An-Najah National University

Faculty of Graduate Studies

SUSTAINABLE URBAN MOBILITY - TRANSIT ORIENTED DEVELOPMENT (TOD) PERSPECTIVE: A PILOT PLANNING APPROACH FOR PALESTINIAN CITIES

By

Shifaa Wael Mohammad Mashaqi

Supervisor

Prof. Sameer Abu-Eisheh

This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Roads & Transports Engineering, Faculty of Graduate Studies, An-Najah National University, Nablus - Palestine.

2024

SUSTAINABLE URBAN MOBILITY - TRANSIT ORIENTED DEVELOPMENT (TOD) PERSPECTIVE:

A PILOT PLANNING APPROACH FOR PALESTINIAN CITIES

By

Shifaa Wael Mohammad Mashaqi

This Thesis was Defended Successfully on 03/03/2024 and approved by

Prof. Sameer Abu-Eisheh	
Supervisor	Signature
Dr. Salem Thawaba	
External Examiner	Signature
Dr. Ali Abdelhamid	
Internal Examiner	Signature

Dedication

To the hearts that beat with prayer, to the always proud souls, to the people of great credit, my mother and father.

To my dearest childhood companions, my beloved ones. My brother and sister

To the gift of a lifetime that I did not expect, to the coincidence that made us “we”, to my inspiration and great certainty, Osaid.

To the pure souls, companions of all paths, Raya & Raghad

To all those who gave us dignity and a homeland from under the rubble, our righteous martyrs

To those seeking the paths of knowledge, to every ambitious person.... I dedicate this work

Acknowledgements

I extend my sincere thanks and great gratitude to everyone who contributed to completion of this thesis, with special thanks to the individual with the power of mind and exceptional expertise, Professor Sameer Abu-Eisheh, who was supervising this work on at all its stages until completion of my thesis.

I also extend my sincere thanks to my colleagues throughout my studies, especially my helpmate husband Osaid for his motivation.

It is my pleasure to thank Ramallah and Rawabi Municipalities, for their cooperation in providing me with the information necessary to conduct this research.

Finally, I would like to thank the people who were interviewed, who are representatives of the relevant institutions and who cooperated with me in giving me information related to the topic of the thesis.

I reiterate my thanks to my parents and family who have been always a source of inspiration.

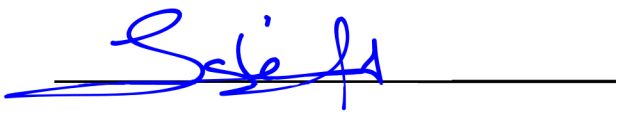
Declaration

I, the undersigned, declare that I submitted the thesis entitled:

SUSTAINABLE URBAN MOBILITY - TRANSIT ORIENTED DEVELOPMENT (TOD) PERSPECTIVE: A PILOT PLANNING APPROACH FOR PALESTINIAN CITIES

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: Shifaa Walid Mohammad Mashaqi

Signature: 

Date: 03.03.2024

List of Contents

List of Tables

List of Figures

List of Appendices

SUSTAINABLE URBAN MOBILITY - TRANSIT ORIENTED DEVELOPMENT (TOD) PERSPECTIVE: A PILOT PLANNING APPROACH FOR PALESTINIAN CITIES

By
Shifaa Wael Mohammad Mashaqi
Supervisor
Prof. Sameer Abu-Eisheh

Abstract

Background: Transit-Oriented Development (TOD) has emerged as a new approach in urban development in recent decades. TOD is characterized by a relatively high-density urban design with proper transit services featuring diverse land uses, complemented by a pedestrian and cyclist-friendly urban environment. Gaining knowledge and learning about good practices related to integrated urban development through urban mobility can be beneficial to reflect on concepts, plans, and policies in order to build livable and resilient Palestinian cities.

Aims: The primary objective of the study was to assess the extent to which sustainable mobility is acknowledged in local urban plans within Palestinian case studies. The study aimed to identify sustainable mobility and integrated development strategies applicable at the local level as related to TOD. Consequently, the study provides recommended TOD policies and strategies.

Methodology: A sequential research methodology was followed to study TOD as a sustainable mobility approach in Palestine. The process began with conducting literature review and examining regional and international experiences in the field. This culminated in extracting TOD principles and measurement indicators. The second phase involved the selection of the study area by choosing two exemplary cases that reflect the urban development reality in Palestine. Subsequently, data necessary for analyzing the current situation were collected from reliable sources and processed to conduct analysis for each study area. Upon accomplishing this phase, results were presented, including development of a general strategic framework to establish TOD as a planning approach in existing and emerging Palestinian cities. This was followed by conclusions and recommendations, serving as guidelines for authorities and relevant entities.

Main results: The results show Rawabi City satisfies a majority of the objectives of best practice in transit-oriented urban development where it has achieved a score of 59%, categorizing it as bronze-standard according to the TOD standards. Therefore, there is a potential to enhance the TOD system at the local level by making some amendments to the city's policies and strategies, which in turn are reflected in its urban master plan. On the other hand, Al-Raihan Suburb cannot be considered to be satisfying the acceptable TOD standard scale, as it has achieved a score of 41%. Therefore, there is a gap between its planning concept and TOD principles, requiring re-consideration of planning aspects, according to the recommended guidelines, in order to align with TOD principles. The thesis results therefore include presenting a proposed strategic planning framework for planning new urban developments, or the transformation of existing ones, to be consistent with TOD principles including the vision, goals and objectives, and the strategies.

Conclusions of the study: TOD incorporates diverse components to foster the creation of sustainable, dynamic, and efficient urban structure centered around public transportation and the reduction of reliance on motorized cars. However, the essential elements of TOD encompass close proximity to transit stations, mixed-use development, high density and compact design, pedestrian-friendly infrastructure, and affordable housing. Furthermore, TOD is in harmony with smart growth principles, emphasizing sustainable development, minimizing environmental impact, and encouraging efficient land utilization. The recommendations include encouraging the development of compact, mixed-use urban form, with emphasis on the planning and operation of public transportation systems with proper transit stations, and prioritizing such systems during the planning of urban communities to fulfill the fundamental principles of TOD.

Keywords: Sustainable Mobility; Transit Oriented Development (TOD); Urban Transport; Integrated Urban Development; Strategic Planning, Palestine.

Chapter One
Introduction

1.1 Background

In the urban space, people are looking for the diversity of activities that give them more opportunities, and consequently achieve personal and professional growth. Cities are multi-functional places that provide housing, work, study, leisure, health, and other activities. As a result, the availability of diverse opportunities shapes the dynamics of cities, which are affected by the social and physical elements of the cities.

Through urbanization and urban sprawl, the industrial revolution created a paradigm shift, where rapid and widespread urbanization put pressure on cities to expand their urban infrastructure for longer distances. This consolidated individual motorized vehicle dependency, which led to several negative consequences, such as high economic, social, and environmental costs of traffic, exceeding road infrastructure capacity, and increasing the severity of accidents. The situation is more critical due to the growing urban population and the emerging climate change phenomena. Therefore, more sustainable means of transportation are required in order to adapt and mitigate the environmental impacts caused by the previous centuries [1].

Transit-Oriented Development (TOD) has emerged as a new approach in urban development in the early 1990s, through the concepts introduced by Peter Calthorpe [2]. It involves the planning and construction of mixed-use urban spaces with moderate to high population density, strategically located along a regional public transportation system.

This approach has become an area of interest for researchers and stakeholders around the world. A number of researchers have defined this notion in a somewhat different way depending on his or her perspective, but the most common understanding is that TOD focuses on the development of all daily activities (residential, commercial, and entertainment) around existing and newly developed transit nodes. TOD is defined as a comparatively high-density urban development that has a variety of land uses and is supported by a walkable and bike-friendly urban fabric. This approach offers a variety of transportation modes (multi-modal transportation system) as an alternative to the use of

private automobiles. From this perspective, TOD is a sustainable development model focusing on the effective integration of land use and public transportation. TOD implementation results in a robust urban fabric that can resist the fast changes that are typical of living in the twenty-first century [3].

This research is, therefore, an attempt to gain knowledge and good practices related to integrated urban development through urban mobility, and therefore, to reflect on concepts, plans, and policies to build livable and resilient Palestinian cities.

1.2 Problem Definition

Palestinian cities are facing a pressing challenge in integrating sustainable mobility principles, particularly TOD, into their urban planning frameworks. This deficiency hampers the development of efficient transportation systems and cohesive urban strategies, resulting in increased reliance on private vehicles, traffic congestion, and fragmented urban sprawl. Despite the recognized benefits of TOD, such as reduced carbon emissions and improved urban connectivity, its effective implementation within local planning contexts is hindered by regulatory constraints and resource limitations.

The research therefore focuses on evaluating the current recognition and integration of sustainable mobility principles, with a specific emphasis on TOD, within local urban plans in the Palestinian urban areas. By analyzing two case studies, Rawabi City and Al-Raihan Suburb, the research identifies the challenges and opportunities for implementing TOD strategies at the local level. It seeks to propose tailored recommendations to enhance the adoption of TOD principles in urban planning processes, thereby creating more sustainable, inclusive, and vibrant urban environments in Palestine.

The significance of addressing this gap in sustainable mobility integration cannot be overstated, as it is essential for leading towards more sustainable and equitable Palestinian cities. By promoting TOD principles and holistic urban planning approaches, the research endeavors to foster resilient, connected, and livable urban environments that prioritize the needs of residents and contribute to long-term socio-economic development. This research is poised to offer valuable insights and recommendations for policymakers, municipal authorities, and community stakeholders to support sustainable urban development in Palestine.

