

**Toolkit from the
US-ASEAN Smart Cities Mobility Program**

**INFORMING TRANSIT STATION LOCATION AND
DESIGN DECISIONS**

INSIGHTS FROM JOHOR BAHRU AND PORTLAND



Sponsorship

The authorship of this toolkit is the result of a collaboration between the organizations listed below.

Volpe National Transportation Systems Center

METRANS Transportation Consortium at the University of Southern California

Univesiti Teknologi Mayalsia

The U.S. ASEAN Smart City (US-ASCP) Program toolkits were supported by the U.S. Department of State and U.S. Department of Transportation. The report is funded, partially or entirely, under award number 69A3452450001 from the U.S. Department of Transportation. This document is disseminated in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof. The results and conclusions in the toolkit are not official positions, standards, or opinions of the authors' organizations or of the sponsors.

Acknowledgements

The project benefited from the participation and contributions from teams representing Johor Bahru and Portland. We thank the Iskandar Regional Development Authority, the City of Portland Bureau of Transportation, Johor Bahru Public Transport Corporation, and Oregon Metro for their engagement throughout the US-ASCP program. The results and conclusions in the toolkit should not be interpreted as reflecting official positions, standards, or opinions from the sponsors (U.S. Department of State and U.S. Department of Transportation), or from any of the participating organizations.

INTRODUCTION

Cities around the world are seeking to shift travel from single-occupancy vehicles to higher capacity modes to reduce congestion. While many policies and operational strategies can influence traveler behavior, few decisions shape transit ridership as fundamentally or as permanently as the location of stations. Station site selection determines who can realistically use the system, how well transit connects to surrounding land uses, and whether subsequent investments in service, vehicles, and station design can deliver their intended benefits.

This toolkit positions station location as the critical first step in expanding transit ridership. Even well-designed stations and frequent service cannot compensate for poor siting decisions that make stations difficult to reach and disconnect stations from key destinations. The toolkit introduces a flexible, low-cost modeling approach that allows cities to evaluate and compare potential station locations using available data, making it particularly suitable for contexts where resources or detailed datasets are limited. Drawing on lessons from Johor Bahru, the toolkit demonstrates how strategic site selection can support network expansion, improve ridership, and create a stronger foundation for subsequent station area design and service planning decisions.

This toolkit is the result of the Smart Mobility Program, a U.S. Department of Transportation (USDOT)-led initiative under the U.S.-ASEAN Smart Cities Partnership. This program engaged experts from four peer-to-peer pairings representing 8 cities across the U.S. and Southeast Asia, with research support from a university team led by the METRANS

Box 1. What is the U.S. - ASEAN Smart Mobility Program?

This program addresses the transportation priorities of participating ASEAN smart cities by identifying innovative solutions to urban transportation challenges. The primary participants are local and regional transportation planner and policymakers from eight cities across the U.S. and Southeast Asia working on projects of mutual interest. The program focuses on how effective policy setting, good planning practices, the judicious use of technology, and targeted engagement with the private sector can increase mobility and improve transportation network operations. Participating cities include:

- Johor Bahru, Malaysia and Portland, Oregon
- Phuket, Thailand and Las Vegas, Nevada
- Phnom Penh, Cambodia and Boston, Massachusetts
- Jakarta, Indonesia and Los Angeles, California

The University Partnership Program (UPP) was formed to assist the city pairs with field research to support policy objective. The UPP is led by the METRANS Transportation Consortium at the University of Southern California and brings together four Southeast Asian Universities to lead research projects:

- Chulalongkorn University
- Institute of Technology of Cambodia
- Universitas Indonesia
- Univerisity Teknologi Malaysia

Transportation Consortium at the University of Southern California (see Box 1). This toolkit summarizes outcomes from the pairing representing Portland, Oregon and Johor Bahru, Malaysia. This partnership included participation from the following agencies:

Iskandar Regional Development Authority (IRDA): IRDA developed strategic policies for Iskandar Malaysia, a major economic corridor in southern Johor, Malaysia, and as part of this mandate played a key role in the planning, promotion, and facilitation of the Bus Rapid Transit (BRT) system from 2010 to 2023. The project subsequently transitioned to the Autonomous Rapid Transit (ART) system, with implementation responsibilities transferred to the Ministry of Transport (MOT). Notwithstanding this transition, IRDA continues to play an important role in facilitating and promoting the development of an effective public transportation system within the region.

PLANMalaysia: PLANMalaysia is an organization under Malaysia's Ministry of Local Government Development responsible for urban and rural planning. Additionally, they support innovative research and development and provide technical assistance to local authorities.

City of Portland, Oregon Bureau of Transportation (PBOT): PBOT is responsible for planning, building, and maintaining Portland's transportation system. The bureau oversees programs including e-scooters, electric vehicles, civil engineering, infrastructure maintenance, and parking.

