5). Furthermore, the number of permanent residences should be planned to serve 46.47% of commuters, of which 42.25% of the purchase prices should be between 200 and 400 million IDR. This level of pricing should be intended primarily for commuters who earn 1.5 to 6 million IDR/month, although they can also acquire housing for <200 million IDR. Those with higher incomes can be targeted to purchase permanent housing at higher prices (Figure 5). Our recommendation for TOD Mixed-use Design Reform for its future implementation in the Jakarta metropolitan area, both within urban and suburban areas, is depicted in the following Figure and is intended to prompt further discussion and debate amongst TOD scholars and policy makers.
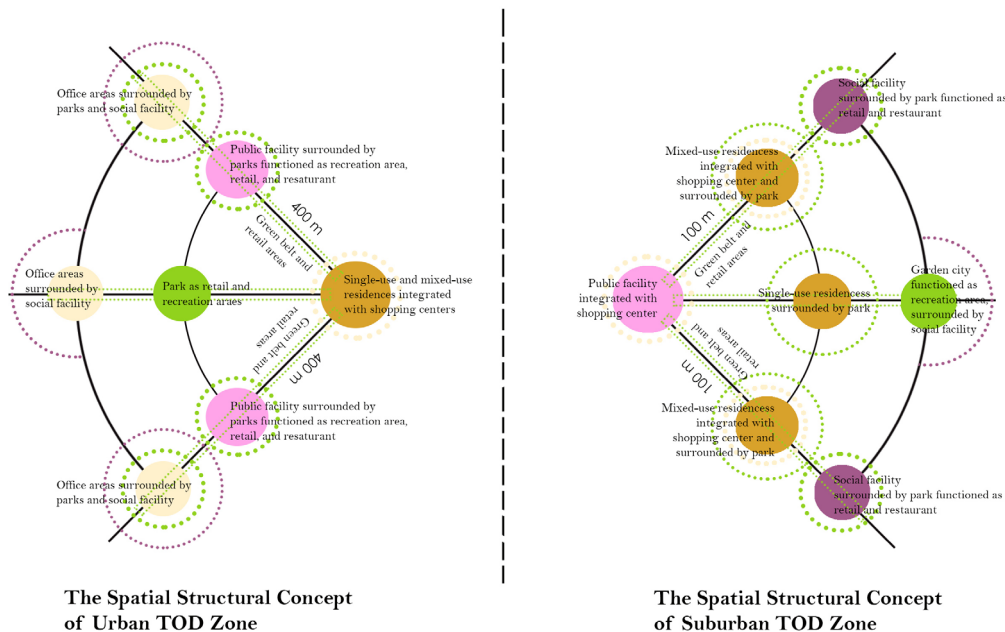

Figure 5. The Spatial Structural Concept of Urban and Suburban TOD Zone.

As shown in Figure 5 our proposed TOD Mixed-use Design Reform is as follows; the key difference between our design and that existing per the Government's Guideline is that we differentiate between urban spatial structures and those suburban, a differentiation which is essential given the differences in their spatial function - urban areas serve as the centre of citizen activities for the whole Jabodetabek, specifically for work and commerce, while the suburban serve as the centre of residential living.

