Examining the Potential of the Clark Loop Bus as a Full-Scale Bus Rapid Transit (BRT): Towards a Localized BRT Readiness Index

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Abstract: The Clark Freeport Zone (CFZ), located in Pampanga, is one of the Philippines' economic and investment hubs managed by the Clark Development Corporation (CDC). Originally launched during the 2019 Southeast Asian (SEA) Games, the Clark Loop provides a modern and convenient transportation service inside the CFZ by operating air-conditioned buses with regular intervals with designated bus stops. Despite these improvements, implementation challenges remained, thereby hindering the bus system to meet the growing transportation needs of commuters while balancing operational efficiency, accessibility, affordability, and integration with existing transport services. The objective of the paper is to propose a BRT Readiness Index (BRT-RI) and provide an initial evaluation of Clark Loop Bus' performance and the potential of transforming the service into a full-scale Bus Rapid Transit (BRT) system. The BRT-RI indicator system is based on a literature review of past BRT studies incorporating various key technical and institutional success factors of BRT implementation worldwide.

Keywords: Clark Loop, Bus Rapid Transit, BRT Readiness Index, AHP, CRITIC Method

1. INTRODUCTION

1.1 Background

The Clark Freeport Zone (CFZ), located in Pampanga, is one of the Philippines' economic and investment hubs. Managed by the Clark Development Corporation (CDC), the freeport area hosts multinational companies, government offices, hotels, educational institutions, commercial establishments, and Clark International Airport. As the number of workers, residents, tourists, and investors continues to grow, the demand for an efficient, reliable, and sustainable public transportation system has become increasingly important. To improve mobility within the Freeport, the Clark Development Corporation relaunched the Clark Loop bus system in September 2024. Originally launched during the 2019 Southeast Asian (SEA) Games, the Clark Loop provides a modern and convenient transportation service connecting major destinations such as SM City Clark, Clark International Airport, business parks, hotels, and industrial locators. The system operates air-conditioned buses with regular intervals with designated bus stops. It was initially operated with a cashless fare collection using Beep cards and QR code payments and was recognized as the first cashless public bus system in Central Luzon.

The implementation of Clark Loop represents the government's commitment to promoting smart and sustainable urban mobility. By providing a reliable public transport option, the bus system aimed to reduce dependence on private vehicles, improve accessibility for employees and visitors, lessen traffic congestion, and support environmental sustainability through more efficient transport operations. The bus service was also intended to enhance connectivity between commercial centers, workplaces, educational institutions, and Clark International Airport, making travel within CFZ more convenient. .Despite these improvements, implementation challenges remained, thereby hindering the bus system to meet the growing transportation needs of commuters while balancing operational efficiency, accessibility, affordability, and integration with existing transport services. Continuous assessment of passenger demand, service quality, route coverage, and commuter satisfaction is necessary to ensure that the bus system effectively supports the economic growth and sustainable development of the Clark Freeport Zone. Figure 1 shows the bus unit and Figure 2 shows the Clark Loo bus route.



Figure 1. The Clark Loop Bus

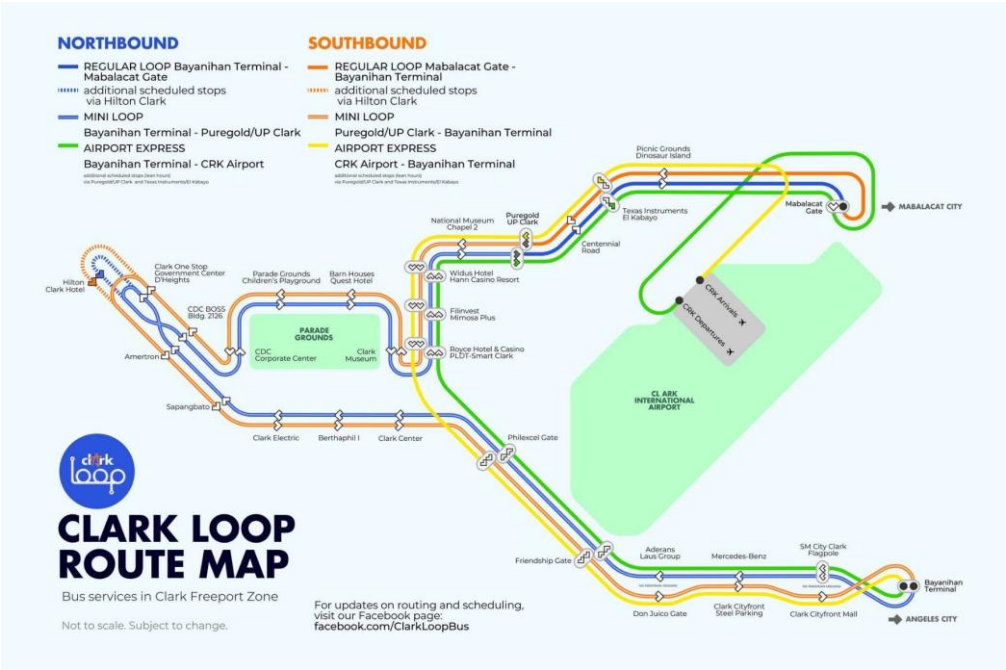


Figure 2. The Clark Loop Bus Route

1.2 Research Objectives

The objective of the paper is to provide a detailed evaluation of the Clark Loop Bus' performance and the potential of transforming the service to a full-scale Bus Rapid Transit (BRT) system. Ultimately, the research aims to develop a framework and quantifiable metrics towards a localized BRT Readiness Index.

2. REVIEW OF LITERATURE

2.1 Bus Rapid Transit (BRT)

Bus Rapid Transit (BRT) as a public transport innovation trace back to the early 1970s, combining measures such as dedicated bus lanes, frequent service with timed transfers, off-board fare collection, and preferential intersection treatment – features that invite frequent comparison to light rail. It gained real traction as a modern approach in Brazil and Colombia during the 1990s (Curitiba and Bogotá are the archetypal cases), later expanding globally as planners and advocates increasingly accepted it as a legitimate alternative to costlier rail investment. Growth since then has been rapid: the number of cities with BRT systems grew from roughly 25 in 2000 to closer to 200 today, with BRT now supporting around 35 million daily passengers worldwide. In developing cities that historically lacked coordinated public transit – relying instead on uncoordinated private bus and informal paratransit services – BRT has served as the backbone of an entirely new formal transit system, as seen in Lagos, Jakarta, and Ahmedabad. In much of Europe, particularly medium-sized cities, BRT (sometimes called BHLS –Buses with High Level of Service) has instead been introduced as a more affordable alternative to tramways, focused on improving reliability, punctuality, and comfort along existing roadways.

The literature consistently frames BRT's appeal around cost-effectiveness relative to rail, plus a distinctive flexibility advantage: the same rubber-tired vehicle that runs express service on a dedicated busway can also operate as a feeder vehicle on local streets, which rail vehicles cannot do. This flexibility makes BRT especially well-suited to low-density suburban markets and small-to-medium cities where rail investment isn't cost-justified. BRT is also positioned as a climate and modal-shift tool–shifting travel away from private vehicles toward a more environmentally friendly mode–and, in the European context, as a tool for advancing sustainable mobility more broadly.

2.2 The (De Facto) BRT Standard

The BRT Standard was conceived by the Institute for Transportation and Development Policy (ITDP) in 2012, with the explicit goal of ensuring that BRT corridors worldwide meet a minimum quality standard and deliver consistent passenger, economic, and environmental benefits. The Standard was designed to function simultaneously as a common definition of BRT, a planning and design tool, an evaluation tool for existing corridors, and a recognition system that publicly celebrates high-performing corridors (ITDP, 2024). One of the primary advantages of the BRT concept is its operating flexibility; because vehicles are rubber-tired, the same bus providing high-speed service on a dedicated corridor can transition to local streets to function as a neighborhood feed. The BRT Standard grades corridors as Gold, Silver, or Bronze based on 5 main categories for design, with 32 metrics totaling 100 points, and an operational deductions category that has 13 metrics totaling 77 points.

2.3 BRT Readiness

Bus Rapid Transit (BRT) has emerged as an important public transport strategy for cities seeking to increase transit capacity, improve travel-time reliability, reduce congestion, and expand access to affordable mobility without the capital requirements typically associated with rail-based mass transit. BRT is generally characterized by the integration of dedicated or priority busways, stations, vehicles, fare collection, passenger information, and operational control into a high-capacity transit system. Although BRT is often promoted as a relatively flexible and cost-effective rapid transit technology, international experience demonstrates that successful implementation depends on considerably more than the physical construction of a busway. Institutional capacity, political commitment, financing, stakeholder cooperation, land-use conditions, operator reform, and operational capability can substantially influence whether a planned BRT project is actually implemented and sustained (Deng & Nelson, 2011; Finn & Muñoz, 2014; Lindau et al., 2014).