1.3 Significance of Study

Many planning documents, such as master plans, sectoral plans, and strategic plans, have been developed in recent years for Palestinian urban areas. Furthermore, for these plans to be effective, they must have a strategic outlook and be capable of facilitating the implementation of the proposed policies with a holistic approach. This will assist in developing public policies in an integrated manner, where all sectors must be considered to promote integrated urban development rather than segregated sectoral public policies.

There are substantial issues associated with the interrelation of many sectors and their positive and negative consequences, particularly in relation to urban mobility. As a result, there is a large gap between what cities around the world aspire to achieve (i.e., sustainable goals) and how planning documents are designed and implemented locally. As a result, this gap is a significant issue, as most urban mobility strategies persist in concentrating on transportation rather than taking a more integrative approach with other disciplines. Under these conditions, instead of transforming and developing the city, they address additional difficulties, threatening the city's sustainability.

The following question is addressed based on the above stated reasons: To what extent is sustainable mobility recognized by the local urban and transportation plans for new or existing cities in Palestine? and how do the local planning approaches can be modified to achieve sustainable urban mobility?

The issue of sustainable urban mobility has not been addressed before, neither through the general policies and strategies implemented locally, nor through comprehensive studies and research on urban planning and transportation in Palestine. Therefore, this research will be the first comprehensive study that clarifies the meaning and mechanisms of implementing sustainable mobility through the exploration of TOD elements. In addition, it identifies and applies general strategies and policies that are compatible with the existing local situation in Palestine, taking two Palestinian urban areas as a case study.

1.4 Objectives of Study

The objectives of this research include the following:

1. To deeply understand sustainable urban mobility, integrated urban development, and TOD through reviewing and analyzing previous related literature, and identifying documented successes, as well as failures, if any, in this field.
2. To investigate and assess to what extent TOD is recognized in the local urban plans in Palestine considering selected case studies, and utilizing a comprehensive procedural framework integrating TOD principles.
3. To suggest how to improve the satisfaction and adoption of TOD principles in the selected case studies.
4. To provide recommended policies and strategies for sustainable urban mobility in general, but more focused on TOD at specific, as well as provide measurable indicators and parameters to evaluate the impacts of implementing these strategies.

1.5 Study Area

The study area is selected from the newly developed urban areas, taking into account the capability for conducting re-planning for the selected cases. Therefore, the case studies were Rawabi City and Al-Raihan Suburb.

Rawabi City is located in the center of the West Bank, it is approximately 18 kilometers to the north from Ramallah and Al-Bireh cities. Rawabi is considered the first exemplary Palestinian city that was established by the private sector with a total investment volume of 1.2 billion US dollars. Rawabi City constructed from scratch according to a structural plan prepared by international experts, combining model design and sustainable development strategies. This makes the city a new model in the field of urban development in Palestine.

The city was planned in multiple stages, and its expected population is projected to exceed 40,000 people upon completion of all phases. Currently, the first phase has been completed, including 6,000 housing units distributed across 22 residential neighborhoods, with a capacity of approximately 25,000 inhabitants [4, 5].

Rawabi City, since it’s a newly constructed city that is not completely implemented. Therefore, this makes the re-planning and re-design relatively easier to transform the city

into a sustainable city through the exploitation of transit-oriented-development elements.

Regarding the second case study, Al-Raihan Suburb was selected, and it is also located in the center of West Bank within the boundaries of the city of Ramallah. It is now considered one of the most important residential suburbs in the Ramallah and Al-Bireh Governorate. It was established by the Palestinian Investment Fund (PIF), and the opportunity for partnership with the private sector and local developers was made available during the construction and implementation phase.

Al-Raihan Suburb comprises approximately 1,600 housing units, with a capacity of 8,000 inhabitants and a total investment volume of 250 million US dollars. These efforts have led to the creation of an exemplary residential neighborhood for families and have attracted various vital investments related to providing integrated services at the highest level. Examples include the Arab Consultative Hospital, La Casa Mall, and the building for postgraduate studies branch affiliated with the Arab American University. These factors have made Al-Raihan Suburb outlines the expansion and urban development of the cities of Ramallah and Al-Bireh.

This study will assess the local strategies and urban master plans of the two selected cases, considering TOD principles and providing recommendations to enhance the potential of having TOD principles in each of them based on the results of the conducted analysis. Additionally, a strategic framework will be formulated to adopt the TOD as a new planning approach in Palestinian cities.

1.6 Methodology of Study

A sequential research methodology was followed to study TOD in Palestine as shown in Figure 1.1. Details of the methodology are presented hereafter.

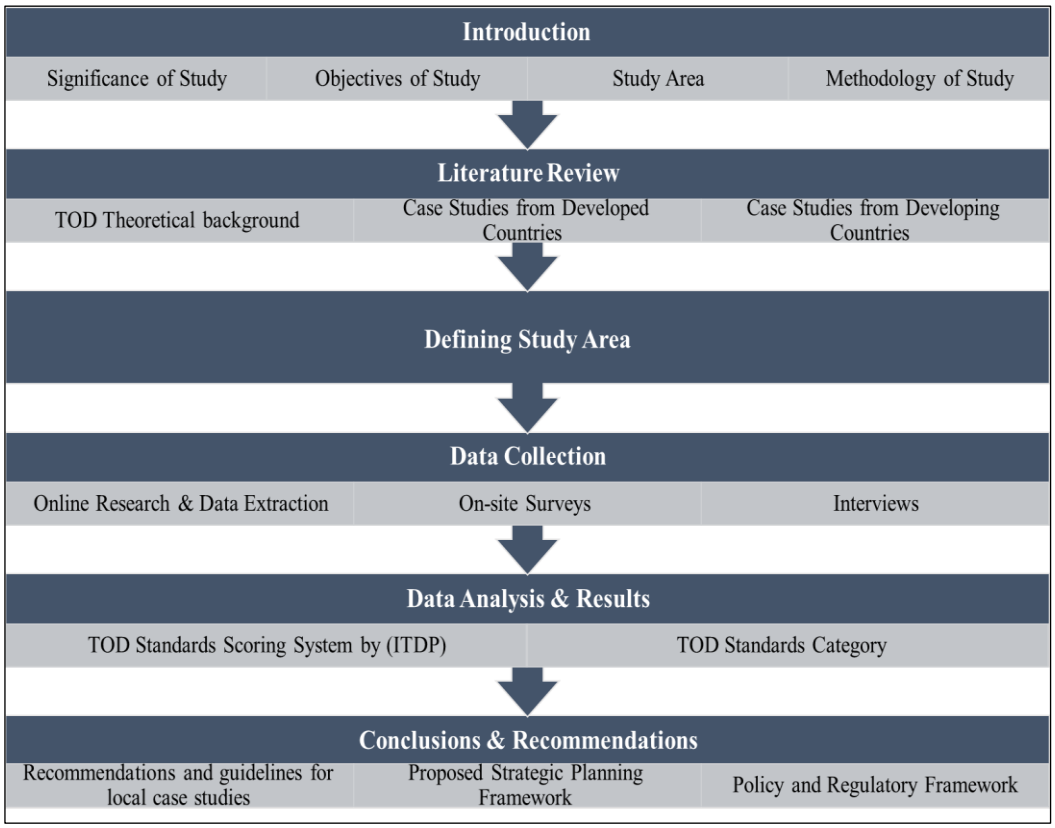
1.6.1 Introduction

The process began with preparing a comprehensive literature review and examining regional and international experiences in the field. This culminated in extracting TOD principles and measurement indicators.

The second phase involved the selection of the study area, where various options were explored before choosing two exemplary cases that reflect the urban development reality in Palestine. Subsequently, data necessary for analyzing the current situation was

collected from reliable sources and processed to transition to the analysis and presentation phase for each study area. This phase concluded with the identification of the results and the issuance of recommendations, serving as guidelines for local authorities and relevant entities in each study area. Additionally, a general strategic framework was provided to establish TOD as a planning approach in emerging Palestinian cities.

Figure 1.1
Methodology of Study



1.6.2 Literature Review

Comprehensive research has been conducted through online sources to explore literature and scientific studies published in the field of TOD, in order to review various aspects of TOD, such as its principles, elements, positive and negative effects, and measurement indicators. Additionally, numerous previous experiences in this field have been examined in both developed and developing countries, in order to study the applicability of TOD, benefit from success stories, and avoid pitfalls during application. The literature review has also assisted in establishing a methodology for studying and analyzing the current situation of case studies, providing recommendations, and proposing suggestions for improvement.

1.6.3 Defining Study Area

Two local case studies have been selected for the study: Rawabi City and Al-Raihan Suburb. These cases were chosen as local models that emulate the reality of urban development in Palestine, since it's limited to residential neighborhoods, large scale housing projects, suburbs and some new cities recently. Rawabi is considered the first Palestinian city since it is the first master planned city from scratch in Palestine, and Al-Raihan is a suburb that has witnessed significant development and notable population growth. The evaluation methodology, based on TOD principles, was applied to both case studies, and appropriate recommendations were provided based on the analysis results.

1.6.4 Data Collection

The necessary data for analyzing the current situation of the case studies was collected through various sources, primarily through online research and data extraction, specifically from the website of the Ministry of Local Government's Geographic Information System (GeoMOLG) and the geographic information website of the Ramallah Municipality. In addition to the data available on these websites, additional information was obtained from the municipalities of Rawabi and Ramallah.