Following our present findings and those of Hasibuan and Mulyani (2022), and since commuters do not have either the freedom or ability to change their workplace (i.e., employers hold the ultimate power), it is important that workplaces are located within the urban TOD zone. Specifically, offices should be located within 0–400 m radius from the transit centre of commuter lines, including BRT, MRT, and LRT and within 400–800 m radius from the transit centre an integrated mixed-use of commercial facilities, including retail and shopping centres, should exist. In short, the placement of offices, residential areas, retail, and shopping centres within 0–800 m radius from a transit centre aims to improve the efficiency, accessibility and effective mobility of workers and residents thereby increasing the motivation to use public transport, walk, or cycle. Meanwhile in suburban TOD zones the 0–800 m radius should comprise predominantly the mixed-use of residential and social facilities.
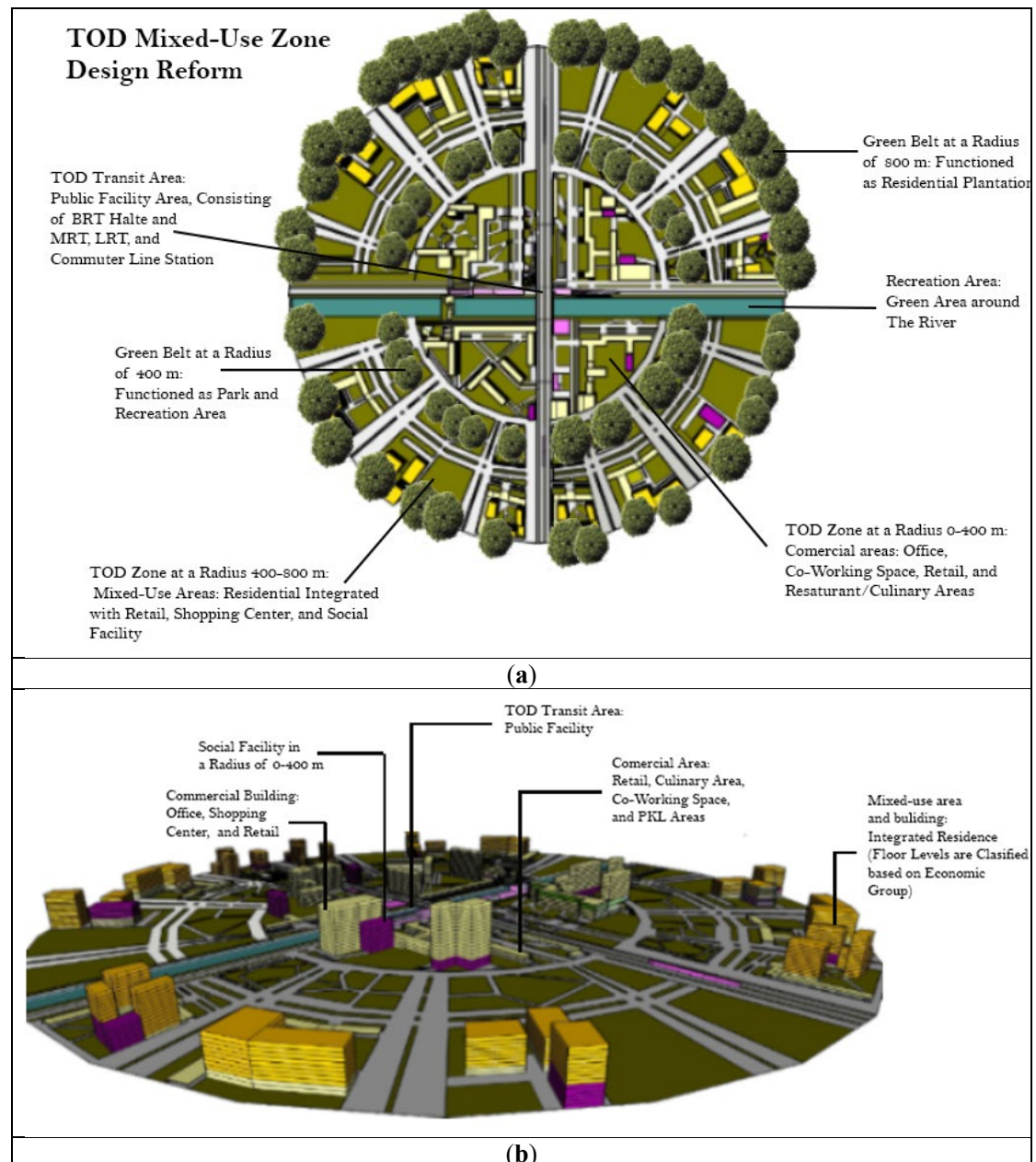

(a)

(b)

Figure 6. The reformation design model: (**a**) classification area based on the radius, (**b**) land and building use details.