Existing BRT assessment frameworks, particularly the Institute for Transportation and Development Policy (ITDP) BRT Standard, primarily evaluate the characteristics and quality of an existing or proposed BRT corridor. In contrast, a BRT Readiness Index would be concerned with the extent to which a city or corridor possesses the conditions necessary to implement and sustain BRT successfully. The development of such an index therefore requires integrating physical, demand, operational, institutional, financial, social, land-use, and environmental dimensions into a single decision-support framework. Literature provides substantial evidence for these individual dimensions, but there is no universally accepted international BRT Readiness Index that integrates them into a standardized composite measure.

The implementation literature demonstrates that BRT projects are multidimensional interventions involving transport infrastructure, public institutions, private operators, communities, and political decision-makers. Finn and Muñoz (2014) conceptualized BRT implementation as a cyclical process involving six broad stages, namely, policy; institutional frameworks; strategy and implementation planning; stakeholder outreach and process management; deployment and operationalization; and 6. post-deployment assessment. Their work emphasizes that BRT implementation requires not only technical planning but also appropriate institutional, regulatory, contractual, and participatory arrangements. This framework provides a theoretical basis for treating readiness as multidimensional and process oriented. Therefore, BRT readiness should not be interpreted as a single physical or economic characteristic. Rather, it represents the degree of preparedness across multiple interdependent dimensions.

3. STUDY AREA

3.1 Location and Demographics

The Clark Freeport Zone (CFZ) is 2,033-hectare, special economic and business zone located in the provinces of Pampanga and Tarlac, Philippines. CFZ comprises a mix of land uses, including business and commercial districts, industrial parks, government offices, educational institutions, residential communities, tourism and recreational areas, logistics hubs, and Clark International Airport. Based on CDC 2025 Accomplishment Report, the Clark Freeport Zone garnered 1,256 registered business locators, 149,138 workers/ employees and 17 new locators over the annual target of 11. The total committed investments totaled ₱14.4 billion with new investments from new locator amounting to ₱2.465 billion (CDC, 2025a, 2025b). Figure 3

shows the location map of CFZ.

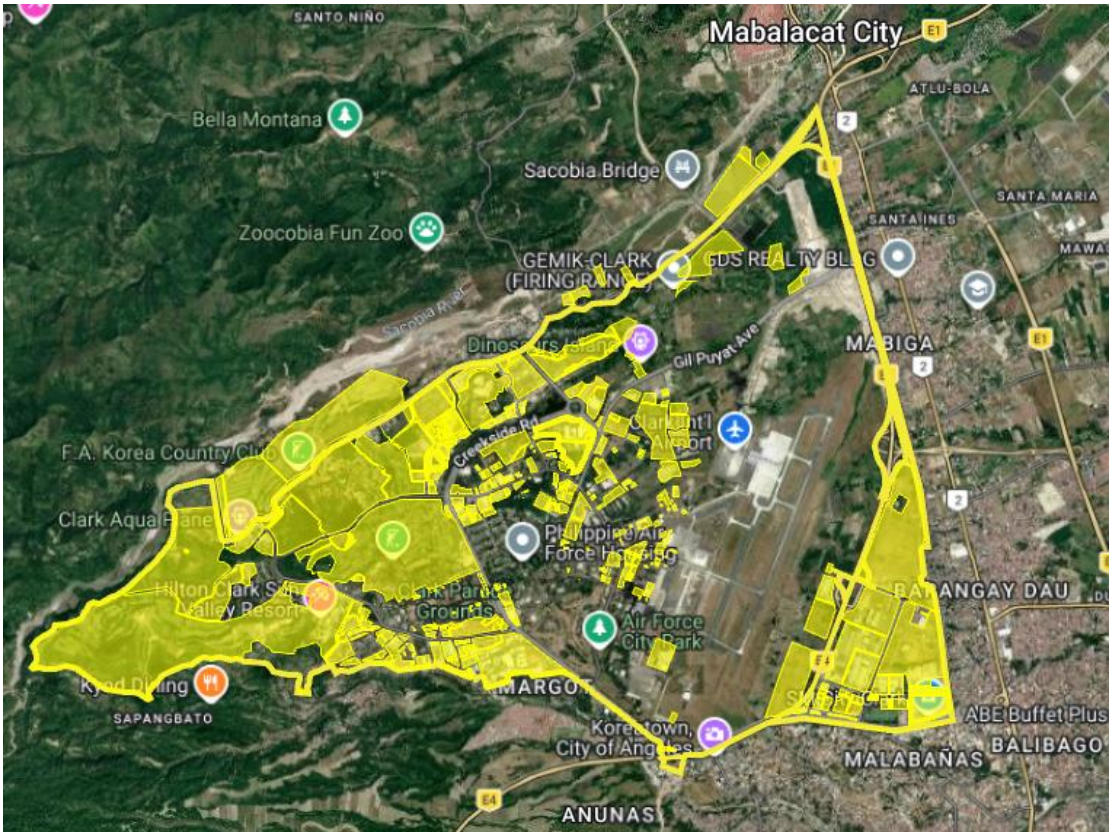


Figure 3. Location Map of Clark Freeport Zone
(Source: CDC GIS, https://gis.clark.com.ph/)

Figure 4 presents the zoning map of the study area and Table 1 presents the zoning description.

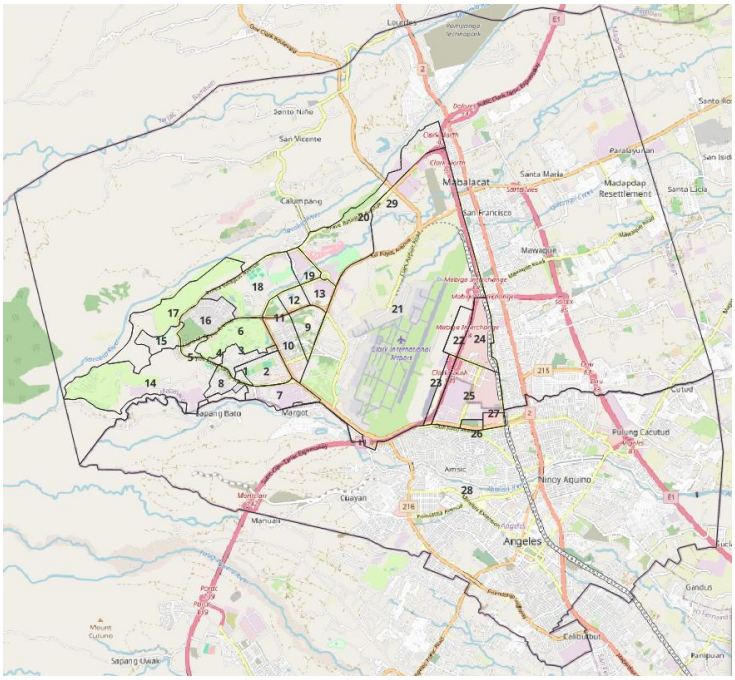


Figure 4. Zoning Map

Table 1. Traffic Analysis Zones

TAZ	Zone Description (Establishments, Landmarks, Buildings, Areas)
Internal Zones	
1	CDC, CDC Museum, Cyber City Teleservices, E-Telecare Clark Services, Public Safety Department, Holiday Inn
2	Mimosa Clark Leisure Park, Mimosa Golf
3	P. Romulo Street
4	Clark Polytechnic Institute
5	Fontana
6	Filinvest Mimosa, Fontana
7	Bertaphil, Philexcel Business Park, Margot Vill, Sutherland Call Center, Amertron Global, Fuji Plastic Industry Phils.,
8	Redwood
9	Creamline, DFA, Golden Stone Garments, Immigration, West Garments Clark
10	Air Force, Housing Area, Macapagal Housing, Officers' Club Air Force City, Oxford Hotel, Traport St., Tomcat St., Jaguar St., Hotel Vida
11	McDonald's Clark, Quaker Oats Clark
12	Chowking Clark, Four Seasons, Parkson, Puregold Duty Free, Clark Robe
13	Texas Instruments
14	Clark Aviation, Polytech Company
15	Korea Golf Course
16	Fontana Leisure Park, Fontana Warehouse
17	BB International Leisure and Resort Devt. Corp.
18	Foton Motor, SFA Semicon
19	Expo Filipino, Marcos Village
20	Chitai Industry Rail, Firing range, Kilton, Outback, El Kabayo, Picnic Ground, Clark Speedway, Macapagal Village
21	CIAC, Agri Clark Farm, DMIA, Casa Blanca Hotel, Oriental Clark
22	Polymer Link (Philippines), Inc.
23	Omni Aviation Corporation, Laus Auto Services - Clark Freeport
24	Global Gateway Development Corporation
25	Aderans Phils. Inc., Bureau of Customs (BOC), Customs Clearance Area (CCA), LNL, Nanox, SMK, Yokohama Tires, Global City GGLC
26	Clark Cemetery
27	SM City Clark
External Zones	
28-32	

3.2 Existing Trip Patterns

Public transport surveys were conducted in April 2025 as part of a project for updating the Comprehensive Master Development Plan for the CFZ which included Boarding and Alighting Survey and Origin-Destination (OD) Interview Surveys for CFZ workers and visitors. The various surveys yielded the following trip patterns.

