TOD KP

ASSESS

INTRODUCTION

The ‘Assess’ step of the TOD Framework is developed to determine how “ready” a city is for TOD, based on analysis of a complementary set of economic, geographic, demographic, economic, urban form, and institutional factors.

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

ABOUT ASSESS

The 'Assess' step of the TOD Framework is developed to determine how "ready" a city is for TOD, based on analysis of a complementary set of economic, geographic, demographic, economic, urban form, and institutional factors. TODs do not simply consist of one project or site located in close proximity to the transit station; they consist of a series of projects encompassing various scales of development. There is no single solution for TODs and not all sites that are accessible from a station exhibit all factors necessary for creating successful TODs. Determining the appropriate scale and scope of work is one of the crucial steps in determining the preparation of a realistic TOD Plan.

For TOD to trigger successful large-scale transformations, conditions such as high levels of transit ridership, rapid population growth, rising incomes, high densities are all pre-existing in many cities in World Bank client countries. On the other hand, infrastructure capacities are grossly inadequate and real estate markets continue to remain unregulated, resulting in a diffusion of the intended positive benefits of TODs.

Determining the scale of TOD intervention in terms of timing of transit and investment, as well as the place value of the transit corridor-whether suburban, urban or intense urban- helps determine the type of strategies that may be adopted for future investments. Once the scale is determined, identifying TOD opportunities and roadblocks is key to understanding whether a city, corridor or station areas is "ready" for TOD, and develop strategies to increase the readiness for TOD at individual station areas. Before any TOD/ transit corridor project is commenced, it is essential that urban planners and economic development experts know the underlying demand for new real estate space in the region, and the projected growth for different types of development products. Smart infrastructure planning and public policy can encourage urban economic growth and increased market interest in certain areas of the city.

Conducting pre-feasibility studies of TOD interventions is the starting point for a city to balance the development potential and public benefits of transit. Transit and land planners often determine transit corridors and station locations based on decision parameters that do not take into consideration the real estate potential required. Furthermore, the time differential between transit implementation and development projects often discourage the private sector to invest in longer-term opportunities and often leads to land speculation that leads to an increase in land values. Planners also need to ensure that the transport investment makes economic sense on its own and is the best alternative, given projected levels of travel flows along the new corridor. When combined with information on existing and future transport capacity, transportation planners can determine which capacity investments should have the highest priority.

In this respect, it is imperative to consider the demand for and the impact of disruptive technologies such as ride-sharing applications. These technologies offer dynamic data that can be used to analyze mobility patterns in real time to better inform TOD decisions. For example, Uber provides a data sharing platform known as Movement (https://movement.uber.com/), which helps cities understand travel patterns spatially as well as temporally. This could help assess and compare locations most appropriate for TOD interventions.

Applying the concept of integrated economic, transport, and land use planning is often complex, because of divergent perspectives of multiple agencies. Pre-feasibility assessments help to determine the technical and economic viability of proposed TOD projects and mitigate any risks for investments early-on in the planning process.

This section builds on the previous research related to TOD, undertaken by World Bank's TOD Community of Practice, GPSC, WRI, ITDP, and other agencies such as Reconnecting America and Florida Department of Transportation (USA). While research in these resources often use case studies and best practices from higher-income countries, some tools, processes and theories are relevant even in the World Bank client countries' context. The Knowledge Products for the 'Assess' Framework, presented in this section, are repurposed to be applied in the context of World Bank client countries, with an emphasis on highlighting the challenges faced from a political, regulatory, enforcement, financing, and other factors in implementing successful TOD projects.

KNOWLEDGE PRODUCTS

ANALYTICAL

AS-A01 **TOD Readiness Assessment** *(Spreadsheet + User Guide)*

AS-A02 **TOD Scale & Context Assessment** *(Checklist)*

AS-A03 **Thresholds for TOD Real Estate Demand** *(Spreadsheet + User Guide)*

AS-A04 **Thresholds for Rapid Transit Mode** *(Spreadsheet + User Guide)*

'HOW-TO' GUIDES

AS-H01 **How to Undertake Real Estate Market Analysis** *(Step-by-Step Guide)*

AS-H02 **How to Undertake Rapid Transit Alternatives Assessment** *(Step-by-Step Guide)*

AS-H03 **Infrastructure Carrying Capacity Assessment** *(Step-by-Step Guide)*

AS-H04 **How to Undertake Road Safety Assessment for TOD Areas** *(Step-by-Step Guide)*

RESOURCES

AS-R01 **Real Estate Analysis Best Practices** *(Ref Doc.)*

PROCUREMENT

AS-P01 **Real Estate Analysis Terms of Reference** *(TOR Template)*

AS-P02 **Transit Alternatives Analysis Terms of Reference** *(TOR Template)*

AS-P03 **Infrastructure Analysis Terms of Reference** *(TOR Template)*

TOD KP

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TOD KP

AS-A01

TOD READINESS ASSESSMENT TOOL

This Knowledge Product is intended to be used as a checklist along with interactive excel spreadsheet. These tools are available online on the GPSC's TOD website and the World Bank's TOD COP website. The reader should first review the summary presented below before using the spreadsheet tool

Type: Spreadsheet + User Guide

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INTRODUCTION

As cities in World Bank client countries continue experiencing rapid urbanization and population growth, plans on developing urban rapid transit systems are gaining much-needed acceptance. From Tanzania (Dar-es-Salaam), Brazil (20+ cities) and South Africa (6 cities) to China (40+ cities), India (15+ cities) and Indonesia (10 + cities) have launched rapid mass transit systems within the last decade. These investments also act as catalysts to reveal untapped opportunities for developing lands surrounding the transit stations in an economically viable, socially equitable, and environmentally sensitive manner. In order to identify these opportunities early-on in the process is critical in maximizing the benefits of transit-oriented developments (TOD).

Government agencies in World Bank client countries have minimal planning and engineering resources in-house to undertake TOD studies, especially in medium-sized cities. Often, the current resources are not well-equipped to understand the nuances and intricacies of TODs or require a lot of hand-holding in understanding, applying and finally implementing TOD concepts during the development phase. Furthermore, access to data is often a daunting task and restricts informed decision-making. The TOD Readiness Assessment helps cities conduct a rapid assessment of TOD readiness with relatively accessible datasets that are often available at local levels.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

PURPOSE

The TOD Readiness Assessment Tool is designed to assess the existing TOD potential for three (3) primary scales of intervention:

- **Initial TOD Readiness Assessment:** A checklist designed to conduct a rapid assessment of external factors that are vital for planning and implementing TOD in any city regardless of the context. These factors include: i) existing policy and regulatory framework; ii) technical capacities available in-house; and iii) existing data availability to conduct detailed studies. This checklist is designed only to develop a better understanding of the factors that indicate the level of political support for TOD and are primarily public sector driven. This tool builds on the WB/WRI TOD Corridor Course on "Building Blocks for TOD" and National-level Guidance Document for India (World Resource Institute and World Bank Group 2015; MoUD, World Bank, India 2016).

  The City-level TOD Readiness Assessment may be used to inform the Enable, Plan + Design and Implement Knowledge Products (EN-P03 & EN-P05; PD-H01; IM-P03).

- **Detailed Station Area Level Readiness Assessment:** This interactive, spreadsheet-based tool, helps urban planners and decision-makers evaluate the TOD readiness at the station area scale. When planning for TOD, the network of stations in a mass transit network form a corridor; however, each station exhibits characteristics that are often unique but also show some similarities. This spreadsheet is designed to assist urban planners and policy-makers identify the station area attributes to develop context-sensitive strategies to increase readiness for TOD and understand the value of each station within the larger corridor network. This tool can be used by government agencies to build a case for retaining a consultant for further studies and/or prioritizing investments in station area and/or drafting the terms of reference for retaining consultants to conduct planning studies. Existing literature, specifically the 3V metrics in World Bank's "Transforming the Urban Space through Transit-Oriented Development: The 3V approach" formed the basis to develop this tool (Salat and Ollivier 2017).

  The Station Area Level TOD Readiness Assessment may be used to inform the Knowledge Products under the Plan + Design (PD-H03, PD-H04 and PD-H05); and Implement (IM-A01)

- **Detailed Corridor-level Readiness Assessment:** This tool overlays the node, place and market potential value for all the stations to show the mosaic of conditions throughout the corridor. All the individual metrics are added, giving each station a total score ranging from 16 points (if it scored "Low" on all 16 metrics) to 48 points (if it scored "High" on all 16). This composite score helps in categorizing stations into three levels: Long-Term, Emerging and Arrived that would require different investment tools and strategies, as well as different phasing of investments will be needed in different locations.

  The Corridor-level TOD Readiness Assessment may be used to inform the Knowledge Products under the Plan + Design (PD-H01, PD-H02, and PD-H03)

ASSUMPTIONS AND LIMITATIONS

- The tool is applicable for city, corridor and station scales. It is not intended to be applied on individual TOD projects at the site level.
- The tool is applicable in multiple contexts- greenfield, urban infill, suburban and redevelopment.
- The tool is not intended to compare different station areas along a corridor but highlight each station area's TOD potential.
- The tool is a relative measure of a station compared to other stations, and of imbalances in terms of connectivity, urban space and market potential. It is used for planning purposes, not design purposes.
- This tool is applicable for municipalities, development agencies, transit agencies, private developers or any agency interested in getting their city ready for TOD.

DATA SOURCES

- High-definition aerials/ satellite photography/ Google Earth/ Open Street
- Census information
- Local government GIS data
- Site Survey; Photos
- Local government transport data
- Secondary documents- applicable zoning codes; adopted master plans
- Field surveys
- Third-party reports
- Community mapping participatory planning exercises
- Open Source data
- Crowdsourced data
- Google Street view or other similar applications

INTENDED OUTCOMES

- Develop a preliminary checklist to identify potential pitfalls early-on in the process that prioritizes interventions needed to enable and implement TOD.
- Create an inventory of data availability.
- Gauge existing strengths and weaknesses of station areas to understand its full TOD potential and opportunities for improvement.
- Prepare a specific scope of work and terms of references for retaining external consultants, based on a preliminary understanding of data availability.
- Utilize spreadsheet tool results to refer other TOD Knowledge Products for additional technical guidance.

HOW TO USE THE TOD READINESS ASSESSMENT TOOL?

First, the user should read the User Guide Tab before using the spreadsheet. The application of the TOD Readiness Assessment tool consists of four basic steps:

01 INITIAL ASSESSMENT TAB

Populate the Initial Assessment tab as a checklist of the citywide policy, regulatory, and institutional framework; and evaluating technical data availability for detailed assessment.

[Refer following pages for details]

02 CREATE A CITY OR CORRIDOR BASE MAP

Identify station nodes along a transit network or transit corridor. Collect base data for each station, including ridership, land use conditions and other important data needs as specified in the Detailed Assessment Tab

03 DETAILED ASSESSMENT TAB

Enter data requirements in the Detailed Evaluation tab. The spreadsheet tool has measures developed that make use of readily available data and in some cases GIS-based analysis.

[Refer following pages for details]

04 SUMMARY TAB

Fill the template under the Summary tab to identify the station area's strengths and weaknesses, based on the readiness score calculated automatically through the tool.

INITIAL ASSESSMENT TOOL

The Initial Assessment tool is applicable at **any scale**. It measures the technical and regulatory readiness of the city agency to take up TOD planning and implementation. It includes three categories of measures –

01 Technical Capacities

02 Data Availability

03 Policy & Regulatory Environment

- Check each applicable measure listed in the spreadsheet.
- 1 point is assigned per item checked; 0 points are assigned if the item is not checked.
- Sub-scores for the three categories are derived from a group of individual metrics. A total of 30 individual metrics are used and reclassified as “Low, “Medium”, “High”.

The total score is converted to the following outputs:

TECHNICAL CAPACITIES

Review of existing technical and professional staff available to manage, implement and monitor TOD planning activities

		Score		Knowledge Product Reference
A	Low	0–3	HIGHER INDICATES BETTER READINESS	If high, refer to **EN-H01.** If medium or low, refer to the following KPs for capacity building: **IM-H01**, **IM-P01,** refer to the following KPs for retaining external consultants: **PD-P01.** If low, external consultants should be hired to undertake TOD planning and activities. Refer to Procurement tools.
B	Medium	4–6		
C	High	7–10		

DATA AVAILABILITY

A comprehensive database as a resource to help document baseline conditions and analyze constraints based on the GIS/ AutoCAD database for the last 5 years.

		Score		Knowledge Product Reference
A	Low	0–5	HIGHER INDICATES BETTER READINESS	If high, refer Plan + Design KPs: **PD-H01 to H04** If medium or low, refer following KPs for retaining external consultants: **PD-P01.**
B	Medium	6–10		
C	High	11–15		

POLICY & REGULATORY FRAMEWORK

To evaluate the TOD readiness of the city with respect to the institutional support, plans, policies, and development market.

		Score		Knowledge Product Reference
A	Low	0–3	HIGHER INDICATES BETTER READINESS	If high, refer Plan + Design KPs: **EN-C01 to C02; EN-P01; PD-H05.** If medium or low, refer following KPs for retaining external consultants: **PD-H01 to H02**
B	Medium	4–6		
C	High	7–10		

DETAILED ASSESSMENT TOOL

The Detailed Readiness Assessment tool is applicable at the **corridor and station scales**. It is a relative measure of a station compared to other stations as well as evaluation of the station itself. It includes three categories of measures –

01 Node Value

02 Place Value

03 Market Potential Value

These categories rely on the "3V Framework", developed by World Bank (Salat and Ollivier 2017). The three values are defined as:

A. NODE VALUE

Node value describes the importance of a station in the public transit network based on its passenger traffic volume, intermodality, and centrality within the network.

B. PLACE VALUE

Place or placemaking value describes the urban quality of a place and its attractiveness in terms of amenities including schools, plazas/open spaces representing the urban fabric around the station.

C. MARKET POTENTIAL VALUE

Market potential value refers to the unrealized market value of station areas. It is derived through market analysis measured analyzing major drivers of demand including current and future human densities (residential plus employment).

Understanding where, when and how potential economic value can be created requires tools that help differentiate the opportunities offered by the diverse stations in a mass transit network. The Detailed Readiness Assessment tool assessment is designed to highlight the interdependencies of economics, land use, urban design and mass transit networks and stations. The results of this tool may be used to direct the city for drafting a TOD vision and subsequently prepare detailed plans that enhance the value and economic potential of a station area.

- Input data into each of the metrics listed in the Detailed Assessment spreadsheet.
- Each metric is evaluated and simplified into a 1 to 5 score, where 5 indicates high readiness, 3 indicates medium readiness and 1 indicates low readiness
- The total score reveals several key strengths and opportunities. Based on the identified strengths, weaknesses, and opportunities, the city can develop targeted strategies to increase the area's readiness for TOD.

References:

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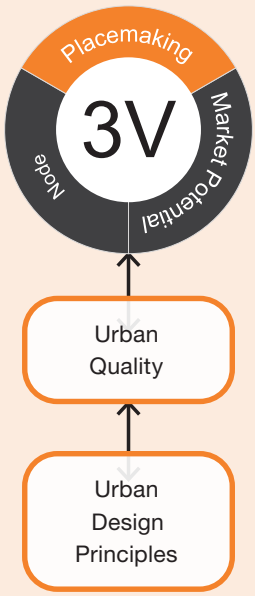
WHAT IS THE 3 VALUE FRAMEWORK?

The 3V Framework is a methodology for identifying economic opportunities in areas around mass transit stations and optimizing them through the interplay between the node, place, and market potential values. It provides a typology to cluster stations based on the three values. It equips policy and decision makers with quantified indicators to better understand the interplay between the economic vision for the city, its land use, its mass transit network, and its stations' urban qualities and market vibrancy. It outlines planning and implementation measures for the different clusters of stations that can help prioritize limited public resources and create value through coordinated interagency measures.

B. PLACEMAKING VALUE



Placemaking value describes the urban quality of a place and its attractiveness in terms of amenities, schools, and healthcare; the type of urban development; local accessibility to daily needs by walking and cycling; the quality of the urban fabric around the station, in particular its pedestrian accessibility, the small sizing of urban blocks, and the fine mesh of connected streets that create vibrant neighborhoods; and the mixed pattern of land use.

Value is calculated through the following indicators:

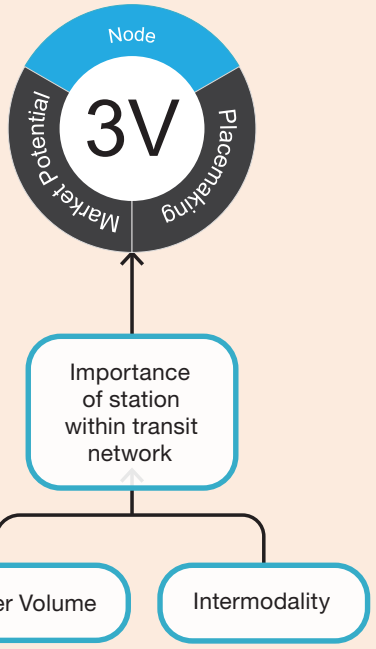
- Density of street intersections
- Local pedestrian accessibility
- Diversity of uses
- Density of social infrastructure within 800 meters of the station

A. NODE VALUE

Node value describes the importance of a station in the public transit network based on its passenger traffic volume, inter-modality, and centrality within the network.

Value is calculated through the following indicators:

- Degree centrality
- Closeness centrality
- Betweenness centrality
- Daily ridership
- Inter-modal Diversity

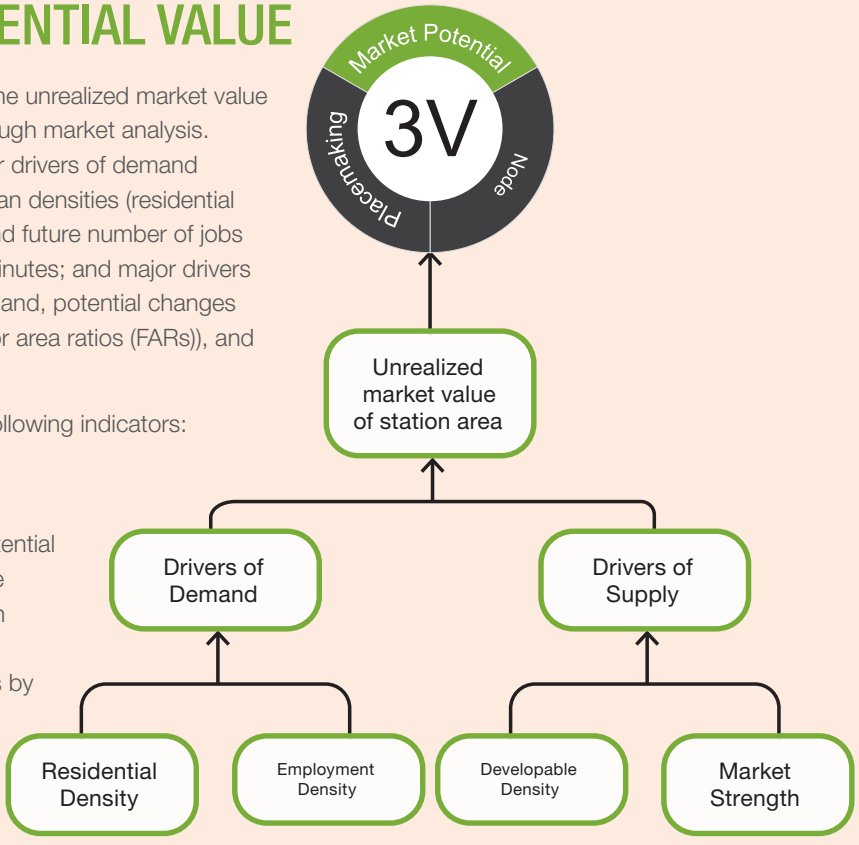


C. MARKET POTENTIAL VALUE

Market potential value refers to the unrealized market value of station areas. It is derived through market analysis. It is measured by analyzing major drivers of demand including current and future human densities (residential plus employment); the current and future number of jobs accessible by transit within 30 minutes; and major drivers of supply, including developable land, potential changes in zoning (such as increasing floor area ratios (FARs)), and market vibrancy.

Value is calculated through the following indicators:

- Human density
- Jobs/residents ratio
- Human density growth potential
- Average or median income
- Percentage of managers in labor force
- Number of accessible jobs by transit
- Real estate opportunities
- Dynamics of real estate development



Hong Kong SAR, China

TOD K P

AS-A02

TOD SCALE ASSESSMENT

Checklist to determine the appropriate scale for TOD planning

Type: Checklist + User Guide

TOD

Global Platform for Sustainable Cities

WORLD BANK GROUP

IBI

INTRODUCTION

Existing literature, both in high income and low to middle-income countries, emphasizes the need for planning TODs at the metropolitan/city level, network/corridor level, local/neighborhood/station area level, and finally the station/site level (Salat and Ollivier 2017; WB/WRI TOD Corridor Module 2015; Ministry of Urban Development, India 2016; Center for Transit Oriented Development 2010). Some progressive cities in World Bank client countries such as Delhi, Hubli-Dharwad in India, Capetown and Johannesburg in South Africa are adopting this multi-level TOD planning approach for their development master plans and mass transit system plans. However, the majority of cities in World Bank client countries have taken an inconsistent approach in aligning transit, land use, infrastructure, and economic planning at macro and micro scales.

From an implementation perspective, station area level planning is the most important because most projects are formulated at this scale and could be aligned with transit investments. Often planning at the city and corridor scales are synchronous with each other, while TOD real estate development projects face the issue of addressing the time lag between transit station construction and real estate project viability. In Bogota, for example, research has indicated that a lengthy plan approval and development permit application process (usually 4-5 years), attributed to the lack of coordination between the Territorial Ordinance Plan (POT) and development plans (Suzuki, Cervero and Iuchi 2013), resulted in opportunity losses for attracting TODs in the first phases of the BRT implementation.

The nature of development context - whether a greenfield, suburban, urban intense or redevelopment areas - has a strong correlation to the value creation potential of TOD projects. In World Bank client countries, developing new towns, cities and developments on former agricultural lands has been a growing trend over the last 20 years. These developments, such as Dodoma, Tanzania's new capital city and Naya Raipur, Chattisgarh state in India's new capital, provide unique opportunities to design cities with TOD concepts embedded in all aspects from the initial stages.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

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Suzuki, Hiroaki, Robert Cervero, and Kanako Iuchi. 2013. Transforming Cities with Transit - Transit and Land Use Integration for Sustainable Urban Development. Washington DC: The World Bank Group.

World Resource Institute and World Bank Group. 2015. Corridor Level Transit-Oriented Development Course. Washington, DC

PURPOSE

The TOD Scale Assessment tool is developed as a checklist to help cities in understanding the inter-relationships between these various scales of planning and their impact on TOD implementation. On the other hand, the Context Assessment tool is designed to determine the typology of a station area's context, based on its current and planned urban form, its relationship to transit and its market strength in attracting TOD-related investments. Combined, these two tools help interested cities gauge the points of intervention for planning TODs, as well as understand the need for context-sensitive designing in urban regeneration projects.

Both tools are designed as user-friendly checklists, taking into consideration development trends. These tools are available online on the GPSC's TOD website and the World Bank's TOD COP website. The reader should first review the summary presented below before using the spreadsheet tool.

ASSUMPTIONS AND LIMITATIONS

- These tools are intended to solely guide users in initial assessments and need to be followed by detailed analyses, where feasible.
- The tools are designed to ensure that they can be used at multiple stages during the TOD implementation process, and not necessarily followed in a sequential manner.

DATA SOURCES

- Secondary sources- applicable zoning codes; adopted master plans; policies
- Third-party reports
- Google maps / other high-quality aerial/ satellite imagery

HOW TO USE THE TOOL?

01 FILL IN THE CHECKLIST

Read through the applicable sections and insert a check mark for each feature listed in the tool. In the Context Checklist, which is primarily applicable at the station area or site scale, the checkboxes correspond to typical conditions that help define the context of the station area. The context can be used to define the station area typology. In the Scale Checklist, the checkboxes refer to parallel planning activities and land ownership considerations that can help planners determine the most effective scale for planning TOD.

[Refer following pages for details]

02 OUTPUT

The city can undertake TOD planning at any scale or context provided there is one check against a feature in the selected option.