Figure 6 shows the proposed reform of TOD are including 5D of TOD's principle:

1. Design: Expanding green open space, as central park and landmark which functioning as social hub, retail, recreation areas, and co-working space.

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2. Diversity: each of different diversity function of land use: public facilities, mixed-use residential, office areas surrounded by the green line or green buffer zone, which functioning as micro-climate effect, thermal comfort zone, and friendly pedestrian.
3. Density: providing inclusive mixed-use residential at affordable prices to increase number of populations in TOD area. The increased density and the introduced mixed-use services have enhanced residents' interaction and contribute to a more socially sustainable community (Shekfa and Galal, 2022)
4. Destination accessibility: Green line dominates the circulation and access for interconnectivity between pedestrian, cycling to the mass transportation.
5. Distance from the mixed use residential to other facilities in a walking distance, radius 800 m, and with the green line along TOD and green open space distributed in TOD area will impact on the comfortable distance walking.

4. Conclusion

Our study revealed that the approach in the existing TOD guideline does not yet represent the reality conditions, necessitating a further bottom-up investigation with the user community participation. Based on research findings, the inevstigation should be expanded to include integrating the TOD mixed-use concept with gender inclusivity along with other socio-economic context, providing an affordable market system for the middle class, calculating density intensity and land use proportions based on physical, socio-cultural, and economic aspects, and regulating land use connectivity accessibility based on economic and socio-cultural aspects. On the other context, this study also highlights that the need for TOD mixed-use development in the Jakarta metropolitan area is associated not only to mobility issues caused by urban sprawl, such as traffic congestion, but also the changes in employment and industrial systems, which have implications for cultural shifts. This underlines the need for more complicated design reform in TOD mixed-use in the future based on short, medium, and long-term assessments of multidisciplinary city development.

List of Acronyms

Acronym	Expanded Form
TOD	Transit Oriented Development
UN	United Nations
JICA	The Japan International Cooperation Agency
JABODETABEK	Jakarta Metropolitan Area includes: Jakarta, Bogor, Depok, Tangerang, and Bekasi
COVID-19	Corona Virus Disease 2019
GOS	Green Open Space
Coef.	coefficient value
Sig.	significance value
LRT	Light Rapid Transit
MRT	Mass Rapid Transit
BRT	Bus Rapid Transit

References

Ahn, B. S. 2011. Compatible weighting method with rank order centroid: Maximum entropy ordered weighted averaging approach. European Journal of Operational Research, 212(3), 552–559. doi: https://doi.org/10.1016/j.ejor.2011.02.017

Bello, F., Lavore, S., Hallett, L.M., et al. 2021. Functional trait effects on ecosystem stability: assembling the jigsaw puzzle. Trends in Ecology & Evolution, 36 (9), 822-836. https://doi.org/10.1016/j.tree.2021.05.001

Blackburn, S. 2011. Jakarta: Sejarah 400 Tahun. Masup Jakarta: Jakarta, Indonesia

Central Bureau of Statistics. 2019. Jabodetabek Commuter Statistics. Available online: https://www.bps.go.id/publication/2019/12/04/eab87d14d99459f4016bb057/statistik-komuter-jabodetabek-2019.html (accessed on 22 September 2023).

Central Bureau of Statistics. 2014. Jabodetabek Commuter Statistics Results of the 2014 Jabodetabek Commuter Survey.. Available online:

https://www.bps.go.id/publication/2019/12/04/eab87d14d99459f4016bb057/statistik-komuter-jabodetabek-2019.html (accessed on 22 September 2023).

Central Bureau of Statistics. 2024. Jabodetabek Commuter Statistics 2023. Available online: https://www.bps.go.id/id/publication/2024/03/28/33b6bef825944e576e7ea3ba/statistik-komuter-jabodetabek-hasil-survei-komuter-jabodetabek-2023.html (accessed on 22 September 2023).