CFZ Workers

Figure 5 presents the trip modes of the CFZ workers. It is quite clear that motorcycle mode dominates (driving 27% and as passenger 6%) the type of vehicle used by workers which accounts for a third of the trips. On the other hand, the use of public transport is still significant, consisting of 15% for Public Utility Jeepney and 12% for Company Van/Bus. The private car accounts for 16% of the trips. It is observed that walking mode is also notable at 9% of the trips. Figure 6 presents the trip purposes of the CFZ workers, which indicates that 50% share of To-Home trips and 46% share of To-Work trips. These patterns reflect routine, cost-sensitive commuting by workers which implies that any BRT-style intervention needs to compete directly with modes that offer door-to-door flexibility — not just with cars.

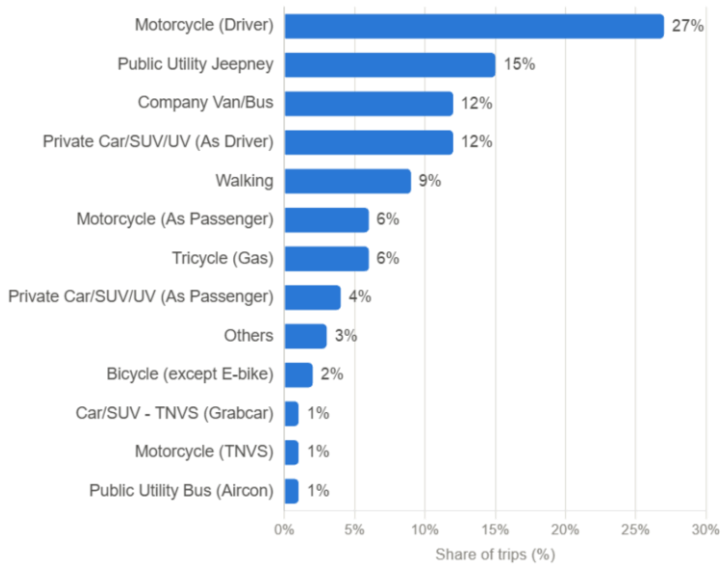


Figure 5. Trip Modes of CFZ Workers

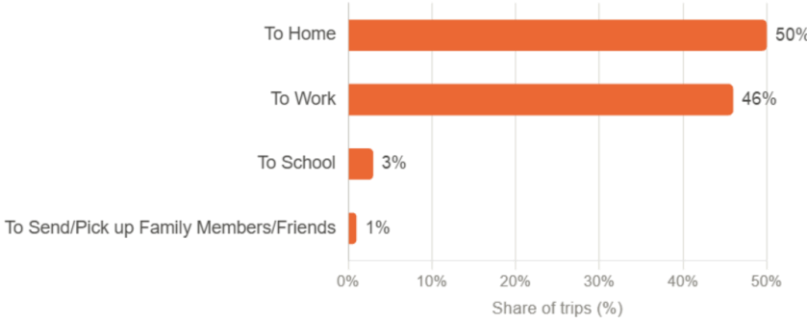


Figure 6. Trip Purposes of CFZ Workers

CFZ Visitors

Figure 7 presents the trip modes of the CFZ visitors which depict overwhelming use of cars and motorcycles, which accounts for more than 70% of the trips. Jeepney and walking modes are tied at 9% each. The share of the standard bus stands at only 2%. In terms of trip purposes, recreation accounts for 51% of the trips by visitors as indicated in Figure 8.

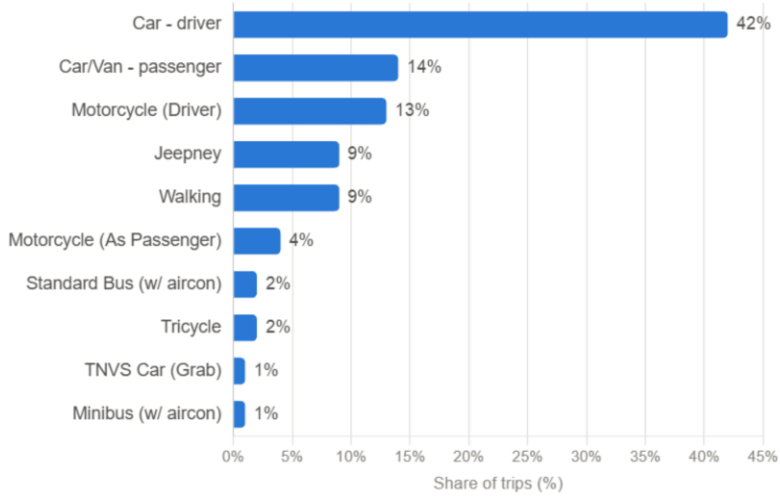


Figure 7. Trip Modes of CFZ Visitors

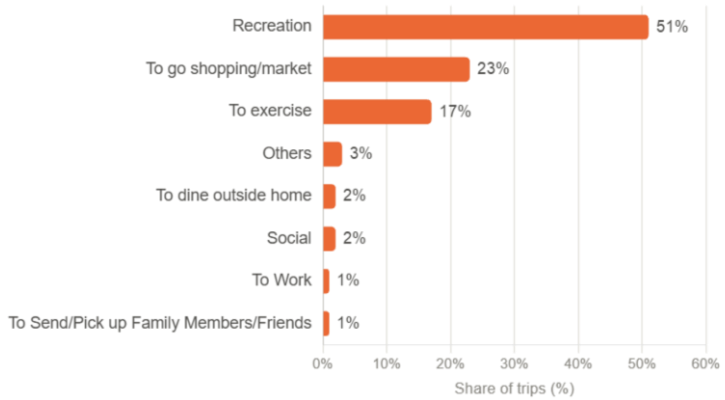


Figure 8. Trip Purposes of CFZ Visitors

3.3 Traffic Volume

Figure 9 presents the entering and existing traffic volumes based on Classified Traffic Volume Count Surveys conducted in March 2025. The peak entering traffic occurs at 6-7 AM with 10,771 vehicles while the peak existing traffic occurs at 5-6 PM with 9,026 vehicles. Motorcycles dominate the number of vehicles at 52.77% followed by Cars at 43.61%.

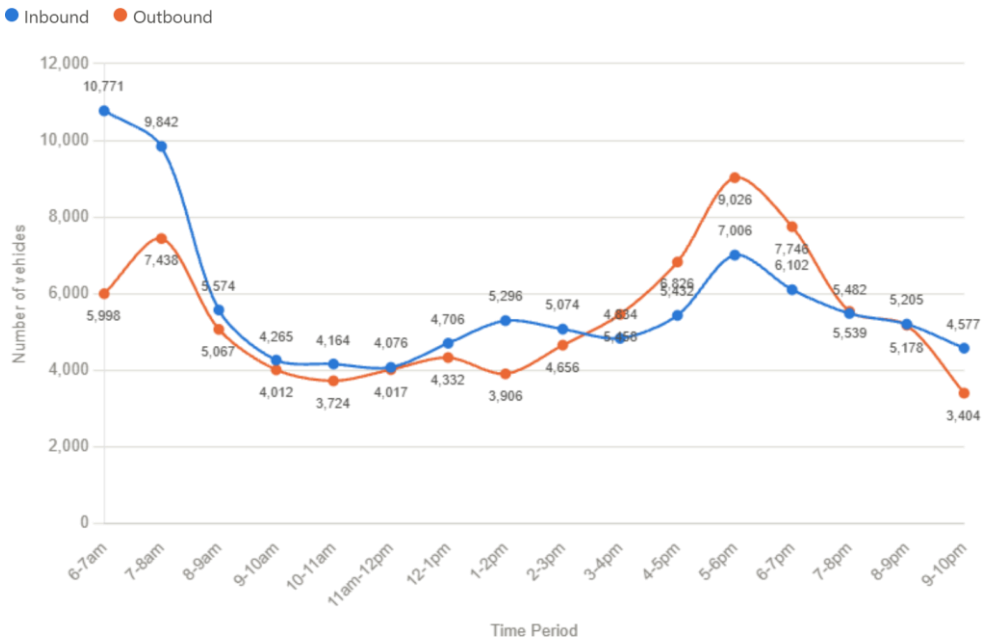


Figure 9. Entering and Exiting Traffic Volume to/from CFZ

3.4 The Clark Loop Bus

The Clark Freeport Zone has experienced rapid economic growth, attracting businesses, industries, educational institutions, and tourists. To address the increasing demand for mobility within CFZ, the Clark Loop bus system was re-introduced to connect major destinations through a modern, cashless, and environmentally conscious public transportation service. As commuter demand continues to evolve, periodic assessments of the bus system are necessary to determine whether it effectively meets users' transportation needs. At present, the Clark Loop consists of ten (10) units of the following make and model:

- Brand: Nanjing Golden Dragon "Skywell"
- Model: NJL6129G
- Voith Brand Automatic Transmission
- Air Suspension
- 250hp Euro 4 Diesel Engine

It was observed that the number of buses in operation is lower than expected, particularly during the off-peak hours between morning and evening. This is compounded by the presence of three variants of the Clark Loop service: the regular Clark Loop, the Airport Express, and the Clark Loop that operates only up to UP Clark/Puregold. Furthermore, the actual trip times do not always follow the schedule posted on the Facebook page. Figures 10 and 11 present the load factor diagrams of the Clark Loop for the inbound and outbound trips, respectively. The operating conditions significantly influence the number of Clark Loop buses in service throughout the day, their routes, and in some cases, fare adjustments. The load factor diagrams show high morning occupancy on routes heading into CFZ, which decreases near workplace areas. Conversely, outbound trips indicate that most passengers alight at transfer points or transport terminals outside CFZ, with few alighting within CFZ.

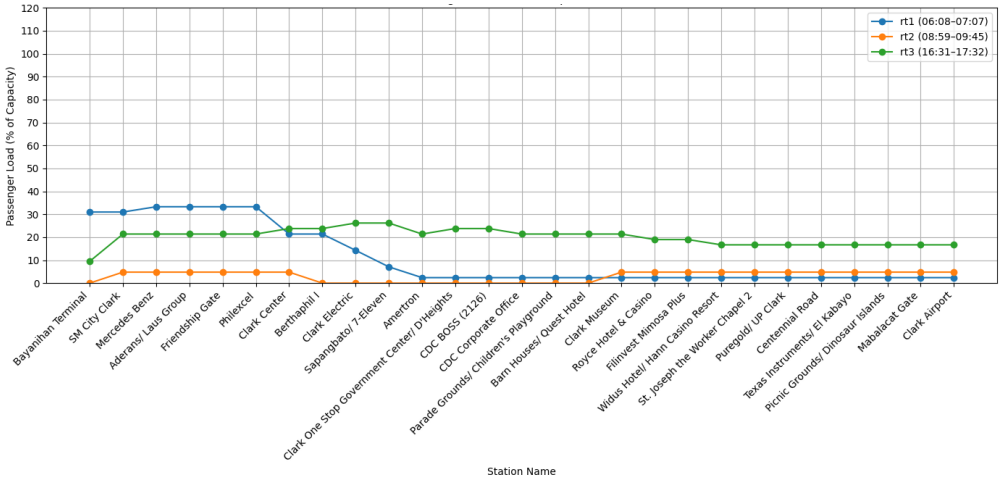


Figure 10. Clark Loop Inbound Load Factor

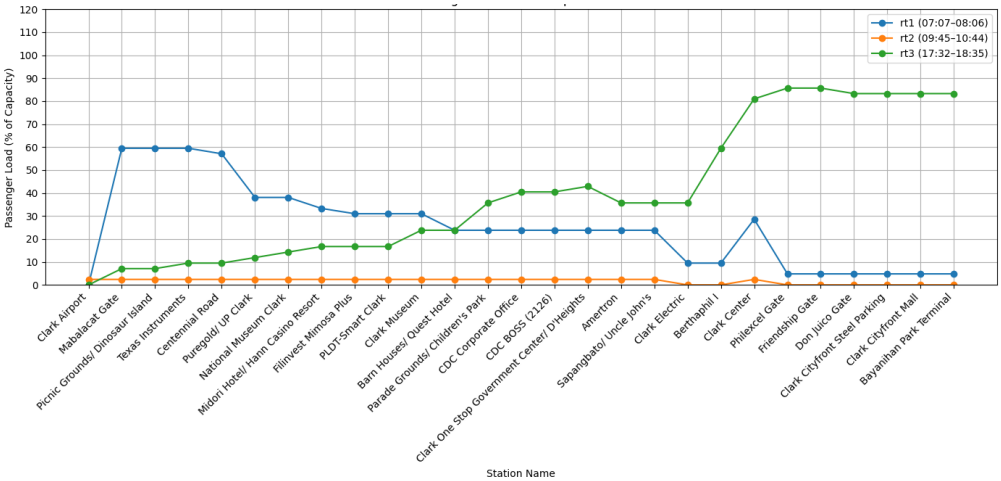


Figure 11. Clark Loop Outbound Load Factor

4. DEVELOPMENT OF BRT READINESS INDEX (BRT-RI)

4.1 Dimensions

Institutional and governance readiness

Institutional capacity is one of the strongest themes in the BRT implementation literature. Lindau et al. (2014) found that many of the principal barriers to BRT implementation in emerging cities were institutional, financial, legal, and political. Their review identified institutional complexity, limited technical capacity, weak stakeholder alignment, competition with other transport modes, opposition from existing operators, political discontinuity, insufficient funding, and weak community participation as important barriers. hese findings have significant implications for the construction of a BRT Readiness Index. They suggest that the availability of road space or the magnitude of passenger demand alone cannot establish whether a city is ready for BRT. A corridor may be technically suitable but institutionally unprepared. The experience of Lagos provides a useful counterexample. Kaenzig et al. (2010) identified sustained political commitment, a capable strategic public transport authority, a clearly defined and deliverable project, stakeholder engagement, widespread benefits, and community participation as important factors underlying the successful implementation of Lagos BRT-Lite.

Similarly, research on Johannesburg demonstrates the importance of integrating existing informal transport operators into the BRT reform process. Venter (2013) found that BRT could facilitate the formalization and transformation of informal minibus-taxi operators, but that the long-term success and scalability of the reform depended on appropriate institutional and management arrangements. More recent evidence from Accra reinforces this finding. BRT implementation required new legal, regulatory, and institutional arrangements and capacity development within local government. Difficulties in incorporating existing paratransit operators also contributed to the divergence between the originally planned BRT system and the service that was ultimately implemented (Agyemang et al., 2022).

Political readiness

Political conditions warrant separate consideration from general institutional capacity. Evidence from rapid-transit projects in Ecuador demonstrates the importance of political conditions in determining whether planned projects progress to implementation. Of 19 rapid-transit projects planned in Ecuador, only nine reached implementation. Using Best-Worst Scaling, the study identified lack of political leadership, commitment or continuity, political friction, underestimation of implementation complexity, and rushed planning as among the most important barriers (Arias et al., 2022). This finding supports the argument that a BRT readiness index should include a political readiness component, or at minimum incorporate political commitment into institutional readiness.

Political readiness may be operationalized through indicators such as:

- existence of an adopted BRT policy;
- inclusion of BRT in the city's transport development plan;
- political leadership;
- intergovernmental support;
- continuity across political administrations;
- legislative support;
- availability of implementation mandates.

This dimension is particularly important in developing-country contexts where changes in political leadership can substantially alter infrastructure priorities.

Demand and market readiness

BRT is fundamentally a high-capacity public transport technology. Therefore, the expected passenger market is an essential component of readiness. BRT systems are most appropriate where existing or projected travel demand is sufficiently high to justify dedicated infrastructure and frequent service. The literature on BRT and the built environment indicates that population density, employment concentration, land-use diversity, accessibility, and proximity to transit can influence transit demand and BRT ridership. Reviews of BRT systems have found that land-use policies supporting higher-density and mixed-use development can strengthen the potential of BRT to attract passengers and stimulate development (Deng & Nelson, 2011; Hidalgo & Gutiérrez, 2013). For a corridor-level BRT-RI, modeled demand from a transport demand model may be preferable to using population density alone. This would allow readiness assessment to incorporate actual OD patterns, network effects, modal competition, and future scenarios.