Oregon Metro: Oregon Metro provides regional leadership across the Portland metropolitan area on topics such as land use, transportation planning, and

housing. The organization serves over 1.7 million people across 24 cities.

Johor Bahru and Portland share a common challenge faced by many cities: transit systems operating in urban environments that have been largely shaped by automobile-oriented development. In both cases, the spatial distribution of activities and incomplete walking and cycling networks make it difficult for many potential riders to use transit, particularly for first- and last-mile trips. These conditions underscore the importance of station siting decisions that account for connectivity, and surrounding land use from the outset. This toolkit draws on lessons from Johor Bahru and Portland to demonstrate how cities can use data-driven, low-cost methods to evaluate and compare potential station locations, identify opportunities for integration with surroundings, and prioritize transit investments that are most likely to increase ridership.

What you will learn from this toolkit

This toolkit is intended for government practitioners and urban planners involved in the planning, design, and operation of transit systems. It is relevant both when



Credit: Steve Morgan [CC-BY-SA 4.0](#)

a city is planning future routes or when assessing existing routes to develop transit-oriented development (TOD) corridors by identifying potential locations for transit stations. The information may be particularly useful for cities and agencies hoping to enhance their data collection and analysis efforts to improve decision-making.

Key information covered will include:

- Evidence-based solutions for identifying transit stop locations that may yield significant ridership demand, including:
 - How to evaluate a region and identify points and corridors of potentially high ridership demand
 - Ability to identify site enhancements to promote high ridership demand
- How to facilitate collaboration among agencies as they develop metrics, tools, and projects to address shared challenges.
- Other considerations related to developing bus transit networks, including station typologies, design elements, enhancing multimodal options, and engaging community stakeholders.

STATION LOCATION AND DESIGN: DEFINING THE PROBLEM IN THE ASEAN CONTEXT

Malaysia is a highly car-oriented country, with more than 86 percent of commute trips made by private vehicles, including cars, motorcycles, taxis, and ride-hailing services. Johor Bahru, the urban center of Malaysia's second-largest metropolitan area, reflects this broader national pattern. Rapid growth has been characterized by low-density development and strong automobile dependence, contributing to

increasing congestion and long travel times. These challenges are compounded by Johor Bahru's role as a major international gateway: the city shares a border with Singapore that accommodates more than 300,000 cross-border trips each day, many of which rely on bus services and a future rail connection known as the Rapid Transit System (RTS) projected to open in 2027.

In response, Johor Bahru has embarked on an ambitious expansion of its public transport system to reduce car reliance and improve access for residents, workers, and cross-border travelers. These investments are intended to significantly increase the capacity and reach of the city's bus-oriented network and double the public transport mode share from 15% of trips in 2024 to 30% by 2035.¹ In April 2024, the Malaysian government announced a reassessment of the region's long-term transit strategy, including a review of the proposed primary transit mode for Greater Johor Bahru and the Iskandar Malaysia region. As part of this process, the region is now pursuing a 32-station elevated autonomous rapid transit (E-ART) system.

The Johor Bahru case illustrates why station site selection is a critical early decision in cities undergoing rapid transit expansion, particularly those with strong regional and international connectivity. Decisions about where stations are located will shape access to employment, border crossings, and emerging activity centers for decades to come. While the research supporting this toolkit is grounded in a city with an existing transit system and focuses on network expansion rather than system creation, the methods presented are adaptable to contexts where transit service is limited or absent. This makes the toolkit relevant not only for expanding

established networks, but also for evaluating potential station locations in underserved areas as cities plan future growth.

METHODS FOR DATA-DRIVEN STATION LOCATION DECISIONS AND INVESTMENT PRIORITIZATION

The primary goal of the research conducted under the Smart Mobility Program was to develop a predictive, station-level model of bus ridership. The model explains variation in average daily ridership across stations in the Johor Bahru network during a typical week, based on a set of built environment and accessibility variables. Its purpose is to help cities identify where high transit demand is likely under existing conditions and to support more informed station siting decisions as networks expand. While the model is calibrated using current land use patterns, it can also be used in exploratory scenarios to assess how future development may align with anticipated ridership.

The model is intentionally parsimonious. It

was designed as a lightweight, transferable tool that can be implemented by cities with limited analytical capacity or incomplete datasets. Accordingly, the research team prioritized variables that are commonly available from public sources and avoided inputs that require specialized data collection or proprietary software. This section walks through each step of the modeling process, including data preparation, variable selection, model estimation, and interpretation of results. It also highlights key assumptions, limitations, and practical considerations that cities should account for when applying the model to local decision-making. The methods are presented in a step-by-step format so that planning and transit agencies can adapt the approach using their own data and institutional constraints.