Add up all the checks to identify the priority scale and/or context if more than one is selected

DETERMINE THE CONTEXT OF A TOD PLAN

GREENFIELD

- ☐ PLANNED LAND CONVERSION FROM AGRICULTURAL TO HIGH-INTENSE USES
- OR
- ☐ HIGH PERCENTAGE OF GOVERNMENT OWNED LANDS
- OR
- ☐ EXTREMELY LOW OR NO EXISTING POPULATION
- OR
- ☐ WITHIN CLOSE PROXIMITY TO EXISTING URBAN CENTRES, GENERALLY ACCESSIBLE BY AUTOMOBILES
- OR
- ☐ HIGH-QUALITY PUBLIC INFRASTRUCTURE INVESTMENT AS THE KEY ECONOMIC DRIVER

SUBURBAN

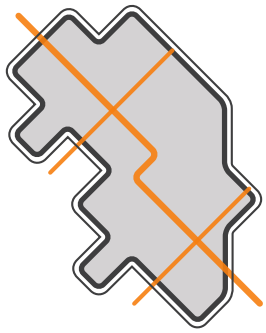
- ☐ NON-TRANSIT SERVICE OR LOW-FREQUENCY TRANSIT SERVICE
- OR
- ☐ LOW TO MODERATELY POPULATED
- OR
- ☐ LACKS A COMBINATION OF STREET CONNECTIVITY, PEDESTRIAN AND BICYCLE FACILITIES, AND URBAN AMENITIES
- OR
- ☐ SINGLE-USE DEVELOPMENTS ON LARGE AREAS OF LAND

URBAN (INFILL AND REDEVELOPMENT)

- ☐ INTENSELY POPULATED AREAS
- OR
- ☐ GOOD OR IMPROVING PEDESTRIAN/BICYCLE NETWORK
- OR
- ☐ MIX OF NEIGHBORHOOD SUPPORTIVE RETAIL AND SERVICE AMENITIES
- OR
- ☐ HIGH MIX OF SUPPORTING JOBS

DETERMINE THE SCALE OF A TOD PLAN

CITY-REGION LEVEL



- ☐ REGIONAL PLAN | CITY DEVELOPMENT PLAN | MASTER PLAN
  (Under preparation | Update underway/ongoing/planned)

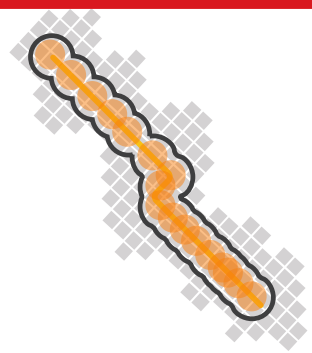
OR

- ☐ TRANSPORTATION PLAN | MOBILITY PLAN
  (Under preparation | Update underway/ongoing/planned)

OR

- ☐ BRT/METRO RAIL SYSTEM PROJECT PLAN
  (Under preparation | Planned)

CORRIDOR LEVEL



- ☐ MODIFICATIONS IN LAND DEVELOPMENT REGULATIONS
  (Under preparation | Update underway/ongoing/planned)

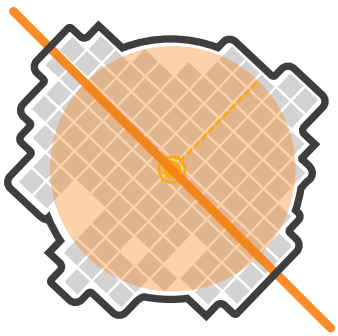
OR

- ☐ TRANSPORTATION PLAN | MOBILITY PLAN
  (Under preparation | Update underway/ongoing/planned)

OR

- ☐ BRT/METRO RAIL SYSTEM PROJECT PLAN
  (Under preparation | Planned)

STATION AREA



- ☐ TRANSIT OPERATIONAL/UNDER CONSTRUCTION

OR

- ☐ PUBLIC OWNED VACANT LANDS/ REDEVELOPMENT OPPORTUNITIES EXISTING NEAR TRANSIT

OR

- ☐ LAND BANKING/ POOLING STRATEGY UNDERWAY

OR

- ☐ MODIFICATIONS IN LAND DEVELOPMENT REGULATIONS
  (Under preparation | Update underway/ongoing/planned)

OR

- ☐ MARKET INTEREST (RAPID CHANGE IN PROPERTY VALUES)

SITE LEVEL

- ☐ REDEVELOPMENT OPPORTUNITIES NEAR TRANSIT

OR

- ☐ MARKET INTEREST IN GREENFIELD, LAND AUCTIONING OR DEVELOPMENT

OR

- ☐ PUBLIC OWNED VACANT LANDS/ REDEVELOPMENT OPPORTUNITIES EXISTING NEAR TRANSIT

BRT Corridor, Pune, India

TOD KP

AS-A03

THRESHOLDS FOR TOD REAL ESTATE DEMAND

This Knowledge Product is intended to be used as an interactive Excel spreadsheet. These tools are available online on the GPSC's TOD website and the World Bank's TOD COP website. The reader should first review the summary presented below before using the spreadsheet tool.

Type: Spreadsheet + User Guide

TOD

Global Platform for Sustainable Cities

WORLD BANK GROUP

IBI

INTRODUCTION

Real estate developments are broadly classified into residential, retail, commercial (offices) and hospitality. In the case of TOD, however, mixed-use developments are highly recommended as they promote 24/7 use of transit-accessible locations and also promote walkability. The success of revenue earnings in such a mixed-use project is dependent on several factors, out of which appropriate sizing and program development are key factors.

Typically, in low-density markets, residential development is assumed to be the market driver dictating demand for all other components of real estate. However, in many TOD projects, the micro-market is governed by commercial and retail developments. Therefore, the proportion of uses within a mixed-use development is dependent on the optimization of different development components in terms of cross-financing requirements.

The demand for real estate is demonstrated through two principal indicators, namely, **price** and **occupancy**. The price is a direct variable of demand and supply scenarios in the real estate micro-market. The occupancy ratio provides the vacancy (supply– demand) status of the market and therefore rationalizes any scenario of overpricing by a seller.

The property yield is an indicator that helps measure future income or the earning potential of a real estate investment. Based on the earning potential of each component, the development components may be ranked as shown below.

To determine the real estate demand of a property, it should be measured across the price and occupancy spectrum as shown in the chart on the next page. Within each possibility, the potential land use mix must be evaluated to best balance the revenue risk with the revenue potential as illustrated below.

For example, in highly priced locations with high revenue risk, development components with moderate property yields are preferred so that the potential return can moderately balance capital investment. In highly priced locations with low risk, on the other hand, high yield investments are preferred so that maximum profitability can be gained. Similarly, in lower-priced locations, low to moderate yield investments are preferred depending on the risk involved.

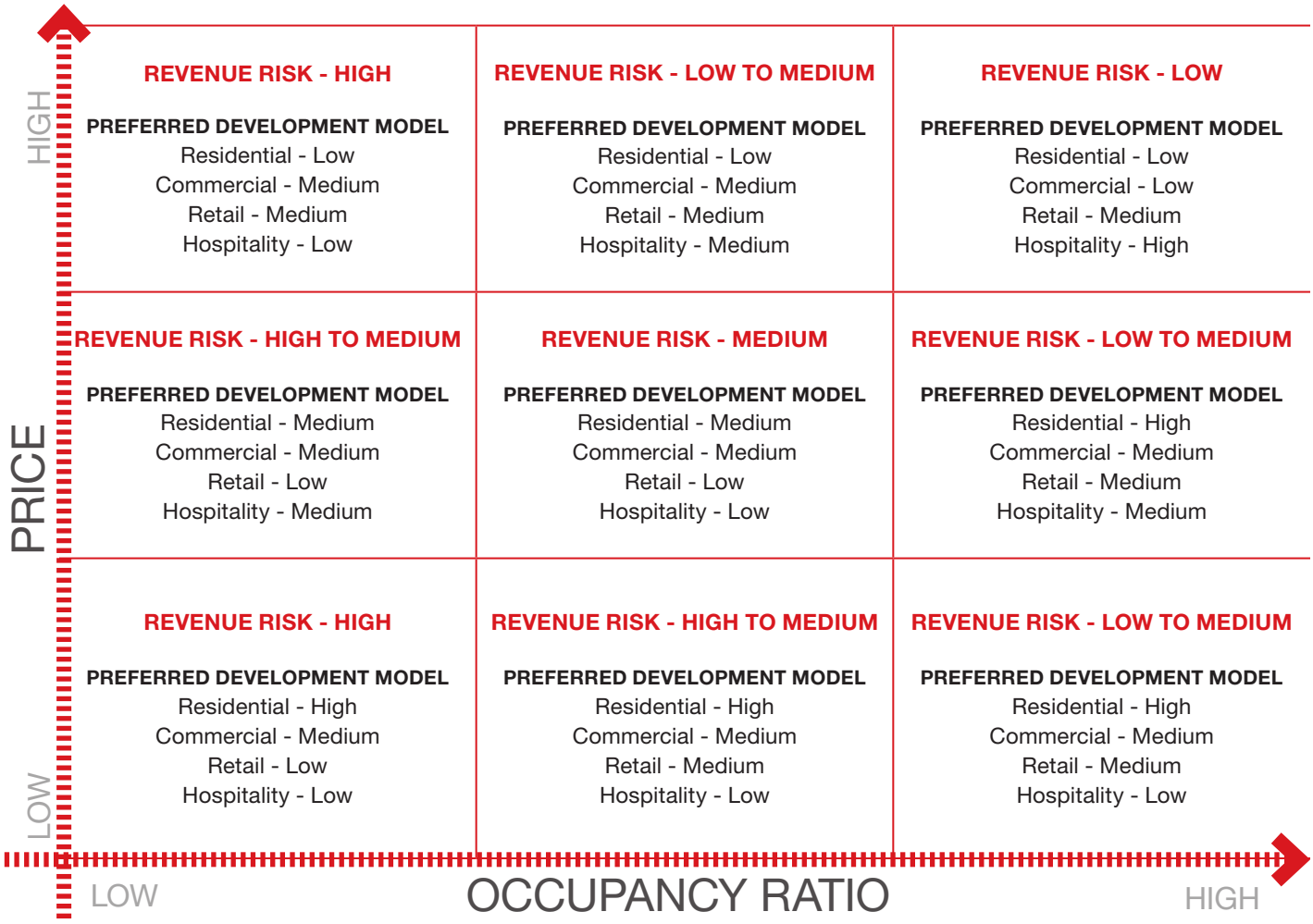
This chart can be used in setting the initial sketch program for a proposed development. Based on the initial sketch, a detailed financial due diligence is highly recommended before proceeding further on project structuring and financing.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

S.No	Development Component	Measurement Indices	Property Yield* (Annual Rental Income / Capital Value)	Ranking based on revenue potential
1	Hospitality	Revenue per Available Room, Average Room Rate	Highest	1
2	Retail	Capital and Rental Values	Moderate to High	2
3	Commercial (Office)	Capital and Rental Values	Moderate to High	3
4	Residential	Capital and Rental Values	Lowest	4

* the Property Yield descriptions shown here are for comparison between different development components. Yield rates are usually governed by factors such as location and micro-market conditions. in 2018, the commercial yield rates ranged from 9% in Sao Paulo to 5% in Beijing (JLL Global Research 2018), whereas residential yield rates ranged from was 4% in Sao Paulo and 1.5% in Beijing (www.numbeo.com).

ASSUMPTIONS



PROPORTION OF THE COMPONENTS IN OVERALL LAND USE MIX

Low	10 - 15 %
Medium	25 - 30%
High	40 - 50% or more

A graphical representation of a typical spectrum on real estate conditions varying from highest to lowest prices and highest to lowest occupancy ratios.

TOD KP

PURPOSE

This tool has been designed to provide assistance in analyzing the potential for real estate development and structuring of different mixed-use development components for optimized revenue generation. The tool identifies the TOD projects under four basic categories viz.

a. Site-based,

b. Station-based,

c. Corridor-based and

d. City-based.

Also, it classifies the region/location of the project planned for development to arrive at suggestive strategies for structuring real estate components. In addition, it also provides a detailed analysis for individual component i.e **Residential, Retail, Commercial** and **Hospitality** based on the market scenario and grade of existing supply. This tool aims to assess the Market Value of the TOD project planned for development

DATA SOURCES

- Population Density - population per sq. km
  - City Region
  - Micro-market Area
- Infrastructure Cost Ratio - pure ratio (total investment planned for the transit infrastructure per square meter divided by the land cost per square meter)
- Realty Price Ratio - pure ratio (average price of the property per square meter divided by the land cost per square meter)
  - Residential
  - Retail
  - Commercial
  - Hospitality
- Premium Supply Ratio - pure ratio (total supply in square meters of grade A property in the micro-market divided by total supply in square meters of grade B property in the micro-market)
  - Residential
  - Retail
  - Commercial
  - Hospitality
- Occupancy Ratio - pure ratio (total rate of occupied units by total units)
  - Residential
  - Retail
  - Commercial
  - Hospitality

HOW TO USE THE REAL ESTATE DEMAND TOOL

First, the user should read the User Guide Tab before using the spreadsheet. The application of the Real Estate Demand tool consists of these basic tabs:

THE TOOL INCLUDES:

- USER GUIDE
- DASHBOARD
- ASSESSMENT
- RESIDENTIAL
- RETAIL
- COMMERCIAL
- HOSPITALITY
- REFERENCE MATRIX
- REFERENCE CASE CITIES

01 SELECTING SCALE AND CONTEXT

- **TOD PROJECT SCALE:** Select the scale of the TOD project to highlight hte appropriate cells on the Dashboard.
- **PLACE VALUE**: Select the development context of the TOD project.
- **NODE VALUE**: Select the context of transit nodes.

Based on the above selection, the reference to development strategy and structuring of real estate components is provided in “Dashboard” sheet. The portion highlighted in yellow is the suggested initial strategy to proceed for further analysis.

02 DATA INPUTS IN ASSESSMENT

Select the value in the orange box, after reading the instructions carefully.

ORANGE
Input Selection Box

03 VIEW THE DETAILED STRATEGY RECOMMENDATIONS

Within each land use, see the specific strategy recommendations on structuring development of real estate components in the project.

Mexico City, Mexico

TOD KP

AS-A04

THRESHOLDS FOR RAPID TRANSIT MODE SELECTION

This Knowledge Product is intended to be used as an interactive Excel spreadsheet. These tools are available online on the GPSC's TOD website and the World Bank's TOD COP website. The reader should first review the summary presented below before using the spreadsheet tool.

Type: Checklist + User Guide

TOD

Global Platform for Sustainable Cities

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INTRODUCTION

As urban economic growth in World Bank client countries outstrips rural economies, cities continue to see a rapid influx of population and jobs. These new jobs require accessibility through public transit means that are faster and more reliable. Public transit demands have necessitated a change from unregulated and local bus systems to more robust and high-quality rapid mass transit systems. Several cities have launched new rapid transit systems in the last 2 decades including cities in Tanzania (Dar-es-Salaam), Brazil (20+ cities) and South Africa (6 cities) to China (40+ cities), India (15+ cities) and Indonesia (10+ cities). Most cities face difficulties in timing transit investments and changes in land use regulations for more integrated TOD outcomes. Rapid transit investments are more appropriately located along corridors with high population densities and employment access. However, a city may choose to proactively invest in rapid transit systems at the same time as land use regulations are relaxed. This will increase choices for the non-driving population in terms of real estate and mobility.

The increasing choices in rapid transit modes in recent years offer developing countries the option of selecting a transit mode that best addresses mobility needs and economic constraints. While rail rapid transit systems have been around longer, they are more expensive to build and offer little flexibility in adjusting for demand variations. Bus rapid transit systems, on the other hand, offer more flexibility in adjusting to varying demand, but the “Rapid” version is comparatively new and is difficult to enforce in many cities with poor traffic behavior.

Transit planners in World Bank client countries, are often ill-equipped to make the decision without considerable data collection and modeling studies. Furthermore, access to data is often a daunting task and restricts informed decision-making. The Rapid Transit Mode Selection Tool helps cities conduct a rapid selection for bus or rail rapid transit modes with relatively accessible data points that are often available at local levels.

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PURPOSE

This Rapid Transit Mode Selection Tool is intended to provide assistance on rapid transit mode selection to cities who are either (1) considering the introduction of a new rapid transit mode for an intended network at the city scale; or (2) in the process of evaluating rapid transit modes for operations along a corridor:

- **Initial Assessment:** This tab is intended to help cities make an initial assessment among a set of modes that should be considered for the Alternative Analysis. The tool is designed to use data that are readily available to assess potential rapid transit modes that differ by technology and right-of-way.

  The Initial Assessment may be used to inform the Assess Rapid Transit Tool (AS-H02)

- **Detailed Evaluation:** This tab is intended to help cities determine the most appropriate mode alternatives for a specific corridor. The tool is designed to use data that represent an informed opinion as to the extent of demand in the corridor with rapid transit in place. Please copy the tab for use for every different corridor. The final selection of Mode Alternative should be based on context-specific criteria, which can be more important than a small numerical difference in the Evaluation Score.

ASSUMPTIONS AND LIMITATIONS

BRT Rapid: E.g: Harmoni Central Busway Transjakarta

BRT Semi-Rapid 1: E.g: Lanzhou BRT

BRT Semi-Rapid 2: E.g: Ahmedabad BRT

1. The tool classifies the modes broadly under rail and bus and further classifies them based on the achievable speed and person-capacity. The classification based on speed is broadly defined by the degree of “separateness” from other traffic movement and conflict points. This degree is classified as ROW (right-of-way) Class A, B, or C, where ROW Class A denotes full separation either through grade separation or continuous barriers; Class B denotes partial separation either through discontinuous lane or grade separation, and Class C denotes mixed traffic movement (Vuchic 1981). Several physical and technological mechanisms can be used to achieve the ROW variations, including actual physical separation, but also including technological measures such as signal priority.
2. The rapid transit modes considered in this selection Tool include:
   a. Bus Rapid Transit (BRT) - is a high-quality bus-based rapid transit system, characterized by better quality and fuel-efficient buses, dedicated right-of-ways, and pre-boarding fare collection. Three types of BRT choices are available in this tool, differentiated mainly by the mode capacity and operating conditions:
      - BRT Rapid – is a BRT system using standard, articulated or double-articulated buses, designed to operate on a fully segregated corridor; either on an elevated or isolated busway or along physically separated bus lanes with continuous passing lanes delivering highly reliable, fast and comfortable services equivalent to Metro systems.
      - BRT Semi-Rapid 1 – is a BRT system using standard, articulated or double-articulated buses, designed to operate with high speeds and reliability on a dedicated bus lane with passing lanes at stations and physical segregation or signal prioritization techniques at junctions for faster movement of buses.
      - BRT Semi-Rapid 2 – is a BRT system using standard or articulated buses and designed to operate at higher than average speeds along a dedicated bus lane with general traffic turns allowed at signals.

ASSUMPTIONS AND LIMITATIONS

LRT-Semi-Rapid: E.g. Manila LRT

Metro: E.g. Delhi Metro

b. Light Rail Transit (LRT) - Light Rail Transit is an electric powered rail based transit system which is lighter than the conventional heavy rail system and characterized by its ability to operate short trains along dedicated lanes. LRTs exist in many forms, including streetcars, trams, and the more modern LRT systems. This tool only includes the option of the modern LRT with dedicated ROW features as described:
   - » LRT Semi-Rapid – is an LRT system using up to 4 train cars, with a physically segregated right-of-way and dedicated tracks at grade, allowing occasional traffic turns at junctions.

c. Metro /Rail Rapid Transit – Metro / Rail Rapid Transit is an electric powered rail-based transit system which is designed to operate in fully grade-separated corridors with closer station spacing than heavy commuter rail.

3. The following transit modes are not included in this tool
   a. Local Bus – because it serves a local connector and feeder connection only and cannot be classified as “rapid”;
   b. Streetcar or Mixed Traffic LRT – because it operates in mixed traffic more often and cannot be classified as “rapid”;
   c. Commuter Rail – because it serves the regional transit function, not urban ‘rapid’; and
   d. Monorail / Skytrain (suspension rail) / gondola cars – because it does not adapt itself to forming a network, an essential requirement for urban transit, but could be used as feeder lines in atypical topographies as deemed necessary.
4. The tool uses a higher and lower case assumption for computing potential travel demand for the given conditions. These higher and lower cases represent density variations within a city or along a city corridor. For a city or corridor where both extreme conditions are observed, a mode must be favorable under both conditions to be viable.
   a. **THE HIGHER CASE** may be interpreted as the computed conditions for the denser core of the city.
   b. **THE LOWER CASE** may be interpreted as the computed conditions for the sparsely developed suburban areas in the city.

ASSUMPTIONS AND LIMITATIONS

5. The tool assumes capacities based on vehicle dimensions per TCQSM methods, using 6 persons per m2 of standee space and load diversity factors depending on train length. (Reilly and Levinson 2011). A load diversity factor is applied to derive optimum capacities, where peak capacities are defined as the maximum number of people that can be carried past a given location during a given time period under specified operating conditions, without unacceptable delay, hazard, or restriction, and with reasonable certainty. It is assumed that a system that operates at peak capacities at all times is over capacity. Typical frequencies for BRT are based on observed actual frequencies. (Global BRT Data n.d.)
6. The tool uses a cost per passenger-km unit to determine cost efficiencies as explained in the optimization model for technology selection developed by L. Moccia. (Moccia, Allen and Bruun 2018). The model uses a synthetic representation of the temporal and spatial variability of demand, and of several operational and design aspects. The model is adjusted to show that planning for a faster technology can be more important than the choice between bus and rail per se, except at very low demand density, and that cost differences between technologies are small in a wide demand range. The social discount rate assumed in running this model is 7%.
7. The tool does not consider contextual parameters such as political preferences, costs of land acquisition and construction of supporting infrastructure.
8. The tool is applicable in multiple contexts- greenfield, urban infill, suburban and redevelopment.
9. The tool is not intended to compare different corridor alignment alternatives, or service planning alternatives. It only provides guidance on the rapid transit mode based on modal characteristics.
10. This tool is applicable for municipalities, development agencies, transit agencies, private developers or any agency interested in proposing a transit system for the city.

DATA SOURCES

- For Initial Assessment
  - Census information – area and population
  - Local bus usage data – in annual terms (multiple daily numbers by 300) and in spatial terms to identify the highest ridership observed at the peak hour at the peak loading point.
- For Detailed Assessment
  - Census information – population
  - Planned Corridor details – corridor length, projected ridership
- Use or add data to the Urban Transport Data Analysis Tool (Agarwal, et al. 2014)

TOD KP

HOW TO USE THE RAPID TRANSIT MODE SELECTION TOOL?

First, the user should read the User Guide Tab before using the spreadsheet. The application of the Rapid Transit Mode Selection tool consists of three basic steps:

THE TOOL INCLUDES:

- USER GUIDE
- INITIAL ASSESSMENT
- DETAILED EVALUATION
- ASSUMPTIONS & THRESHOLDS
- GLOSSARY

01 SELECTING THE APPROPRIATE TAB FOR YOUR NEEDS

- **INITIAL ASSESSMENT:** This tab is intended to help cities make an initial assessment among a set of modes that should be considered for the Alternative Analysis.
- **DETAILED EVALUATION**: This tool is intended to help cities determine the most appropriate mode alternatives for a specific corridor. Please copy the tab for use for every different corridor.

02 DATA INPUTS

Populate the Input Cells using readily available data

ORANGE
Input Selection Box

YELLOW
Input Entry Box

03 STEP 3: READ AND INTERPRET THE RESULTS

HOW TO INTERPRET THE RESULTS?

Initial Assessment: In this tool, the results are expressed as the degree to which a mode is favorable or competitive or unfavorable in terms of (1) the ability of the mode to manage peak passenger demand at higher and lower ranges of demand; and (2) the cost efficiency of the mode technology at higher and lower ranges of demand.

A city that is home to a high variation of population and employment densities, would need to consider the results for both higher and lower cases. On the other hand, a city that is characteristically closer to either the higher or lower end of the density range may use the results from the most applicable scenario. The results of the tool should be used not as direct recommendations but as preliminary guidance on appropriate mode(s) for the city, given prevailing conditions of population density and travel habits. For instance, if the INITIAL ASSESSMENT tool suggests that rail is COMPETITIVE for the whole network whereas bus is FAVORABLE, it may well be that part of the network would be better off as rail. Mixed results could be interpreted in some instances to indicate a mixed-mode solution warranting at least DETAILED consideration by corridor.

Detailed Evaluation: If passenger is known by segment/ corridor, the DETAILED EVALUATION tool could be used to explore the particular segment that works better as rail. In effect, both tools together could be used to assign segments of a large notional network to either rapid (BRT or Metro) or semirapid (BRT or LRT).