Infrastructure readiness

Infrastructure is the most visible component of BRT readiness but should not be interpreted independently of other dimensions. The ITDP BRT Standard provides an important foundation for identifying infrastructure indicators. Its framework emphasizes dedicated right-of-way, appropriate busway alignment, off-board fare collection, intersection treatments, platform-level boarding, station design, and other physical characteristics that contribute to high-quality BRT. Infrastructure readiness can therefore be interpreted as the physical feasibility of implementing the required BRT infrastructure within the existing urban corridor. Importantly, infrastructure readiness should measure implementation feasibility, not merely existing infrastructure quality. A narrow road, for example, may have low infrastructure readiness even if traffic demand is extremely high.

Operational readiness

A successful BRT requires more than physical infrastructure. It requires the ability to deliver frequent, reliable, high-capacity service. The BRT literature emphasizes the integration of running ways, stations, vehicles, service planning, operational control, fare collection, and passenger information. Hidalgo and Gutiérrez (2013) argue that these elements must function as an integrated system to produce the speed, capacity, reliability, accessibility, and safety characteristics associated with BRT (Wirasinghe et al., 2013)). This dimension is especially relevant where BRT is being developed from an existing fragmented bus or paratransit system.

Financial and economic readiness

Financial sustainability is repeatedly identified as a critical BRT implementation issue. Lindau et al. (2014) identify insufficient funding as an important implementation barrier, while the ITDP BRT Standard explicitly incorporates the business model into its assessment framework. Financial readiness should therefore extend beyond whether initial capital funding has been identified. It should consider the entire financial lifecycle of the system. A particularly important distinction should be made between financial feasibility and financial readiness. Financial feasibility asks whether a project generates sufficient economic or financial benefits,

whereas readiness asks whether the institutional and financial mechanisms required to implement and operate the project are actually available.

Social and stakeholder readiness

BRT implementation reallocates road space, modifies routes, changes passenger boarding arrangements, restructures operators, and potentially affects businesses and communities along the corridor. Consequently, social acceptance and stakeholder participation can strongly influence implementation. Lindau et al. (2014) identify opposition from existing operators and insufficient community participation as significant barriers. The Lagos experience demonstrates the opposite relationship: community engagement and stakeholder involvement contributed to implementation success (Kaenzig et al., 2010). The experience of Johannesburg further illustrates the importance of addressing the interests of incumbent informal operators during BRT implementation (Venter, 2013).

Land-use and Transit-Oriented Development readiness

BRT should also be evaluated within the broader urban development system. Stokenberga (2014) reviewed the literature on BRT and land development and found that BRT's land-use and property-value effects vary substantially across cities. The evidence suggests that BRT does not automatically produce transit-oriented development; outcomes depend on surrounding land-use policies, development conditions, and accessibility. Likewise, BRT-oriented development can generate both opportunities and risks. Cervero et al. (2017) emphasize the potential for BRT investments to support transit-oriented development, while also noting tensions between the mobility and place-making functions of BRT corridors. More recent empirical evidence indicates that BRT can influence land-use transformation and urban density, although the magnitude and nature of these effects remain context-dependent (Basheer et al., 2020).

Environmental and climate readiness

Environmental sustainability is increasingly relevant to BRT planning. BRT can contribute to reductions in vehicle emissions by shifting trips from private vehicles to high-capacity public transport and by improving bus operating efficiency. However, the environmental performance of BRT depends on fleet technology, ridership, operating conditions, and the extent of modal shift. Climate resilience introduces another dimension that has received comparatively less attention in traditional BRT readiness frameworks. Flooding, extreme heat, storms, and other hazards can disrupt busways, stations, depots, and operations. For developing cities that are increasingly exposed to climate hazards, a contemporary BRT-RI could therefore include:

- flood exposure;
- drainage conditions;
- climate vulnerability;
- emergency operational capacity;
- fleet resilience;
- station resilience;
- emissions reduction potential;
- environmental benefits.

This would extend conventional BRT assessment beyond the traditional infrastructure-demand-institution framework.

4.2 Multi-Criteria Decision-Making and Index Development

BRT Readiness Indicators

The methodological literature provides support for developing a composite BRT Readiness Index using multi-criteria decision-making (MCDM). BRT planning inherently involves competing objectives. A corridor may have high passenger demand but poor infrastructure feasibility; another may have excellent infrastructure conditions but insufficient demand. MCDM methods provide a means of integrating these heterogeneous criteria. Mavi et al. (2018), for example, developed an MCDM framework for BRT involving simulation and multicriteria assessment. Their approach incorporated sustainability and risk considerations and used weighting and ranking techniques to compare BRT alternatives. Similarly, AHP has been applied to public transport performance assessment, allowing stakeholder preferences and objective performance criteria to be combined within a structured decision framework (Mou et al., 2018).

Nikitas and Karlsson (2015) organize the strengths, weaknesses, and success conditions of BRT into six analytical perspectives, namely, Economy, Technology, Flexibility, Implementation, Performance, and Impact as shown in Table 2. Their framework is not a readiness index itself; rather, it provides a broad way of understanding why BRT succeeds or fails across different contexts. These categories are explicitly presented as six perspectives for examining the realistic strengths and weaknesses of BRT. Nikitas and Karlsson (2015) themselves conclude that successful BRT requires appropriate design, policy support, political consensus, branding, marketing, and user education, and that BRT can substantially alter road-space allocation and urban development priorities.

Table 2. BRT Success Analytical Perspective based on Nikitas and Karlsson (2015)

Perspective	What it examines	Key BRT success factors identified
1. Economy	• Whether BRT provides a financially attractive alternative to rail and conventional buses	• Cost, funding, financial planning, fare policy
2. Technology	• Technologies that improve the quality and efficiency of BRT	• ICT, pre-board fare collection, priority systems
3. Flexibility	• BRT's ability to adapt to different operating and urban contexts	• Operational flexibility, multimodal integration
4. Implementation	• How readily and effectively BRT can be planned and delivered	• Rapid implementation, straightforward implementation, road-user engagement, political leadership
5. Performance	• The quality of service delivered to passengers	• Capacity, speed, reliability, comfort
6. Impact	• The wider effects of BRT on society, environment, and urban development	• Environment, traffic safety, user satisfaction, image, urban development, land use

The conceptual model for the BRT-RI is:

$$\text{BRT-RI} = W_1D_1 + W_2D_2 + W_3D_3 + W_4D_4 + W_5D_5 + W_6D_6$$

where D_1–D_6 correspond respectively to Economy, Technology, Flexibility, Implementation, Performance, and Impact. The dimension weights sum to 1. The final index ranges from 0 to 100 when all dimension and indicator scores are expressed on a 0–100 scale. The six dimensions of the BRT-RI are theoretically derived from the six analytical perspectives proposed by Nikitas

and Karlsson (2015). These dimensions can be operationalized into measurable ex-ante indicators representing the readiness of a city or corridor to implement BRT as indicated in Table 3.

Table 3. BRT Readiness Index (BRT-RI) Indicators

BRT-RI Dimension	Nikitas & Karlsson (2015) basis	Core components
D1 Economic & Financial Readiness	Economy	cost, funding, fare, subsidy, BCR
D2 Technology & Infrastructure Readiness	Technology	ROW, busway, stations, AFC, ITS, priority
D3 Network & Integration Readiness	Flexibility	multimodal integration, feeders, transfers
D4 Institutional & Implementation Readiness	Implementation	governance, political support, stakeholders, implementation capacity
D5 Operational & Service Readiness	Performance	capacity, speed, reliability, frequency, comfort
D6 Social, Environmental & Urban Development Readiness	Impact	equity, acceptance, environment, TOD, land use

Normalization of Indicators

Because BRT readiness indicators have different units, they should be normalized to a common 0–100 scale before aggregation.

For a beneficial indicator (higher values indicate greater readiness):

$$X_{ij} = 100 \times (x_{ij} - \min x_j) / (\max x_j - \min x_j)$$

For a cost/disbenefit indicator (higher values indicate lower readiness):

$$X_{ij} = 100 \times (\max x_j - x_{ij}) / (\max x_j - \min x_j)$$

For policy or expert-scored indicators that do not have meaningful observed minimum and maximum values, a predefined ordinal-to-100 scoring rubric can be used instead.