The ridership data were provided by the bus operator and is based on transit payment card that require tapping in when boarding and tapping out when alighting. Therefore, the data includes the origin and destination of each rider based on the station where



Credit: Seloloving - CC BY-SA 4.0

they embarked and disembarked from the bus. The team collected data on population, land use, points of interest, and the road network as predictive variables for the model.

This research assumes that the area surrounding a station is the most important in determining ridership. Therefore, each predictive variable is summarized for a 400m buffer surrounding each station (see Figure 2). This means that, for example, population density is calculated for the area directly surrounding the station only, with the expectation that where more people live within 400m of a station, there is a higher number of potential riders.

Data Collection and Preliminary Analysis

Collecting and preparing data is a critical first step in any quantitative analysis. Because data availability and quality vary widely across cities, the modeling approach presented in this toolkit emphasizes flexible workflows that can accommodate different data types, sources, and spatial resolutions. For example, population data may be available only as raster surfaces, while points of interest or transit stops are often provided as point-based datasets. Designing a workflow that can integrate these heterogeneous inputs is essential to ensuring that the model can be reproduced and adapted across contexts.

Baseline Data Audit and assembling a database

A baseline data audit is a necessary first step to determine what data are available, what permissions are required, and which agencies or partners must be engaged to secure access. The approach outlined in this toolkit relies on a mix of data sources and it identifies administrative datasets commonly held by

municipal or regional government entities, and open-source alternatives. Establishing what data exist, in what formats, and at what spatial and temporal scales is critical, as many datasets require reformatting, aggregation, or rescaling to support station-level modeling.

In the Johor Bahru case, the research team engaged early with planning agencies and bus operators to assess data availability. Although most of the required data existed, constraints related to data sharing, geographic coverage, and formatting necessitated the use of alternative sources for several inputs. As a result, the data audit extended beyond inventorying datasets to evaluating data quality, completeness, and potential sources of bias.

Table 1 summarizes two broad strategies for sourcing model inputs. The first relies on administrative data, such as planning documents and official land use maps. These sources often provide authoritative and detailed information but may be difficult to access, subject to sharing restrictions, or require substantial preprocessing due to complex formats. The second strategy relies on open-source or crowd-sourced datasets. While these data are more accessible and easier to integrate, they can vary significantly in coverage and accuracy and are not designed to replicate official administrative records. As a result, they often require the construction of proxies by combining multiple data sources.

In practice, most cities fall somewhere between these two approaches, and effective workflows typically combine administrative and open-source data. In Johor Bahru, the research team relied on transit operator data for ridership and bus stop locations, city data for land use, and open-source

data for all other model variables.

The variables listed in Table 1 form the backbone of the model. A key consideration in assessing each dataset was whether its spatial resolution was sufficient to capture conditions in the immediate vicinity of the station. Because the model operates at the station level, data needed to reflect the local built environment rather than broader neighborhood- or district-scale conditions. In Johor Bahru, the research team used a 400 m radius around stations to represent the local environment, consistent with commonly used estimates of a comfortable walking distance to bus stops.² All variables were therefore measured within a 400 m radius of each station, requiring the underlying datasets to be sufficiently fine-grained to support aggregation at that scale (see Figure 1 for station locations and buffers).

Cities applying this approach may adjust the buffer distance based on local context, mode type, or observed access patterns.

The primary dependent variable is station-level ridership, which can be derived from manual passenger counts, automated passenger counters, or fare collection systems. These sources vary substantially in reliability and spatial specificity. For this study, the research team obtained ridership data from the bus operator based on payment card transactions, providing a relatively high level of accuracy. However, due to the sensitive nature of the data, only one week of observations was made available. This limitation required close coordination with the operator to verify that the selected week reflected typical ridership patterns rather than atypical events or seasonal fluctuations.

MODEL DATA	VARIABLE DEFINITION	ADMINISTRATIVE SOURCE	OPEN SOURCE
Transit Rider-ship Volume	Average daily number of onboarding and alighting at station	Transit Operator	Not available
Land Use Mix	Entropy index of the number of land use categories	Planning agency (parcel-level land use map)	Open Street Map (OSM) land use field
Points-of-Interest Density	Number of points of interest per km ²	Planning agency (parcel-level land use map)	OSM point of interests
Access to Transit Services	Ratio of area within distance to station on the road network to straight line distance	Transit operator coordinates for stops	OSM point data for transit stops
Population Density	Number of people per km ²	Census data at the enumeration unit scale	Worldpop 100x100 meter population raster

Table 1. Source of data based on city strategy

The independent variables listed in Table 1 represent factors hypothesized to influence transit demand. Land use mix captures the diversity of activities around a station, reflecting the range of trip purposes that may generate ridership. Points-of-interest density measures the concentration of destinations likely to attract visitors. Access to transit is measured by comparing the theoretical walking catchment defined by a straight-line buffer (400 m in the Johor Bahru case) with the effective walking area defined by the road network. The closer the network-based catchment is to the maximum theoretical area, the greater the level of accessibility. Population density is calculated as the number of residents within the station catchment divided by its area.