In this tool, the results are expressed in terms of an Evaluation Score. The evaluation considers the following parameters:

a. Provides Adequate Capacity (Scored out of 3)
b. ROW Availability (Need vs. availability of dedicated corridors) (Scored out of 3)
c. Potential to Integrate Pedestrian Needs (Such as safe crossings) (Scored out of 2)
d. Potential to Improve Living Conditions in surrounding Development (Scored out of 2)
e. High Estimate of TAC per PKT (High Cost = Low Score) (Scored out of 3)
f. Low Estimate of TAC per PKT (High Cost = Low Score) (Scored out of 3)
g. Ease of Implementation with respect to: Familiarity with Technology (Scored out of 2)

REFERENCES

Agarwal, O. P., Gouthami Padam, Aroha Bahuguna, and Salvador Pena. 2014. Urban Transport Data Analysis Tool (UT-DAT) : user's manual (English). Energy Sector Management Assistance Program (ESMAP). Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/395261468147569317/Urban-Transport-Data-Analysis-Tool-UT-DAT-users-manual.

n.d. Global BRT Data. Accessed 08 20, 2018. https://brtdata.org/.

Moccia, Luigi, Duncan W Allen, and Eric C Bruun. 2018. "A Technology Selection and Design Model of a Semi-Rapid Transit Line." Researchgate .

Reilly, Jack, and Herbert Levinson. 2011. Public Transport Capacity Analysis Procedures for Developing Cities. Washington DC: The International Bank for Reconstruction and Development / The World Bank.

Vuchic, Vukan R. 1981. Urban Public Transportation Systems and Technology. Englewood Cliffs, NJ.

GLOSSARY

CAPACITY

The maximum number of people that can be carried past a given location during a given time period under specified operating conditions, without unacceptable delay, hazard, or restriction, and with reasonable certainty.

HISTORICAL DAILY PEAK HOUR FACTOR

The ratio of Peak Hour Peak Direction Passenger Demand for a typical route (i.e. representative of the system as a whole) to its total daily boardings in both directions. His factor helps to convert daily passenger flows into peak hour passenger flows. It should be ideally be determined by looking at historical data. Please note that this factor is usually higher for public transport as compared to total traffic.

LOCAL TRANSIT

Public transport operating on fixed routes with frequent stops (100-400 m apart), generally in mixed traffic on surface roadways, relying heavily on walk access and egress.

LOCAL TRANSIT BOARDINGS

The annual number of passengers boarding local transit vehicles, counting separately each boarding made in the course of single journey or trip between origin and destination. Also known as unlinked passenger trips (UPT). Boardings on regional services should not be included in city totals when using this tool.

LOCAL TRANSIT SERVICE AREA

The reasonably contiguous area served by the local transit network, not including regional services. Indicative extent would be the area within 1 km of regularly served local stops. This area does not include portions of the metropolis connected to the local service area solely by regional services.

MEAN LOCAL TRANSIT TRIP LENGTH

The average distance traveled by one public transit boarding passenger, calculated by dividing total local transit person-km by total local transit boardings.

NETWORK EXTENT

The number of kilometers of a route in a public transport network, without double-counting kilometers where routes share the same path.

PASSENGER TRAFFIC DENSITY (PTD)

The total number annual transit passengers passing the average point along a system or route in both directions combined, formed by dividing system PKT by network extent (for a system) or route PKT by route length (for a single route).

PASSENGER-KILOMETERS TRAVELLED (PKT)

The total distance traveled by passengers on transit vehicles (for a single route or a system), which may be determined by multiplying the number of unlinked passenger trips by the average length of such trips.

PEAK HOUR PEAK DIRECTION PASSENGER DEMAND (PHPD)

The number of transit passengers carried in the peak hour in the peak direction. This occurs almost universally on weekdays and is measured for a single route at its maximum load point.

PROJECTED ANNUAL RAPID TRANSIT PASSENGER BOARDINGS IN A CORRIDOR/ ANNUAL CORRIDOR RIDERSHIP

The estimated or projected annual passenger boardings for a specific rapid transit corridor of known length. The estimate should be consistent with operating characteristics (such as average speed) for the available ROW

RAPID TRANSIT

Public transport operating on fixed routes at a significantly higher average speed than local service, usually in exclusive rights-of-way and/or completely separated from surface traffic. Access depends on both walking and local public transport service. Stations are typically 800m-2km apart.

REGIONAL TRANSIT

Public transport operating on fixed routes within and outside the local service area, offering higher average speeds than even rapid transit, with average station spacings usually longer than 2 km. A large share of access may be by motorized transport.

RIGHT-OF-WAY

Land that is used for moving vehicles carrying passengers or goods, such as railways or highways. Rights-of-way may be identified, purchased, or reserved in advance for future transportation use, and may be required to construct elevated or underground rapid transit.

ROW CLASS

Classification of the type of operating environment of the RoW. ROW Class A = fully grade-separated ROW, Class B = at-grade lane separation, Class C = mixed traffic.

TOTAL ANNUALIZED COST

Total annualized cost is the annualized value of the total net present cost expressed in per PKT.

VEHICLE CAPACITY

The average number of people that a vehicle can be scheduled to carry at capacity (as defined herein).

Indore, India

TOD K P

AS-H01

HOW TO UNDERTAKE REAL ESTATE MARKET ANALYSIS

This tool aids in establishing the real estate knowledge required to carry out a successful TOD development. Through the use of the tool, the market area with the appropriate demand can be determined. It can also be better understood what development is most in demand, based on demographic, geographic and economic trends.

Type: Step-by-Step Guide

TOD

Global Platform for Sustainable Cities

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TOD KP

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01 UNDERSTAND THE REGIONAL OR CITY-WIDE SETTING

To understand and compare the regional or city-wide economic trends with conditions along the TOD corridor or station area where the project is proposed.

DEMOGRAPHIC TRENDS: POPULATION | DENSITY | HOUSEHOLDS

+

EMPLOYMENT TRENDS: TOTAL NUMBER OF JOBS | UNEMPLOYMENT RATE | TOTAL NUMBER OF ESTABLISHMENTS

+

LARGEST AREA EMPLOYERS

+

CONSTRUCTION ACTIVITY: RESIDENTIAL AND NON-RESIDENTIAL

DATA SOURCES

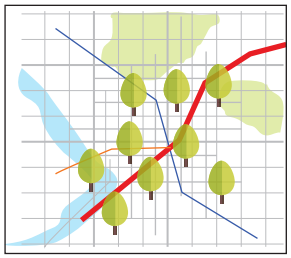
- City-level Census Information
- World Bank Open Data (https://datacatalog.worldbank.org/)
- Municipalities (Building Permit/ Plan Approval Departments)
- Local Real Estate Industry Associations
- Interviews with local property brokers

02 DELINEATE THE TOD MARKET AREA BOUNDARY

To define the two boundaries of the TOD Market Area: Primary (3 mile/5 km) and Secondary Trade Area (5 mile/8 km) to understand the market's potential size, catchment and expenditure potential. Factors that affect the size and shape include:

NATURAL FEATURES

Lakes/ Rivers/ Mountains

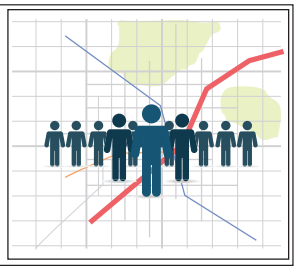


DATA SOURCES

- Satellite Imagery | Google Earth
- GIS data

JURISDICTIONS

Political boundaries | Neighborhood boundaries



DATA SOURCES

- GIS data
- Community Mapping

BUILT INFRASTRUCTURE

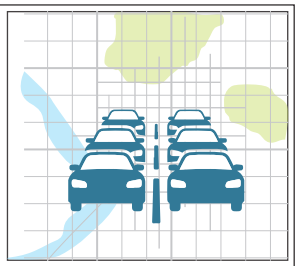
Railroad tracks | Highways | Airports | Large-scale Industrial

DATA SOURCES

- Satellite Imagery
- GIS data

TRAFFIC

Traffic Volume | Congestion Data



DATA SOURCES

- Google Real-Time Traffic Data | General Transit Feed Specification | Commercial Ride sharing Application
- Mobility/ Transport Studies
- As per approved Master Plan/ Development Plan

TOD KP

03 CONDUCT A DEMAND & SUPPLY ANALYSIS

To understand the demand and supply within the TOD Market Area with respect to different development components. Create an economic profile to understand the purchasing power and prepare a competition analysis to understand the risk and revenue potential for different types of development components.

ECONOMIC INDICATORS/ SOCIOECONOMIC PROFILE

- Demographic trends: Age | Household Composition | Migration
- Economic trends: Household Income | Disposable Income (Retail)
- Tourism Data (Hospitality)
- Employment Trends: Job Growth (Office)

COMPETITION ANALYSIS

- Number of residential units and square feet of housing types
- Commercial built space supply
- Number of hotel rooms
- Land Values (Market & Assessed)
- Rental Yield Rates
- Approved & Planned Projects
- Absorption Rates / Occupancy Rates

DATA SOURCES

- Interviews with local city staff
- Building permit data
- Meetings with local real estate brokers
- City tourist traffic data
- Online property websites
- Crowdsourcing Apps
- Mail/Internet Surveys

04 DEFINE POTENTIAL AND DESIRED DEVELOPMENT MIX

Define the most appropriate development mix based on location, investment risk and revenue potential. Some other criteria to be considered in defining the development mix include:

- Zoning and Planning Regulations
- Local Political Willingness
- Land Ownership and Land Control Options
- Environmental & Infrastructure Conditions
- Size/Program Area
- Potential Synergies with surrounding land uses

Refer to AS-A03

DATA SOURCES

- Stakeholder meetings
- Community Workshops
- Collaboration with planning & design team

05 PREPARE A DEVELOPMENT PROFORMA

Prepare a Development Proforma that includes Development Costs, Potential Income and Cash Flow over the project timeline, presenting finally the Net Present Value (NPV) and Internal Rate of Return (IRR):

COSTS

- Land Acquisition | Site Improvements | Planning, Engineering & Design | Marketing | Property Taxes | General Overhead | Financing Costs

REVENUES

- Sales Revenue | Sales Percentage | Lease Revenue | Lease Percentage | User Fees | Grants & Loans

PROJECT TIMELINE

- Pre-Development | Construction Phase | Stabilization | Asset Management/Sale | Operations

Refer to FI-A02

Also Refer to SAMPLE MIXED-USE DEVELOPMENT PROFORMA

Source: Economic Research Associates, Washington DC shared via ULI Resources.

Also Refer to COMMERCIAL MIXED USE PROFORMA

Source: HUD Exchange Resources, US Department of Housing and Urban Development, Washington DC.

ASSESS KNOWLEDGE PRODUCT | 65

06 PREPARE A REAL ESTATE MARKET ANALYSIS REPORT

Prepare a Real Estate Market Analysis Report summarizing the key findings through the process. The proposed report structure is shown.

1. Real Estate Market Performance Trends.
2. Worker Travel Characteristics.
3. Competitive Advantage and Industry Cluster Analysis.
4. Long-term Residential and Employment Demand Analysis.
5. Recommended Development and Redevelopment Opportunities.
6. Profitability & Revenue Potential in NPV and IRR.
7. Recommended set of Incentives and Possible Finance Structures.

TOD KP

AS-H02

HOW TO UNDERTAKE RAPID TRANSIT ALTERNATIVES ASSESSMENT

An overall framework for identifying, evaluating and selecting the appropriate rapid transit alternative including alignment, mode and operating environment.

Type: Step-by-Step Guide

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

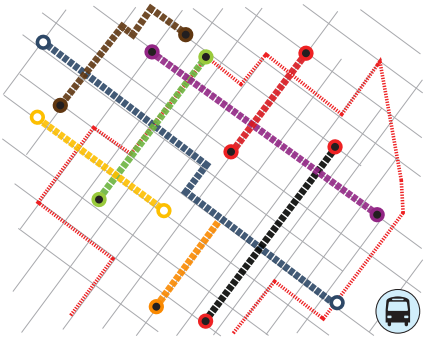
TOD KP

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

01 DEVELOP INITIAL RANGE OF ROUTE & MODE OPTIONS

Use (A) **PRELIMINARY REFERENCE CRITERIA** to map initial corridors and collect feedback on it from political stakeholders, municipal & transit agencies and the public.

- People and Jobs Density
- Destinations and Land Uses
- Potential and Desired Connections
- Existing Recommendations
- Viable Modes



DATA SOURCES

- Satellite Imagery
- Statutory Policy and Plan Documents
- Existing Transport Studies
- Field Surveys
- Stakeholder Workshops

STAKEHOLDERS

Primary:

- Transit Planning/ Urban Planning Agency

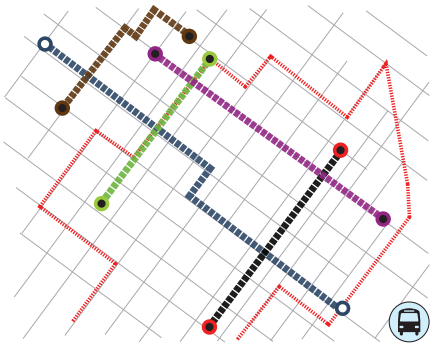
Secondary:

- Formal and Informal Transit Operators
- Land Use Planners, Environmental Planners
- Housing, Infrastructure, and Transportation Departments
- Neighborhood/ Community Organizations

02 UNDERTAKE INITIAL SCREENING

Use (B) **CORRIDOR SCREENING CRITERIA** to perform initial screening of the corridors identified in step 1

- City Vision and Goals
- Transportation Demand
- Ease of Implementation
- Community Building



DATA SOURCES

- Satellite Imagery
- Existing Census Data
- Population /Employment Projections
- Statutory Policy and Plan Documents
- Land uses and nodes along corridor

STAKEHOLDERS

Primary:

- Transit Planning Agency

Secondary:

- Formal and Informal Transit Operators
- Land Use Planners, Environmental Planners
- Housing, Infrastructure, and Transportation Departments
- Neighborhood/ Community Organizations

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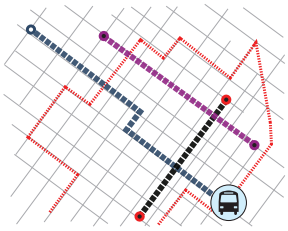
03-A UNDERTAKE DETAILED CORRIDOR SCREENING

Use B **CORRIDOR SCREENING CRITERIA** to undertake detailed screening of the corridors shortlisted in step 2.

- City Vision and Goals
- Transportation Demand
- Ease of Implementation
- Community Building



03-B UNDERTAKE TECHNOLOGY/ MODE REVIEW

Evaluate transit technology based on:

- Potential Ridership
- Mode Capacity
- Cost Comparison

Refer to AS-A04

DATA SOURCES

- Transit Ridership Projections
- Statutory Policy and Plan Documents
- Land uses and nodes along corridor
- Environmental Assessment Reports
- Capital and Operating Costs
- Stakeholder Workshops

STAKEHOLDERS

Primary:

- Transit Planning Agency

Secondary:

- Political Leadership / Appointed Executives
- State or Federal Departments
- Funding Agencies
- Formal and Informal Transit Operators
- Urban Planning Agencies
- Land Owners and Potential Real Estate Developers
- Academic Institutions, Advocacy Groups

04 UNDERTAKE BUSINESS CASE

Undertake C **DETAILED COSTING COMPARISON** and develop a detailed Cost-Benefit Analysis

I	Establish base and projected case	Based on current and future demand
II	List Benefits	Including productivity savings, healthcare cost savings, regional economic and environmental benefits
III	List Costs	Including transit capital and operating costs, costs of changing institutional procedures and negative externalities
IV	Monetize Benefits and Costs	Assign $ value to as many benefits and costs as possible. Where needed, use an equivalence factor to assign $ value
V	Calculate Net Present Value	Annual net costs and benefits in each year to be discounted to current day dollars value; derive Benefit-Cost Ratio

DATA SOURCES

- Capital and Operating Costs
- Ridership and Total Trip Data
- Emissions and Fuel Data
- Public Expenditure Data

STAKEHOLDERS

Primary:

- Transit Planning Agency

Secondary:

- Political Leadership / Appointed Executives
- State or Federal Departments
- Funding Agencies

A PRELIMINARY REFERENCE CRITERIA

Develop a long list of alternatives, building upon the work previously undertaken by the city and incorporate additional consultation with various stakeholder groups. The following Criteria must be considered in defining the long list of alternatives.

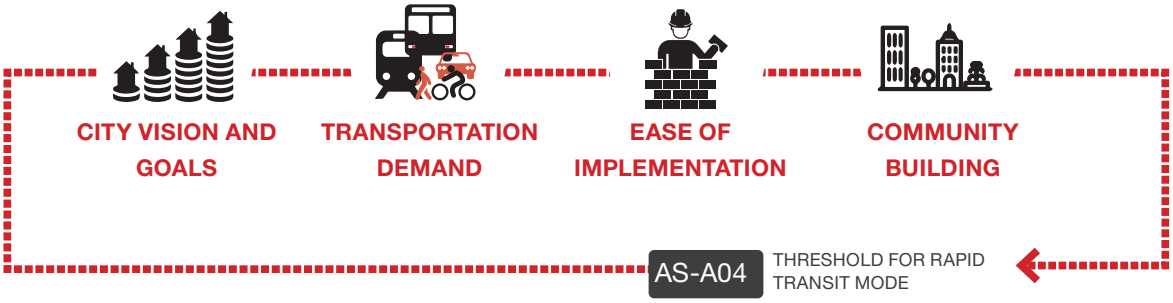
CRITERIA	MEASURE	IMPORTANCE
PEOPLE AND JOB DENSITY	**Density** of housing units and jobs identified through Census data and other surveys.	Areas with high population densities need Rapid Transit services to equitably fulfill mobility needs of all people.
DESTINATIONS AND LAND USE	**Major trip generators** within the city (weekdays & weekends) identified through destination mapping and land use maps.	Serving public destinations and high activity centers with Rapid Transit alleviates the potential for congestion and ensures optimum ridership.
POTENTIAL AND DESIRED CONNECTIONS	Identification of **existing and potential desired connections** measured from travel data and people's perception	Determine travel patterns using data from existing transit services or cab aggregators or congestion mapping.
EXISTING RECOMMENDATIONS	Review **recommendations from existing Plans and Policy Documents** and ensure they are still relevant & valid	Ensure that existing (and relevant) studies are reviewed and recommendations are considered in transit planning e.g. Transportation Master Plan, Master Plan, etc.
	Shortlist Viable Modes based on density thresholds AS-A04 THRESHOLD FOR RAPID TRANSIT MODE	Carry out a quick assessment of the most viable transit technologies and operating environment options for the city

DATA SOURCES

- Google Earth, Satellite Images, GIS Data, Worldwind, Marble, Virtual Ocean, Ossimplanet, GeoMappApp, OpenStreeetMap
- Statutory policy documents and relevant studies– Master Plan/ Development Plans/Transportation Master Plan
- Data from existing transit/busways/ private transit operators
- Field surveys
- Best practices
- Stakeholder workshops
- Public workshops

B CORRIDOR SCREENING CRITERIA

The intent of corridor-level screening is to evaluate the long list and short list of the corridor segment alternatives and advance those that demonstrate suitability for Rapid Transit. Corridor alignment alternatives need to be evaluated in parallel with mode and technology alternatives. The screening process described here is a two-step process, where initial screening criteria are suggested for evaluation of a long list of alternatives, followed by a detailed screening at a later stage of the shortlist of selected alternatives. Where required, cities may skip one level of screening depending on the availability of data and resources.



CITY VISION AND GOALS

CRITERIA	INITIAL SCREENING MEASURE	DETAILED SCREENING MEASURE
Growth Potential	Projected growth (10 year) within 500m in population density (person /ha) and employment density (jobs/ha). HIGHER IS BETTER	Supports growth management to focus high-intensity, mixed-use development in strategic locations; Supports transit-oriented development (Transit Villages), compatible with incentives for development along Rapid Transit corridors and at transit stations.
Economic Development	Connectivity to major growth centers, existing or proposed, within 500m of the corridor. HIGHER IS BETTER	Ability to attract and retain talent and influence long-term employment goals, improve business viability and attractiveness.
Mixed Use Development Potential	Areas that have a mix (2 or more) of land uses within a 500m buffer along the corridor. HIGHER IS BETTER	Land availability and market acceptance for new mixed-use development or redevelopment opportunities.
Land Value Capture Potential		Property value uplift along the corridor, increased attractiveness to live along the corridors, changes to parking and access.

DATA SOURCES

- Google Earth, Satellite Images, GIS Data, Worldwind, Marble, Virtual Ocean, Ossimplanet, GeoMappApp, OpenStreeetMap
- Census Data Existing
- Population /Employment Projections from Statutory Policy Documents & Relevant Studies
- Statutory Policy Documents & Relevant Studies – Master Plan / Development Plans / Transportation Master Plan
- Land Uses along corridor
- Key Nodes and Destinations
- Infrastructure Construction and Operating Costs
- Land Ownership Data

B CORRIDOR SCREENING CRITERIA

TRANSPORTATION DEMAND

CRITERIA	INITIAL SCREENING MEASURE	DETAILED SCREENING MEASURE
Transit ridership potential	Existing and projected population and job densities; existing transit ridership on existing services. HIGHER IS BETTER	Opening day and longer-term forecast of transit ridership projections compared to transit system capacity (persons/hour) of all modes on the mobility network.
Travel time improvement potential	Route length; average auto delay; maximum V/C Ratio; travel time (Auto vs Existing Transit). LOWER PERFORMING ROADWAY IS PREFERRED	Forecasted travel times to major trip generators, balancing transit and auto should show substantive improvements in travel time by transit compared to auto.
Existing transit network integration	Transfer points with existing transit network. HIGHER IS BETTER	Possibilities of integrating with local, rapid and regional transit systems, existing and planned, focusing on the highest potential for network reach and future expansion.
Transit service reliability		Right-of-way characteristics affecting reliability, frequency, quality, and flexibility of Rapid Transit service, including: o Availability of width for dedicated lanes/tracks o Intersections, restricted turning movements, and signalization
Support active transportation		Urban form characteristics that support active mobility choices such as walking, cycling and transit that are accessible and accommodate people of all abilities, including: o Block sizes and street connectivity o Availability of walking and cycling facilities
Safety of all corridor users		Road characteristics that allow for improvement to intersections, crossing locations and emergency vehicle access.

DATA SOURCES

- Statutory Policy Documents & Relevant Studies – Master Plan / Development Plans / Transportation Master Plan
- Existing Transit Ridership data - Boarding & Alighting Data
- Street Network in CAD, GIS, or any Transport Demand Modelling Software formats including ROW, Intersections, and Signalization Information
- Corridor Performance and/or Traffic Volume Data
- Data from Existing transit / busways / Private Transit Operators
- Accident Data

B CORRIDOR SCREENING CRITERIA

EASE OF IMPLEMENTATION AND OPERATIONAL VIABILITY

CRITERIA	INITIAL SCREENING MEASURE	DETAILED SCREENING MEASURE
Ability to Implement	Coordinated jurisdictional control under a single or few coordinated agencies. FEWER COORDINATION CHALLENGES ARE BETTER	Relative flexibility to implement the Rapid Transit network in stages.
Ease of Construction	Availability of Right-of-Way (ROW) and minimal immovable barriers. MORE SPACE IS BETTER	Number and complexity of construction challenges, including rail crossings, waterway crossings, sensitive or historical areas, sharp turns, right-of-way issues, utilities, or other construction challenges.
Financial Viability	Approximate annualized costs per person-km based on the type of operating environment and mode.	Rapid Cost-Benefit Analysis (CBA) comparing the cost of implementation and operations against revenue potential and quality of life benefits.
Property Impacts		Minimize the need for land acquisition or major land readjustment; undue negative impact on property ownership or property values.
Environmental Impact		Minimize impacts to designated environmentally significant areas, wetlands and provincially significant wetlands, fish habitat, woodlands and significant woodlands, significant valley lands, or environmentally sensitive areas, the habitat of endangered and threatened species and designated areas of natural and scientific interest

DATA SOURCES

- Statutory Policy Documents & Relevant Studies – Regional Plans, Environmental Studies
- Google Earth, Satellite Images, GIS Data, Worldwind, Marble, Virtual Ocean, Ossimplanet, GeoMappApp, OpenStreeetMap for Natural Features
- Infrastructure Alignment Data and Future Plans in CAD, GIS or other such format allowing for overlay analysis and identification of overlaps, interferences
- Land Ownership Data
- Property Valuation Data
- Capital and Operating Costs

B CORRIDOR SCREENING CRITERIA

COMMUNITY BUILDING AND REVITALIZATION

CRITERIA	INITIAL SCREENING MEASURE	DETAILED SCREENING MEASURE
Supports Inclusive Growth Objectives	Low/ middle-income neighborhoods who can benefit from affordable mobility choices to access key nodes and destinations HIGHER IS BETTER	Appropriate development potential with high affordability compared to planned growth, infill and intensification.
Connectivity to Neighborhoods and Business Areas	Higher neighborhood penetration and accessibility choices through a denser street network. HIGHER IS BETTER	Improved access to community amenities (schools, libraries, hospitals etc.), while maintaining vehicular access to residential and commercial properties and minimize vehicular infiltration of adjacent neighborhoods.
Intensification Potential	Corridors designated for growth and intensification are preferable, as they have the potential to intensify over time (TOD) and support ridership potential. HIGHER NO OF UNDERUTILIZED LOTS ARE PREFERRED	Availability of land for intensification within a 500m buffer of the corridor, including: o Parking lots, o Underutilized spaced o Dilapidated/end of life-cycle buildings o Transitional land uses, e.g. former industrial uses, etc.
Public Space and Amenities		Allow greater use of the public realm and improved aesthetics, enhance community connections, support safety and security through design and minimize impacts on existing public and private trees.
Cultural Heritage Impacts		Minimize impacts to built cultural heritage features and archaeological resources.
Climate Resilience		Resiliency to global warming trends (e.g. floods, droughts) following urban densification principles; impacts on air pollution and greenhouse gas (GHG) emissions.