AHP Weighting

AHP (Saaty, 1980; 1987) uses pairwise comparisons to determine the relative importance of dimensions and indicators. Experts compare each pair using Saaty's fundamental 1–9 scale. The resulting priority vector provides the subjective weights. The consistency ratio should be checked; a commonly used criterion is $CR < 0.10$.

CRITIC Objective Weighting

The CRITIC method (Diakoulaki et al., 1995) determines objective weights using both the contrast intensity of an indicator and its correlation with other indicators. For indicator j:

$$C_j = \sigma_j \times \Sigma_k(1 - r_{jk})$$
$$W_j^{cRITIc} = C_j / \Sigma_j C_j$$

Here σ_j is the standard deviation of indicator j and r_{jk} is the correlation between indicators j and

k. Thus, an indicator receives greater weight when it has substantial variation across candidate corridors and contributes information that is not redundant with other indicators.

Recommended Hybrid Weighting Method

Table 4 presents the comparison of potential weighting methods. For the proposed BRT-RI, a hybrid AHP–CRITIC approach is recommended after Delphi validation. AHP captures expert judgments about the relative importance of indicators, while CRITIC derives objective weights from data variability and inter-indicator correlation.

Table 4. Potential Weighting Methods

Method	Type	Main source of weights	Main strength	Main limitation
AHP	Expert-based	Pairwise comparisons	Transparent and interpretable	Subjective; potentially inconsistent
CRITIC	Data-driven	Variation + correlation among indicators	Accounts for redundancy/conflict	Requires sufficient quantitative data
Hybrid AHP–CRITIC	Expert + data-driven	Both	More robust and defensible	More complex

The hybrid weights can be computed as

$$W_j^H = \alpha W_j^{AHP} + (1 - \alpha) W_j^{cRITIc}$$

where W_j^H is the hybrid weight, W_j^{AHP} is the AHP weight, W_j^{cRITIc} is the CRITIC weight, and α is the relative contribution of expert versus objective weighting. A starting specification may use $\alpha = 0.50$, followed by sensitivity analysis using alternative values such as 0.30, 0.50, and 0.70.

Table 12 presents the computation of the BRT-RI.

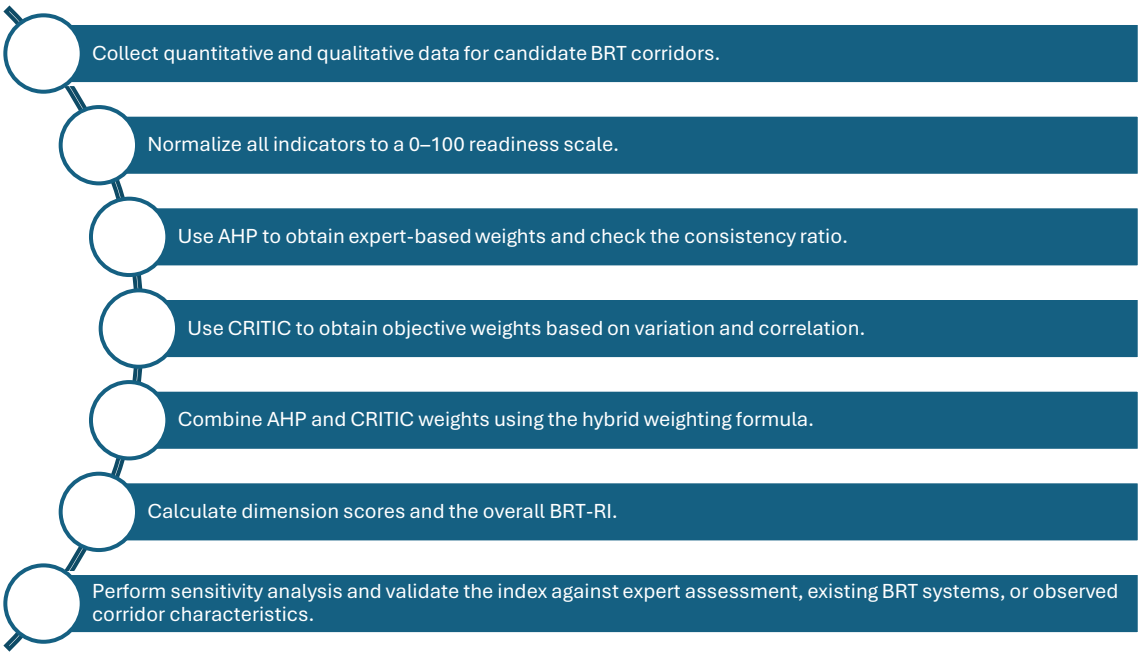


Figure 12. Computation of BRT-RI

5. INITIAL EVALUATION

5.1 Trip Generation

Table 5 presents the trip generation values by zone and Table 6 presents the regression results of the trip generation model by major land use type. Except for General Institutional, all other land use exhibited moderate to good fit.

Table 5. Traffic Generation by Zone

	AM Trip Generation			PM Trip Generation		
Zone	Production	Attraction	Total	Production	Attraction	Total
1	179	918	1,097	470	505	975
2	781	4,607	5,388	2,314	4,568	6,882
3	2,075	2,070	4,146	7,410	7,404	14,814
4	163	449	612	201	229	430
5	0	0	0	0	0	0
6	1,316	1,708	3,023	1,932	2,100	4,033
7	667	4,272	4,939	1,584	6,362	7,946
8	2,117	3,065	5,182	2,805	3,195	5,999
9	1,273	2,934	4,207	1,231	2,835	4,067
10	558	1,537	2,095	1,334	1,944	3,278
11	67	254	321	306	438	744
12	156	229	386	486	553	1,039
13	284	2,559	2,843	426	2,615	3,040
14	570	713	1,283	519	1,047	1,566
15	70	493	563	99	450	549
16	27	45	72	79	76	155
17	12	21	33	36	35	71
18	710	1,484	2,194	795	1,510	2,305
19	156	1,402	1,557	233	1,432	1,665
20	318	1,613	1,931	577	1,707	2,284
21	2,440	6,494	8,935	4,139	7,167	11,306
22	10	88	98	15	90	105
23	80	442	521	236	592	829
24	115	401	516	141	333	474
25	2,269	7,524	9,794	3,163	7095	10,258
26	53	250	303	72	195	267
27	270	641	911	4,267	4,766	9033

Table 6. Trip Generation Regression Analysis

Major Land Use Type	Unit of Input	AM Attraction	AM Production	PM Attraction	PM Production	Remarks
General Institutional (Services)	1000 sqft of GFA	0.499	0.178	0.49	0.509	Low Fit
General Institutional (Educational)	1000 sqft of GFA	0.043	0.029	0.07	0.058	Low Fit
Light Industrial	1000 sqft of GFA	0.168	0.1	0.187	0.175	Good Fit
Mixed-Use Development	1000 sqft of GFA	0.158	0.109	0.23	0.239	Moderate Fit
Mixed-Use Residential	1000 sqft of GFA	0.128	0.148	0.098	0.111	Moderate Fit
Recreation	1000 sqft of GFA	0.03	0.025	0.031	0.052	Good Fit
Retail/Commercial	1000 sqft of GFA	0.34	0.164	0.832	0.715	Good Fit
Utilities	1000 sqft of GFA	0.167	0.073	0.231	0.141	Good Fit
Parks and Open Spaces	Acres	0.222	0.09	0.124	0.23	*Reduced ITE Trip Gen Rates
Golf Course	Acres	0.093	0.105	0.101	0.133	*Reduced ITE Trip Gen Rates

Table 7 presents the estimated trip generation by development phase across the Traffic Analysis Zones and Figure 13 depicts the trip generation values. For Phase 1 (2025-2040), the top zones with highest trip generation values are Zone 25 (20,204 trips), Zone 3 (13,591 trips), Zone 7 (11,308 trips), Zone 14 (10,806 trips) and Zone 21 (9,338 trips).