For each dataset, the research team evaluated the source, format, accuracy, temporal relevance, and spatial coverage to ensure that model results were not unduly influenced by data limitations or inconsistencies.

Data cleaning and inspection

Once data were collected and assessed, they were cleaned and formatted into a unified dataset suitable for analysis. This step is especially critical when relying on open-source or crowd-sourced data, as it allows researchers to identify anomalies, inconsistencies, or gaps before proceeding to modeling. Data cleaning involved standard statistical diagnostics—such as verifying that values fall within plausible ranges and checking for missing or duplicate records—as well as visual inspection.

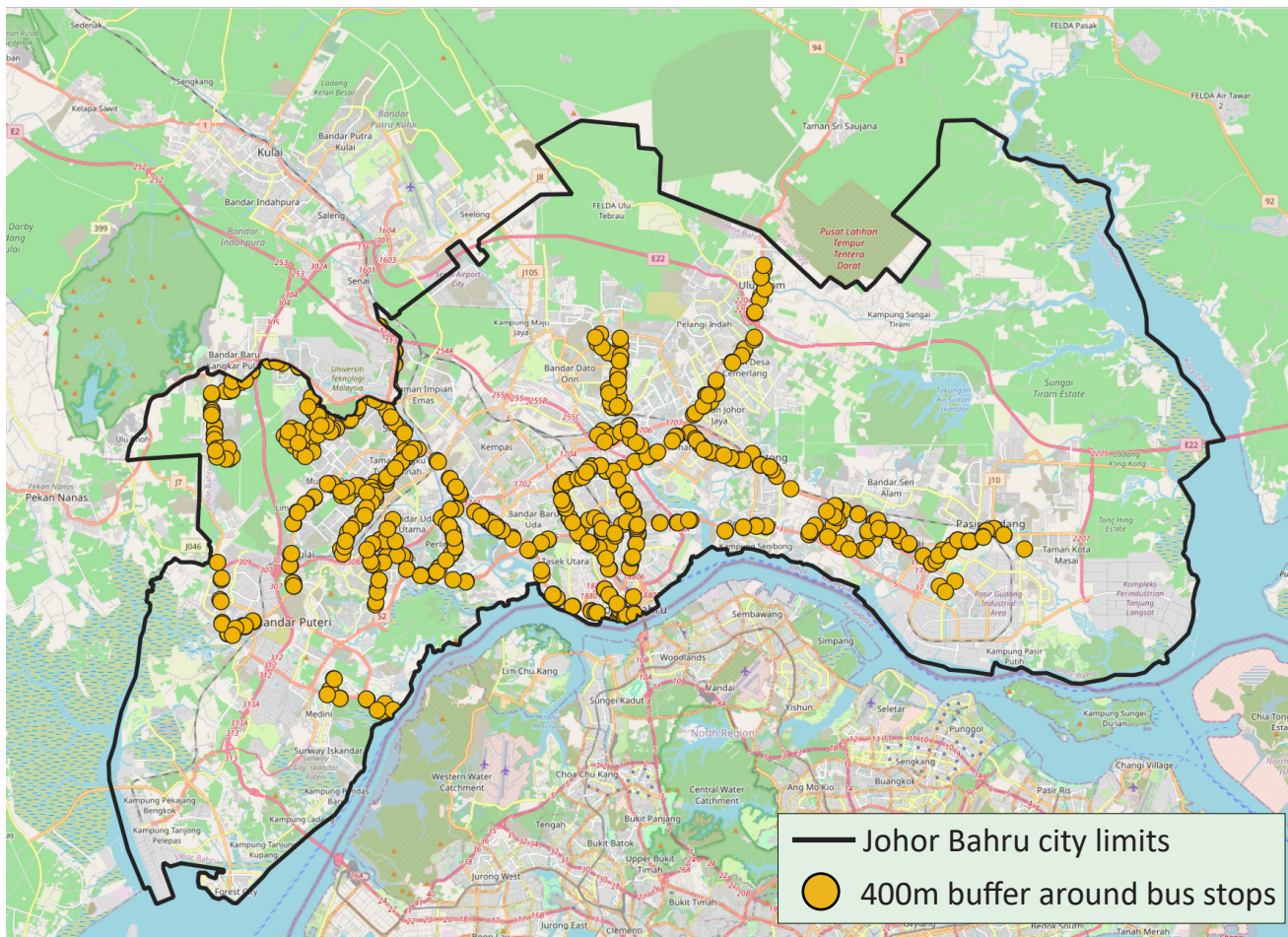


Figure 1: Transit stops in Johor Bahru with 400m buffer zone



Credit: Truflip99 - [CC-BY-SA 4.0](#)

All spatial datasets were mapped to support validation against on-the-ground conditions. Visualizing data spatially makes it possible to identify implausible patterns, such as stations with unexpectedly high ridership or activity located in areas with little surrounding development. At this stage, soliciting input from local experts can be particularly valuable to confirm whether observed patterns align with lived experience and operational knowledge.