The data collection process extended beyond the aforementioned methods, necessitating field visits to both sites and conducting on-site surveys to address any deficiencies in the data collected from online sources. Field observations were crucial in evaluating many measurements, as there are aspects that can only be assessed through direct observation on-site. The virtual touring feature on Google Maps was utilized to assess some measurements accurately.

Furthermore, interviews and discussions were conducted with relevant stakeholders at both study sites, including municipalities, as well as planners and local residents. This approach ensured a comprehensive understanding of the context and enriched the study with insights from those directly involved in or affected by urban development in the areas under consideration.

1.6.5 Conducting Interviews

This section presents the interviews conducted. One of these was conducted with the Ministry of Transportation (MOT) representative in order to obtain information related to transportation and commuting in the study areas, whether dedicated service lines for each area or lines designated for neighboring communities that also serve the study areas. This in addition to determine if there are licensed taxi offices and their numbers for each area.

Another interview was conducted with Rawabi's city planner in order to understand the city's planning approaches and its strategic vision, as well as to identify planned services that have not been implemented yet. It also aimed to comprehend the stages of the city's execution and development. Additionally, it involved understanding the city's building codes and regulations, and reviewing the details of its provisions. Interviews were conducted with residents to explore details of their daily lives, assess their perceptions, evaluate the services provided to them, and understand the daily challenges they encounter.

1.6.6 Analysis

The analysis process was based on the Institute for Transportation and Development Policy (ITDP) TOD standard scoring system that provides a quantitative method that distributes 100 points across 21 metrics, and the allocation of these points approximately reflects the level of impact of each metric in the creation of TOD that all indicated in Appendix A. The total score represents to what extent the land use plan and urban design support the use of transit, active transportation and to minimize car usage.

The analysis methodology relied on evaluating the eight basic principles of TOD (Walk, Cycle, Connect, Transit, Mix, Densify, Compact, and Shift), which are outlined by ITDP in their research on sustainable communities and transport. Each of these principles was given a weight over 100 according to its importance to the TOD system except the transit principle it has no weight since it’s a fundamental requirement for TOD [6]. Next, several sub-metrics were developed for each principle, giving it partial points from the total weight of its main principle, provided that the sum of the sub-metrics is equal to the weight of the main principle to which they belong. All the main principles and their sub-metrics were detailed and explained in Chapter Three. Additionally, spatial analysis using geographic information system (GIS) was prepared for the measures that can be spatially expressed in both study areas.

1.6.7 Recommendation

After completing literature studies, data collection, and the analytical process, a set of recommendations has been presented to establish the TOD principles as a new planning approach in the planning of Palestinian cities. The recommendations of the study varied to encompass all planning levels. At the local level, specific recommendations and guidelines were provided for each study area based on its analysis results. Similarly, at the higher level, a proposal for a general strategic framework for TOD planning was put forward. As for the national level, the recommendations consisted of general policies and the regulatory framework.

1.7 Thesis Structures

This thesis is composed of four chapters, Chapter One includes the background, overview of TOD, significance of study, objectives of study, the research methodology, study area, and thesis structure. Chapter Two presents a literature review for publications and similar previous experiences in developed and developing countries related to TOD, including their urban plans, strategies and evaluating indicators. Chapter Three explores data collection and analysis of the collected data from different sources and the evaluation for each study area based on results. Finally, Chapter Four proposed a strategic framework and stated recommendations in order to enhance TOD as a pilot planning approach for Palestinian cities.

Chapter Two
Literature Review

2.1 Chapter Overview

This section explores several fundamental subjects that serve as a solid basis for this master's thesis. Therefore, extensive study was carried out through scientific publications and official documents in order to understand what had been addressed concerning TOD. However, various research and planning efforts have been reviewed and presented in this chapter, which are categorized into theoretical background and case studies, whether for developed and developing countries, as illustrated hereafter.

2.2 TOD Theoretical Background

The genesis of TOD traces back to Harrison Feileik with the evolution of American urban centers [7]. Pre-1930s, urban mobility in the United States predominantly revolved around trams and buses. However, post-World War II, propelled by economic growth and the burgeoning automotive industry, private cars became ubiquitous among households, leading to a shift towards car-centric urban transportation. This transition precipitated a myriad of urbanization challenges including inefficient land utilization, rampant traffic congestion, substantial energy consumption, and alarming air pollution levels. In response, scholars began exploring novel urban development paradigms. Feileik introduced the TOD concept, advocating for the prioritization of public transit and the cultivation of pedestrian-friendly urban layouts centered around transit stops [7].

2.2.1 Concept of TOD

Since the introduction of TOD, its concept and implications have seen considerable advancement and refinement, resulting in varied definitions across different stages. In summary, TOD embodies four main characteristics: leveraging bus stops as focal points for mixed-use and high-density land development; fostering a pedestrian and cyclist-friendly environment; incorporating well-designed transit systems; and positioning bus stops as local area hubs [8,9,10,11]. Building upon these aspects, TOD can be defined as a form of land development centered around transit, featuring mixed and high-density land use along bus stops, and the establishment of pedestrian-friendly traffic systems. By concentrating residential, commercial, recreational, and public spaces within a circular

area surrounding bus stops, TOD aims to promote walking, cycling, and public transit usage while reducing reliance on private automobiles, thereby facilitating the integrated development of urban transportation and land use.

2.2.2 The fundamental framework of a Transit-Oriented Development

TOD community typically comprises several key land-based components. These include:

- **Public transportation station:** Serving as the central node for transit connections, facilitating seamless movement between different modes of transportation. It serves as the central hub for a TOD community, akin to the heart of a neighborhood. It acts as the primary link connecting the community with the surrounding area, facilitating transportation and connectivity. The strategic allocation of land surrounding the bus station adheres to the principle of "the closer to the station, the higher intensity of development." This means that land use planning prioritizes denser development closer to the station, maximizing accessibility and encouraging transit-oriented living and commerce.

- **Core commercial district:** Concentrating retail establishments, dining options, and other commercial amenities to cater to the needs of residents and commuters. Every TOD community necessitates a central business district situated in proximity to the bus station. The scale of this district should be tailored to align with the community's size, geographical location, and intended function. This ensures that the business district effectively caters to the needs of residents and commuters while fostering economic activity and vitality within the TOD environment.

- **Office/employment area:** Providing workspace for professionals and businesses, promoting employment opportunities within the community. To maintain a balanced distribution of residences and job opportunities, every TOD community should incorporate designated office and employment areas. This strategic allocation aims to mitigate the significant traffic congestion often induced by the separation of workplaces and residential areas, reducing the necessity for long-distance commuting. By integrating job opportunities within the TOD community, residents have

convenient access to employment options, promoting a more sustainable and harmonious urban environment.

- **TOD residential area:** Featuring high-density housing options such as apartments and condominiums, designed to accommodate residents within close proximity to transit facilities. Generally speaking, the planning and construction of TOD community require a high residential density. On one hand, it can balance a large number of job opportunities; on the other hand, it can provide a stable source of travelers for public transit to ensure its efficiency.

- **Secondary area:** Additional residential or mixed-use zones that complement the core TOD residential area, contributing to the diversity and vibrancy of the community. The secondary area of a TOD community typically refers to the peripheral zone characterized by low-density development. This area, adjacent to the core TOD community, primarily encompasses low-density residential zones, educational institutions such as schools, community parks, and public green spaces. These components contribute to the overall livability and functionality of the TOD environment, providing essential amenities and recreational areas for residents while maintaining a more relaxed, suburban ambiance compared to the higher-density core area.

- **Public open space:** Parks, plazas, or green areas designed to enhance the livability and recreational opportunities within the TOD community. Within a TOD community, it's imperative to incorporate public open spaces that foster social interaction and community engagement. These spaces serve as gathering points for residents and visitors, promoting connectivity and a sense of belonging. Examples of such spaces include parks, squares, plazas, and community gardens. Additionally, public buildings like libraries, community centers, and cultural institutions further enrich the social fabric of the TOD community, providing venues for learning, recreation, and civic engagement. By integrating these elements, TOD communities cultivate vibrant and inclusive environments that enhance the overall quality of life for residents [12,13] .

2.2.3 Planning Principle of TOD

Since the inception of the TOD theory, scholars have been actively translating it from theory into practical urban planning strategies. introduced the following planning principles [8]:

- Embrace a compact, organized urban model supported by a robust public transportation system at the regional planning level.
- Arrange commercial, residential, work, and public facilities around bus stops within walkable distances.
- Establish a walkable road network and pedestrian-friendly street spaces conducive to a positive pedestrian experience, ensuring convenient and direct connectivity between destinations.
- Provide a range of residential options in terms of pricing and density to accommodate diverse needs.
- Preserve ecologically sensitive areas, waterfronts, and high-quality open spaces to maintain environmental integrity.
- Prioritize public spaces as hubs of human activity, emphasizing their utilization by buildings rather than parking lots.
- Promote new construction and redevelopment around public transportation nodes within existing development areas.

These principles serve as guiding frameworks for integrating TOD concepts into real-world urban planning endeavors, aiming to create sustainable, accessible, and livable communities.

Cervero & Kockelman introduced the "3D" principle for TOD planning, encompassing the "High-Density," "Diversity," and "Rational Design" principles. "High-Density" emphasizes the concentration of land development intensity around bus stations. "Diversity" advocates for mixed land use, encouraging people to live, work, and study within a concentrated area or along transit lines to alleviate urban traffic congestion. "Rational Design" calls for the logical integration of pedestrian, bicycle, bus, and motor vehicle traffic to minimize confusion and enhance efficiency [14].