Table 7. Trip Generation by Development Phase

Zone	Phase 1 (2025-2040)				Phase 2 (2041-2060)				Phase 3 (2061-2075)			
	AM Attraction	AM Production	PM Attraction	PM Production	AM Attraction	AM Production	PM Attraction	PM Production	AM Attraction	AM Production	PM Attraction	PM Production
1	758	296	811	831	2,492	1,415	3,219	3,337	3,354	1,904	4,333	4,492
2	2,157	973	2,121	2,167	3,206	1,445	3,151	3,220	4,315	1,945	4,241	4,333
3	1,702	2,193	6,113	3,583	2,529	3,259	9,084	5,324	3,403	4,386	12,226	7,166
4	311	184	289	351	463	274	430	521	697	369	688	712
5	0	0	0	0	0	0	0	0	0	0	0	0
6	1,109	1,079	1,342	621	1,648	1,603	1,995	923	2,217	2,157	3,164	3,052
7	2,472	1,713	3,432	3,691	3,674	2,545	5,100	5,484	4,944	3,425	6,864	7,381
8	1,578	1,760	2,474	2,278	2,802	2,615	3,677	3,623	3,772	3,520	4,948	4,876
9	1,400	940	1,481	1,512	2,080	1,397	2,200	2,246	2,799	1,880	2,961	3,023
10	1,606	1,041	2,232	2,294	3,068	2,117	4,222	4,373	4,129	2,849	5,682	5,886
11	1,949	1,325	2,890	2,951	2,896	1,969	4,294	4,385	3,898	2,650	5,779	5,902
12	967	650	1,504	1,487	4,449	3,068	6,555	6,646	5,988	4,129	8,822	8,945
13	924	765	1,014	1,050	1,489	1,136	1,919	1,897	2,004	1,529	2,583	2,553
14	2,182	1,561	3,533	3,530	12,341	9,143	19,545	18,566	16,610	12,305	26,305	24,987
15	418	83	146	542	621	124	217	806	1,304	1,006	1,729	1,850
16	187	130	272	283	278	193	404	421	6,270	4,257	8,894	9,132
17	91	83	132	138	135	124	197	205	1,217	1,290	1,050	1,306
18	1,516	1,031	1,969	2,089	7,793	5,165	11,982	12,050	13,043	8,189	18,302	18,602
19	665	369	953	885	988	549	1,416	1,315	1,330	783	1,906	1,864
20	1,621	1,162	2,201	2,278	5,554	3,566	6,693	6,569	7,475	4,799	9,008	8,841
21	2,271	1,776	2,481	2,810	3,374	2,640	3,687	4,176	4,541	3,553	4,962	5,620
22	22	13	25	23	33	20	37	34	45	27	50	46
23	254	134	494	432	377	200	735	642	508	269	989	864
24	441	57	482	122	655	85	716	182	882	115	964	244
25	4,530	2,475	6,858	6,341	6,731	3,678	10,190	9,422	9,059	4,950	13,715	12,681
26	45	965	65	201	206	1,435	297	298	278	1,931	400	401
27	1,486	711	3,669	3,160	2,208	1,057	5,452	4,695	2,971	1,423	7,338	6,319

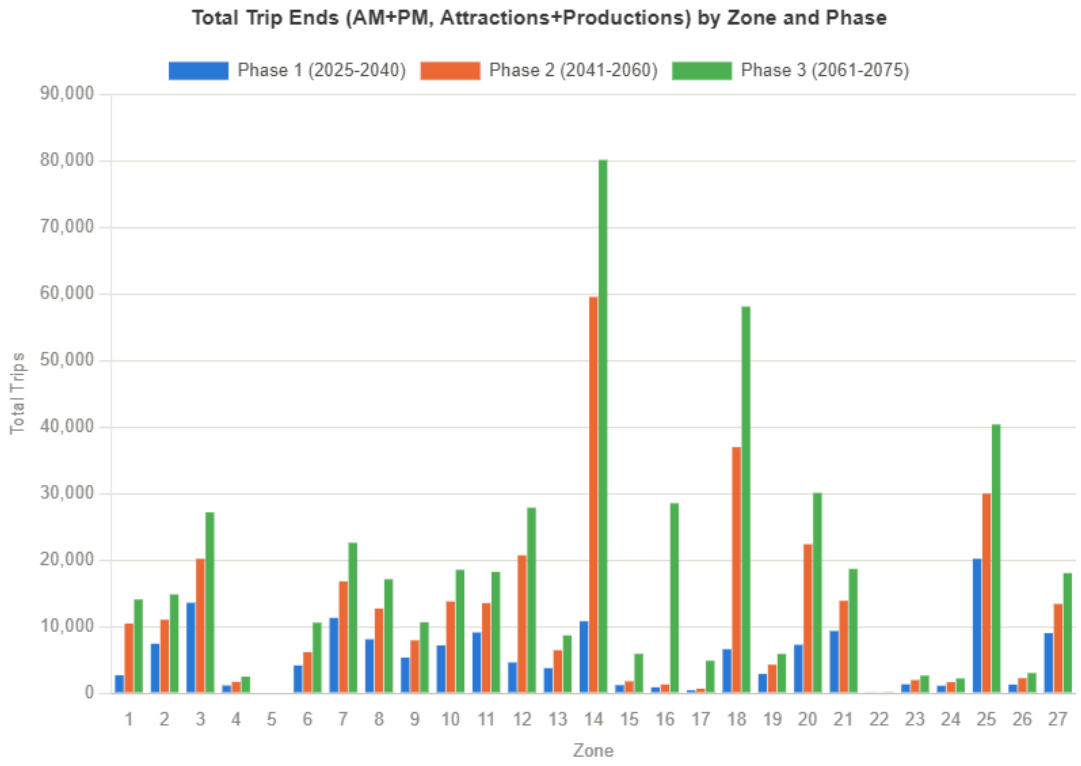


Figure 13. Trip Generation per Development Phase

Figures 14 and 15 present the estimated vehicle composition per phase for the AM and PM peak periods, respectively. For Phase 1, the total traffic is expected to increase from 20,500 to 29,000 vehicles representing an annual traffic growth rate of 2.5% based on AM peak period. However, it is expected that there will be a drastic increase in traffic from 24,700 to 42,700 vehicles based on PM peak period estimated which represents a 3.7% annual traffic growth rate.

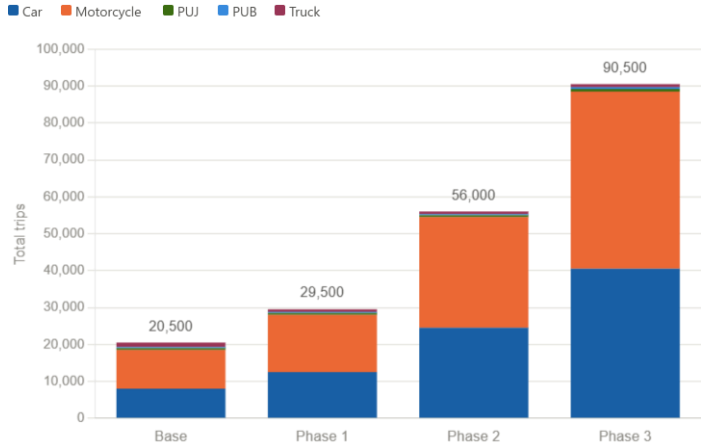


Figure 14. Vehicle Composition per Phase, AM Peak

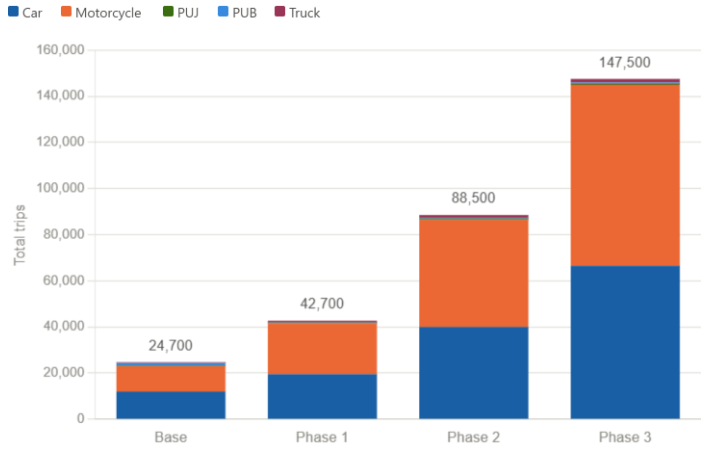


Figure 15. Vehicle Composition per Phase, PM Peak

5.2 Assessment of BRT Option

Table 8 presents the performance metrics of the proposed enhanced bus system for the northbound and southbound direction during the Phase 1 scenario. The forecasted average travel distance is 2.57 km and average travel time is 3.74 mins. Figures 16 and 17 present the transit on/off and transit line profile for the northbound direction. Figures 18 and 19 present the transit on/off and transit line profile for the southbound direction.

With a peak-hour factor of 0.1, the expected daily ridership for Phase 1 is expected to reach 7,768 passenger which represents a 10.7% annual growth rate from the prevailing average of about 1,700 passengers daily.