Beyond quality control, mapping also served an exploratory function. Overlaying ridership data with land use, population density, and points of interest helped illustrate where passengers are boarding or alighting in relation to key destinations and residential areas. These integrated visualizations highlight ridership concentrations, underserved areas, and spatial mismatches between demand and service provision.

As a result, the data cleaning and inspection phase also functions as an initial diagnostic tool. It allows planners to identify coverage gaps, redundancies, and potential opportunities for optimizing station locations along existing or proposed routes before advancing to formal modeling.

Quantitative Framework for Identifying Suitable Station Locations

The final step of the analysis brings together all of the collected data to understand where transit stations are most likely to perform well. Rather than focusing on a single factor, the approach examines how multiple characteristics of the built environment combine to influence ridership. These include how many people live nearby, the mix and intensity of land uses, the concentration of destinations, and how easily people can reach a station on foot using the street network.

Using these inputs, the research team developed a simple predictive model that estimates the level of ridership a station is likely to generate based on existing conditions. The purpose of the model is not to produce exact forecasts, but to allow cities to compare locations and identify areas with relatively higher or lower potential demand.

The model supports two practical outcomes. First, it allows planners to scan a city or corridor and identify locations where new stations or routes are most likely to attract riders. Second, it helps identify which site-level improvements—such as better pedestrian access, increased density

of activities, or improved connectivity—could meaningfully increase ridership at existing or proposed stations.

Conceptually, the model works by learning from the current transit system. It examines how ridership varies across existing stations and identifies patterns linking higher ridership to specific local conditions. Those relationships can then be applied to other locations to assess their potential performance under current or improved conditions. In this way, the model serves as a decision-support tool that helps prioritize transit investments, test alternative siting options, and make trade-offs transparent to decision-makers and stakeholders.

Using Model Outputs to Support Transit Station Planning

The outputs from the model provide estimates of the relative influence of different factors on transit ridership within the existing network. The outputs, a set of coefficients, are intermediate analytical results that can be easily translated into maps and station-level scores or rankings that support station prioritization. The coefficients can also be used to give planners a sense of how ridership is likely to change if aspects of the local environment, such as land use, access, or density, are modified. These outputs are useful in two main ways.

Identifying priority locations for new stations or corridors. The city can be segmented into a grid of local environment units, with model results applied to each unit. This helps highlight areas with high potential ridership where stations do not currently exist, guiding decisions about where to expand the network most effectively.

Assessing the performance of existing or planned stations. If a station is underperforming, the model can suggest which local conditions may be limiting ridership. For example, a station in a dense area but separated from residential zones by a difficult-to-cross road may benefit from improved pedestrian connections. The model can also support scenario testing, such as estimating how a new commercial development or transit link might influence station-level ridership.

In practice, these results are best used to narrow a large set of possible locations into a smaller group of priority sites for more detailed feasibility, design, and community engagement work. Outputs should inform, but not replace, decisions about station prioritization. Local knowledge, policy priorities, community input, and broader planning considerations must also be taken into account. Statistical models include uncertainty and cannot capture all contextual factors. In Johor Bahru, for instance, the upcoming rail link to Singapore adds a layer of strategic importance to border-adjacent stations that the model alone cannot fully quantify. Using model outputs alongside other inputs ensures more robust, evidence-based planning.

Alternative use of the model output

The model outputs reported below are based on data from Johor Bahru and reflect the city's specific built environment, travel behavior, and transit network. As such, the results should not be directly transferred to other cities as predictive estimates of ridership. However, they can inform preliminary analysis and early-stage planning.

In particular, the model highlights the relative importance of different factors associated with station-level ridership, such as land use mix, accessibility, and population density. Cities that are unable to reproduce the full model due to limited ridership data or analytical capacity can still use these results as indicative guidance when assessing which built environment factors are likely to matter most. When applied outside Johor Bahru, these insights should be treated as directional and complemented by local knowledge, qualitative assessment, or targeted data collection.

As more cities in the ASEAN region develop comparable models, these individual case studies can contribute to a growing regional evidence base. Over time, this shared knowledge will help cities better gauge which built environment and accessibility factors most consistently influence transit demand in Southeast Asian contexts, strengthening the transferability and usefulness of future analyses

Expertise and Information Needed

Developing the station-level ridership model requires a small set of technical skills, the precise mix of which will depend on

data availability and the depth of analysis a city intends to pursue. At a minimum, the following roles are recommended:

- **Transportation Planner (Project Lead):** Owns the overall process, defines planning objectives, coordinates with agencies and operators, and assembles the transit ridership database. This role is essential in all cases and should retain project ownership regardless of the modeling approach.
- **GIS Analyst:** Prepares and manages spatial data, performs network and buffer analyses, and integrates land use, population, and accessibility datasets.
- **Data Analyst:** Conducts data cleaning and statistical analysis, including regression modeling and interpretation of results.