DATA SOURCES

- Development Potential
- Property Valuation and Affordability Dats
- Population /Employment Projections from Statutory Policy Documents & Relevant Studies
- Statutory Policy Documents & Relevant Studies – Master Plan / Development Plans / Public Realm Plan
- Community nodes and destinations
- Heritage or Archaeological Data
- Air Quality Data
- Stakeholder Workshops

C DETAILED COSTING COMPARISON

PROJECT CAPITAL COST

Capital costs are those required to install and launch each phase of the system and include equipment purchase, infrastructure cost and engineering and support costs.

HARD INFRASTRUCTURE COSTS	CURRENCY
Property Acquisition	
Civil Works	
Staging/Enabling Works	
Maintenance Facility/Yard	
Parking Facilities/Park & Ride Lots	
Structures	
Utility Relocation	
Streetscape Improvements/Placemaking	
Stations	
Electrical Power, Lines & Substation(s)	
Water Supply	
Signaling	
Operations & Control Centre	
SUB TOTAL A	
CONTINGENCY A1	~10%

SOFT INFRASTRUCTURE COSTS	CURRENCY
Engineering Design	
Construction Management	
Design Support (Construction Administration)	
Operating Agency Costs	
Program Management	
SUB TOTAL B	
CONTINGENCY B1	~5%

VEHICLE COSTS	CURRENCY
Capital Vehicle Costs	
SUB TOTAL C	
CONTINGENCY C1	~5%

TOTAL COST	CURRENCY
GRAND TOTAL (A+B+C)	
CONTINGENCY GRAND TOTAL (A1+B1+C1)	

FORECAST OPERATING COST & REVENUES

Operating costs are the cost to operate and maintain the system. These include hiring employees for operational tasks, as well as maintenance costs including purchasing tools and spare parts, upkeep of software, etc.

HARD INFRASTRUCTURE COSTS	OPENING YEAR	LIFECYCLE YEAR
Daily Ridership		
Annual Revenues		
Annual Operations & Maintenance		

Copacabana Beach, Rio de Janeiro, Brazil

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AS-H03

INFRASTRUCTURE CARRYING CAPACITY ASSESSMENT

An overall framework for evaluating the infrastructure needs of the city

Type: Step-by-Step Guide

TOD

Global Platform for Sustainable Cities

WORLD BANK GROUP

IBI

ABOUT THE ASSESSMENT TOOL

PURPOSE

Infrastructure serves as the foundation for planning sustainable and resilient cities (Pollalis 2016). The viability and sustainability of any TOD development must, therefore, include an assessment of infrastructure to ensure the current provision is adequate and has the capacity to support growth in the future.

In World Bank client countries, infrastructure capacities are often mismatched with current needs, largely due to unanticipated rapid urban growth. A TOD development without infrastructure carrying capacity considerations may further deteriorate living conditions. Such an assessment is essential before density changes are proposed.

As transit-oriented development requires major built form and transportation development, this tool assesses the capability of regions to support infrastructure needs. Based on current municipal deficits, strategies to offset the necessary capital investment required by additional or upgraded infrastructure are explored through the creation of a capital investment needs plan.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

THIS TOOL INCLUDES:

- OVERALL INFRASTRUCTURE ASSESSMENT PROCESS
- INFRASTRUCTURE GOALS
- DETAILED INFRASTRUCTURE PLANNING PROCESSES

VARIATION IN INFRASTRUCTURE ASSESSMENT PROCESSES FOR DEVELOPMENT CONTEXTS

GREENFIELD

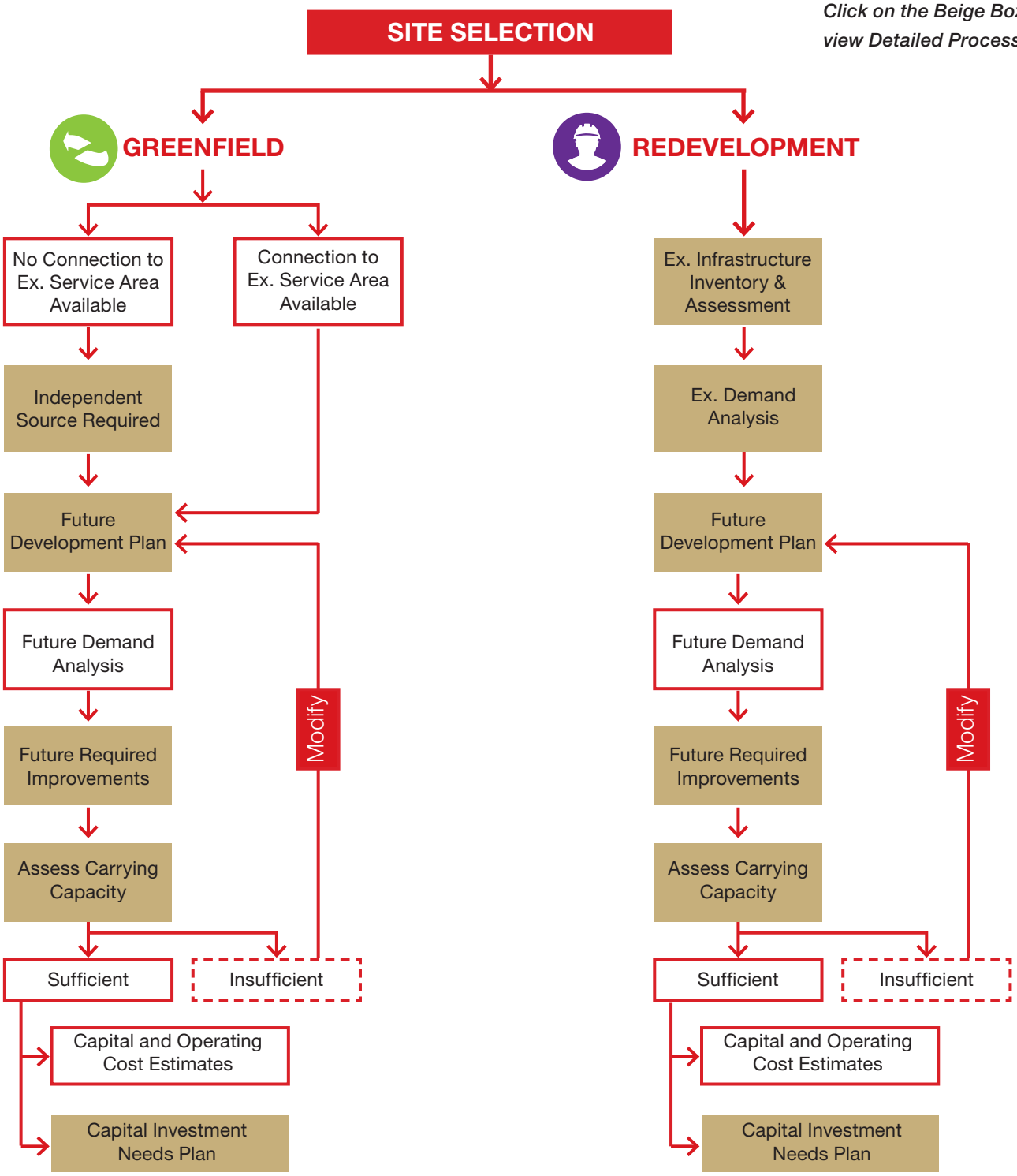
A greenfield project is one which is not constrained by prior work. It is constructing on unused land, where there is no need to remodel or demolish an existing structure.

URBAN/ SUBURBAN

Urban and suburban projects refer to site parcels within previously built areas. These areas are already served by public infrastructure and other utilities. It may also include converting an existing built property into another use.

THE INFRASTRUCTURE ASSESSMENT PROCESS

Click on the Beige Boxes to view Detailed Processes



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INFRASTRUCTURE ASSESSMENT GOALS

PHYSICAL INFRASTRUCTURE

Physical Infrastructure includes basic service delivery systems, such as water supply, sewage, solid waste management, energy, and landscape. Pedestrian and cycling infrastructure are also integral to physical infrastructure. These systems are high-cost investments and are vital to a city's development (Pollalis 2016).

WATER SUPPLY

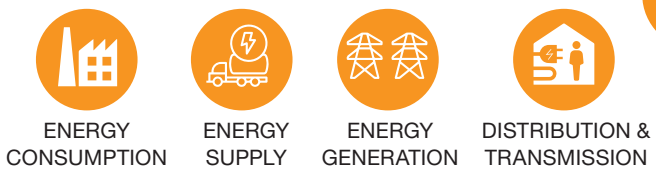
- To determine capital investment needs
- To identify the existing designed capacity and capability of serving additional densities.

SEWERAGE

- To determine capital investment needs.
- To determine the network capacity required to serve additional densities.

ENERGY

- To determine capital investment and secure energy supply.
- To assess and manage existing grid capacity.

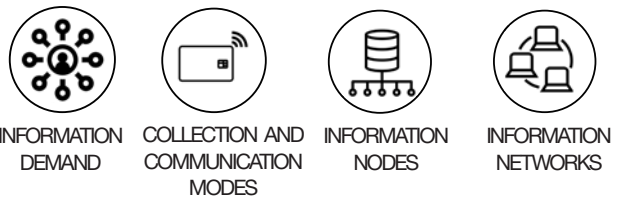


SOLID WASTE

- To determine capital investment to treat, collect and transfer waste.
- To determine excess solid waste generation for additional densities

INFORMATION

- To determine capital investment and secure information needs.
- To determine information need increases for additional densities



LANDSCAPE

- To understand vulnerabilities and planning opportunities.
- To identify the ability of the landscape to provide functional requirements.

INFRASTRUCTURE ASSESSMENT GOALS

SOCIAL INFRASTRUCTURE

Social infrastructure is a subset of the infrastructure sector that typically includes assets that accommodate social services. It includes schools, colleges, universities, hospitals, prisons, police, fire stations, markets, etc. The quality of life in any urban center depends upon the availability of and accessibility to quality social infrastructure.

HEALTHCARE

- To determine zoning reservations and capital investment needs.
- To ensure the adequacy of medical facilities to serve the additional population.

ADEQUACY ACCESSIBILITY AFFORDABILITY QUALITY

EDUCATION

- To determine zoning reservations and capital investment needs.
- To ensure adequacy of educational facilities to serve the additional population.

ADEQUACY ACCESSIBILITY AFFORDABILITY QUALITY

RECREATION

- To determine zoning reservations and capital investment needs.
- To ensure sufficient recreational zones to serve the additional needs.

ADEQUACY ACCESSIBILITY AFFORDABILITY QUALITY

POLICE/ FIRE/ OTHERS

- To determine zoning reservations and capital investment needs.
- To ensure adequate emergency response services to serve the additional densities.

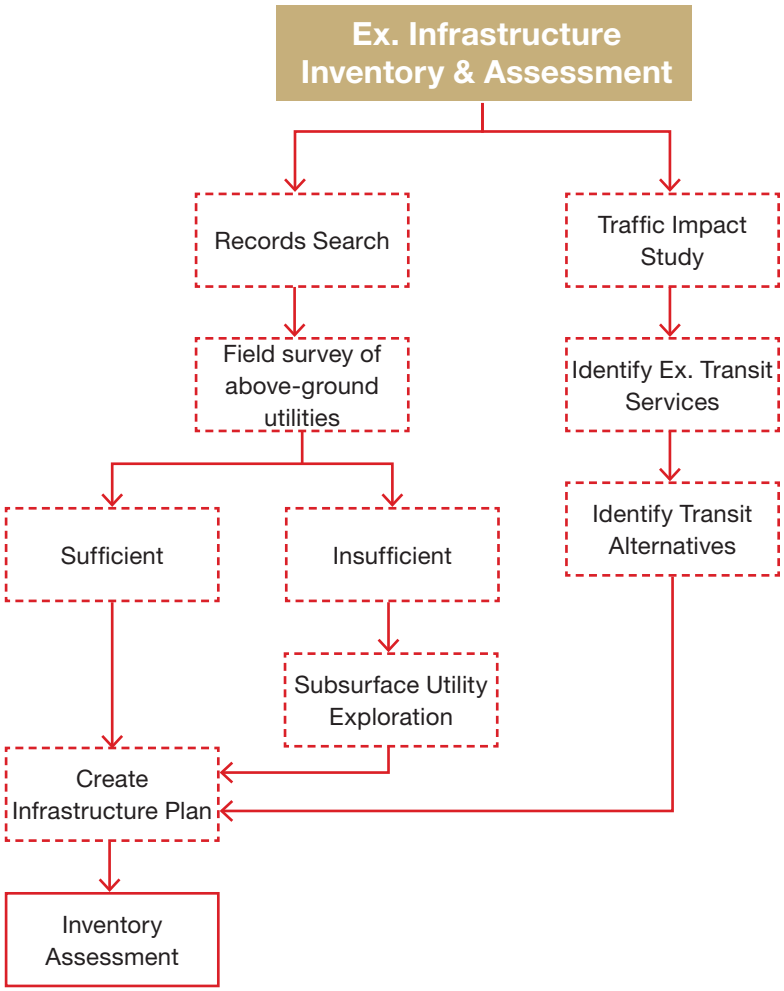
ADEQUACY ACCESSIBILITY QUALITY

**Applicable at all scales*

Greenfield Urban/ Suburban

EXISTING INFRASTRUCTURE INVENTORY

In distributing infrastructure, planned densities and population play the guiding role. Therefore, indications of population and densities served by a facility or service are considered when estimating the infrastructure needs.

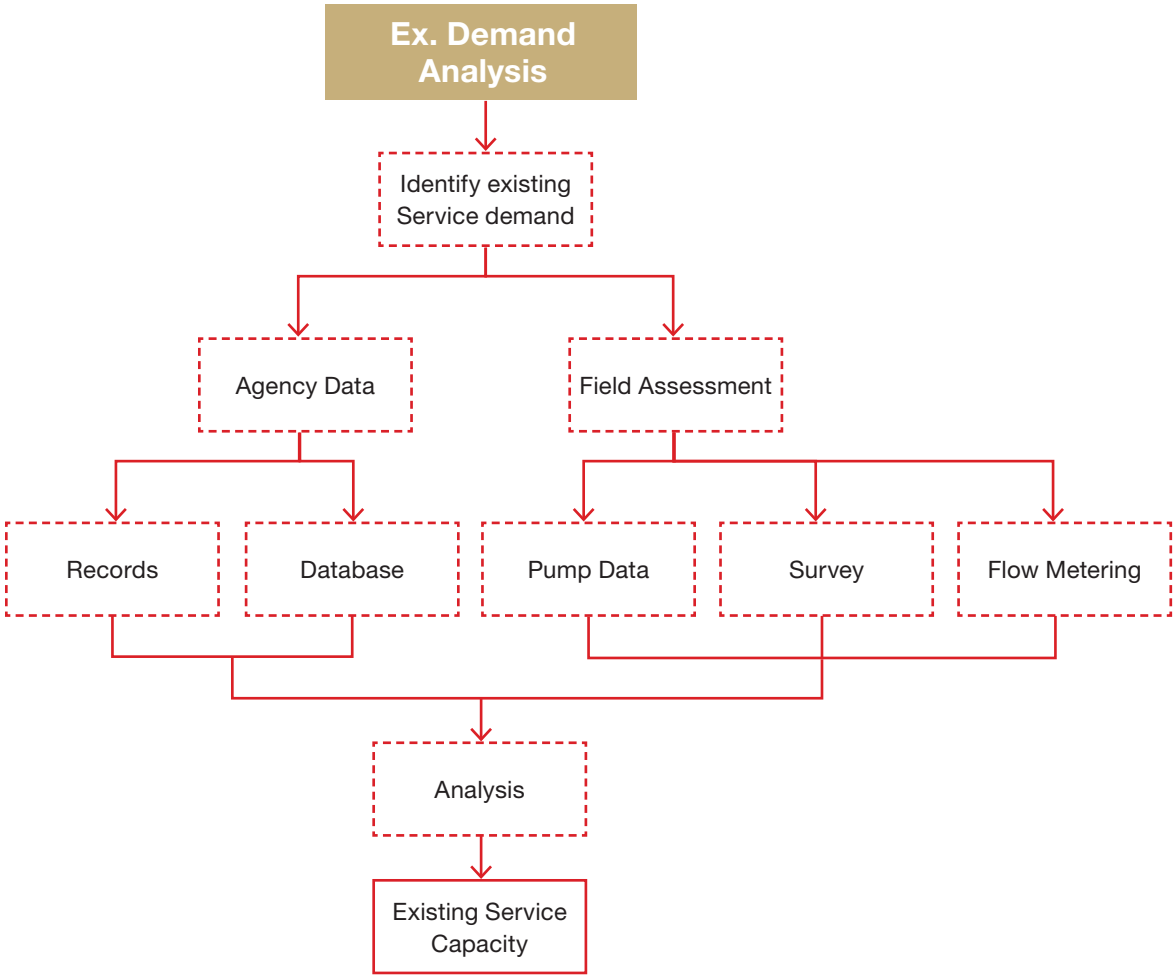


INFRASTRUCTURE CAPACITY MEASURES

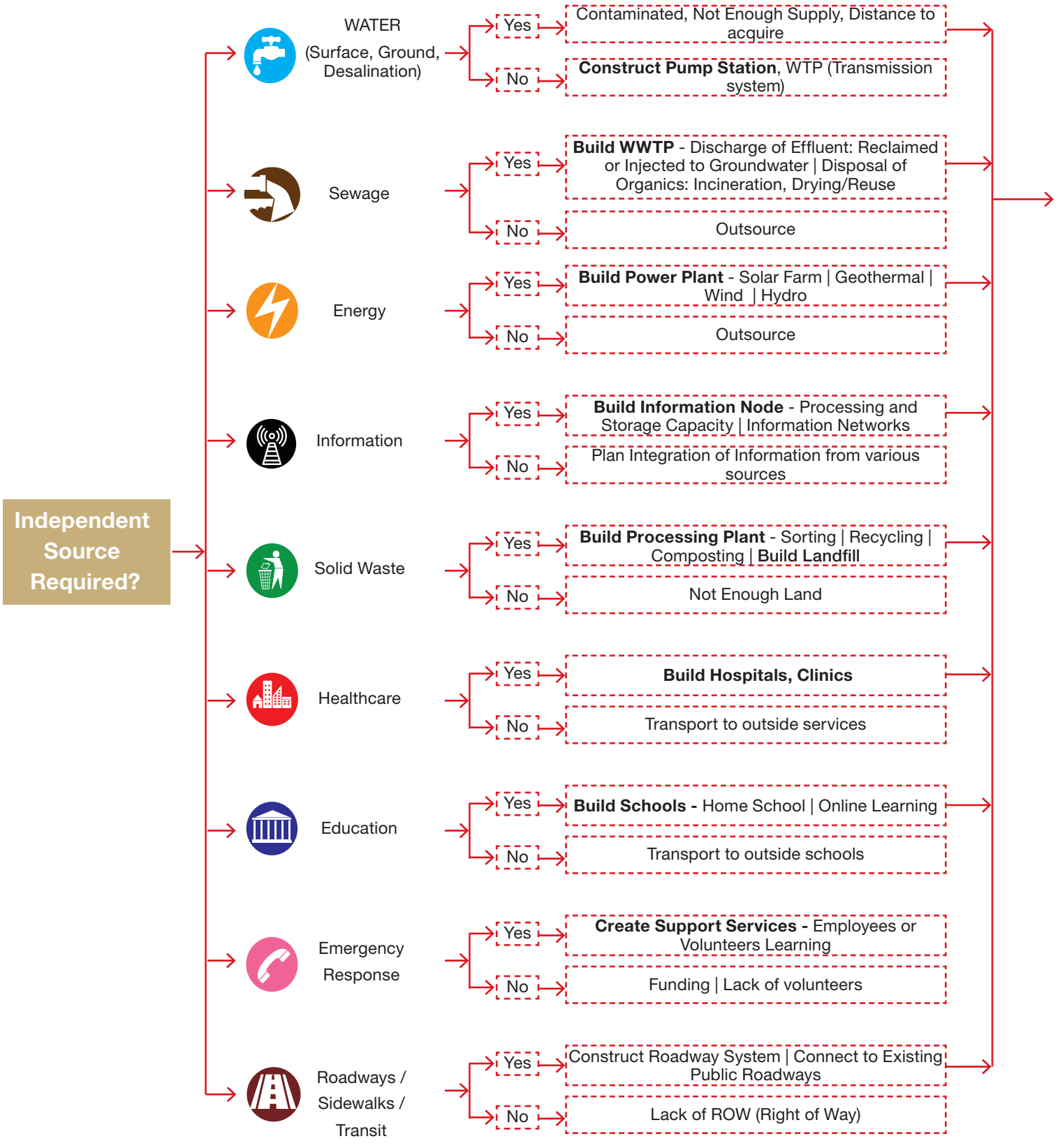
Water availability	- Installed capacity (MLD)
Source of water supply	- Within city limits or no
Water coverage	- Area served by supply network - Per capita supply (LPCD) - Supply duration
Wastewater disposal	- Wastewater generated daily - Disposal capacity (MLD) - Present Operating Capacity (MLD)
Solid waste	- Waste generated daily (tonnes/day) - Collection daily (tonnes/day)

EXISTING DEMAND ANALYSIS

Infrastructure demand is expected to increase with an anticipated increase in densities in TOD areas. This step is intended to quantify the needs of the respective city, corridor, station area or site.