Central Bureau of Statistics. 2021. 2020 Population Cencus Results of DKI Jakarta Province. Available online: https://jakarta.bps.go.id/id/pressrelease/2021/01/22/541/jumlah-penduduk-hasil-sp2020-provinsi-dki-jakarta-sebesar-10-56-juta-jiwa.html (accessed on 6 January 2025).

Cervero, R.1998. The Transit Metropolis: A Global Inquiry; Island Press: Washington, DC, USA.

Chava, J., Newman, P., & Tiwari, R. .2018. Gentrification of Station Areas and Its Impact on Transit Ridership. Case Studien on Transport Policy, vol. 6 (1), pp. 1--10. https://doi.org/10.1016/j.cstp.2018.01.007

Chou, D. C.2018. Applying design thinking method to social entrepreneurship project. Computer Standards & Interfaces, 55, 73-79. https://doi.org/10.1016/j.csi.2017.05.001

Cohen, B.2006. Urbanization in Developing Countries: Current Trends, Future Projection, and Key Challenges for Sustainability. Technology in Society, 28, 63-80. https://doi.org/10.1016/j.techsoc.2005.10.005

Curtis, C.; & Scheurer, J.2010. Planning for Sustainable Accessibility: Developing Tools to Aid Discussion and Decision-Making. *Prog. Plan*, 74, 53-106

Elizandri, B.N. 2017. Manusia Gerobak in Bekasi City Wandering Sense of Home Urban Space. Bachelor Degree Thesis in University of Indonesia. https://lib.ui.ac.id/detail?id=20445494&lokasi=lokal

Ewing, R. & Cervero, R. 2010. Travel and The Built Environment. Journal of The American Planning Association, 76, 265-294. https://doi/org/10.1080/01944361003766766

Ferreira, L. K., Meireles, J. F. F., & Ferreira, M. E. C.2018. Evaluation of lifestyle and quality of life in the elderly: A literature review. Revista Brasileira de Geriatria e Gerontologia, 21(5), 616–627. https://doi.org/10.1590/1981-22562018021.180028

Fisher, M. J., & Marshall, A. P.2009. Understanding descriptive statistics. Australian Critical Care, 22(2), 93–97. doi: https://doi.org/10.1016/j.aucc.2008.11.003

Goldman, A. I.1970. *Theory of human action*. Princeton, NJ: Princeton University Press.

Gu, P.; He, D.; Chen, Y.; Christoper, Z., P.; & Jiang, Y. 2019. Transit-Oriented Development and Air Quality in Chinese Cities: A City Level Examination. Transp. Res. Part D Transp. Environ. 2019, 68, 10-25 https://doi.org/10.1016/j.trd.2018.03.009

Gu, C. 2019. Urbanization: Processes and Driving Forces. Science China Earth Sciences, vol. 62 (9), pp. 1351-1360. doi: https://doi.org/10.1007/s11430-018-9359-y.

Harris, A. 2008. From London to Mumbai and Back Again: Gentrification and Public Policy in Comparative Perspective. Urban Studies, vol. 45 (12), pp. 2407–2428. https://doi. org/10.1177/004209800809710

Hasibuan, H. S., and Permana, C. T. 2022. Socio-cultural characteristics of people and the shape of transit-oriented development (TOD) in Indonesia: a mobility culture perspective. Journal of Transport and Land Use, vol. 15 (1), pp. 295-314. https://doi.org/10.5198/jtlu.2022.1997

Hasibuan, H. S., and Mulyani, M. 2022. Trasit-oriented development: towards achieving sustainable transport and urban development in Jakarta metropolitan, Indonesia. *Sustainability*, vol. 14 (9), 5244. https://doi.org/10.3390/su14095244

Hasibuan, H. S., Soemardi, T. P., Koestoer, R., & Moersidik, S. 2014. The Role of Transit-Oriented Development in constructing urban environment sustainability, the case of Jabodetabek, Indonesia. *Procedia Environmental Science*, *20*, 622–631. https://doi.org/10.1016/j.proenv.2014.03.075

Henderson, V., & Kuncoro, A. 1996. The dynamics of Jabotabek development. Bulletin of Indonesian Economic Studies, vol. 32 (1), pp. 71-95. https://doi.org/10.1080/00074919612331336898