In practice, these skills are often consolidated within one or two individuals. In many cities, a Transportation Planner with GIS training can also perform the spatial analysis, reducing staffing needs. Where data availability is limited and the goal is preliminary or exploratory analysis rather than full model estimation, advanced statistical expertise is less critical, and cities can rely more heavily on existing model outputs and descriptive mapping.



Credit: Lionel Lim CC-BY 2.0

Depending on how results are used, additional expertise may be beneficial. Input from transit operations staff can help interpret ridership patterns and operational constraints, while urban planning expertise can support translation of model outputs into land use or station-area strategies. Strong local institutional knowledge and data visualization skills can further improve the relevance, credibility, and uptake of results

Tools Needed

This toolkit is intentionally designed to rely on widely available, open-source tools to minimize financial and technical barriers. For the approach outlined here, the following tools are sufficient:

- **Spreadsheet software** (e.g., Microsoft Excel, Google Sheets, LibreOffice Calc) for organizing ridership data and intermediate datasets.
- **R or Python** for data cleaning, preparation, and statistical analysis.
- **QGIS** for spatial analysis, visualization, and mapping.

Because all recommended software is open source, the model can be implemented with minimal financial investment. Aside from potential training or staff time, there are no direct software costs, making this approach accessible to cities with limited resources.

RESULTS FROM THE CASE STUDY IN JOHOR BAHRU, MALAYSIA

As noted above, one of the primary applications of the model outputs is identifying areas where new transit stations or corridors are likely to generate significant ridership. Because the model is estimated using existing station locations,

predicted values for areas without stations were generated by dividing the city into 1 × 1 km grid cells. For each grid cell, values for the same built environment variables used in the model were calculated, allowing the model coefficients to be applied consistently across the city.

The model results indicate that three variables—points-of-interest density, population density, and access to transit—are statistically significant predictors of station-level ridership. The model achieved a strong fit, meaning that predicted ridership values closely align with observed ridership at existing stations. To support interpretation and mapping, predicted values for each grid cell were classified into five categories, ranging from low to very high ridership potential.

Figure 2 illustrates the spatial distribution of predicted ridership potential across Johor Bahru alongside existing station locations. As expected, areas with high predicted ridership largely coincide with current stations, providing confidence that the model reflects real-world conditions. More importantly for planning purposes, the map highlights areas with high ridership potential that are not currently served by stations, pointing to candidate locations for future investment. In particular, the results reveal strong east–west corridors of high demand and a dense cluster of high ridership potential immediately north of the Singapore border crossing. These patterns support prioritizing additional transit capacity, improved station spacing, or higher-frequency service in areas that are already functioning as major travel generators but remain underserved by the existing network. These results are intended to support early-stage screening and prioritization, helping planners focus detailed feasibility studies

and stakeholder engagement on locations with the greatest potential impact.

Additional Considerations Related to Transit Station Development

This toolkit focuses primarily on identifying areas where new transit stations are most likely to generate ridership. However, station siting alone does not determine station performance. How a station is designed and integrated into its surrounding environment plays a critical role in shaping access, usability, and long-term ridership outcomes. As highlighted in the Johor Bahru results, areas with high demand potential may still underperform if stations lack clear connections to the street network or require improved first- and last-mile access.

This section introduces additional considerations drawn from Portland's

experience with its station improvement program to complement the siting strategy. By examining how station design and station-area integration influence accessibility and user experience, the toolkit extends the analysis from identifying where stations should be located to understanding how they can be designed to realize their full potential within the built environment.

Station Typologies

Typical station typologies for BRT systems are (1) Median, (2) Curb, and (3) Elevated Stations.

- Median Stations allow travel in both directions of the BRT corridor. This configuration can simplify transfers, which can be increasingly useful as the network expands.
- Curb Stations are generally designed for