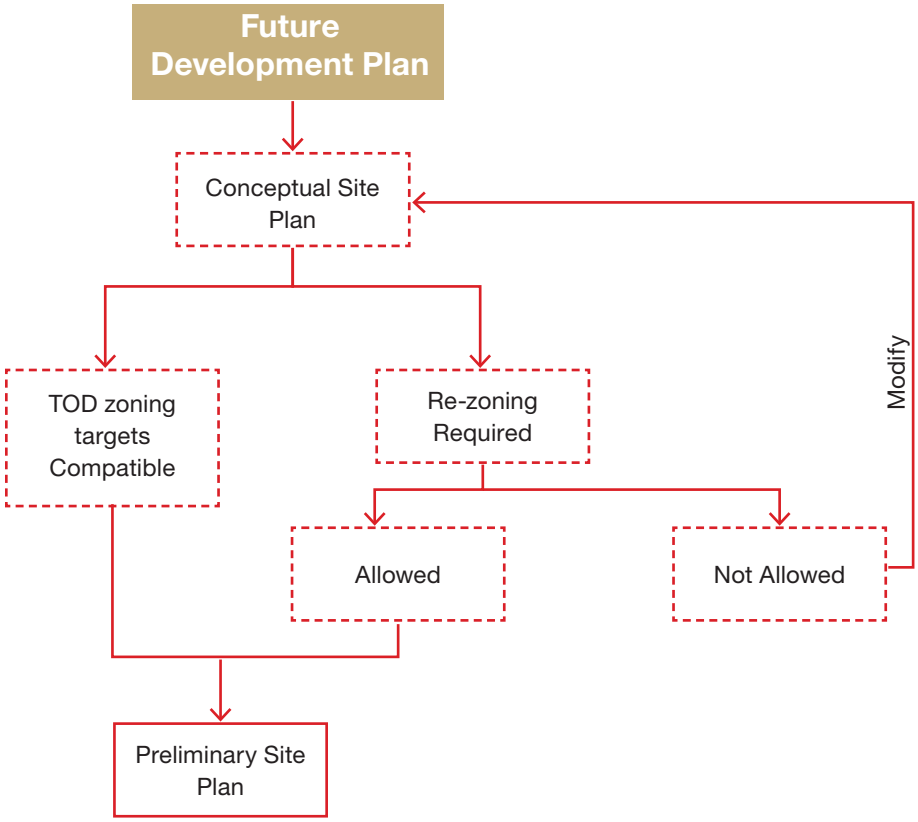


NEW INFRASTRUCTURE SOURCE REQUIRED



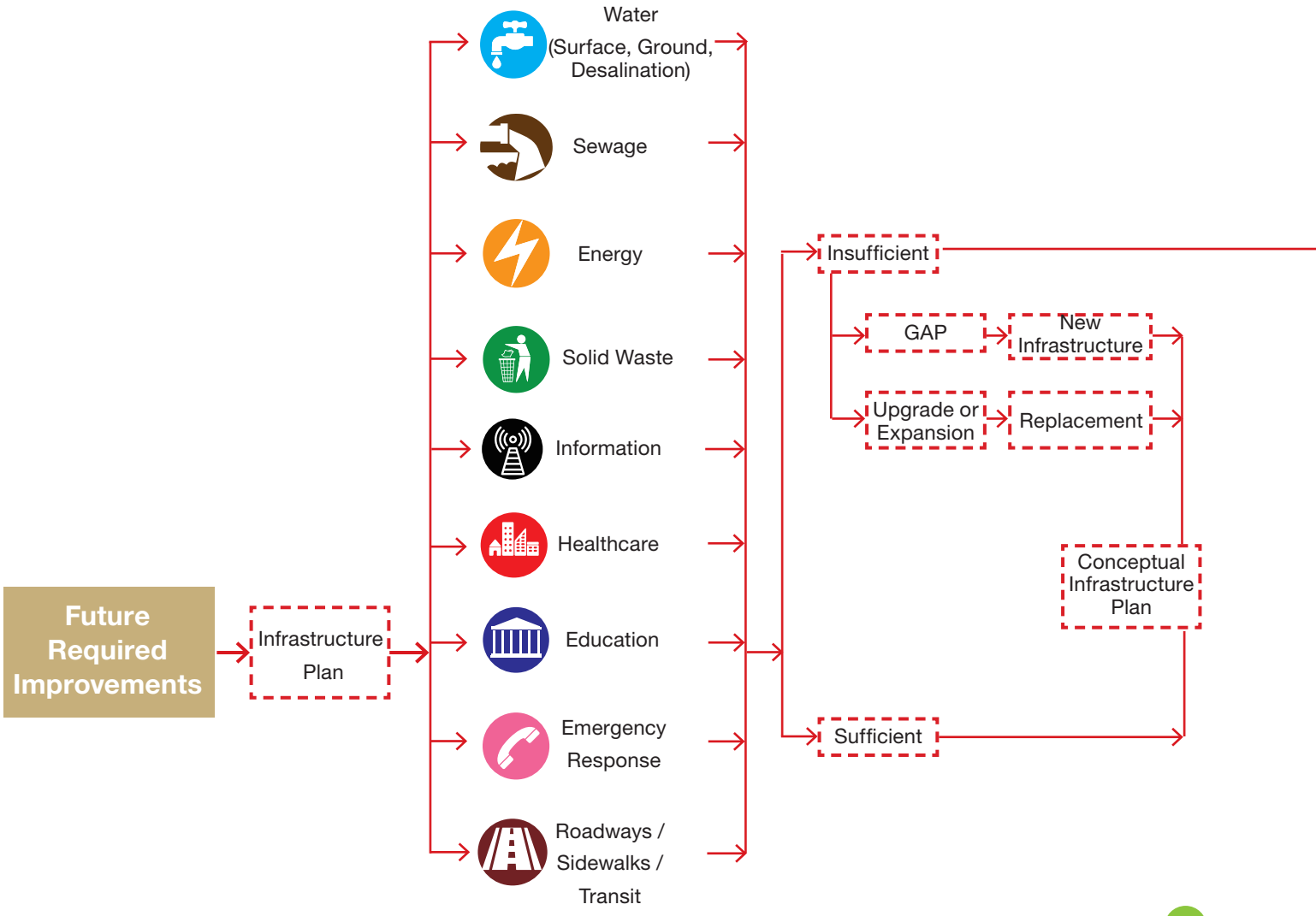
FUTURE DEVELOPMENT PLAN

Validate the Future Infrastructure Development Plan with the Conceptual Site Plan by assessing if zoning needs and TOD targets are met. If TOD requirements are not met by the infrastructure plan, trade-offs must be decided that can allow for transit-supportive development while fulfilling infrastructure needs.



FUTURE INFRASTRUCTURE REQUIREMENT

After calculating the infrastructure deficit, the infrastructure needs of the area must be defined with regards to new infrastructure, infrastructure upgrades and network expansion.



NEW INFRASTRUCTURE

In any greenfield project, new infrastructure has to be provided as per planned development. This requires heavy capital investment.

INFRASTRUCTURE UPGRADES

Upgrading infrastructure systems is required where the current capacity of the infrastructure is not sufficient enough for serving the estimated infrastructure needs. This can be undertaken where the expansion of the physical asset is costly or prohibitive due to broader physical constraints.

NETWORK EXPANSION

In any greenfield or redevelopment project that lacks the basic infrastructure, but is within the proximity of the existing infrastructure network, a network expansion should be proposed.

DETERMINE STRATEGIES TO OFFSET CAPITAL INVESTMENT (LOCAL/DECENTRALIZED FACILITIES)

When planning for future infrastructure needs for a TOD site area, it is necessary to consider facilities that are local or decentralized. These facilities not only reduce the pressure on the central distribution system/nodal facility, allow for higher densities and also offset/relax the heavy capital investment required for these critical infrastructure systems. The infrastructure demand can be effectively managed through the optimal use of resources and preventing/controlling any waste of resources.

DETERMINE STRATEGIES TO OFFSET CAPITAL INVESTMENT NEEDS?

01 Identify the critical infrastructure needs and shortage

02 Develop strategies for decentralization of facilities

- Water Supply: Strategies that help reduce the consumption pattern, and produce more water resources
- Wastewater: Strategies that help reduce wastewater generation and promote use of recycled wastewater
- Energy: Strategies that help reduce energy consumption patterns and produce clean and renewable sources of energy
- Solid Waste: Strategies that help reduce waste generation and help reuse/recycle it
- Landscape: Strategies that minimize disruption of the natural landscape
- Information: Strategies that serve as the foundation for the use of integrated information technologies
- Social Infrastructure: Strategies that allow for multiplicity of functions in already built areas
- Strategies that allow for reservation of land/BUA for social amenities in new developments

03 Estimate a realistic quantity that can be offset through decentralization

04 Create policy or zoning guidelines to mandate requirements for decentralized facilities by private developers

05 Create incentives for additional green building compliance (LEED or equivalent)

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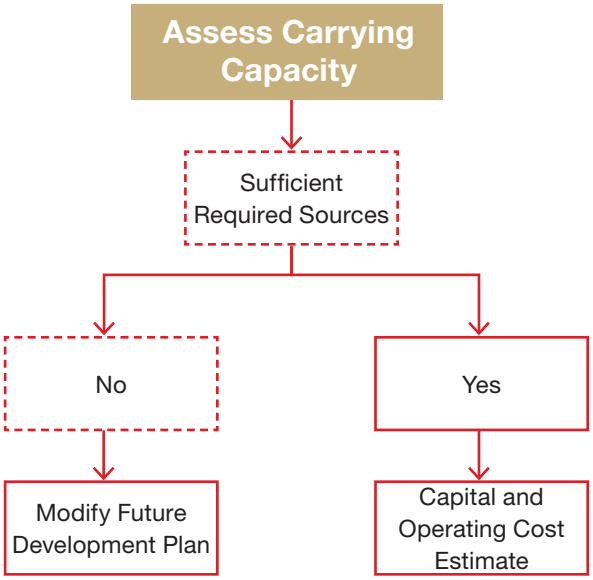
ASSESS CARRYING CAPACITY

Physical and social infrastructure provisions such as water treatment plants, sewage treatment plants, transformer stations, universities, hospitals, fire stations, etc. require a large portion of land. At times, land may be available, but resources may be scarce. Therefore, it is necessary to assess the land and resource capability of the region to support the city's infrastructure needs. Identification of land for infrastructure development is an essential parameter. It is necessary to earmark land for critical infrastructural facilities in a city's statutory plan.



ASSESS CARRYING CAPACITY

LAND

Is there enough land available within the study area, or in close proximity, to meet the infrastructure needs?

RESOURCES

Does the region fare sufficient in natural and human resources?

1. What are the available sources of water supply in the region?

2. Does the region receive sufficient rainfall?

3. Does the region have soil with high percolation capacity?

4. Does the region have a high water table?

5. Is the groundwater contaminated/not fit for use?

5. Is there a provision for wastewater recycling or water supply mix in the region?

4. Does the climate of the region support composting of generated solid waste?

5. Does the region have any other alternate method of disposing waste?

6. Does the region have enough sources for energy production such as crude oil, petroleum, coal, natural gas, nuclear, wind, solar, geothermal, hydro, tidal energy, biomass, waste, etc.?

7. Does the region have natural and biodiversity reserves?

8. Is the region vulnerable to natural disasters?

9. Does the region have sufficient green spaces?

10. Does the region have sufficient professionals, such as doctors, teachers, etc.?

CAPITAL INVESTMENT NEEDS PLAN

Capital investment planning is an evolving area of public management. A local government (LG) takes care of assets only if they are needed to provide municipal services to constituencies or to perform other mandatory obligations of the LG. Since the financial resources available to an LG for capital projects are limited, a process should be established to evaluate the competing needs of various municipal services to maximize the use of the financial resources in the areas of highest priority. Local financial policy needs to be formulated and enacted to define which assets to invest in, capital investment priorities and finance sources. The approach should be multi-year. Capital investment should be considered within the frameworks of life cycle costing and assessment of alternatives (for example, reducing demand for the service/facility, engaging the private sector).

SECTOR	PROJECT	CAPITAL INVESTMENTS					
		YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
WATER							
SEWAGE							
ENERGY							
SOLID WASTE							
HEALTHCARE							
INFORMATION							
EDUCATION							
EMERGENCY RESPONSE SERVICES							
ROADWAYS/ TRANSIT/ SIDEWALKS							

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TOD KP

AS-H04

HOW TO UNDERTAKE ROAD SAFETY ASSESSMENT FOR TOD AREAS

Measures for conducting a road safety assessment while assessing the TOD readiness of a city.

Type: Step-by-Step Guide

WORLD BANK GROUP · TOD · Global Platform for Sustainable Cities · gef · UKaid from the British people · GRSF Global Road Safety Facility · IBI · WRI INDIA

As an extension to earlier AS-A01 section to undertake TOD readiness assessment for a city, a road safety assessment needs to be carried out. Along with advocating for a TOD project to address road safety challenges around a transit station and the city at large, this assessment also helps in identifying gaps at the institutional levels, critical areas in the network that require attention and can thus be prioritized, and provide mitigation strategies and designs to address the same. Below are the steps to be undertaken to carry out a road safety assessment while assessing TOD readiness.

01 ROAD SAFETY CAPACITY REVIEWS

The first measure looks at assessing 'efficiency and effectiveness' of the various existing policies and regulatory frameworks for road safety, and institutional setup for carrying out safety measures that are available at the local, regional, and national levels. These are analyzed based on their capacities to execute planning, design and implementation of road safety measures and how they can be suitable in supporting a future TOD project based on the type of transit services, scale of TOD and urban context.

Along with policy and regulatory assessment, it is essential to identify a lead implementation agency, and assess the existing expertise to determine its ability to efficiently deliver road safety considerations while executing a TOD project.

[Refer to AS-H01 *'How to undertake Rapid Transit Alternative Analysis' for TOD readiness assessment and* IM-H01 *'How to Undertake Capacity Building' and* IM-P01 *'Capacity Development Strategy Terms of Reference'*

02-A DATA COLLECTION

For a road safety assessment, two types of data are required to be collected:

1. **Physical context data**

   Information about the existing context of the city and the station areas is required for the assessment. A road inventory data is a critical information required for a road safety assessment as it provides information of the physical conditions that may have led to a crash. The various kinds of information collected as part of the road inventory have been detailed out in A **PHYSICAL CONTEXT DATA**

   Along with a road inventory, information regarding the larger urban fabric of the city and within the station area such as socio-economic demographics, urban density, land use, transportation network, traffic counts etc will also be collected to support the road safety assessment.

DATA SOURCES

- Local Government
- Census Data
- GIS Data with the city and its various departments such as transport, planning etc.

2. **Road crash data**

   Road crash data includes details specific to the road crash. These details include variables such as the date, time, location and type of crash, characteristics of the persons and vehicles (modes) that are involved in the crash, and the severity of the crash including injuries and fatalities. These have been detailed out in B **ROAD CRASH DATA COLLECTION.**

DATA SOURCES

Primary Source

- Police Records

Secondary Source

- Hospital Records
- Vehicle Insurance Records

02-B DATA ANALYSIS

The next stage of the road safety assessment is to analyze the data collected and identify trends and priority areas for interventions. The three types of analyses and their relevance to TOD readiness have been explained in C **DATA ANALYSIS.**

In absence of reliable and/ or sufficient data for assessment, a 'crash-conflict analysis' may be undertaken as alternative. It involves a count of all "near-miss" incidents that could potentially lead to a crash. This has been highlighted in the D **CRASH CONFLICT ANALYSIS.**

03 ROAD SAFETY ENGINEERING TOOLS

Many proactive tools for road crash risk assessment have been developed which provide a holistic assessment of the road by considering various physical and contextual elements present. These risk identification tools are adopted at different stages of implementation of a road design and may be undertaken for both new roads or modification to an existing road and help in identification solutions to the risks identified and prioritization of suggested interventions. These tools are designed for all kinds of roads, however, the assessment carried out is modified to cater to the context of TOD influence area within a framework to ensure functionality, homogeneity of volume of users, and predictability for all users using the roads and road network within the TOD area.

Following are four different tools that have been further elaborated in E **ROAD SAFETY ENGINEERING TOOLS**:

1. Road Safety Impact Assessments or RSIA
2. Road Safety Audits or RSA
3. Road Safety Inspections or RSI
4. Different road assessment programs

A PHYSICAL CONTEXT DATA

Evidence based advocacy helps in decision making and prioritization of funding and project implementation. Data collection and proper analysis of the same helps in gaining support from the community and various stakeholders and provides the basis for making relevant improvements. Data based analysis helps in advocating for decision making and prioritization for funding and project implementation, and most importantly generating support from the community and various stakeholders involved in the project. For undertaking a road safety assessment, its is essential to prepare a road inventory as basis for crash data analysis. This information may typically be sourced from the transportation department preferably as part of city-wide GIS data. A typical inventory includes:

FUNCTIONAL ATTRIBUTES OF THE ROAD

1. **Type of road:**
   - Arterial
   - Connector
   - Shared street
2. **Presence of NMT facilities:**
   - Sidewalks
   - Bike lanes
   - Multi-use trails
3. **Use of transit along the ROW and type:**
   - Public transport- buses and feeder services
   - BRT
   - Streetcars
   - Light rail
   - Mass transit- Metro, Commuter rail

PHYSICAL CHARACTERISTICS OF THE ROAD

1. **ROW:**
   - Width
2. **Vehicle travel lane:**
   - Number of lanes and Directionality- One-way or Two-way
   - Width
   - Type of separator markings or medians
   - Width of median
   - Type of median- raised, landscaped, barriers
3. **Walking infrastructure:**
   - Availability- none, on one side or both sides
   - Width
4. **Cycling Infrastructure:**
   - Availability- none, on one side or both sides
   - Type- shared lane, cycle lane, Contra-flow lane, Cycle track, Bi-directional track, multi-use trails etc
   - Width
   - At grade or raised
   - Buffer type and width
5. **Transit infrastructure**
   - Grade- Elevated, at-grade, underground
   - Dedicated lanes for transit or Shared lanes
   - Width
   - At grade or raised
   - Buffer type and width

USER AMENITIES ALONG THE ROAD

1. **Intersections**
   - Signalized or unsignalized
   - Crosswalk width
   - Availability of pushbuttons
   - Universal accessibility and Tactile surfaces
2. **Mid-block crossings**
   - Crosswalk width
   - Pushbuttons, HAWK beacons etc
   - Universal accessibility and Tactile surfaces
   - At grade or raised
   - Any other types of crossing: Foot-over-bridge (FOB), underpass
3. **Street amenities**
   - Streetlights,utility boxes
   - Landscape- trees, planters, furniture
   - Information/ signage
   - On-street vending
4. **Parking facilities:**
   - Bike racks, Bike share
   - Vehicular parking- parallel, angled
   - Metered or free parking
5. **Transit amenities:**
   - Bus stops, BRT stops, train stations
   - Ticket facilities

SURROUNDING SOCIAL AND URBAN CONTEXT

Apart from a road inventory, other information about the context, would help in supporting the road crash assessment and also assist in determining the TOD readiness of the place. These include:

1. **Surrounding context:**
   - Greenfield
   - Suburban
   - Urban
2. **Socio-economic demographic data** of the population within the station area –
   - Population density
   - Income levels
   - Vehicle ownership
   - Mode choice etc
3. **Land use pattern** to help understand movement patterns, identify activity generators etc
4. **Traffic count** of the number of vehicles, cyclists, and pedestrians passing through

B ROAD CRASH DATA COLLECTION

To understand road safety management, it is essential to acquire and analyze road crash data as they help in scientifically identifying concerns and equip stakeholders in decision making processes. Therefore, a robust dataset is required to assist in the analysis. Often road crash data that is collected is either insufficient to make assessments or are incomplete and may also have human errors during the collection and recording stages. A typical road crash data set contains different types of variables that must be collected. However, depending on the local context and the efficiency of collection agency, this information maybe basic or detailed.

Following is set of information that is collected as part of road crash data:

DATE & TIME	Recording of date and time variable allows for seasonal and hourly comparisons of the incidents. Frequent occurrences of road crashes during a time of the day can be compared with the local traffic data to establish if any correlation exists between the occurrences and traffic volumes. Seasonal variations also impact the occurrences of road crashes. For example, in cities where it snows, formation of black-ice can increase number of incidents. Some cities also have dense fogs during early hours in winters. This reduces visibility and leads to early morning crashes.
CHARACTERISTICS OF PERSONS INVOLVED	Crash data must include the number of persons involved in the incident and other basic information. Variables that need to be recorded about the persons involved in the crash include: • Road user type (pedestrian, cyclist, vehicle driver, vehicle passenger etc) • Age and gender • Persons with special needs including disabled and pregnant women • Physical condition of the users including level of alcohol in the body • Details about use of any safety equipment such as protective gears, seat belts etc • Type of injury sustained This information helps in identifying the most vulnerable users and making a case for road safety. An area with higher number of seniors as vulnerable users may require interventions like longer crossing times or where minors are the most vulnerable users may require measures like wider or protected buffers. It also helps in understanding the risk factors.
CHARACTERISTICS OF VEHICLE	Data also should be collected about the vehicles involved in the crash including: type, age, country, safety equipment if any, date of last periodical technical check according to applicable legislation.
CRASH SEVERITY	Crashes are also defined by its severity – which is based on the impact on the persons involved: • **Fatal injury:** any person killed immediately or dying within a stipulated number of days (varies based on country) • **Serious injury:** Injury that requires admission to hospital for at least 24 hours, or specialist attention, such as fractures, concussions, severe shock and severe lacerations • **Other/minor injury:** Injury that requires little or no medical attention (e.g. sprains, bruises, superficial cuts and scratches) • **Property damage/non-injury:** No injury is sustained as a result of the crash but there is damage to vehicles and/or property Not all crashes are fatal in nature. However, the severity of the crash can also be determined by the level of injury sustained. High frequency of similar type of minor crashes may require a smaller tactical intervention whereas frequent fatal crashes may require stricter measures. *(Continued.)*

B ROAD CRASH DATA COLLECTION

CRASH TYPE

Information on type of crash including modes involved for example vehicle-vehicle or vehicle-pedestrian or vehicle-bicycle etc during the crash needs to be recorded. Reasons for the crash can be collected through first-hand information from bystanders and from those involved. Additionally, photographs and closed-circuit television (CCTV) footage from nearby buildings and other means may help in placing the events of the crash. Other information that is required includes:

- Maneuver of vehicles during the crash
- Type of impact or collision
- Speed of vehicles

Understanding the events of the crash can help in determining the interventions necessary. For example, frequent crashes due to over speeding of vehicles or due to lack of mid-block crossings, both involve pedestrians however require different types of interventions. Similarly crashes with cyclists could be in due to different scenarios that could be due to narrow bike lanes, shared streets, or even lack of adequate buffers between the lanes. Higher frequency of a scenario would determine the necessary safety measures that have to be undertaken.

CRASH LOCATION (GEO-CODED)

Maintaining records of crash location over a period, will help identify black-spots and critical areas within the city. Higher the number of occurrences in an area would mean higher priority and a greater scope of implementing improvements. Geo-coding crash location eases the data processing and interpretation using GIS software. Also, this helps in linking different variables, that may be collected from various sources, to the single incident and reduce duplication of data.

These records also help determining the surrounding environments in which the crashes have happened. Different urban contexts i.e. intense urban to suburban, require different levels of interventions. The decision-making processes and the choices of interventions vary based on the context. High occurrences of crashes in an intense urban environment such as a Central Business District (CBD) may require re-routing of vehicles and identifying an area as pedestrian only. On the other hand, a similar situation in a suburban area may be mitigated by introducing road diets and speed reduction techniques such as speed tables.

B ROAD CRASH DATA COLLECTION

Road crash data can be sourced from multiple agencies. However, each have their own challenges and limitations. The Road Safety Manual developed by PIARC ascertains that any single crash-injury database does not provide adequate information to give a holistic picture of road traffic injuries. Many countries have therefore started using both crash data collected by the police along with the health sector data.

DATA SOURCES

POLICE RECORDS

As the police are often the first to be informed of a crash, police reported data is the hence the primary source for crash data. A standard template report is created for each incident; the contents of which, will differ from country to country. Most reports will contain, at the very least, date & time of crash, location, vehicles involved and number of injuries & fatalities. In addition, the crash description may contain information about how the crash occurred, as inferred by the reporting officer, and as described by the involved parties and eyewitnesses. Some cities also mandate the inclusion of a crash diagram. Precinct-level data is then rolled-up and aggregated by the central police department, which is usually what is made available publicly. Some information tends to get omitted during this aggregation process, which may be important for analysis.

While this is the major source for many jurisdictions, it however, isn't always the most accurate information – primarily due to human errors in the process of collecting and recording the data. One of the major challenges in acquiring accurate data is often attributed to discrepancies in definitions of the variables or the absence of the same. Also, only major crashes that cause serious injuries or fatalities or involve more vehicles get reported to the police. Minor crashes are often under-reported and thus do not always get included in this primary crash data source.

It is therefore recommended to complement police data with other secondary data sources.

HOSPITAL RECORDS:

This information is normally aggregated by the City Municipal Health Department. Hospital data is particularly useful in cases where there isn't adequate follow-up by the Police to update their own records, when a road crash victim is initially reported as injured, but may have subsequently died after the police report was filed. Also, in some cases, a police report does not get filed, perhaps because the involved parties were unwilling, or unaware, or cajoled into not filing a police report.

VEHICLE INSURANCE RECORDS:

A third source for traffic crash data is vehicle insurance providers. Like with hospital data, this is a useful source to supplement police records, in cases where a police report was not filed. Insurance records tend to provide a more comprehensive description of vehicle damage information, which is useful in understanding the causes of the crash.