In China, Zhao proposed a TOD planning methodology tailored to Chinese cities. This approach offers both qualitative and quantitative descriptions of key TOD aspects at the

macro, meso, and micro levels, providing a comprehensive framework for TOD implementation in the Chinese urban context [15].

2.3 Studies in Developed Countries

2.3.1 Zurich, Switzerland

Zurich, which typically scores highly across a range of indicators, including sustainability and smart cities, is highlighted. There are various strategies that the city has used to become more sustainable. In order to enhance the TOD, the city had focused on three main general policies, each has specific measures. The three main policies were: (I) Discouraging private motorized transportation; (II) Support public transportation; and (III) Support human-powered mobility [16].

Discouraging Private Motorized Transportation

This policy is an attempt to transform travelling from private automobiles to public transportation using many measures such as:

- Parking measures: Limit and reduce parking spaces, implement high parking fee, and limit the maximum parking time to two hours.
- Speed and traffic calming policies: Implement 30 km/h on more than 50% of roads, and high density of speed cameras. Additionally, most residential streets have certain types of traffic-calming measures, such as chokers, on-street parking clusters with 2 to 5 automobiles on each, alternately parked on the street side, or other road restrictions.

Encouraging Public Transport

The city has a population of 400,000, and the public transportation system moved over 1,030,000 passengers every day in 2019. This is not surprising given the quality and reliability of the system, as well as the density of the network. However, trams and buses run rather frequently, with average headways between 5 and 8 minutes [16].

To keep the induced demand for vehicular mobility from vaporizing the improvements, the previously described mechanisms limiting and optimizing the car network are used. The city's public transportation system obtains the gains from these efficiency upgrades at the same time. The following set of actions is specifically undertaken to enhance public transportation:

- Transit signal priority: Full priority for public transport.
- Bus and tram stops: There are few bus bays in Zurich; however, curbside bus stops are more typical. This ensures that buses have no trouble re-entering the traffic flow. However, it should also be mentioned that in Switzerland, motorists usually give way to buses.

Encouraging Human-Powered Mobility

As part of its commitment to encourage more environmentally friendly transportation, the city of Zurich has developed incentives for utilizing alternative modes of transportation as well, such as walking, bicycling, and other types of shared micro-mobility. The measures listed below to assist human-powered mobility:

- Pedestrians: the focus has been on giving priority to and ensuring the safety of pedestrians, particularly in downtown Zurich through short cycles, green phase when public transport arrives at a traffic signal, and road crossing anywhere in 30 km/h zones.
- Cyclists: speed reduction, comfort routes, and right turn on red. Two different types of routes -main and comfort- are included in a master plan from 2012. While the former competes with other forms of transportation for space by aiming to provide direct and quick connections, the other operates on less-used roads, such as residential streets. Additionally, many crossroads have been redesigned to include "bicycle boxes" in front of the signal whenever it is feasible providing for improved visibility of waiting cyclists and increasing priority over cars [17].
- Shared micro-mobility: Per vehicle fee, public dockless bike-sharing system. In 2019, the city of Zurich implemented a new operating fee per vehicle, asserting that operators utilizing city space for economic activities should contribute financially. As an illustration, a free-floating shared bicycle operator is charged CHF 10 per bicycle per month, a deposit of CHF 50 per bicycle, and an annual flat fee of CHF 1500 (EUR 1370). However, Zurich City offers "Publibike," a funded citywide bicycle-sharing program [18].

2.3.2 Phoenix, USA

The first step in the TOD planning process is the establishment of a citywide framework to improve the linkage between land use and transportation. Phoenix TOD policies concentrate redevelopment near high-capacity transit stops and shape walkable mixed-use communities. The planning paradigm for this nodal configuration is referred to as "connected centers." A city's center is defined as a concentration of activities there. By integrating analyses of the transit system and urban form structure, eight mixed-use Center Place Types have been proposed. The Phoenix TOD Typology uses a hierarchical classification approach to specify generic growth parameters. The most intense category is defined as the Downtown Core Place Type, which gradually decreases to lower intensity Neighborhood Center Place Types [19].

Methods

The features of current centers in Phoenix were examined to establish an initial list of TOD place categories. These categories were then refined and suggested for all current and future light rail stations, excluding those in downtown. City specialists evaluated various factors such as land use, zoning, demographics, and market studies within a 14-mile radius of the stations to gauge the existing environment and its potential for future changes. The suggested TOD place category for each current or planned light rail station outside downtown Phoenix is illustrated in Figures 2.1 and 2.2.

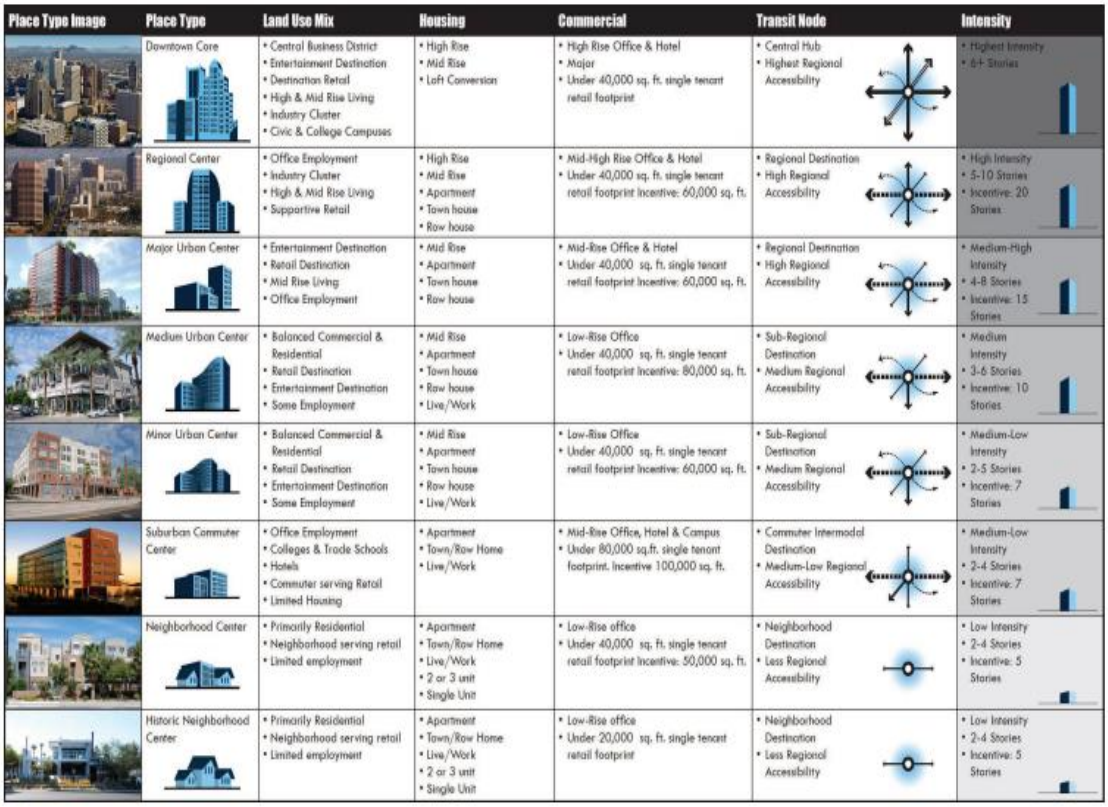
Implementation

The "Five P's" were emphasized since TOD implementation is led by a performance-based strategy.

- Prioritization: To increase the effectiveness of resources in promoting the community's goal, implementation was given priority for certain types of expenditures in particular areas.
- Partnerships: Investments were coordinated with partners in the community as well as within the government to get the most out of the limited resources available.