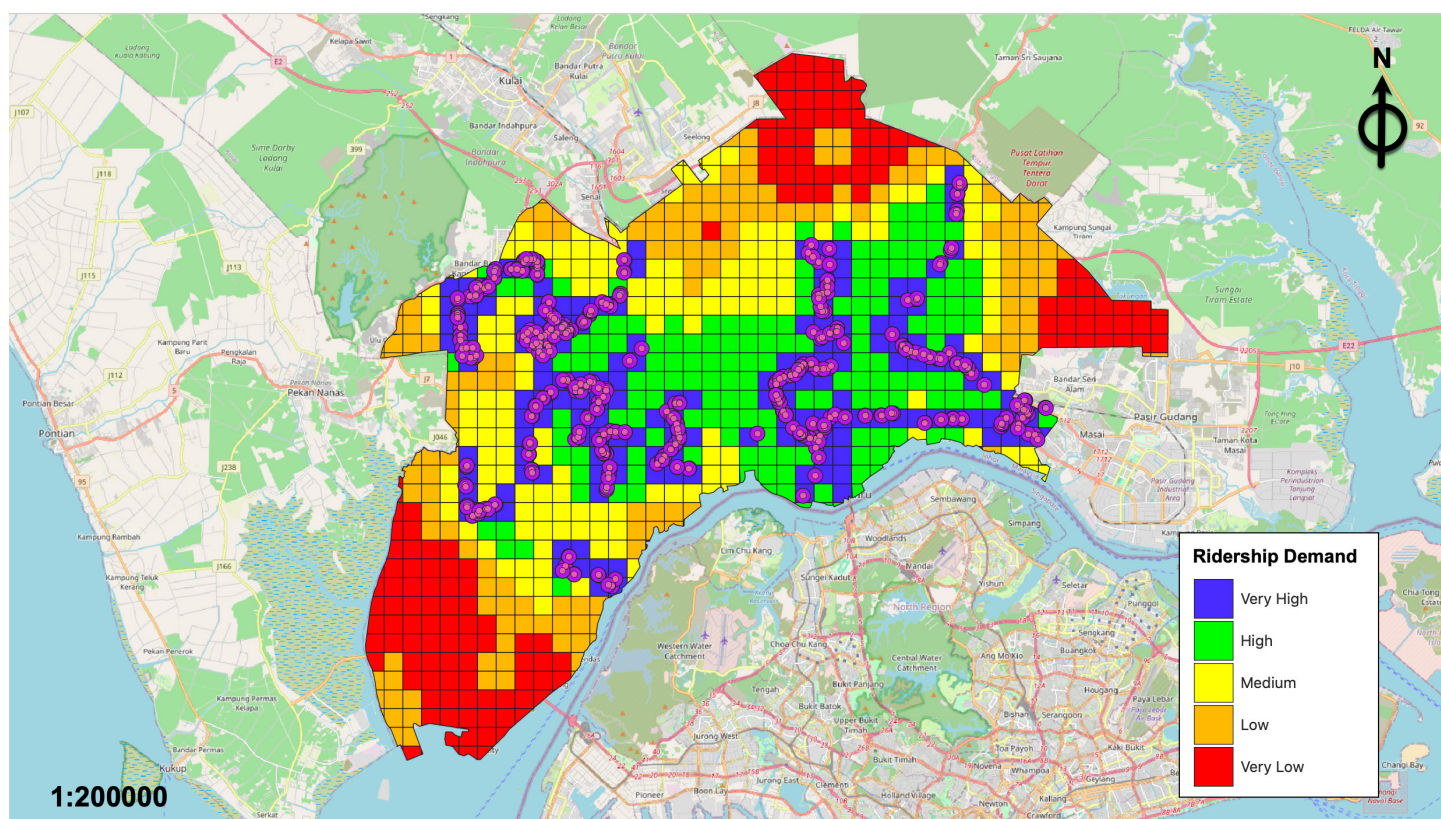


Figure 2: Potential ridership demand of Johor Bahru overlaid with existing transit stations in Johor Bahru (Grid size = 1 km²)

one-way roads and may distribute activity between stations. This type of station offers access to only one travel direction per curb.

- Elevated Stations are faster than street level station, but they have a higher cost and may reduce local access as compared to street-level stations.

Design Features and Operational Guidelines

Selection of design features can help to improve station demand, efficiency, and accessibility. Information about design features can be found in documents developed by transit agencies (e.g., TriMet Design Criteria and Guidelines for Arterial BRT, Chapter 29), industry associations, (e.g., American Public Transportation Association Bus Rapid Transit Station Guidance), or international organizations (e.g., Institute for Transportation & Development Policy Bus Rapid Transit Standard).

Some key design criteria elements included in the documents noted above include the selection and use of durable, low-maintenance materials; design for weather protection and user comfort; universal accessibility for people of all abilities; appropriate platform heights for level boarding; and the integration of advanced safety features such as transparent shelters and effective lighting. Design guidance also extends to station placement, optimizing distance from intersections, spacing between stations, and clear delineation of spaces to ensure operational efficiency and passenger safety. Service design principles ensure frequent, reliable operations with minimized dwell times, and support features like off-board fare collection and integrated branding to enhance service clarity and system identity.