Hudalah, D., Viantari, D., Firman, T., & Woltjer, J. 2013. Industrial Land Development and Manufacturing deconcentration in Greater Jakarta. Urban Geography, vol. 34 (7), pp. 950-971. https://doi.org/10.1080/02723638.2013.783281

Hudalah, D., Winarso, H., & Woltjer, J. 2016. Gentrifying the Peri-Urban: Land Use Conflicts and Institutional Dynamics at the Frontier of an Indonesian Metropolis. Urban Studies, vol. 53(3), 593-608. doi: https://doi.org/10.1177/0042098014557208

Ilina, I. N. 2016. Economics of municipal economy. Moscow: Knorus, 248

Justin, C.S., Bolin, B. L., & Marks, K.R.2020. Experimental and Clinical Psychopharmacology. (Non-) Impact of Task Experience on Behavioral Economic Decision-Making. University of Kentucky, Department of Behavioral Science: US.

JICA. 2004. *The Study on Integrated Transportation Master Plan for Jabodetabek: Final Report Summary Report*; JICA: Tokyo, Japan

JICA. 2012. *Project for the study on JABODETABEK public transportation policy implementation strategy (JAPTraPIS)*. JICA: Jakarta

Kopytkov, D., Levchenko1, O., Rossolov, O., & Samchuk, G. 2018. Determination Of Passenger Transport Fatigue in Urban Mass Transportation. Municipal Economy of Cities, 7 (146), 2-11. https://doi.org/10.33042/2522-1809-2018-7-146-2-11

Lehmann, S. 2016. Sustainable urbanism: towards a framework for quality and optimal density? Future Cities and Environment, 2: 8. DOI: https://doi.org/10.1186/s40984-016-0021-3

Liu, Y., He, S., Wu, F., & Webster, C. 2010. Urban Villages under China's Rapid Urbanization: Unregulated Assets and Transitional Neighbourhoods. Habitat International, vol. 34 (2), pp. 135-144. doi: https://doi.org/10.1016/j.habitatint.2009.08.003

Lockwood, T. (ed.) 2010, Design Thinking. Integrating Innovation, Customer Experience, and Brand Value. New York, NY: Allworth Press.

Lowe, P. A. & Steven, W. L.2008. Settings Scores Across Gender Among Students in Elementary and Secondary School Factor Structure of the Test Anxiety Inventory for Children and Adolescents (TAICA). Journal of Psychoeducational Assessment. 26: 231

Mangunwijaya, Y.B. 2009. Wastu Citra, Gramedia Pustaka Utama, Jakarta https://doi.org/10.1177/0734282907303773

Mikhailov, A.S. 2003. Management for the urban travel market. – Alma-Aty: Research Center Gylym, 237

Moovit. 2020. Global Public Transport Report. San Fransisco, USA https://static-main.moovit.com/wp-content/uploads/2020/04/2019-Moovit-Global-Transport-Report-EN-USA.pdf

Nyunt, T, K. T.; & Wongchavalidkul, N. 2020. Evaluation of Relationship between Ridership Demand and Transit-Oriented Development (TOD) Indicators Focused on Land Use Density, Diversity, and Accessibility: A Case Study of Existing Metro Stations in Bangkok. Urban Rail Transit 6(1), 56-70. https://doi.org/10.1007/s40864-019-00122-2

Rapoport, A. 1980. Environmental Preference, Habitat Selection and Urban Housing. Journal of Social Issues, 36, 118-134. http://dx.doi.org/10.1111/j.1540-4560.1980.tb02039.x

Rianawati, E., Alberdi, H., Salsabilla, A.H., Larasati, M. et al. 2023. Jakarta Transportation Transformation: ressessing Net Zero Emission target of transportation sector for 2050. Greenpeace Indonesia. Jakarta, Indonesia

Sarstedt, M., Mooi, E. 2019. Regression Analysis. In: A Concise Guide to Market Research. Springer Texts in Business and Economics. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-56707-4_7