Figure 2.1

Place Type Topologies and land use mix in Phoenix

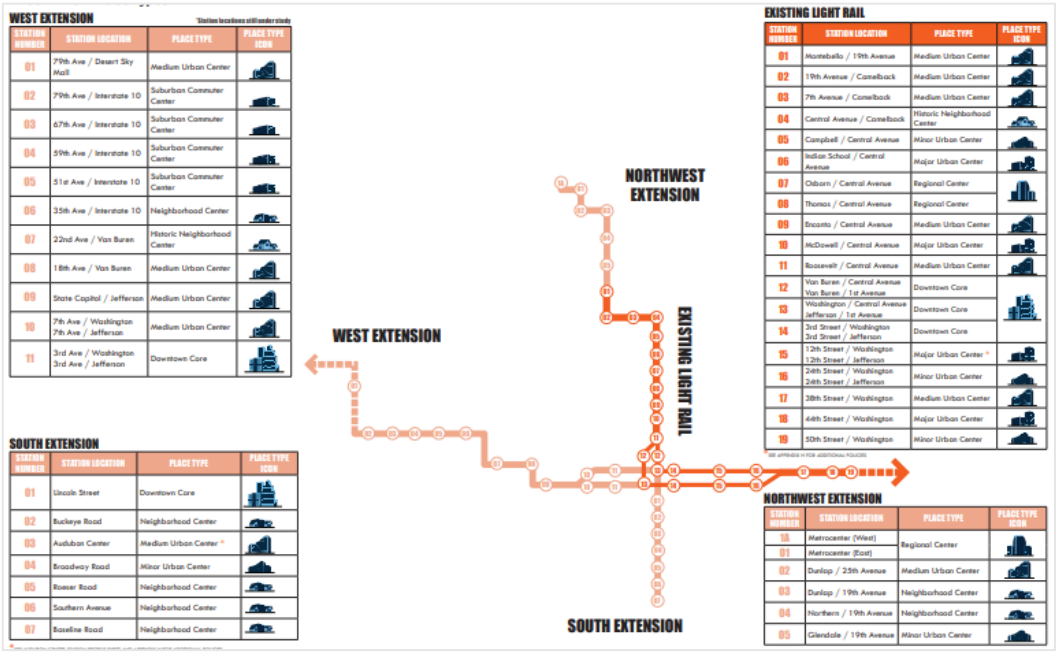


Place Type Image	Place Type	Land Use Mix	Housing	Commercial	Transit Node	Intensity
	Downtown Core	• Central Business District • Entertainment Destination • Destination Retail • High & Mid Rise Living • Industry Cluster • Civic & College Campuses	• High Rise • Mid Rise • Loft Conversion	• High Rise Office & Hotel • Major • Under 40,000 sq. ft. single tenant retail footprint	• Central Hub • Highest Regional Accessibility	• Highest Intensity • 6+ Stories
	Regional Center	• Office Employment • Industry Cluster • High & Mid Rise Living • Supportive Retail	• High Rise • Mid Rise • Apartment • Town house • Row house	• Mid-High Rise Office & Hotel • Under 40,000 sq. ft. single tenant retail footprint Incentive: 60,000 sq. ft.	• Regional Destination • High Regional Accessibility	• High Intensity • 5-10 Stories • Incentive: 20 Stories
	Major Urban Center	• Entertainment Destination • Retail Destination • Mid Rise Living • Office Employment	• Mid Rise • Apartment • Town house • Row house	• Mid-Rise Office & Hotel • Under 40,000 sq. ft. single tenant retail footprint Incentive: 60,000 sq. ft.	• Regional Destination • High Regional Accessibility	• Medium-High Intensity • 4-8 Stories • Incentive: 15 Stories
	Medium Urban Center	• Balanced Commercial & Residential • Retail Destination • Entertainment Destination • Some Employment	• Mid Rise • Apartment • Town house • Row house • Live/Work	• Low-Rise Office • Under 40,000 sq. ft. single tenant retail footprint Incentive: 80,000 sq. ft.	• Sub-Regional Destination • Medium Regional Accessibility	• Medium Intensity • 3-6 Stories • Incentive: 10 Stories
	Minor Urban Center	• Balanced Commercial & Residential • Retail Destination • Entertainment Destination • Some Employment	• Mid Rise • Apartment • Town house • Row house • Live/Work	• Low-Rise Office • Under 40,000 sq. ft. single tenant retail footprint Incentive: 60,000 sq. ft.	• Sub-Regional Destination • Medium Regional Accessibility	• Medium-Low Intensity • 2-5 Stories • Incentive: 7 Stories
	Suburban Commuter Center	• Office Employment • Colleges & Trade Schools • Hotels • Commuter serving Retail • Limited Housing	• Apartment • Town/Row Home • Live/Work	• Mid-Rise Office, Hotel & Campus • Under 80,000 sq.ft. single tenant footprint. Incentive 100,000 sq. ft.	• Commuter Intermodal Destination • Medium-Low Regional Accessibility	• Medium-Low Intensity • 2-4 Stories • Incentive: 7 Stories
	Neighborhood Center	• Primarily Residential • Neighborhood serving retail • Limited employment	• Apartment • Town/Row Home • Live/Work • 2 or 3 unit • Single Unit	• Low-Rise office • Under 40,000 sq. ft. single tenant retail footprint Incentive: 50,000 sq. ft.	• Neighborhood Destination • Less Regional Accessibility	• Low Intensity • 2-4 Stories • Incentive: 5 Stories
	Historic Neighborhood Center	• Primarily Residential • Neighborhood serving retail • Limited employment	• Apartment • Town/Row Home • Live/Work • 2 or 3 unit • Single Unit	• Low-Rise office • Under 20,000 sq. ft. single tenant retail footprint	• Neighborhood Destination • Less Regional Accessibility	• Low Intensity • 2-4 Stories • Incentive: 5 Stories

Source: Ref. (City of Phoenix, 2018)

Figure 2.2

The Application of Place Type Topologies in Phoenix



Source: Ref. (City of Phoenix, 2018)

- Predictability: To ensure create communities of lasting value and safeguard investors from delayed approvals and incompatible development, zoning and other rules that follow district plans were in place.
- Promotion: To engage and encourage potential investors, the community's vision and the existence of incentives was publicly shared.
- Persistence: in order to achieve the vision, a coordinated coalition of stakeholders, including locals, companies, investors, governments, and non-profits, must continue to be actively involved over the long term.

2.3.3 King's Cross, London, United Kingdome

King's Cross, located in Central London, is a comprehensive urban regeneration project and a major transportation hub. With connections to six metro lines, two national train stations, and an international high-speed rail line, it stands as a central and well-connected hub in the city [20]. The project, identified in 1996 for strategic development, focused on mixed-use development, increased densities, and commercial activities around the station. The plan also emphasized urban regeneration, community support, and the preservation of historic features. Covering 27 hectares of former rail and industrial facilities, the regeneration involved restoring historic structures and constructing new buildings, creating an attractive environment with extensive public spaces. The development prioritized local connectivity, accessibility, and permeability, featuring a dense network of internal streets. King's Cross includes open spaces, office space, residential units (with a significant portion being affordable housing), retail and leisure spaces, a hotel, and educational facilities.

Major features of the King's Cross include:

1. **Increasing Node Value**

   King's Cross Station, centrally located in London, serves as a major transportation hub with exceptional node value on a city, national, and European scale. Renowned for its connectivity and accessibility, the station links to five international airports within an hour, including three with direct connections. As the largest inner-city transit interchange in London, King's Cross connects six metro lines and 17 bus routes. Alongside St Pancras and Euston stations, it is poised to be the primary transit center for London.

2. Increasing Place Value

The unique planning over six years aimed to address the imbalance between high connectivity and low land use, emphasizing adaptive planning and collaboration between the developer and the government. The value of the place has been increased by Appling following several strategies:

- Maintaining Flexible Master Plan

  Key physical elements were fixed for continuity and identity, while building heights were regulated for consistency. Design guidelines allowed for unity and diversity, enabling specific details to emerge over time. The planning approach viewed development as an ongoing process, promoting flexibility, negotiation, and experimentation with occupiers and activities [21].

- Attracting High-Tech Firms

  Google, impressed by the high-caliber development, invested approximately £650 million to acquire and develop a 1-hectare site under a long-term lease from King's Cross Central Limited Partnership. Google's presence is anticipated to attract other technology companies, particularly small start-ups, and contribute to an increase in rental rates.

- Blending High Density with Medium-Sized Structures

  Rather than relying on tall buildings, King's Cross achieves high density through the incorporation of 50 medium-sized buildings designed at a human scale. The development embraces a high-density, mixed-use, infill approach, featuring an average floor area ratio (FAR) of 4.6 at the block scale.

- Reforming the Image of King's Cross

  The King's Cross Public Realm Strategy acknowledges the area's historical significance and integrates early Victorian buildings in a sophisticated manner rather than merely preserving them. The introduction of a pedestrian bridge and other links aims to enhance the positive contributions of the canal, improving accessibility, safety, and the overall character of King's Cross [22].

- Developing Public Spaces of Superior Quality

  The King's Cross development prioritizes the establishment of a vibrant and accessible public realm as a core element of its urban vision. With a commitment to open, democratic, and accessible spaces, 40% of the development is designated for open areas, including courtyards and gardens. The design interconnects various elements

like streets, parks, squares, pedestrian areas, canal promenades, cycle paths, and trails to support a diverse range of activities and encourage pedestrian movement [23]. The success of King's Cross lies in the collaboration of high-quality design and long-term management strategies. The result is a seamless flow of spaces, routes, and views, creating a dynamic and ever-changing environment that fosters vibrant interactions within the public realm, contributing to a thriving urban experience for pedestrians [21].

- Ensuring Unrestricted Use of the Public Spaces

  In King's Cross, the distinction between public and private areas is achieved through built structures rather than physical barriers, utilizing features like rumble strips and distinct road surfaces where necessary to convey restricted access [23].

- Developing Active Streets

  The King's Cross design focuses on creating dynamic streets by leasing ground-floor units to retail stores, bars, cafes, and restaurants, ensuring a lively neighborhood throughout the day. This approach extends beyond individual streets, establishing a network of safe pedestrian routes that connect key sites within King's Cross Central and foster connections with the surrounding communities in Camden and Islington [20].

3. Increasing Market Potential Value

Value capture has been made possible by embracing flexible utilization and maintaining a clear emphasis on enhancing market value, as evidenced in this section, drawing insights from Suzuki and others [24].

- Ensuring Flexible Uses to Enhance Market Adaptability

  The King's Cross redevelopment agreement permits flexibility in land uses, allowing the developer to adjust to market conditions. There is a 20 percent variation allowance within the total floor space, and limited trading of floor space allocated to one use against another is permitted.

- Securing Funding and Cultivating Market Value Potential

  King's Cross is financed through a combination of equity, debt, and recycled revenues, allowing for versatile project funding. The overall estimated value of the King's Cross project is projected to be £3 billion, covering construction, professional fees, and interest [21].