Box 2. Station Typology: Lessons from Johor Bahru and Portland

Johor Bahru's Transit station typologies predominantly feature median stations (18 out of 22 stations), selected primarily for operational efficiency and spatial economy. Median stations support bidirectional boarding within constrained right-of-way footprints and enable simplified transfers, vital for network scalability. The limited number of elevated and curb stations serve more specialized roles, balancing cost, speed, and local accessibility. Median station implementation emphasizes cost containment while striving to accommodate increasing passenger volumes and multimodal connections.

Portland employs a more diversified typology portfolio across its transit and light rail network, including side-running curb stations, median stations, and occasional elevated stations. Median stations, as demonstrated on the MAX Orange Line, effectively facilitate bi-directional transfers and serve as strategic nodes, particularly in redevelopment corridors such as South Waterfront. Portland's emphasis on curb stations supports distributed pedestrian access in mixed-traffic, one-way street contexts, supporting seamless integration with adjacent sidewalks and commercial areas. Elevated stations are sporadically employed where speed and grade separation are priorities despite higher capital costs.

Multimodal Access to Stations

Successful station design prioritizes safe, direct, and convenient routes for pedestrians and cyclists, facilitated by features such as wide, shaded walkways, accessible crossings, secure bike parking, and clear wayfinding signage. Multimodal integration extends to coordinated transfer points with local buses, shared micro-mobility (e-bikes, scooters), ride-hailing and taxi zones, and accessible car-sharing services. Real-time travel information and digital fare payment solutions further enhance ease of transfer and accessibility. The focus on multimodal integration not only improves user experience but also increases the reach and attractiveness of transit by connecting it effectively to the broader urban mobility system. Elements that could enhance access via different modes of transportation include:

- Covered pedestrian walkways
- Secure bike parking, bike share, and scooter docks
- Designated ride-share and taxi drop-off zones
- Compatible zoning to encourage transit-oriented development.

LESSONS LEARNED AND RECOMMENDATIONS

Data Collection and Analysis

Collecting data to develop a robust model for public transit ridership, even in cases where the data exist, is challenging. The data tend to come in entirely different formats, requiring a degree of expertise and access to specialized software to standardize, and they are often only available under

certain conditions or for limited time spans. Despite these limitations, the case of Johor Bahru shows that much can be achieved through a combination of data sources.

Many bus operators have transitioned to payment systems that enable the collection of precise data and the analysis shows the value to not only the users, but also the operators. Understanding what factors influence usage is key to reducing reliance on subsidies. This kind of analysis can also serve to inform local government on what data and in what format is most useful to achieve goals such as increasing public transit ridership.

The lessons in this research project can provide a template for other ASEAN cities. In particular, using bus system data is underleveraged, and presents an opportunity. Combining those data with land use is more difficult in countries without regular censuses or granular data collection, but ongoing research is examining data that can be obtained from Open Street Map and similar open data.

Regional Context

Understanding the context for the region that you're planning for is critical in making informed decisions regarding transit station location and design. Population density, climate, cultural considerations, and other factors will influence traveler needs and preferences. For example, in Portland, half a mile (~800 meters) is considered to be a comfortable walking distance to a transit station as compared to 400 meters in Johor Bahru. Engaging with community members throughout the planning process can help ensure that local context is appropriately incorporated into agency decision making.

Governance

Planners and policymakers must have a clear understanding of how decisions regarding transit station location and design are made in their jurisdiction. This includes knowing what organizations or entities have authority over a given project, what factors are considered or prioritized when making investment decisions.

Recommendations for Future Work

Continue Knowledge Exchange: Ongoing dialogue and joint development through peer exchanges, conferences, or other fora, will ensure lessons remain current and adaptable as cities evolve.

Expand Data-Driven Planning: Agencies should invest in technology and analytic capacity for real-time monitoring, with dashboards and data-sharing portals making insights accessible to all stakeholders.

Strengthen Community Partnerships:

Stakeholder engagement strategies should be documented and expanded, ensuring underrepresented voices are included from visioning to evaluation.

Pilot and Scale Innovations: Experiment with new technologies, multimodal solutions, and pilot projects with robust evaluation frameworks, scaling successful models across cities and regions.

Promote Policy Alignment: Local, regional, and national policies should be aligned to reinforce investments in innovative mobility, land use integration, and resilience.

Document and Share for Replicability:

Systematically document experiences and outcomes to inform other cities and agencies addressing similar challenges.



Credit: [CCO 1.0](#)

ENDNOTES

- 1 Johor Bahru Local Plan 2035 (RTJB 2035)
- 2 For more detailed background on the choice of distance buffer see, for example: Biba, S., et al. (2010). On the measurement of walkability and its influence on transit proximity and usage. *Journal of Transport and Land Use*, 3(2), 3-26; Yiau, H. G., et al. (2021). Analysis of Walking Distance to Public Transport in Kuala Lumpur. *Planning Malaysia*, 19: <http://stag.planmalaysia.gov.my/index.php/pages/view/1519?cats=7>