The variables collected as part of crash data should not be analyzed individually. As the examples discussed above, the differences in variables can determine the nest steps for addressing the concerns. In case during assessment it is noted that the variables in the crash data aren't robust enough, then steps must be taken by the concerned authorities to further strengthen the data at the source. Some steps in may be undertaken in this regard are:

1. Inclusion of variables in the primary survey and database
2. Having clarity in definition of variables
3. Ensuring proper recording of variables in a digital format
4. Capacity building of police officers and agencies in recording of data

C DATA ANALYSIS

Based on the types of variables collected and its quality of detail, three different types of analyses may be undertaken, as explained:

BASIC TREND ANALYSIS

This analysis helps determine the important trends in traffic crashes in the city. It helps identify the most vulnerable modes, as determined by percentage share among crash victims. This data can also be relatively weighed against data on traffic mode share or vehicle-kilometers traveled, to get a more accurate description of crash risk for each mode group.

DATA REPRESENTATION	RELEVANCE TO TOD ASSESSMENT	INFORMATION REQUIRED
Tables, graphs (pie-charts, bar-diagrams, line graphs)	This analysis helps determine risk vulnerability of transit commuters, either on transit, or while accessing transit and is useful in identifying temporal trends (spikes or drops) in the data during a particular time of the day or year. This is relevant for TOD assessment, if the high-risk time periods correspond to the peak commuting hours.	• Date & time of crash • Characteristics of person(s) involved • Characteristics of vehicles & modes involved • Number of serious injuries and fatalities • Location of crash The data is recorded at the crash-level and corresponds to one unique crash. It is important to procure data normally between 5 and 10 years. Aggregated data is normally adequate for this analysis.

CRASH FACTOR ANALYSIS

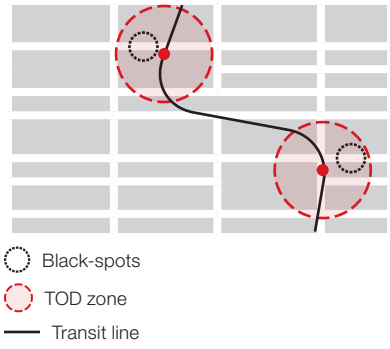
A crash-factor analysis is useful in understanding the underlying causes of traffic crashes. When conducted on a large number of cases, it provides enough data to determine trends and identify dominant crash factors (causes). Traffic crashes are a multi-factor, random event, and most crashes cannot be attributed to a single cause. It is a combination of different factors that contribute to the occurrence and severity of the crash, including human, vehicle and road infrastructure factors.

DATA REPRESENTATION	RELEVANCE TO TOD ASSESSMENT	INFORMATION REQUIRED
Haddon Matrix The Haddon Matrix is a two-dimensional model which is commonly used to approach safety analysis at a site in a systematic fashion. It is completed through the evaluation of site and crash details, and applies basic principles of public health to motor vehicle-related injuries.	Such an analysis is costly and time-consuming, and not essential for the broad assessment of TOD-readiness of the city. Its utility comes into play during the assessment of TOD infrastructure at the planning and design stage.	It is often observed that the cause is often identified as an error on the part of the driver of the vehicle(s) involved. Moreover, only one factor is reported as “causing” the crash, and doesn’t take into consideration the multi-factorial nature of road crashes. For a crash factor analysis, it is important to analyze the detailed crash report recorded at the police precinct level, and not just rely on the aggregated dataset. Data collected includes various non-behavioral factors, such as: • Road design (part of a detailed road inventory) • Characteristics of the vehicle(s) involved including vehicle failure • Crash type

	Human Factors	Vehicle Factors	Road Factors
Pre-crash			
During crash			
Post-crash			

BLACKSPOT IDENTIFICATION

This analysis is useful in identifying black-spots; that is locations with a high crash risk, as determined by a high crash frequency. Crashes are classified into mid-block and intersection locations. Depending on the city density, crash locations within 50 to 150 meters of each other may be clubbed together as one spot. Usually, a frequency of major crashes (with fatality or serious injury) of more than 3 occurrences in 1 year is considered grounds for inclusion as a blackspot. However, this rule may differ from city to city, depending upon overall crash frequency.

DATA REPRESENTATION	RELEVANCE TO TOD ASSESSMENT	INFORMATION REQUIRED
Thematic Map with transit alignment  	This analysis is useful for TOD assessment as it helps to identify high priority locations within the TOD commuting zones. When black-spots are further categorized by mode type, it helps to determine the crash risk for the main access mode to transit.	Black-spots are locations with high crash risk, as determined by high crash occurrences. This analysis requires: • Geo-coded location of each crash recorded as accurately as possible • Date and time of crash • Characteristics of person(s) involved • Crash severity Location information is particularly important in identifying priority areas for intervention and course correction. For instance, this analysis will help determine if there are any black-spots near an existing or planned transit corridor, which will affect the safety of access for transit commuters.

D CRASH CONFLICT ANALYSIS

Sometimes traffic crash data is inadequate in determining crash risk. At the site level, if there are not enough data points, then it is difficult to determine the extent of crash risk, or identify the key safety issues. A road safety inspection, to some extent, addresses this issue, as it relies on a qualified road safety expert to make this assessment. However, this may not always be a reliable strategy, because, sometimes, the occurrence of an issue is random, and may not take place during the time of the inspection.

A crash conflict analysis is one such measure to overcome the limitations of insufficient crash data. It involves a classified count of all incidents that could potentially lead to a crash during a given period of time. These incidents can be called near-misses; that is, situations that almost caused a crash. A near-miss includes incidents where the travel paths of two road users (vehicle-vehicle or vehicle-pedestrian) cross each other in a very brief fraction of time. It can also include the count of incidents where a road user undertook some form of evasive action to avoid a crash, such as abruptly braking or changing lanes at the last second; or suddenly darting across the street, (in the case of pedestrians).

Crash-conflict counts, today, are almost always, carried out with the aid of video cameras. These surveys have been gradually moving to automated systems in recent years, carried out with the aid of video cameras. The data is then fed into a computer program that is capable, through sophisticated algorithms, of automatically classifying vehicles, determining vehicular speeds, identifying intersection of travel paths, and identifying evasive actions by road-users.

The frequency of near-miss occurrences is then converted into a crash-risk frequency using predetermined coefficients of crash risk. These coefficients have been established over many years of scientific study of the correlation between crash-conflict risk situations and actual crash occurrences.

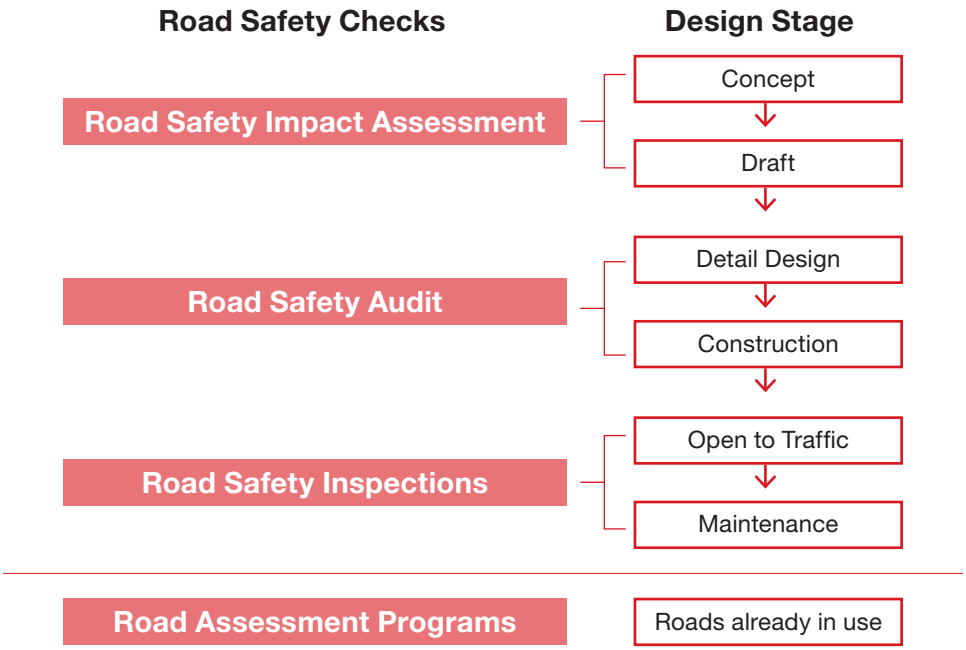
A crash-conflict study is useful in assessing crash risk on major nodes in the TOD zone. Normally, crash risk is the highest at major intersections, which is also, typically, the location where traffic video surveillance data is most easily available. This is, thus, a useful measure in determining site-specific crash-risk mitigation strategies.

E ROAD SAFETY ENGINEERING TOOLS

There are four road safety checking tools -

1. Road Safety Impact Assessments or RSIA
2. Road Safety Audits or RSA
3. Road Safety Inspections or RSI
4. Different road assessment programs such iRAP

The different road assessment programs are typically used to assess roads that are already in use and are an extension to the concept of RSA and RSI. They help estimating the risks for different street sections based on the road and roadside characteristics in the given context. While they may seem to be like each other, however they differ in their application and project cycle. The main distinction is in the timing and scope of the tools, as shown below.



As discussed earlier, these tools are applicable for all types of contexts and road types and help in determining the quality of the existing physical road infrastructure by identifying potential threats that may cause severe or fatal crashes in the future. However, for the purpose of road safety assessment for TOD readiness, their algorithms and considerations for assessments need to be modified for assessing roads and road network in a TOD. The roads and road networks with the TOD areas, need to be analyzed specific to the principles of TOD and the local socio-cultural contexts and need to be within an overarching framework designed specifically for requirements within a TOD, aligned with the Dutch *'Sustainability Safety'* vision design principles. Based on this assessment, any future planning and design interventions may be determined along with implementation strategies.

The modifications of these tools should be made in such a manner that they are able to identify weaknesses in the network based on the principles of safety in a TOD and are able to provide solutions that would help in mitigating them. To begin with, the tools need to ascertain the functions within the street – whether it has a mix of transit in its ROW or a mix of vehicular and NMT modes, if it caters towards accessing a transit station, or connects to various activity generator areas in the network or is a local neighborhood street. This mix of functions would therefore help in determining the future impact to the area and carry out required inspections. It will also help in ascertaining the kinds of users that may be allowed to commute on certain streets which may thus require redistributing the ROW to segregate the modes depending on the volumes of users that may be using it. While it is easier to determine the behavior of users for mono-functional roads; the multi-functionality of roads in TOD require adequate measures to minimize conflicts. The tools modified for a TOD assessment will help identifying these conflict areas and provide design solutions so that users are able to recognize their allocated spaces within the ROW and behave accordingly.

E ROAD SAFETY ENGINEERING TOOLS

ROAD SAFETY IMPACT ASSESSMENTS OR RSIA

It is a strategic comparative analysis of impact between different possible schemes of a new road design or any modifications to an existing network, to ensure the scheme is selected that has the best outcome for road safety for all users in the TOD area. This is carried out at the initial planning stage before detailed planning begins and helps in the decision-making process.

Road safety impact assessment highlights the road safety considerations and provides information for a cost-benefit analysis of different options or proposals that are based on the network planning principles for a TOD area and design safety design guidelines, along with the existing 'business as usual' scenario, which allows to compare the impact of the proposals on the safety performances for all road users. The RSIA typically has five main steps:

1. **Establish the baseline situation (year zero)** which measures existing traffic volumes, crashes per road type, risks, and other local conditions including topography, activity centers, weather conditions etc.
2. **Determine the future situation without any implemented measures ("Do Nothing" scenario)** that anticipates the impact by taking into considerations the current conditions and accounts for a future traffic growth.
3. **Determine the future situation under each scheme** for all road user by considering effect of the scheme per road type and function with respect to accessing station, orientations and movement of users within the larger road network in the TOD area.
4. **Perform Cost-benefit analysis for each alternative** and rank them by their individual effectiveness within the TOD.
5. **Optimize the plans for each scheme** to achieve optimal safety effect and best cost-benefit rating.

ROAD SAFETY AUDITS OR RSA

This is a formal detailed systematic and technical safety check performed to check that the selected scheme is designed and constructed in such a way as to yield the greatest road safety benefits, and to detect any potential hazards throughout all stages from planning to early operation. Usually a list of potential safety deficiencies and recommendations for improvement are included in the audit report.

The RSA process aims to identify and address any road safety issues under all operating conditions for all road users. It however does not check against design standards. As a cost-effective tool for identifying potential safety issues, it is typically undertaken at the earlier stages in order to adjust the design plans versus retrofitting features after implementation of the project. The European Union Directive on road infrastructure safety management states that such audits should be conducted at the draft design, detailed design, pre opening and early operation stages.

The RSA must be carried out by a skilled audit team with members having necessary skills and training to carry out road safety audit and must be independent of the design team and form the contractors. The auditors should also be aware of the local context and concepts of TOD and planning of road network with the station area. Certain countries have developed training for these purposes and maintain a list of qualified auditors. They have also prepared a checklists and guides for conducting audits (that may be adapted depending on the local contexts and specialized audits such as for a TOD area) to ensure key issues are considered during the process. More proactive audits have recently been developed based on the safe systems approach. These adopt a more holistic view of the issues and pay attention to reduction of fatal and serious crashes.

ROAD SAFETY INSPECTIONS OR RSI

These are periodical on-site review of the characteristics and defects, undertaken as part of an inspection of an existing road, or through maintenance procedures to detect potential crash risks. It is an independent, comprehensive and systematic assessment of an existing road by a qualified road safety expert, to identify locations or situations with the potential for crash risk, as well as to determine countermeasures to mitigate this risk. This crash risk within the TOD area is determined by the road safety expert's perception of both the likely frequency of such an occurrence, as well as the likely severity of injury and damage if it happens. As the identification of each issue is accompanied by its corresponding countermeasure catered to conditions and requirements of a

E ROAD SAFETY ENGINEERING TOOLS

TOD, it provides the city authority and the implementing agency with a clearly understandable road map of on-ground interventions. These measures can then be taken to the design team, where the design specifications can be developed based on the network planning principles and design guidelines for safety measures in a TOD. It must however be noted that an RSI is not equivalent to a periodical maintenance check. It however helps in identifying safety issues that are resulting from improper maintenance practices such as deteriorating surfaces, poor traffic signs, unclear line markings, inadequate street lighting etc.

The inspection may be carried out for the entire network or for specific segments that are considered at higher risks. These may then be prioritized using previous crash data. Crash data is however not required to conduct the actual inspection. A road safety inspection is particularly useful in assessing the trunk routes to the transit station, within the TOD zone. These routes warrant the additional attention, as they are expected to carry the bulk of commuters to and from transit.

ROAD ASSESSMENT PROGRAMS

These are typically undertaken on existing roads, these quantify the expected safety outcomes for a network, route or location. These are 'surrogate' measures, programmed to determine crash risk and priority locations.

The global umbrella organization known as iRAP, which stands for International Roads Assessment Programme (www.irap.org), has developed measures for Star Rating of road infrastructure based on crash risk assessment. Star Ratings are based on observation data that is usually captured by a video recorder mounted on top of a vehicle and driven along the road. Various aspects of road infrastructure are captured through this process, such as the presence of median dividers, footpaths, pedestrian crossings, speed humps, lane markings, etc. This data is then fed into a central database, where it is interpreted to determine crash-risk. The lower the safety risk for a particular road, the higher is its star rating. The star rating can be generated for different modes separately, such as for pedestrians, cyclists and motorists.

The iRAP Star Ratings tool is helpful in generating large volume of crash risk data for assessing roads within a TOD zone. Since the tool generates crash-risk by mode, it can be used to assess safety risk for access modes to transit. It can, thus, be used to determine priority areas of intervention for road safety improvement in the TOD zone. Moreover, the iRAP tool allows the user to see how the Star Rating for a road can be improved by adopting different interventions. It allows the user to determine the most appropriate combination of interventions to minimize risk and improve safety assessment.

E ROAD SAFETY ENGINEERING TOOLS

TIANJIN URBAN TRANSPORT IMPROVEMENT PROJECT, TIANJIN CHINA

The Tianjin Urban Transport Improvement Project is a World Bank funded project. The aim of the project is to prioritize and enhance the non-motorized transport systems – walking and cycling with respect the public transportation system to create "safe, clean, and affordable accessibility and mobility solutions" for the city. It consists of four components:

1. NMT Improvement in the Heping and Nankai Districts
2. Access Improvement to the Mass Transit System
3. Public Bicycle Sharing System Demonstration Project
4. Bus Terminals

Baseline assessment studies were carried out for the first two components using ChinaRAP assessment tool to evaluate section of existing roads around transit stations within the two districts. This assessment was carried out for all road users: Vehicle occupants, Pedestrians and Cyclists. The assessment for Motorcyclists wasn't carried out as use of motorcycles is not allowed within the city limits.

The first component of NMT improvements aims at redevelopment of approximately 50 km of streetscape, covering 7.2 sqkm area, following the complete streets approach – re-prioritizing the street layouts to give more focus to the supporting biking and walking environments with respect to the public transport network especially metro lines. This will help reduce road safety hazards and challenges for the NMT network and all vulnerable users. Various types of improvements include:

1. **Street Pavement Updates and Drainage Improvement** which will involve lane redistribution and repaving of the ROW to include travel lanes, cycle and pedestrian infrastructure.
2. **Street Facilities** including lane markings, signage, on streetcar parking, bike parking, traffic signals, bicycle lane guide-rails, sidewalk bollards, pedestrian safety islands, bus stop sheds, and street lights.
3. **Landscapes Improvement** including street trees, installation of street furniture, and other landscape features.

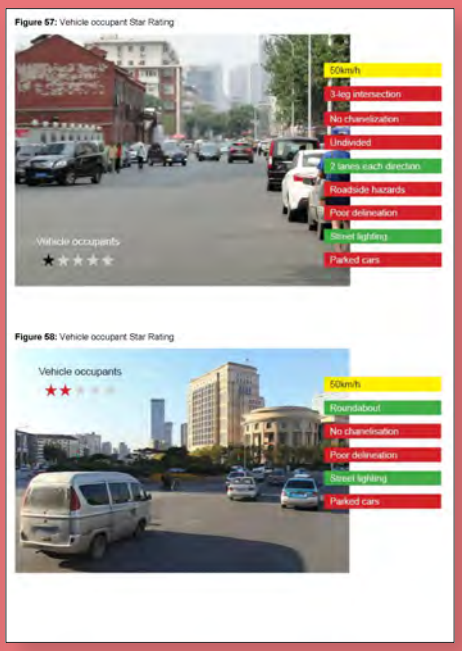
The second component of the project evaluates streets leading to the various transit stations in the Heping and Nankai districts to increase and improve the catchment area to better support the transit system. Based on the existing land use, demand and availability of the spaces around the transit station various measures have been proposed. The transit stations have been typically categorized into four types:

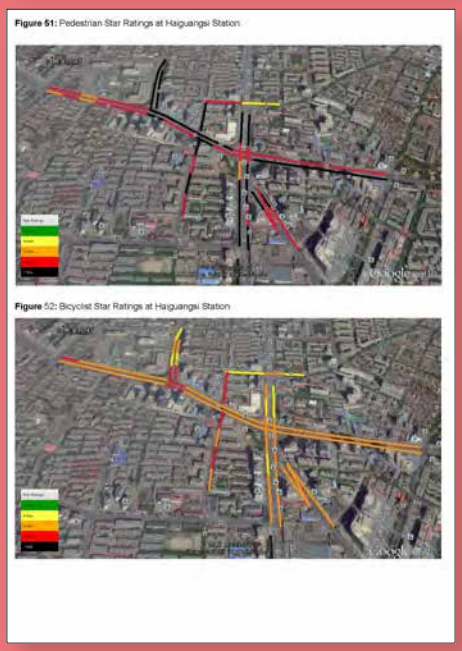
1. **'Transport Connection Stations'** that are located near planned bus terminals and car parking lots. The access improvements aim to improve the connections and transfers among different transport modes.
2. **'Park Vitality Improvement Stations'** which are located close to parks, and the types of improvements aim at enhancing the parks, pedestrian environment connecting to those parks, and connection to other transport modes.
3. **'Green Belt Vitality Improvement Stations'** are stations whose entrances are located near small landscaped or green areas. The intervention is to improve the environment surrounding the stations to enhance the attraction of Metro system.
4. **'Other Stations'** have limited space surrounding them. Improvements aim to promote transfers with bikes and other transport modes.

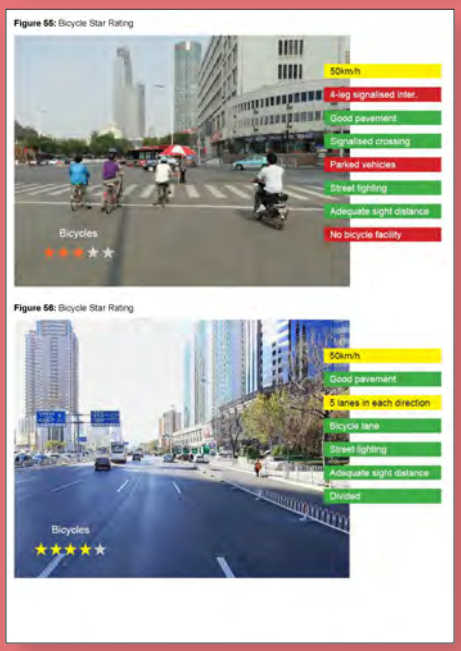
E ROAD SAFETY ENGINEERING TOOLS

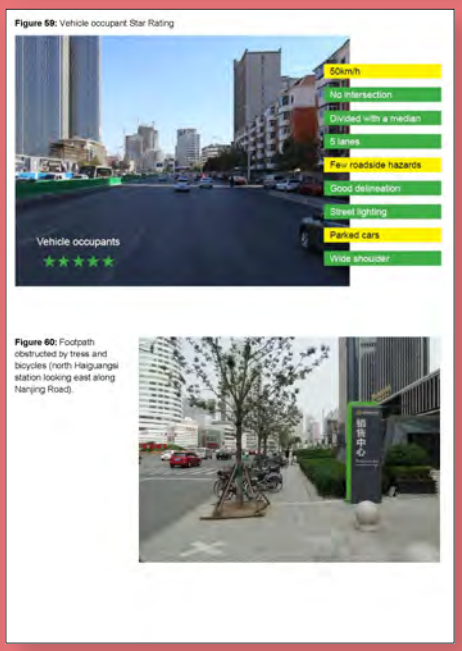
Below is a snapshot of a typical star rating assessment carried out within the project area. Based on these assessment findings, different levels of improvements were suggested using the safe systems approach. These included:

- Reduction in vehicle speed
- Redistribution of space within the row to accommodate infrastructure and facilities for NMT needs including sidewalks, redesign, safer cycling services, local shared streets and public transport facilities including bus stops, vehicle parking
- Pedestrian crossings at intersections and mid-block, intersection design









Pages extracted from *"Baseline ChinaRAP Assessment of Roads in Tianjin (2015)"* showing star-rating of roads for all users around the Haiguangsi Station in Tianjin, China

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TOD KP

AS-R01

REAL ESTATE ANALYSIS BEST PRACTICES

Examples of real estate analysis for a TOD project in World Bank client countries

Type: Reference Document

TOD
Global Platform for Sustainable Cities
WORLD BANK GROUP
IBI

TOD KP

INTRODUCTION

Real estate development presents a real opportunity for transit agencies and operators to monetize real estate assets as a means to increase their revenue streams. It breaks away from the traditional notion of separating transit and land use and different city functions. TOD allows for an effective synergy where transit investments increase the value of land and, on the other hand, denser development in close proximity to transit improves transit ridership. The case studies presented here demonstrate such attempts by transit authorities and redevelopment agencies in seeking this synergy to create new avenues for urban financing. Three cases are presented here:

- Revenue Maximising Study for the Mumbai Suburban Rail - This study is an attempt by the railway authority to identify real-estate assets across the network as a means to increase non-farebox revenue and subsidize transport fares.
- TOD of Dwarka Bus Station - this feasibility study is an attempt by the Visakhapatnam Municipal Corporation to utilize the existing bus station for a mixed-use development as a means to create more space for administrative needs and create a sustainable revenue stream.
- REALIS - A real estate market information tool. This tool provides information for the private sector to learn about the market opportunities and participate in potential transit-oriented developments.

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

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REVENUE MAXIMIZING STUDY IN PARTICULAR FOR NON-FARE BOX REVENUES WITH AFFORDABILITY STUDIES

AUTHOR:	PWC, India
CLIENT:	Mumbai Railway Vikas Corporation Ltd. (MRVC)
LOCATION:	Mumbai
YEAR OF STUDY:	2014

CONTEXT

The suburban railway system of the city is one of the most complex, densely loaded and intensively utilized systems in the world. It is the cheapest and fastest mode of transport in Mumbai. To sustain this service in the long-term, it is proposed that other sources of revenue, particularly in the non-fare box areas, are explored. The non-fare box revenues can be categorized in four broad categories- Advertisement, Station Rental, Indirect benefits and Real Estate Development. This section focuses on the concept plan of four stations to demonstrate enhancing of revenue potential through real estate development.