- Capturing Value

  The redevelopment of King’s Cross in England utilizes the Section 106 technique for land value capture. This involves negotiations between local authorities and developers to address the negative impact of development in exchange for planning permissions [24].

2.4 Studies in Developing Countries

2.4.1 Qatar National Museum's (QNM) Transit Village

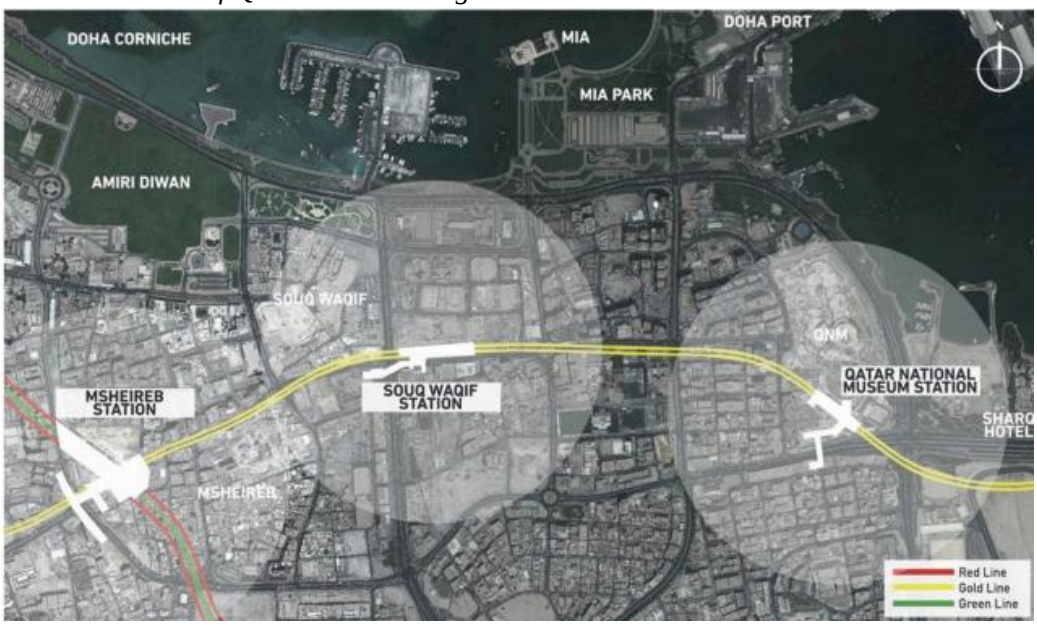
This part is a quick review for Al-Harami & Raffaello study that explores the urban development of Qatar National Museum's (QNM) Transit Village, which is developed along Doha Metro's Gold Line, near to Doha Cornice, the Museum of Islamic Art and MIA Park. This village follows the approach of Green Urbanism and TOD design strategy to propose a master plan for the urban regeneration of QNM's transit village [25].

The ongoing construction of the new Doha-metro system in the State of Qatar provide a high potential to apply the urban regeneration of the major transit villages (TODs) along the metropolitan premises. The metro system has approximately 100 metro stations distributed along four main lines. The most relevant urban village is (QNM).

The transit village has an area of 1.13 km^2 and a radius of 600 m (0.38 mile), which is considered an ideal walking distance. The QNM Station will be linked to the stations of the Souq Waqif and Msheireb (the Heritage-Historic districts), providing a cultural connection in the ancient Doha City. Furthermore, the transit village is bounded by huge parks and is connected to the Museum of Islamic Art and the MIA Park [providing yet another linkage to a significant cultural zone]. As a result, the urban village may serve as a green zone connecting the MIA Park and the Doha Corniche, reflecting the other side of the corniche green area while preserving a historic-heritage character, as shown in Figure 2.3.

Figure 2.3

The General Context of QNM Transit Village



Source: Ref. (Al-Harami & Furlan, 2020)

The proposed master plan

The QNM-TOD masterplan was crafted with a strategy centered on establishing a vibrant transit hub that prioritizes access to essential amenities and communal spaces, fostering social interactions, and ultimately cultivating a vibrant, enriching urban atmosphere conducive to a high quality of life. Three key factors considered in conceptualizing the TOD include: (1) varied transportation options ensuring accessibility and connectivity; (2) a mix of diverse, densely arranged land uses; and (3) integration with natural surroundings (landscape, connection to public spaces, parks, and waterfront).

To enrich the livability and quality of life for QNM-TOD users, the proposed master plan is grounded on the following key-elements:

- **Walkability and connectivity:**
- Establishing a public, open pedestrian network along the TOD with sitting areas with landscaping and shade;
- Improve ground-level pedestrian accessibility;
- Establishing a network of unimpeded cycling lanes;
- Linking different urban settlement public and private transportation networks;
- Establishing a network of pedestrian and bicycle lanes to connect and integrate mixed-use zones; and

- Planning parking garages.

- **Land-use and diversity:**
- Increasing density and diversity by proposing various mixed-use development;
- Giving priority to compact constructed forms; and
- Creating a variety of open green spaces of different sized, including big parks for the public and private pocket gardens.

- **Public Realm:**
- Improving connections between main and minor roadways, as well as paved and/or planted open areas; and
- Designing open areas with a range of viewpoints on or from the urban settlement.

2.4.2 Abu-Dhabi, Master Transportation Plan 2030

By the year 2008, Abu Dhabi Department of Transport had begun to develop the Surface Transport Master Plan 2030 for the city, which addresses the regional transport needs of the Emirate as a whole while particularly focusing on metropolitan Abu Dhabi to respond to the urban dynamics of Abu Dhabi. This plan proposed a comprehensive, large-scale, and sustainable transport system with a budget of multi-billion dirhams. However, it attempts to achieve a paradigm shift in transportation system in a record time that no state/city ever attempted to implement in such period. All decision makers believed that the master plan with its components would help Abu Dhabi become a sustainable, globally oriented, world-class city [26]

The plan primarily aims to provide various mobility options for people, reduce traffic congestion to a minimum, and support Abu Dhabi's vision for a sustainable, world-class transport system. Although the plan implied a huge infrastructure investment, including highways, freight rail, and regional rail, it also includes the providing of multi-modal public transport system supported by all required pedestrian amenities fully integrated with the land use system and the larger urban structure.

The 2030 plan provides a general policy in different fields, including land use, urban transport, open public space, urban design and landscaping, housing in all categories, and economics. Briefly, it guides future development throughout the city. Since this plan is a step forward for sustainable development, it recognizes the three main actors in

sustainable development: the economy, the environment, and the society. The plan determined three main goals: an economic goal, an environmental goal, and a social and cultural goal. Furthermore, the economic goal is "promoting economic competitiveness and vitality through efficient, high-quality transport services for passengers and freight." Additionally, "delivering world-leading performance in environmental sustainability by using resources responsibly, minimizing pollution, and preserving Abu Dhabi's unique environment" is the environmental goal, while its social goal is "protecting and enriching people's lives by maximizing safety and access to opportunities for all." After setting the main goals, the plan follows the general methodology summarized in Figure 2.4 through identifying objectives and strategies to achieve each goal.

The plan aims to improve the physical environment by acknowledging the crucial interplay between transportation and land use, fostering sustainable enhancements in both urban and natural environments, that's thorough reducing traffic congestion, creating an attractive urban environment while protecting environmental resources and then sustainable low carbon future.

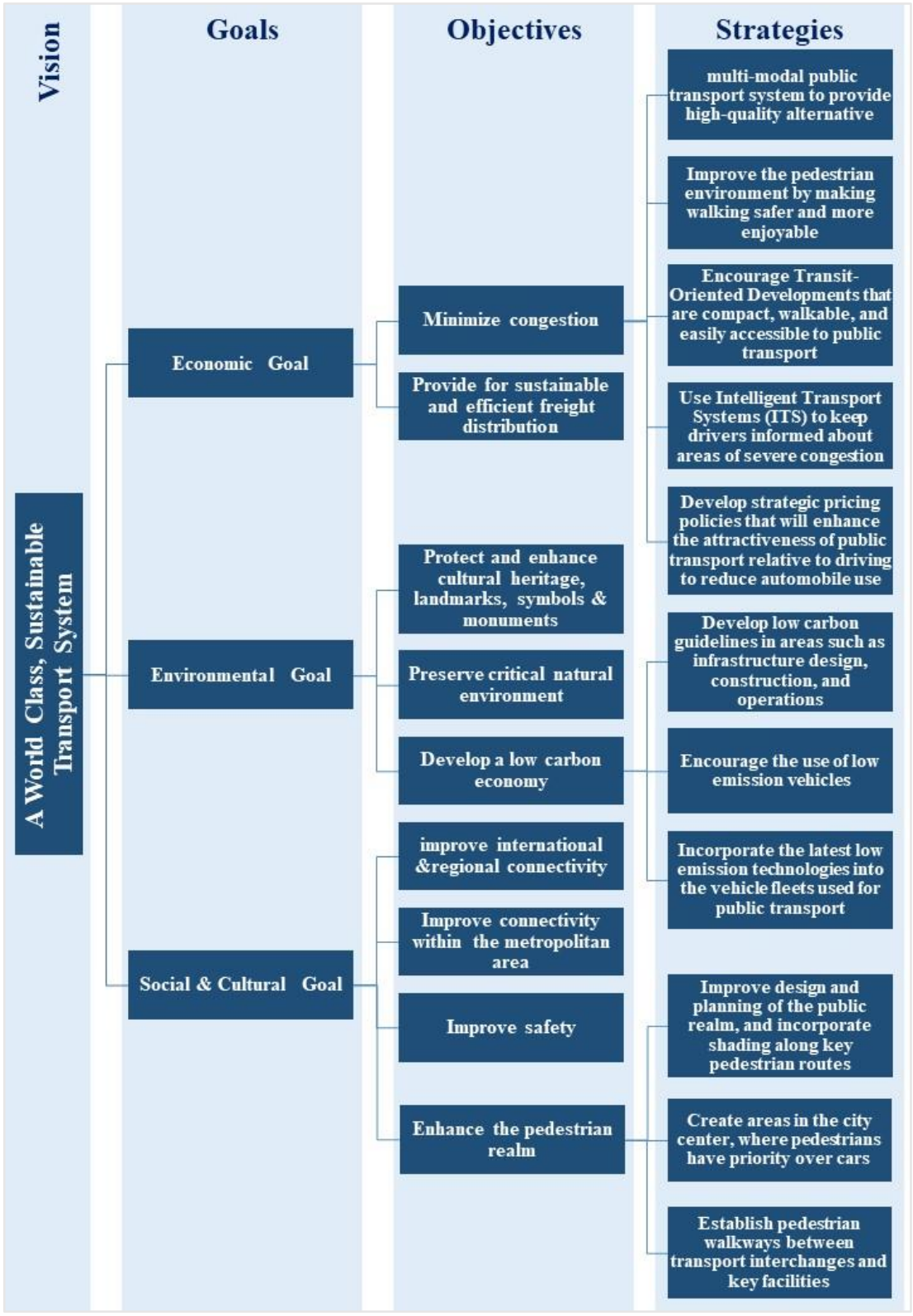
Abu Dhabi's Transport Master Plan aims to create a highly coordinated and integrated multimodal transport system. In other words, it is planning to have a set of well-connected transportation modes that work effectively in isolation. Each mode that is related to TOD could be briefly explained as follows:

- **High-speed regional train**

  Very fast trains will be used on the high-speed regional rail network to deliver high-quality intercity service that is competitive with air travel and as convenient as driving a vehicle. High-speed rail service will be connected to hubs that offer quick connections to the metro, tram, bus, and taxi services. To improve regional accessibility to and from Abu Dhabi, a high-speed regional rail network is proposed.

Figure 2.4

The Strategic Framework of Abu Dhabi



Source: Ref. (Abu Dhabi Department of Transport, 2009)

- **Metro network**

  A large and comprehensive metro train system is being built in order to offer competitive travel times for longer distance trips inside the metropolitan area. The metro network will have regular stops and two-way tracks for about 130 kilometers.

- **Tram network**

  A substantial tram network will provide extensive transportation coverage for the high-density growth zones. The majority of people will typically be able to reach a tram stop within a walking distance of 300 meters.

- **Bus service**

  In areas where travel demands do not necessitate the capacity offered by trams or the metro, the bus system offers a suitable addition to the public transportation network. High-quality, air-conditioned buses will provide passengers with a calm, secure, and comfortable experience when using public transportation.

- **Ferry and water taxi service**

  Passenger ferries and water taxis will serve both sides of Abu Dhabi Island as well as offshore business, residential, recreational, and tourism locations, completing the network of land-based transportation that is envisioned. The intended land-based transportation network will seamlessly incorporate these water-based services. The routes and schedules for the ferries will be predetermined, whereas the taxis will have local operating permits.

- **Pedestrian and cyclists facilities**

  Both the Abu Dhabi 2030 Plan and the Surface Transport Master Plan underscore the vision for the future, emphasizing the significance of creating an appealing and comfortable pedestrian space. Enhancements in pedestrian pathways are a priority, particularly in areas witnessing high pedestrian traffic or connecting transportation hubs. It is crucial to establish a secure and enjoyable walking environment across Abu Dhabi, spanning residential neighborhoods to densely populated urban centers. This is essential to promote the utilization of public transportation and reduce reliance on private car trips.

Pedestrian facilities should instill a sense of safety and security, ensuring that pedestrians feel shielded from surrounding traffic. An aesthetically pleasing setting will further promote walking by adding an engaging element to the journey between destinations. Considering Abu Dhabi's summer climate, it becomes imperative to provide protection from the heat and establish a reasonable level of comfort along pedestrian pathways. Elements like trees, screens, and covered arcades can provide pedestrians with shading and designated resting areas.

The Surface Transport Master Plan advocates for the establishment of a network comprising safe and well-defined bicycle routes that link existing and emerging developments. Short-term bicycle rental services will be accessible in proximity to major transportation hubs and concentrated activity areas, including business and shopping centers. Additionally, there will be provisions for appealing and convenient bicycle parking and storage facilities, intended to promote cycling as a viable alternative to motorized transport.

2.4.3 Dhaka City, Bangladesh

Anwar Uddin and colleagues conducted an evaluation of Transit-Oriented Development (TOD) in Dhaka, Bangladesh, utilizing criteria such as density, diversity, destination accessibility, and design. They selected eight indicators to assess TOD, considering an 800-meter buffer radius around each of the 17 transit stations for calculations [27]. Employing an objective-weighted spatial multi-criteria analysis, the authors evaluated the effectiveness of the framework. They assessed the model's robustness by analyzing the sensitivity of eight TOD scenarios and identifying hotspot clusters using statistical methods. Furthermore, the stations were ranked based on their TOD scores, and a comparison with TOD in developed and developing cities was conducted to derive planning insights. The authors proposed three distinct TOD planning methodologies for nodes, highlighting the importance of design, destination access, and density in redevelopment, zoning, and affordable housing policies across different regions of Dhaka. The study concludes by discussing limitations and outlining potential avenues for future research.

The examination of TOD index hotspots yielded insights into patterns and trends within the study area. Notable stations are identified as significant TOD hotspots due to their high potential for development. These locations exhibit characteristics such as dense population, mixed land use, and accessibility to public transportation. The hotspot map indicates a concentration of TOD along a main route, with specific areas showing greater potential for development. Factors contributing to TOD in these areas include existing urban infrastructure, proximity to key employment centers, and accessibility to public transportation. The analysis also predicts future TOD hotspots, based on mixed land use and high accessibility.

The assessment of different approaches to enhance TOD in Dhaka stations offers significant insights for neighborhood-level planning and policy implications. The results indicate the importance of customizing TOD improvement strategies to the distinct characteristics and requirements of each station area. Elevating density and diversity emerge as pivotal for augmenting TOD scores in medium and low-ranked stations, underscoring the need to encourage mixed-use development and small enterprises. In contrast, for top-ranked stations, enhancing destination accessibility and station design holds paramount importance, necessitating improvements in connectivity with other modes of transportation and infrastructure enhancements.

In summary, this study represents a significant step toward a more comprehensive framework for measuring TOD in developing cities like Dhaka, Bangladesh [27].

2.4.4 Challenges for TOD in Developing Countries

Abdi & Lamíquiz-Daudén identified the most significant challenges for TOD in developing countries [28].

The study identified contextual challenges, organizing them into three key themes: challenges related to transportation, urban design, and sociocultural aspects. In the realm of transportation, concerns included insufficient regional and multimodal connections, poorly designed transit stations lacking essential facilities, inadequate selection of transit lines and stations with limited accessibility, a decline in the overall quality of public transport services, and weak connectivity. Urban design challenges encompassed issues such as inconsistent density, urban and residential environments favoring cars, an

unfriendly atmosphere for active transport and the handicapped, insufficient urban design practices, limited attention to the physical integration of transit stops with surrounding neighborhoods, and challenges in implementing mixed-use designs. Sociocultural challenges were characterized by a lack of consideration for understanding socio-cultural attitudes, social segregation and displacement, restricted social coverage that excluded high-income users due to crowded and unsafe public transport, and the influence of wealthier car users opposing public transport initiatives.

Addressing policy and planning hurdles involved categorizing them into two main themes: policies and regulations, and planning instruments. Within the domain of policies and regulations, obstacles ranged from a proclivity towards car-centric and road-focused policymaking to the absence of incentives for stakeholders in Transit-Oriented Development (TOD). Other challenges encompassed issues with density planning and zoning geared towards TOD, the lack of design codes conducive to TOD, and skewed parking policies in transit-rich areas. Furthermore, there were inadequacies in supporting affordable transit options such as Bus Rapid Transit (BRT), as well as a tendency to prioritize economic allure over technical feasibility or social impact. Neglect of affordable housing linked to public transit, scattered transit infrastructure, conflicting political objectives regarding urbanization, and insufficient consideration of regional factors in TOD planning were also notable challenges. Additionally, there were limitations in political support and susceptibility to political instability.

In terms of planning instruments, challenges included a propensity for short-term problem-solving, inadequate planning capacity, imitation of western urban planning patterns, and the absence of a comprehensive approach covering various aspects of TOD. Political obstacles hindering policy innovation and insufficient systematic research into the appropriateness of TOD proposals were also notable challenges within this realm.

implementation challenges include financial limitations, notably the exorbitant expenses associated with (rail) transit infrastructure, alongside sluggish demand within the local real estate sector and ineffective bidding procedures. Process-related and managerial obstacles also emerge, such as inadequate land supply management, instances of corruption, failure to highlight the benefits of TOD, scarcity of local expertise, subpar management of transit systems, insufficient funding for swift infrastructure expansion,

and bureaucratic red tape leading to inefficiencies and delays. Furthermore, hurdles in public participation and acceptance manifest through community resistance, lack of awareness due to inadequate educational initiatives, and insufficient community engagement characterized by top-down approaches lacking in accountability.