Saunders, B. & Smith, K. 2014. Quality of Live, (E) Quality of Place: Growing Local Economies through Equitable Transit Oriented Development. Open Communities and the Center for Neighborhood Technology: Chicago

Shekfa, L and Galal Ahmed, K, 2022.The Other Side of the Urban Desentification "Coin"L impacts on Social Sustainability in Redeveloped Urban Sprawled Communities in United Arab Emirates. Future Cities and Environment, 8(1):11, 1=19. DOI: https://doi.org/10.5334/fce.155

Sorokin, A.A., & Kastornova, T.A. 2004. Passenger transportation – a mechanism for the development of social and economic infrastructure of the city. Materials of the 49th scientific and methodological conference "University science to the region". – Stavropol: SSU Publishing House, 89-91

Supreme Court. 2011. Age Limit Capacity and Authority to Act based on Aged Limit. Supreme Court of Repbulic Indonesia.

Thomas, R. & Bertolini, L. 2017. Defining Critical Success Factors in TOD Implementation Using Rought Set Analysis. Journal Transportation Land Use, 10, 139-154. https://doi.org/10.5198/jtlu.2015.513

United Nations (2019). World Urbanization Prospects 2018: highlights, Department of economic and Social Affairs UN, New York,

UNFPA. 2013. State of World Population 2013. New York: US

UNFPA. 2015. Urbanization in Indonesia. Monograph Series No. 4. New York: US

Nisic, N. and Kley, S. 2019. Gender-specific effects of commuting and relocation on a couple's social life. Demographic Research 40(36): 1047–1062. doi: https://doi.org/10.4054/D emRes.2019.40.36

Nurhijrah, N., Kasman, T. M. S., & Akbar, B. M. 2018. Relevansi Pemikiran Irigaray Terhadap Arsitektur. Nature: National Academic Journal of Architecture, 5(2), 143. https://doi.org/10.24252/nature.v5i2a7

Rosni, N. A., Ponrahono, Z., & Noor, N. M. 2018. Segregated Land Use Sprawl: Tod Approach for Mixeduse Housing Development in Kuala Lumpur. *Planning Malaysia*, *16*. https://doi.org/10.21837/pm.v16i5.418

Rukmana, D. 2014. Peripheral Pressures: Jakarta. Archeology of the Periphery of Megacities. Roger Connah (Ed.). Moscow: Strelka Press. pp. 158-167

Shatu, F., Aston, L., Patel, L. B., & Khamruzzaman, Md.2022. Chapter Ten-Transit oriented development: A Bibliometric Analysis of Reseach. Advances in Transport Policy and Planning, 9, 231-275. https://doi.org/10.1016/bs.atpp.2021.06.001

Spatial Planning Ministry of Republic Indonesia. 2017. Ministry Regulation of ATR/BPN Agency No. 16 of 2017 concerning Transit-Development Area Guidelines. Ministry of ATR/BPN Agency. Jakarta, Indonesia.

Wildemuth, B. M. 2009. Frequencies, cross-tabulation, and the chi-square statistic. Applications of social research methods to questions in information and library science, 348-360.

Winarso, H., & Firman. T. 2002. Residential Land Development in Jabotabek, Indonesia: Triggering Economic Crisis. Habitat International, vol. 26 (4), pp. 487-506. https://doi.org/10.1016/S0197-3975(02)00023-1

Wolford, R. L. 2008. Wandering in Dwelling. Master's degree Thesis in Washington State University School of Architecture and Construction Management. December 2008. https://api.semanticscholar.org/CorpusID:73700964}

Zhang, X.Q. 2016. The Trends, Promises and Challenges of Urbanization in the World. Habitat International, 54 (3), 24-252. https://doi.org/10.1016/j.habitatint.2015.11.018.

Zou, Z., & Ergan, S. 2019. A Framework towards Quantifying Human Restorativeness in Virtual Built Environments. arXiv:1902.052. https://doi.org/10.48550/arXiv.1902.052