OBJECTIVE OF THE STUDY

- To identify ways to increase the revenue of the suburban train system, focusing on non-fare box revenue.
- To study and review the socio-economic profile of customers and examine the justification for financial cross-support from other economic agents, as well as the potential for fare adjustment in relation to affordability and service quality.
- To help strengthen knowledge in assessing non-fare box revenue through the study to MRVC and other agencies as appropriate (such as Mumbai Metropolitan Regional Development Authority, Ministry of Railways, Government of Maharashtra, Western & Central Railways).

APPROACH

In real estate, railway owned properties can be broadly classified into: Stations, operational assets (tracks), Operational plots (Workshops, car shed, store depot, parcel depot, open/ vacant plots, etc), residential colonies, offices. The approach developed for potential estimation of different asset classes can be explained as follows:

01 DEVELOP FILTER CRITERIA

Filter criteria were developed to arrive at a list of assets which are commercially more viable. The factors considered for developing the criteria are listed below:

- Regulations
- Market conditions
- Inferences drawn from literature review
- Overall City Development Plan

02 SELECT SITES BASED ON THE FILTER CRITERIA

1. Favorable market conditions.
2. In and around the identified development nodes.
3. Stations with high ridership and strategic importance and possibility of TOD.
4. Existing Usage/trends and interference between operations and commercial development.
5. Age of assets/condition of the buildings in case of residential quarters
6. Site characteristics (Shape, size and accessibility)

03 ASSESS MARKET CONDITIONS AND REGULATIONS

The factors considered are:

- Market factors
- Absorption level
- Rental rates
- DCR regulations
- Permissible FSIs
- RLDA guidelines

04 ESTIMATE SITE POTENTIAL

Impact of densification considered on revenue potential through real estate development.

4 ESTIMATION OF REVENUE POTENTIAL BY REAL ESTATE DEVELOPMENT

The study includes an estimation of potential revenue that can be generated through real estate development of plots owned by the railways. It estimates the revenue that 25 stations, under prevailing conditions, would theoretically generate in the 5th year from the start of construction on an annuity basis. However, the study notes that the revenue potentials could be generated only if all the identified 25 stations were brought to the market simultaneously, which is not practically implementable.

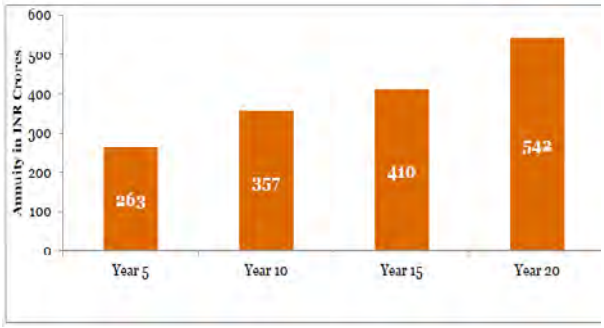

Figure 1: Annuity* at prevailing FSI

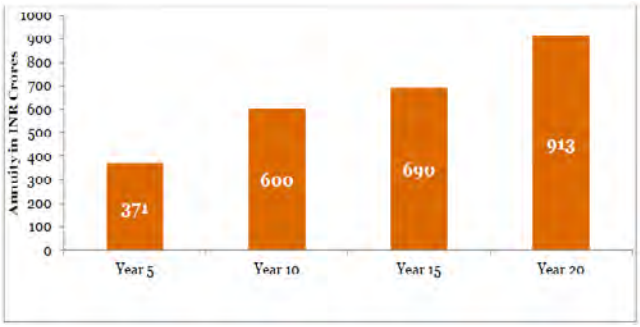

Figure 2: Annuity at enhancing FSI

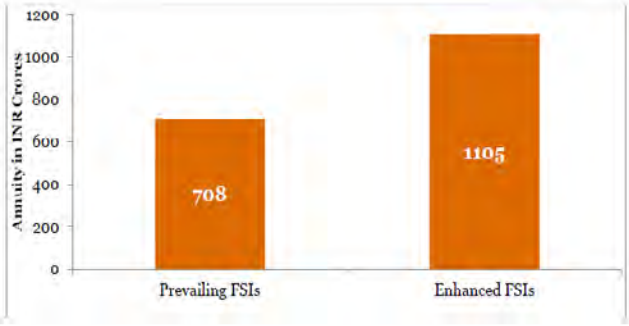

Figure 3: Upfront Revenue;

Reproduced from

The study identifies barriers to monetization of real estate assets, including DCR regulations, existing site conditions and institutional arrangements. In order to maximize value capture through real estate development, the study suggests enhancements to site conditions to ease the implementation process and timely phased release based on market conditions. The study recommends engaging with the municipal authorities for favorable regulations and enhancing institutional arrangements to make them more conducive for property development.

*Annuity- The payment received at regular interval after making a lumpsum investment.

TRANSIT-ORIENTED REDEVELOPMENT OF THE DWARAKA BUS STATION— FEASIBILITY STUDY FINAL REPORT

AUTHOR:	AECOM, India
CLIENT:	Greater Vishakapatnam Municipal Corporation (GVMC)
LOCATION:	Visakhapatnam
YEAR OF STUDY:	2017

OBJECTIVE

The purpose of this project is to study the feasibility of redeveloping Visakhapatnam's Dwaraka Bus Station (RTC Complex), and the adjacent administrative offices of GVMC into an improved bus station, new GVMC administrative offices, and new mixed-use transit-oriented development.

PROCESS FOR ASSESSING THE FEASIBILITY OF THE PROJECT

01 ASSESSMENT OF EXISTING CONDITION

The existing conditions are assessed with regard to:

- Existing situation and land use regulation
- Future Transit Access
- Climatic Analysis

02 DEVELOPMENT OF TECHNICAL OPTIONS

- Different variables were created adhering to TOD principles
- Review of micro-market rates for residential (sale), commercial-office (both sale and rental), commercial-retail (both sale and rental), hospitality and recreation, around the RTC Complex to understand the expected return of the project.

03 ESTIMATION OF PROJECT COST

The anticipated rough order of magnitude construction costs for the redevelopment of the RTC Complex and GVMC site were listed down. The unit costs for construction in India were informed by verified sources.

04 PRELIMINARY FINANCIAL AND ECONOMIC ANALYSIS

The preliminary cash flow analysis is based on average revenue assumptions based on land use, a 3 year construction period, and a debt repayment period of 12 years.

05 BUSINESS MODEL AND PROJECT FINANCING

The project is financed through private capital through a Private-Public-Partnership model.

06 INSTITUTIONAL ARRANGEMENT FOR PROJECT IMPLEMENTATION

07 ANTICIPATED SOCIAL IMPACT

08 ANTICIPATED ENVIRONMENTAL IMPACT

PROJECT COST ESTIMATION AND ECONOMIC ANALYSIS

3 ESTIMATION OF PROJECT COST

The study included a detailed assessment of market condition across various asset classes -residential, office, retail, hospitality and recreational.

ASSET CLASS - RESIDENTIAL

Traditionally, Visakhapatnam's residential activity was concentrated around the CBD areas of the city, comprised of micro-markets such as Siripuram, Beach Road, Lawson's Bay, Waltair Uplands, etc. However, due to an increasing population, escalating land values in established residential hubs, growth of IT/ITeS segment in the Madhurawada, Pendurthi and Gajuwaka regions, the real estate development activity in the residential segment is witnessing a gradual transition from central areas to suburban areas, and subsequently to the peripheral areas of the city. Most of the residential developments are 20 – 50 dwelling units (DU) in size; however, the city has seen several large-scale developments (in excess of 100 DUs) in recent years.

The increase in larger proposed developments is likely to gain momentum in the coming years, due to an influx of larger/ national developers to the region. About 60% of the total residential supply has been introduced in the past 2 years— Madhurwada and Yendada micro-markets have been major contributors.

Micro-Market Overview

The average price for residential apartments in the micro-market around RTC complex ranges from Rs 3,000 – Rs 5,800 per sqft ($USD44- $USD84), as illustrated in the table below:

S. No.	Locality	Average Sale Price (Rs per sqft)
1	CBM Compound Road	5,600
2	Seethammapetha Road, Dwaraka Nagar	5,000
3	Ramatakies Road	5,100
4	Ram Nagar	3,000
5	Jaganadhapuram	3,500
6	Lalitha Nagar	5,800

Source: www.makaan.com & www.magicbricks.com

ASSET CLASS - COMMERCIAL (OFFICE)

Most of the organized activity in the commercial segment in the city is concentrated in the IT/ITeS segment. The city is home to prominent IT/ITeS companies such as Wipro, Tech Mahindra, etc. Two of the more prominent commercial markets in the city are Asilmetta – Waltair Uplands and the IT hub of Madhurawada – Rushikonda. Non-IT building supply mainly driven by BFSI, Telecom, and Technology Segment in Visakhapatnam. Increase in IT/ITeS activity is expected to have a spillover effect on non-IT activity as well. Limited land availability has led to high capital values for land in the region.

Micro-Market Overview

The Micro-market around RTC complex is one of the prominent markets of the city in terms of Grade-A developments for Office spaces. Asilmetta houses about 52% of the city's Grade-A developments while the rest is spread through NAD Road, Waltair Uplands and Ramnagar. Limited land availability in this region has led to higher capital values of land which in turn has resulted in higher sale and rental prices. The current supply of Grade-A Office spaces is very low in the micro-market around the RTC omplex. (Source: Discussion with CBRE Representative) The available inventories of Grade-A Office spaces in the micro-market around the RTC complex have average sale price ranging from Rs 6,500 – Rs 8,200 per sqft as illustrated in the table:

S. No.	Locality	Average Sale Price (Rs per sqft)
1	Dwaraka Nagar	8,200
2	Asilmeta	6,500
3	Daba Garden Road	7,600
4	Siripuram	7,000

Source: www.magicbricks.com

The average rental pricing for the available inventories of Grade-A office spaces in the micro-market around RTC complex ranges between Rs 50-55 per sqft per month as illustrated in the table below:

S. No.	Locality	Average Rental Price (Rs per sqft per month)
1	Dwaraka Nagar	55
2	Asilmeta	50
3	CBM Compound Road	55
4	Siripuram	50

ASSET CLASS - COMMERCIAL (RETAIL)

Retail developments in Visakhapatnam are typically part of larger mixed-use developments. Organized retail activity has seen a marginal increase in the last few years, however, the same is still in its nascent stages in this market. Two retail malls (Visakhapatnam Central and Chitralaya Mall) have recently been added to the Daba Gardens-Jagdamba junction micro-market.

Micro-Market Overview

Dwaraka Nagar and Waltair Uplands micro-market which includes regions such as Asilmetta, Ramnagar, Telugu Talli Flyover Road, VIP Road, etc are predominately characterized by organized retail/big box retail. The stretch near RTC complex (between Asilmetta Junction and Telugu Talli Flyover) is regarded as a prominent commercial and retail hubs, owing to its strategic location at the center of the city. This high street retail hub is characterized by the presence of a mix of local, national and international brands. CMR Central, the biggest retail mall in Visakhapatnam lies within the micro-market. The current supply of retail spaces is almost negligible in the micro-market around the RTC complex. The average rental pricing for the available inventories of retail spaces in the micro-market around RTC complex ranges between Rs 60-65 per sqft per month as illustrated in the table below:

S. No.	Locality	Average Rental Price (Rs per sqft per month)
1	Dwaraka Nagar	65
2	Akkayapalem	60
3	Siripuram	65

Sources: www.quicker.com & www.magicbricks.com

4 PRELIMINARY FINANCIAL AND ECONOMIC ANALYSIS

The preliminary cash flow analysis is determined with average revenue assumptions, based on land-use, a 3 year construction period, and a debt repayment period of 12 years.

		Y1														
Project IRR	5%						Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y7
Project cash flows		(3,033)	(3,450)	(7,256)	407	596	689	719	566	799	840	880	884	705	861
Add : Debt		1,820	2,070	4,353	-	-	-	-	-	-	-	-	-	-	-
Less : Debt Repayment					687	687	687	687	687	687	687	687	687	687	687
Less : interest on debt		127	[illegible]	[illegible]	[illegible]	[illegible]	914	817	721	625	529	434	337	240	144
Cashflow to Equity (Post Tax)		(1,340)	(1,780)	(3,752)	(1,386)	(1,101)	(911)	(786)	(842)	(513)	(376)	(240)	(139)	(223)	30
Equity NPV	(7,512) Rs Million														
Equity IRR	3%														

Accuracy of costs estimates is +/- 50%

REALIS—A REAL ESTATE INFORMATION SYSTEM FOR TRANSPARENT MARKET DATA

SOURCE:	Urban Redevelopment Authority
LOCATION:	Singapore
YEAR OF STUDY:	2006

CONTEXT

To keep track of the rapidly changing real estate market in the country of Singapore, the Urban Development Authority released a database of real estate information to private developers and other interested stakeholders and citizens. The tool, REALIS, provides data on price, availability, market conditions, and stock of residential, commercial and industrial properties in Singapore.

OBJECTIVE OF THE STUDY

- To encourage private investors to participate in the real estate market, with an improved awareness of market conditions and trends.
- To study and review the trends in the real estate market to predict future trends and inform sustainable development.
- To ensure the real estate market is transparent and inclusive, with a simplified tool for receiving up-to-date information on market conditions.

APPROACH

REALIS is a subscription-based web tool for private developers and citizens to engage with live and daily updated real estate market data.

01 DEVELOP AN OPEN SOURCE REAL ESTATE INFORMATION SYSTEM

Create an easily accessible tool that provides citizens and private developers with an intuitive way to track real estate market conditions. The tool should be:

- Open Source, Intuitive and Transparent
- Easy to Access via the Internet
- Regularly Updated

02 ALLOW CITIZENS AND PRIVATE DEVELOPERS TO SUBSCRIBE AND RECEIVE UPDATES ON MARKET TRENDS

03 REGULARLY UPDATE AND SHARE CHANGES IN MARKET CONDITIONS WITH PRIVATE DEVELOPERS AND INVESTORS TO ENCOURAGE THEIR PARTICIPATION IN THE MARKET

TOD KP

AS-P01

REAL ESTATE ANALYSIS TERMS OF REFERENCE

Template for a city to hire a real estate consultant to perform targeted demand analysis along a specific corridor

Type: TOR Template

TOD Global Platform for Sustainable Cities WORLD BANK GROUP IBI

BACKGROUND

The Terms of Reference for a Real Estate Market Study should provide the following background material:

A. **Study Area**: The TOR must define the approximate area for which the Real Estate Analysis (REA) is to be developed. The study area must coincide as far as possible with jurisdictional boundaries for which population and employment data is readily available. The Background should also summarize the factors that have historically influenced real estate demand in the study area.
B. **Existing Plans and Proposals**: The Background section should also provide information on previous or ongoing studies that are expected to influence the REA Study.
C. Bibliography of Reference Plans, Polices and Studies
D. List of Project Stakeholders

OBJECTIVE OF THE ASSIGNMENT

The overall objectives of the TOD REA Study are to better understand the economic environment in which the City/ Urban Areas can plan for TOD, and to develop specific strategies related to the types and intensities of uses that are appropriate for the specified scale and context. Specifically, TOD Strategies provides preliminary actions for the areas with the highest potential, including:

- Design and use themes
- Market niches
- Potential development programs (e.g. activity type, amount, mix).

The Market Study must support the desired outcomes of TOD, including:

- Create transit-supportive densities that provide an optimal ridership base for the City
- Create a variety of mixed use, mixed-income neighbourhoods and greater employment opportunities within easy access of stations
- Provide supporting infrastructure as needed
- Create opportunities for non-fare revenue generation through land value capture and available public financing mechanisms.

SCOPE OF ACTIVITIES

The scope of activities for the Real Estate Market Study primarily consists of the tasks described below. The proposer is encouraged to provide suggested refinements to the work plan and schedule based upon experience with similar economic and market studies, and in compliance with national and state policies, where applicable.

1. **Project Initiation and Identification of Market Area Parameters:** The selected Consultant will schedule a kick-off meeting with the Client's project management team to present the regional context setting and identification of TOD Market Area Delineation parameters. The regional context should be defined for the corresponding geographic or jurisdictional areas. It should include the entire transit catchment area. The Consultant will define market selection parameters using historic observations of how socio-economic and physical factors influence travel patterns

in the region. The Consultant will review all existing documents and plans before the kick-off meeting, synthesize the findings and propose potential refinements to the work plan so as to mitigate any anticipated challenges to the project. The Consultant will also review and refine the initial problem statement, goals, and objectives of the study.

a. Client responsibility: Identify key stakeholders and assist in coordinating schedules for kick-off meeting.
b. Deliverables: Inception Report including Existing Issues and Goals, Objectives and Study Parameters.

2. **Market Area Definition:** The Consultant will delineate the TOD Market Area based on the parameters selected in the kick-off stage. Some of these parameters that may be considered include: natural features, physical infrastructure, travel patterns, population densities, jurisdictions, development types and scales. In many cities, the type and fabric of development and nature of the real estate market varies considerably even in adjoining neighbourhoods. For e.g., some areas may demonstrate higher walkability and/or higher rent sensitivity compared to others. Where micro levels of detail is available, the Consultant should break up the study area into different “zones” or blocks to allow for a finer grained study. Preferably, the break-up of zones or blocks should correspond with population census data collection blocks.
   a. Client responsibility: Provide data at macro and micro scales.
   b. Deliverables: Market Area Definition Report including delineation of TOD market area and break up of zones with primary characteristics.
3. **Market Demand and Supply Analysis:** The Consultant will prepare an inventory of existing real estate development types, businesses and summary of characteristics and performance metrics for housing, retail, office, and other commercial (e.g. type, class, square footage, typical rents, vacancy rates, lease terms, location, business size with respect to number of housing units and employees, and their relationship to economic clusters in the greater area). The Consultant will synthesize the information to develop a current and forecasted demand and supply assessment for various types of real estate development within and directly adjacent to the study area. The Consultant may conduct surveys, interviews or use existing data to prepare the assessment. Some types of data include: socio-economic indicators that influence demand such as income; historical trends of real estate project launches and sale transactions from land registration agencies or real estate agents; types of upcoming development projects and their absorption rates or sales/year through developer interviews.
   a. Client responsibility: Facilitate access to land transaction records and organize discussions with private developers and real estate agents.
   b. Deliverables: Market Area Demand and Supply Assessment Report including description of different types of real estate products, their supply and demand numbers, including historic trends.
4. **Identification of Market Opportunities:** The Consultant will prepare a fiscal analysis of project area zones/blocks, including prevalent conditions of the real estate market and their economic relationship to the possible transit project. It is also important to understand how the economy of the transit nodes or corridors is, or could be, linked to commercial clusters of retail and office in the larger study area. The market opportunities shall also determine the potential for multi-family residential at various densities, retail, mixed use, office, institutional, and other land uses and land use mixes that support transit ridership and/or benefit from transit proximity. It should also identify

opportunities for redevelopment or urban infill that can help fill existing gaps in key industries, types of services, amenities, and/or leasing space that is lacking in area to service demographic profile. This should address the status of neighborhoods or areas serving retail, businesses, and emerging or shrinking employment sectors. The Consultant should also identify and describe opportunities and barriers to developing, leasing, or opening businesses in the TOD market area.

a. Client responsibility: Provide inputs.
b. Deliverables: Market Opportunities Report including potential for different types of real estate products, gaps in existing land use mix, and challenges in real estate development.

5. **Preparation of Financial Feasibility Assessment:** The Consultant will prepare a financial feasibility assessment for many of the opportunities identified in Task 4. The feasibility assessment should map the local investment climate and evaluate access to financial capital before carrying out the feasibility analysis. The Consultant should compare and select the best project funding structure in collaboration with the Client. A typical real estate proforma (as provided in the sample World Bank knowledge products) should be developed to determine the total return on investment.
   c. Client responsibility: Provide inputs.
   d. Deliverables: Real Estate Financial Proformas.
6. **Community, neighborhood and stakeholder outreach:** A comprehensive approach should be developed to engage relevant agencies, corridor neighborhoods and businesses, key stakeholders, and the general public throughout the process. The outreach program will include policy and technical advisory committees, public meetings, presentations at neighborhood and business associations, websites and social media, a variety of communication tools, and direct outreach to non-traditional populations and organizations. Stakeholder workshops and/or public open houses will be held at key points in the study process including, at a minimum: (1) the discussion of problems, goals, objectives, study findings and opportunities; (2) definition of project proposals and financial feasibility assessments; and (3) proposed development mix and catalyst projects. Project information should be translated, as appropriate, to allow for effective outreach. At a minimum, the Consultant will:
   - Prepare a stakeholder engagement plan.
   - Prepare presentation materials for advisory committee meetings, public meetings, and other stakeholder presentations.
   - Prepare and provide logistical support including organizing, scheduling, notifying and participating in all meetings and preparing summary notes for all meetings.
   - Track public comments and response and provide to Client upon project completion.
   - Prepare content for the project website, to be maintained by Client upon project completion.
   - Prepare a draft and final report summarizing the stakeholder engagement process and stakeholder feedback.

   a. Deliverable: Stakeholder engagement plan; stakeholder engagement summary report; newsletters, website content, presentation materials, public meetings, advisory committee meetings, meeting notes, translation services, and other engagement tools identified in stakeholder engagement plan.
7. **Preparation of Desired Development Mix in TOD Area:** The Consultant will create a desirable product mix in the TOD Area, along with a phased plan of implementation based on the financial

feasibility assessment. The phased plan of implementation should include identification of catalyst projects and project structuring for the same. A Capital Investment Plan should also be prepared to support the phased development plan.

a. Client responsibility: Provide inputs.
b. Deliverables: TOD Area Proposed Development Mix.

DELIVERABLES

TASK	DELIVERABLE	TIMELINE
1	Memo #1: Inception Report	M + 2 weeks
2	Memo #2: Market Area Definition Report	M + 1 month
3	Memo #3: Market Area Demand and Supply Assessment Report	M + 3 months
4	Memo #4: Market Opportunities Report	M + 4 months
5	Memo #5: Real Estate Financial Proformas	M + 5 months
6	Memo #6: Stakeholder Engagement Summary Report	M + 6 months
7	Memo #7: TOD Area Proposed Development Mix	M + 7 months

QUALIFICATION OF CONSULTANTS

The Consultant Team must have experience in at least

A. One similar Real Estate Analysis Study for a TOD project

OR

B. At least two studies, which included a real estate market assessment and development proforma for a mixed use development

The Consultant Team must include the following key expertise:

	Key Experts	Years of Experience
1	Project Manager and Real Estate Expert	15 years
2	Real Estate Analyst	5-10 years
3	Urban Planner/ Designer	5-10 years
4	Infrastructure Specialist	5-10 years
5	Affordable Housing Specialist	5-10 years

Disclaimer: *The Transit-Orientated Development Implementation Resources & Tools knowledge product is designed to provide a high-level framework for the implementation of TOD and offer direction to cities in addressing barriers at all stages. As the context in low and middle-income cities varies, the application of the knowledge product must be adapted to local needs and priorities, and customized on a case-by-case basis.*

Sao Paulo, Brazil

TOD KP

AS-P02

TRANSIT ALTERNATIVES ANALYSIS TERMS OF REFERENCE

Template (with estimated consultant time required) for a city to perform a major transit investments alternatives analysis

Type: TOR Template

TOD
Global Platform for Sustainable Cities
WORLD BANK GROUP
IBI

BACKGROUND

The Terms of Reference for a Rapid Transit Alternative Analysis Process (RTAAP) should provide the following background material:

A. **Study Area**: The TOR must define the approximate area for which the RTAAP is to be developed. The study area must coincide as far as possible with jurisdictional boundaries for which population and employment data is readily available. The Background should also summarize the envisioned corridors and populations that Rapid Transit will intend to serve.

B. **Existing Transit Services**: The Background section should provide a summarized description of current transit services, including any information on current ridership and expected ridership for the new service. Existing challenges and opportunities should also be discussed.

C. **Other Studies and Initiatives**: The Background section should also provide information on previous or ongoing studies that are expected to influence the RTAAP. Other transportation initiatives, such as construction of highways or pedestrian and bicycle facilities should be discussed.