Table 8. Forecast Bus Performance by Direction

Direction	Distance (km)	Time (mins)	Pass	PassDist	PassHr	Ave. Travel Distance	Ave. Travel Time
NB	20.63	27.65	392.09	1,008.38	26.15	2.57	4.00
SB	20.52	26.42	384.74	987.85	22.34	2.57	3.48
Total	41.15	54.07	776.83	1,996.23	48.49		

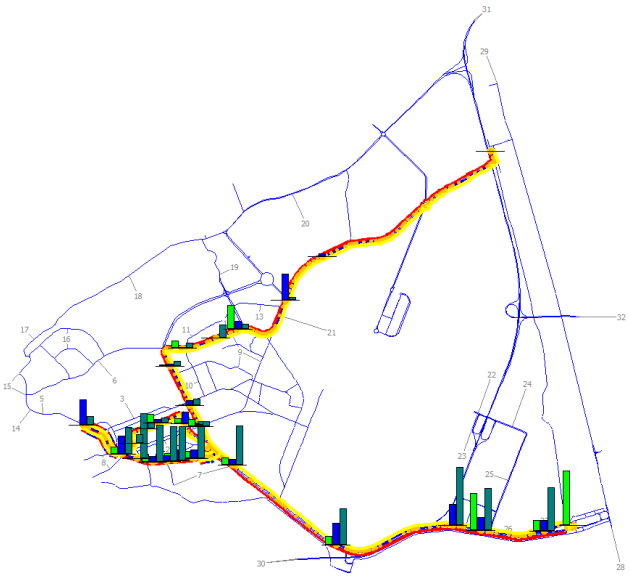


Figure 16. Transit On/Off for the Northbound Direction

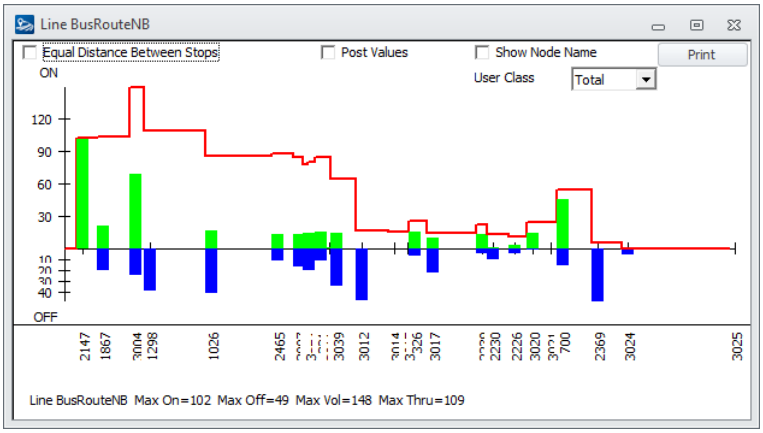


Figure 17. Transit Line Profile for the Northbound Direction



Figure 18. Transit On/Off for the Southbound Direction

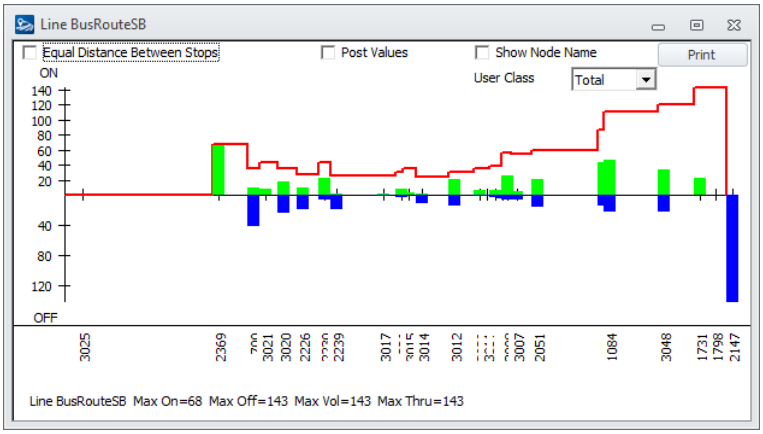
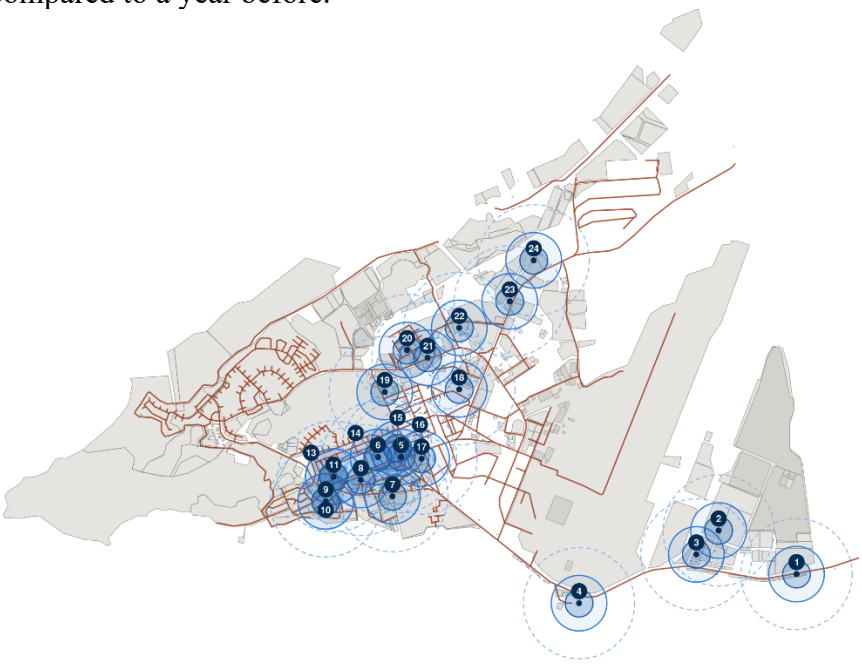


Figure 19. Transit Line Profile for the Southbound Direction

To validate the potential magnitude of riders, Figure 20 shows the buffer analysis on the number of locators on each Clark Loop bus stop at 200m, 400m and 800m, respectively. The buffer map indicates that on average, there are 11 locators within 200m from the bus stop. Correspondingly, there are 31 locators within 400m and 67 locators within 800m. This indicates a sizeable number of employees that can be served by an improved bus system. Figure 21 presents the trend in bus ridership which indicates very high increase averaging at 150% growth rates on a month-by-month basis compared to a year before.



200 m 400 m 800 m Locator parcel Road section Stop

Locators within 200 / 400 / 800 m

1 FLAGPOLE / CITYFRONT	3 / 6 / 17	13 CDC CORPORATE	10 / 35 / 96
2 MERCEDES / STEEL PARK	5 / 13 / 30	14 PLAYGROUND	13 / 55 / 94
3 ADERANS / DON JUICO	8 / 16 / 24	15 BARNHOUSE	26 / 56 / 84
4 FRIENDSHIP GATE	2 / 5 / 11	16 CLARK MUSEUM	26 / 56 / 84
5 PHILEXCEL GATE	35 / 55 / 84	17 ROYCE / PLDT	10 / 40 / 73
6 CLARK CENTER	13 / 55 / 94	18 MIMOSA	6 / 25 / 60
7 BERTHAPHIL 1	13 / 33 / 104	19 HANN / WIDUS	6 / 15 / 55
8 CLARK ELECTRIC	7 / 26 / 119	20 NAT. MUSEUM / CHAPEL 2	10 / 21 / 70
9 SAPANGBATO / 711	18 / 50 / 78	21 PUREGOLD / UP	12 / 31 / 66
10 AMERTRON	18 / 50 / 78	22 CENTENNIAL ROAD	8 / 13 / 59
11 ONE STOP / D'HEIGHTS	10 / 35 / 96	23 TEXAS / EL KABAYO	6 / 11 / 28
12 CDC BOSS	10 / 35 / 96	24 PICNIC GROUND	3 / 10 / 22

Figure 20. Buffer Analysis of Number of Locator around Bus Stops



Figure 22. Clark Loop Bus Ridership for 2025-2026

5. FINDINGS AND RECOMMENDATIONS

The implementation of Clark Loop represents the government's commitment to promoting smart and sustainable urban mobility. By providing a reliable public transport option, the bus system aimed to reduce dependence on private vehicles, improve accessibility for employees and visitors, lessen traffic congestion, and support environmental sustainability through more efficient transport operations. There is strong potential in transforming the Clark Loop Bus service into a full-scale BRT system. This paper proposes a BRT Readiness Index (BRT-RI) indicator system that is underpinned by BRT success factors, Further research is need to validate the validity and reliability of the index based on empirical data.

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