D. **Bibliography of Reference Plans, Polices and Studies**

E. **List of Project Stakeholders**

OBJECTIVE OF THE ASSIGNMENT

The goals and objectives of the study must be defined clearly. These objectives may be considered further in the study as the basis of development of evaluation criteria. A sample is as follows:

The purpose of the Rapid Transit Alternative Analysis Process (RTAAP) is to evaluate the comparative benefits, costs and impacts of implementing a transit network among a list of alternative routes and corridors and among a choice of rapid transit technologies. The Study must recommend a locally preferred alternative (LPA) for transit services in the City.

The desired outcomes of the Rapid Transit Service, if implemented, are to:

- Increase ridership through high-quality, frequent and reliable transit service
- Enhance connections with the region's existing transport system and regular route bus service
- Improve mobility by offering more attractive transportation choices in the most viable corridor
- Catalyze transit-oriented development along key corridors.

SCOPE OF ACTIVITIES

The scope of activities for the RTAAP is described in this section. The proposer is encouraged to provide suggested refinements to the work plan and schedule based upon experience with similar transit planning studies, and in compliance with national and state policies, where applicable.

1. **Project Initiation and Development of Evaluation Criteria:** The selected Consultant will schedule a kick-off meeting with the Client's project management team and identify relevant issues for the RTAAP process based upon a review of existing documents and existing conditions. A tour of the possible corridors may also be included in the initial or follow-up meeting. The proposer will synthesize relevant issues and identify how these issues are to be addressed in the RTAAP work plan, including potential refinements to the work plan.

The Consultant will also review and refine the initial problem statement, goals, and objectives and define evaluation criteria based upon the RTAAP Framework. The evaluation criteria may be single-step or multi-step as appropriate and corresponding to the stage of the Rapid Transit Planning Process. The Consultant will present and further refine this information during the kickoff meeting. The problem statement, goals, objectives and evaluation criteria will create the framework for the development and evaluation of alternatives and the content of the Alternatives Analysis.

a. Client responsibility: Identify key stakeholders and assist in coordinating schedules for kick-off meeting.

b. Deliverables: Inception Report including Existing Issues and Goals, Objectives and Evaluation Criteria.

2. **Develop Initial Range of Route and Mode Options:** The Consultant will be required to review and summarize the findings of all relevant policy and plan studies, and existing data to understand travel patterns and identify potential transit route alternatives. In addition, the Consultant will review other transportation and land use resources from the area to estimate potential demand for the proposed transit system. The Consultant will identify transit alternatives, including at a minimum a no build alternative, an enhanced transit service alternative, and two or more rapid transit mode and route alternatives. The enhanced transit service alternative will include the considerations for changes to routing, service frequencies, or integration of ITS upgrades such as transit signal priority or real-time arrival prediction systems that can lead to marginal improvements in transit performance. The new route and mode alternatives should be conceptualized to enough detail to include proposed route alignments, and basic choice of modes.

a. Client responsibility: Provide access to previous plans, policies and studies.

b. Deliverables: Technical memorandum summarizing conceptual network of initial route options.

3. **Community, neighborhood and stakeholder outreach:** The consultant team shall engage relevant agencies, corridor neighborhoods and businesses, key stakeholders, and the general public throughout the process. The outreach program will include policy and technical advisory committees, public meetings, presentations at neighborhood and business associations, websites and social media, a variety of communication tools, and direct outreach to non-traditional populations and organizations. Stakeholder workshops and/or public open houses should be held at key points in the RTAAP process including: (1) discussion of problems, goals, objectives, evaluation criteria and alternatives, and data gathering (2) evaluation of alternatives, (3) presentation of the draft AA, and (4) selection of the locally preferred alternative. Project information should be translated, as appropriate, to allow for effective outreach. At a minimum, the Consultant will:

- Prepare a stakeholder engagement plan.
- Prepare presentation materials for advisory committee meetings, public meetings, and other stakeholder presentations.
- Prepare and provide logistical support including organizing, scheduling, notifying and participating in all meetings and preparing summary notes for all meetings.
- Track public comments and response and provide to Client upon project completion.
- Prepare content for the project website, to be maintained by Client upon project completion.
- Prepare a draft and final report summarizing the stakeholder engagement process and stakeholder feedback.

a. Client responsibility: Facilitation of Public involvement process.

b. Deliverable: Stakeholder engagement plan; stakeholder engagement summary report; newsletters, website content, presentation materials, public meetings, advisory committee meetings, meeting notes, translation services, and other engagement tools identified in stakeholder engagement plan.

4. **Undertake Initial Corridor Screening:** The Consultant will evaluate the initial set of transit route and mode options based on Intensification Capacity, Transportation Capacity and Mobility, Ease of Implementation and Operational Viability, and the potential for Community Building. The development and definition of project alternatives is expected to be an iterative process. The initial set of corridor alternatives developed will most likely include a broad range of options defined in very conceptual terms. Initial activities under this task will focus on narrowing this set of alternatives based on the evaluation criteria. The goal will be to evaluate and refine the alternatives as needed to identify those options that have a high feasibility for implementation.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Technical memorandum defining the evaluation of initial alternatives, including assessment of barriers and opportunities.

5. **Conduct Detailed Corridor Assessment:** It is expected that several cycles of analysis and review will take place during this task as the stakeholders build consensus on the assessment results. At this stage, the Consultant should develop preliminary operating plans and ridership estimations for each alternative. The operating plans will define the frequency and span of service, stop locations (spacing), fare collection system, traffic operations (such as queue jumping and signal priority), and other factors that would impact operating speed, boarding and dwell times, service reliability, and overall service quality. Initial forecasting will be completed using any existing travel demand model for forecasting.

    a. Client responsibility: Provide information on existing transit operating conditions and existing ridership figures for existing transit services.

    b. Deliverable: Technical memorandum describing operation plans and ridership estimations for each alternative.

6. **Undertake Technology/Mode Review:** Concurrent with Task 5, the Consultant will evaluate the transit technologies, including vehicle type, size, and operating environment, that will most likely fit the needs of the corridor. The transit technologies should be evaluated based on capacity, quality of service, impact on the surroundings and cost. The best mode for each alternative should be selected for a more detailed costing and environmental assessment in the future steps. This will be an iterative process with Task 5. As mode preferences are known, they will need to be fed into the operational plans and ridership forecasts under preparation for Task 5.

    a. Client responsibility: Provide input on preferences.

    b. Deliverable: Technical memorandum describing mode and technology review and reasons for selected the final mode.

7. **Prepare capital cost and operating and maintenance cost estimates:** The Consultant will prepare capital cost estimates and operating and maintenance costs based on the operating plans prepared previously for the alternatives. For all alternatives, the Consultant will complete a condition assessment to determine if complete street/track reconstruction is required in any segments. The assessment will also identify any physical constraints or special needs that would have a significant impact on capital cost, as well as any needed right-of-way acquisition. Cost estimates will be prepared utilizing up-to-date unit costs. Unit costs will be adjusted to the targeted year-of-opening based on anticipated annual inflation rates. Costs will include track work, roadway/paving, infrastructure modifications, signals and communications, stations and shelters, equipment, utilities, structures, vehicles, maintenance facility, modifications to existing facilities (for example, intersections), project development/design, project administration, and all other items necessary for design and construction of each alternative.

    a. Client responsibility: Share knowledge of existing vehicle costs and operating costs.

    b. Deliverable: Technical memorandum documenting capital and operating and maintenance cost estimates and methodology.

8. **Assess environmental, historic and community issues:** An initial assessment of potential environmental impacts will be undertaken for the corridor including air quality, noise, vibrations, traffic, energy consumption, cultural and historic resources, native plants and animals, parklands, floodplains, wetlands, lakes, water resources, stormwater management, environmental justice, land use, TOD potential and other significant environmental, social and/or economic impacts. Key impacts that should be studied include: traffic/parking impacts and potential impacts to bicycle and pedestrian mobility.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Documentation of these elements and a concept mitigation plan, including an examination of the impacts that each alternative would have to key socio-cultural and environmental characteristics.

9. **Evaluation of alternatives:** The Consultant will evaluate the alternatives based on the evaluation criteria defined in Task 1, utilizing the technical and cost data developed in the previously described work tasks. The comparison of alternatives will be vetted through the public involvement process described in Task 4.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Memorandum documenting evaluation of alternatives methodology and results.

10. **Prepare final Transit Business Case Report:** The Consultant will prepare draft and final Business Case Report documenting the business case for final selection of the rapid transit alternative. The Business Case will be communicated to the public and stakeholders along the finally selected corridor. The Final Report will incorporate the feedback received from stakeholders, advisory committees and the public.

    a. Deliverable: Final RTAAP Business Case Report

DELIVERABLES

TASK	DELIVERABLE	TIMELINE
1	Memo #1: : Inception Report including Existing Issues and Goals, Objectives and Evaluation Criteria	M + 2 weeks
2	Memo #2: Technical memorandum summarizing conceptual network of initial route options	M + 1 months
3	Memo #3: Stakeholder engagement plan	M + 1 months
4	Memo #4: Shortlist of alternatives, including assessment of barriers and opportunities.	M + 2 months
5	Memo #5: Detailed Corridor Assessment with operation plans and ridership estimations for each alternative	M + 4 months
6	Memo #6: Mode and Technology Review	M + 4 months
7	Memo #7: Capital and Operating and Maintenance cost estimates and methodology	M + 5 months
8	Memo #8: Summary of environmental, historic and community issues with concept mitigation plan	M + 5 months
8	Memo #9: Evaluation of alternatives results and methodology, including stakeholder engagement summary report	M + 5 months
9	Draft RTAAP Business Case Report	M + 6 months
10	Final RTAAP Business Case Report	M + 7 months

QUALIFICATION OF CONSULTANTS

The Consultant Team must have experience in at least:

A. One similar Rapid Transit Alternative Analysis Study

OR

B. At least two studies or project reports which included at least two of the following components: Transit Corridor Concept Plans, Transit Operating Plans, and Transit Ridership Estimates

OR

C. At least two Transit Feasibility Studies

The Consultant Team must include the following key expertise:

	Key Experts	Year of Experience
1	Project Manager and Senior Transportation Planner	15 years
2	Public Transport Specialist	5-10 years
2	Transport Modeller	5-10 years
3	GIS expert	5-10 years
4	Land Use Planner	5-10 years
5	Environmental Planner	5-10 years
6	Transportation Engineer	5-10 years
7	Social Safeguards Expert	5-10 years

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Muscat, Oman

TOD KP

AS-P03

INFRASTRUCTURE ASSESSMENT TERMS OF REFERENCE

Template terms of reference (with estimated consultant time required) to conduct infrastructure analysis

Type: TOR Template

TOD

Global Platform for Sustainable Cities

WORLD BANK GROUP

IBI

BACKGROUND

The Terms of Reference for a Physical and Social Infrastructure Assessment should provide the following background material:

A. **Study Area**: The TOR must define the approximate area for which the Assessment is to be developed. The study area must coincide as far as possible with jurisdictional boundaries for which population and employment data is readily available. The Background should also summarize the transportation and transit services and other details of the TOD Plan.

B. **Existing Development**: The Background section should provide a summarized description of existing development and ongoing activities, including any information on critical infrastructure shortages.

C. **Benchmarks and Guidelines**: The Background section should also provide information on resources that a consultant is expected to refer to while preparing the assessment, specifically including Global or National Benchmarks or Guidelines.

D. **Bibliography of Reference Plans, Polices and Studies**

E. **List of Project Stakeholders**

OBJECTIVE OF THE ASSIGNMENT

The objective of this assignment is to undertake a capacity and needs assessment for various Infrastructure services including but not limited to physical infrastructure such as water supply, electricity provision, solid waste management, sewerage treatment, sidewalks, bike lanes, landscape infrastructure and information systems; and social infrastructure such as education facilities, healthcare facilities, recreational and community facilities. The intended outcome of the assignment is a Feasibility Report that recommends a clear plan for construction, management, rehabilitation, or augmentation of infrastructure services as per the Client's requirements in a clear and predictable manner with a view to ensuring:

(i) efficient, economical, and integrated systems or schemes;

(ii) reliability and security of services to all of the population equitably;

(iii) efficient operation and maintenance of the systems/schemes;

(iv) minimal adverse impact on the local population and environment;

(v) minimal additional acquisition of land;

(vi) improving the financial viability of the TOD Project consistent with the need to minimize disruptions to services provided to existing populations and to eliminate constraints in a cost effective manner; and

(vii) phased development of the Project on techno-economic considerations, till the final year of TOD implementation

SCOPE OF ACTIVITIES

The scope of activities for the infrastructure assessment is described in this section. The proposer is encouraged to provide suggested refinements to the work plan and schedule based upon experience with similar studies, and in compliance with national and state policies, where applicable.

1. **Project Initiation and Development of Methodology:** The selected Consultant will schedule a kick-off meeting with the Client's project management team and identify relevant issues for the capacity and needs assessment process based upon a review of existing documents and existing conditions. A tour of the project area may also be included in the initial or follow-up meeting. The proposer will synthesize relevant issues and critical needs and identify how these issues are to be addressed in the work plan, including potential refinements to the work plan. The Consultant will also review and refine the initial problem statement, goals, and objectives and define key infrastructure services for which the study will be carried out. The Consultant will prepare a basic assessment of study needs for each of the infrastructure service defined, and propose factors to be used for each of the study methodologies, including population forecasts or similar. The methodologies should consider factors in a manner that they capture the demographics in different distribution and collection zones, as the case may be, of the Project Area. The problem statement, goals, objectives, study needs and methods should be submitted as part of the Inception Report.

    a. Client responsibility: Identify key stakeholders and assist in coordinating schedules for kick-off meeting.

    b. Deliverables: Inception Report including problem statement, goals, objectives, study needs and methods.

2. **Develop population forecast and assessment of demand:** The horizon years for the population forecast should be set at approximately 10 and 20 years from the year of study, aligned as far as possible to parallel Master Plans or Development Plans. The Consultant shall determine the extent of the area for which new infrastructure or augmentation needs to be planned. For the present and prospective area to be served by the infrastructure systems, the Consultant shall also review the past records of population growth to forecast the population by using the methodologies and factors determined under Task 1. These population forecasts shall be compared with any other study(s) conducted by any other agency with a view to recommending the population forecast for adoption in the two planning horizons. The Consultant shall also assign suitable population densities for different zones/ sections/ areas as per the TOD Plan for assessing the infrastructure demand. The Consultant shall calculate the demand using national standards for per capita or per household needs. If such data does not exist, the Consultant may use global standards from countries of comparative economies and validate it through a small sample survey of actual consumption or production and demand for different purposes. Based on the forecasts of aggregate demand for physical infrastructure such as water, electricity and waste management, and social infrastructure such as education and healthcare, and the topographical and existing developmental features of the Project Area, the Consultant shall recommend suitable sub-divisions to formulate distribution/collection zones for each infrastructure need.

    a. Client responsibility: Provide access to population data, previous plans, policies and studies.

    b. Deliverables: Technical memorandum summarizing existing and projected infrastructure demands.

3. **Assessment on the sufficiency of existing physical infrastructure capacities (not required for greenfield context):** The Consultant shall review the existing reports prepared by the relevant public infrastructure departments with the intent to evaluate the existing infrastructure capacities. The Consultant will be expected to meet stakeholders from relevant agencies to identify if the current infrastructural capacities are sufficient for the projected needs, and if not, how much of the excess need can be fulfilled through pre-existing augmentation plans.

    a. Client responsibility: Sharing existing reports and facilitation of stakeholder meetings.

    b. Deliverable: Technical memorandum summarizing sufficiency of capacity of existing and planned systems.

4. **Identify Land and Resource Capability of the Project Area:** The Consultant will evaluate area-specific land and resource constraints that are a barrier in meeting the projected demand, primarily related to availability of land and resources. Examples of critical constraints include:

    a. Water Supply: Water shortage, if any, due to insufficient rainfall or depleting ground water reserves.

    b. Electricity: Shortage of renewable sources to harness for power, or shortage of land to establish distribution centers.

    c. Sewerage or Solid Waste Management: Shortage of land to establish treatment centers or landfills.

    d. Landscape Infrastructure: Shortage of land or soil fertility to develop landscape infrastructure

    e. Information Infrastructure: Lack of means to distribute information and real-time data efficiently.

    f. Social infrastructure such as schools or hospitals or police centers: Shortage of public land to build necessary developments.

    In areas of constraint, the Consultant will evaluate potential strategies to increase resource availability where possible. For example, the Consultant may identify land amalgamation or acquisition needs to fulfill land demands, or identify water recharge strategies to augment ground water reserves. If the constraints are too large and cannot be overcome through any means, the Consultant may be required to suggest changes to suggested population forecasts or planned densities.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Technical memorandum summarizing the current land and resource constraints and potential strategies to overcome them.

5. **Identify Strategies and Mechanisms to Reduce Consumption:** The Consultant will also define strategies for reducing consumption where possible. In cases where larger developments of high density are proposed, it is possible to leverage the potential of resource sharing and thereby reducing overall demand. For example, larger developments may be able to accommodate grey water recycling plants to meet all non-domestic needs, or they may be able to install smart meters to monitor and reduce electricity consumption. The Consultant will recommend statutory and regulatory mechanisms or financial incentives that can be implemented to reduce consumption.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Technical memorandum describing statutory, regulatory, or financial incentives to reduce consumption.

6. **Prepare indicative designs and layout plans for development or rehabilitation of physical infrastructure:** The Consultant will prepare conceptual layouts for any new infrastructure proposed, including central facilities and distribution systems. The Consultant should also prepare conceptual designs for the rehabilitation of facilities of augmentation of networks where applicable. In addition, the Consultant will also be required to prepare design guidelines for decentralized physical infrastructure systems, where appropriate (e.g. recycled water system, waste segregation and composting center, minor solar installations). National standards or global best practices must be followed in design preparation.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Technical memorandum describing indicative designs and layout plans and guidelines.

7. **Conduct Social and Environmental Impact Assessment (including impacts of land acquisitions, etc):** The Consultant will prepare a social and environmental impact assessment to document the possible impact of building or enhancing infrastructure systems on the local population and environment in the short, mid and long term. In particular, social impact of any displacement due to land acquisition, and environmental impact of building large facilities or landfills shall be studied. The Consultant should work alongside the Client to propose strategies to mitigate impacts as far as possible.

    a. Client responsibility: Input and guidance.

    b. Deliverable: Social and Environmental Impact Assessment Reports, including summaries of Tasks 2 to 6.

8. **Prepare capital cost and operating and maintenance cost estimates:** The Consultant will prepare capital cost estimates and operating and maintenance costs based on the layout plans and designs proposed in Task 6. Cost estimates will be prepared utilizing up-to-date unit costs. Unit costs will be adjusted to the targeted year-of-opening based on anticipated annual inflation rates. Costs will include land acquisition costs, land clearing costs, facility construction costs, laying of pipelines or conduits along roadways, vehicles, maintenance facility construction, modifications to existing facilities, project development/design, and project administration. Costs of financial incentives will also be included in the estimates.

    a. Client responsibility: Share knowledge of existing infrastructure and utility construction costs.

    b. Deliverable: Technical memorandum documenting capital and operating and maintenance cost estimates and methodology.

9. **Prepare Final Infrastructure Assessment and Feasibility Report:** The Consultant will summarize the entire assessment and cost estimation process in the Final Infrastructure Assessment and Feasibility Report.

    a. Deliverable: Final Infrastructure Assessment and Feasibility Report

DELIVERABLES

TASK	DELIVERABLE	TIMELINE
1	**Inception Report** including problem statement, goals, objectives, study needs and methods	M + 2 weeks
2	Memo #1: Existing and projected infrastructure demands	M + 1 months
3	Memo #2: Sufficiency of capacity of existing and planned systems	M + 1 months
4	Memo #3: Current land and resource constraints and potential strategies to overcome them.	M + 2 months
5	Memo #4: Recommended statutory, regulatory, or financial incentives to reduce consumption	M + 4 months
6	Memo #5: Indicative designs and layout plans and guidelines	M + 4 months
7	Social and Environmental Impact Assessment Report	M + 5 months
8	Memo #6: Summary of capital and operating and maintenance cost estimates and methodology	M + 6 months
9	Draft Infrastructure Assessment and Feasibility Report	M + 7 months
10	Final Infrastructure Assessment and Feasibility Report	M + 8 months

QUALIFICATION OF CONSULTANTS

The Consultant Team must have experience in at least:

A. One similar Infrastructure Assessment Study

OR

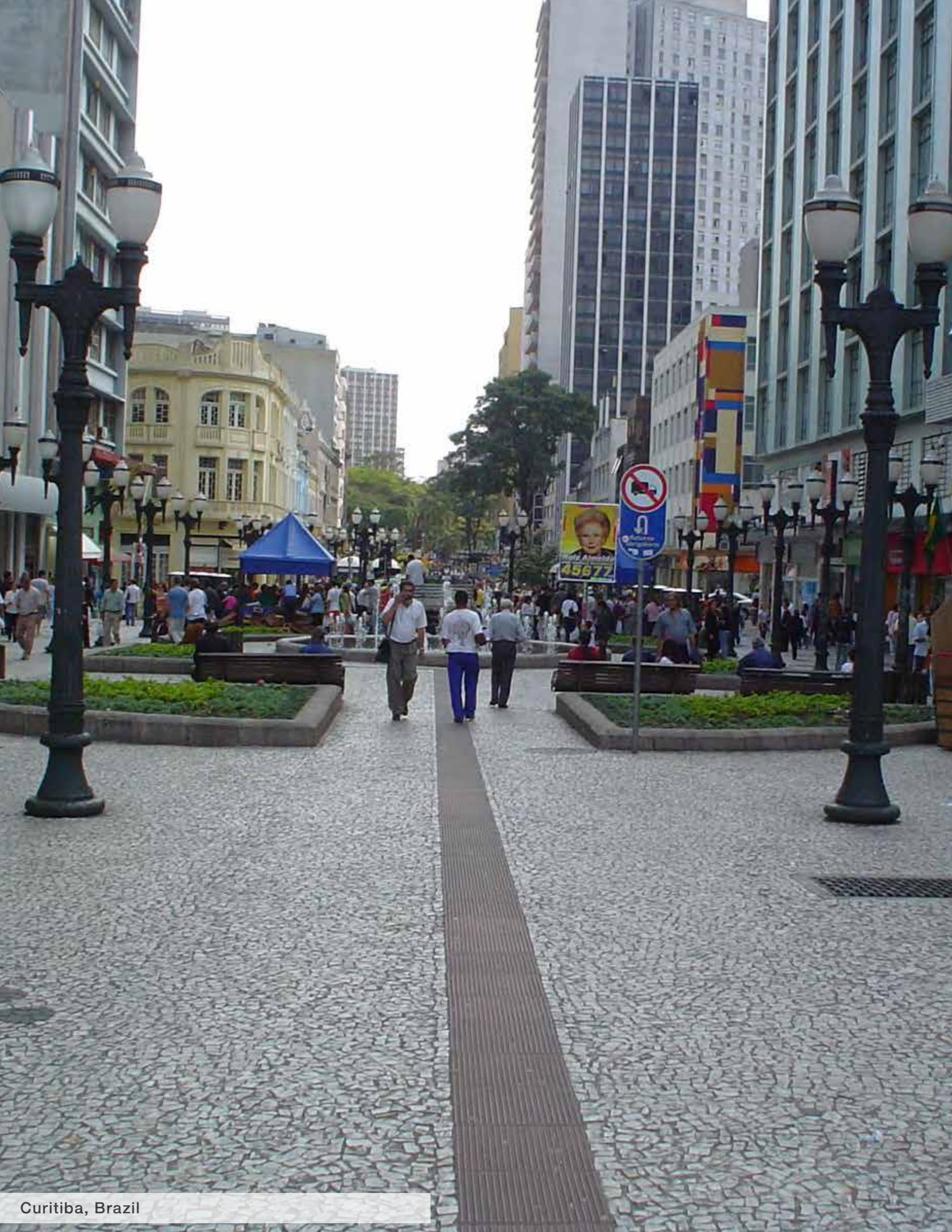
B. At least two studies or project reports which included at least two of the following components: Infrastructure Demand Assessment, Resource Capability Assessment, Social and Environmental Impact Assessment of Infrastructure Plans

OR

C. At least two Infrastructure Feasibility Studies

The Consultant Team must include the following key expertise:

	Key Experts	Year of Experience
1	Project Manager and Senior Infrastructure Planner	15 years
2	Physical Infrastructure Specialist	5-10 years
2	Urban Planner	5-10 years
3	Municipal Infrastructure Engineer	5-10 years
4	Environmental Planner	5-10 years
5	Social Safeguard Specialist	5-10 years
6	Municipal Finance Specialist	5-10 years



Curitiba, Brazil