The complexities surrounding actors in TOD include a divergence in disciplinary discourse between land use and transport planners, resulting in fragmented responsibilities. Decentralization has led to competition rather than collaboration among local governments, further compounded by the limited capacities of local authorities to plan, authorize, and execute TOD initiatives. Additionally, conflicting interests, individual pursuit of privilege, and opposing views regarding TOD add layers of challenge to the intricate dynamics that must be navigated for effective implementation and long-term urban sustainability [28].

2.5 Summary

After reviewing the literature and previous experiences of a number of countries, the basic principles of TOD approach and the strategies necessary to achieve it can be summarized as follows in Table 2.1.

Table 2.1

TOD Principles extracted from literature review

TOD Principle	Strategies
Transit	– Provide frequent, reliable, integrated and high-capacity transit system
Connect	– Establish dense and interconnected networks of streets and pathways.
	– Create enhanced infrastructure for waking and cycling
	– Minimize urban blocks sizes
Walk	– Design active pedestrian environments that promote activity through spacious and unobstructed sidewalks.
Cycle	– Emphasize bicycle usage by establishing a network of clearly designated and physically separated bicycle lanes, alongside ensuring secure bicycle parking facilities.
	– Enhance cyclist safety by implementing speed reduction measures on cycling lanes.
Shift	– Reduce the space designated for automobile traffic to discourage car usage.
	– Implement parking management strategies such as reducing the number of available parking spaces while enforcing high parking fees.
Compact	– Promote close proximity of residences to workplaces, schools, amenities, and other essential destinations to minimize daily commuting.
Mix	– Encourage diverse land utilization, integrating both residential and non-residential spaces, horizontally and vertically to minimize daily commuting.
Walk & Mix	– Encourage lively and transparent street facades to enhance pedestrian safety.
	– Stimulate vibrant streets and open spaces scene
Densify	– Boost population density in the vicinity of rapid and high-capacity public transit hubs.

Chapter Three
Data Collection and Case Studies Assessment

3.1 Chapter Overview

This chapter presents the framework for TOD scoring assessment for the study areas based on quantitative data as well as accessible master plans and policies related to urban development or transportation. Evaluating each study area involves gathering diverse data, including some details particularly about block dimensions and urban frontages, as well as information pertaining to local policies and site features. This chapter outlines and applies a detailed, step-by-step process for scoring urban areas from TOD perspective.

3.2 Data Collection

The data collection stage is one of the most important stages of preparing this research, due to the importance and impact of the quality of that data on the credibility and realism of the analysis process. For this reason, more than one method has been used to collect the necessary data to evaluate the current situation, such as online research, site visits, and field surveys.

- **Internet research and online data platforms**

  Conducting desktop research is the initial step in order to obtain compiled data such as plans, designs, maps, and reports to assess a broad range of metrics within the TOD Standard. The main data source was GeoMOLG and Ramallah Municipality official website. Various metrics can be scored through measurements and calculations, while others determined through straightforward counts. However, certain metrics were challenging to be evaluated solely based on document information, necessitating on-site visits or interviews with individuals and organizations familiar with the study area.

- **Site visits and field surveys**

  The on-site visits were conducted equipped with a copy of the TOD standard, a detailed map for the area, metrics sheet, and a camera. Comprehensive notes were taken, including actual distances and observational details, along with photos capturing the elements of the site undergoing assessment. Subsequent to the site

survey, the notes were reviewed and the points to be awarded to the site were determined based on the observations.

- **Other Data Sources**

  Gathering information through reports and on-site observations did not supply all the necessary data for the scoring process. Therefore, there were information gaps, necessitating contact with stakeholders and related institutions such as municipalities, planners, as well as local residents for information that include details of fresh food sources and bicycles' amenities in the residential buildings. In some cases, the aerial photo was a tool for measuring distances, as several metrics involve point assignments based on distances and areas. Moreover, Google Street View for Rawabi City was used to collect data that enables measuring some metrics accurately.

3.3 Analysis Methodology

The analysis of the current situation for both study areas had been conducted using qualitative and quantitative measurement indicators that represent each TOD principle as specified by ITDP. This was done after allocating the weight for each principle across all its sub-measures, forming a total of one hundred points. In this section, the details of the analytical methodology presented in Chapter One are elaborated in greater detail. The distribution of weights on TOD principles are outlined, along with specific points for each sub-metrics corresponding to each principle. All of these details are explained in tables hereafter. All standard values for all metrics are presented in Appendix A.

1. **Walk principle**

   Walking stands out as the most natural, cost-effective, health-promoting, and environmentally friendly mode of transportation for short distances, forming an integral part of the majority of transit journeys. It serves as a foundational element of sustainable transport, offering an enjoyable and productive means of mobility when paths and streets are well-populated, and essential services are conveniently located. Despite its benefits, walking involves physical effort and is greatly influenced by environmental conditions. Additionally, aspects like shortness and directness, integral to walkability, are further explored under Principle 3 (Connect). Three key performance objectives underpin the appeal of walking: safety, activity, and comfort.

All objectives, metrics and points for walk principle are explained in Table 3.1 hereafter [6].

Table 3.1
Objectives, metrics and points for walk principle

Walk Principle			
Objectives	Metrics	Metrics Definition	Points
Objective A (The pedestrian realm is safe and complete)	Walkways	Percentage of block frontage with safe, wheelchair-accessible walkways	3
	Crosswalks	Percentage of intersections with safe, wheelchair accessible crosswalks in all directions	3
Objective B (The pedestrian realm is active and vibrant)	Visually Active Frontage	Percentage of walkway segments with visual connection to interior building activity	6
	Physically Permeable Frontage	Average number of shops and pedestrian building entrances per 100 meters of block frontage	2
Objective C (The pedestrian realm is temperate and comfortable)	Shade & shelter	Percentage of walkway segments that incorporate adequate shade or shelter element.	1
	Total		15

To ensure safety, a variety of path and street configurations can be employed. The adequacy of walkways and road-crossing systems is assessed through Metrics 1.1 (Walkways) and 1.2 (Crosswalks), measuring the availability and coverage of these infrastructures.

However, the appeal of walking is highlighted when sidewalks are bustling, dynamic, and adorned with practical ground-floor activities and services, such as storefronts and restaurants. Proximity to passing pedestrians and cyclists not only captures attention but also infuses energy and vibrancy into local retail establishments. Metric 1.3 (Visually Active Frontage) assesses the potential for visual connections between sidewalks and the interior ground floors of neighboring buildings. This metric encompasses various

premises, including not only shops and restaurants but also workplaces and residences. Similarly, Metric 1.4 (Physically Permeable Frontage) gauges active physical connections along the block frontage, considering entrances and exits to and from storefronts, building lobbies, courtyard entrances, passageways, and other relevant elements.

The inclination to walk can be notably improved by incorporating straightforward elements that enhance the walking environment, such as street trees. The provision of trees, considered the simplest and most efficient method of offering shade in most climates, is quantified through Metric 1.5 (Shade and Shelter). Trees not only provide shade but also bring about numerous environmental and psychological benefits. Additionally, various forms of shelter, including arcades and awnings, contribute to enhancing walkability.

2. Cycle Principle

Cycling is an emission-free, healthy, and cost-effective mode of transportation that is remarkably efficient, requiring minimal space and resources. Bicycles and other people-powered transport options, like pedicabs, activate streets and significantly expand the coverage area of transit stations. An essential requirement for TOD is the establishment of a secure cycling network that links all buildings and destinations via the most direct routes. This fundamental provision is measured by Metric 2.1 (Cycle Network). The cycling network can encompass different types of cycleways, such as dedicated cycle paths, lanes designated for cycling on roads, and streets designed to be cycle-friendly.

The attractiveness of cycling as a travel option is contingent on the availability of cycle racks at destinations and the ability to securely store bicycles within private premises overnight or for extended periods. These considerations are addressed through specific metrics, namely Metric 2.2 (Cycle Parking at Transit Stations), Metric 2.3 (Cycle Parking at Buildings), and Metric 2.4 (Cycle Access in Buildings). All details of cycle Principle including objectives, metrics and points are explained in Table A22 in Appendix A.

3. Connect Principle

Efficient and direct pedestrian and cycling routes necessitate a well-connected network of paths and streets surrounding small, permeable blocks. A straightforward indicator of path connectivity quality is the density of pedestrian intersections, heavily reliant on having small blocks. Metric 3.1 (Small Blocks) is a measure that recognizes and rewards a development with a small average block size. When coupled with the establishment of a comprehensive pedestrian network, this contributes to creating a dense mesh of pedestrian and cycling routes. Such a mesh provides a diverse range of route options for individuals to choose from when traveling to their destinations, enabling access to numerous activities along the way.

Streets with frequent corners, narrower right-of-way's, slower vehicular speeds, and a high volume of pedestrians promote street activity and local commerce. An urban layout that prioritizes pedestrians and cyclists over cars by providing greater permeability further emphasizes non-motorized and transit modes, while robust pedestrian and cycling connectivity is a crucial aspect of TOD. Metric 3.2 (Prioritized Connectivity) directly compares these two categories and incentivizes higher ratios of non-motorized travel (NMT) path connectivity to car-accessible road connectivity. This metric encourages a focus on enhancing connectivity for non-motorized modes of travel over prioritizing road networks for motor vehicles. Table A23 in Appendix A illustrates the objectives, metrics and points for connect principle.

4. Transit Principle

Transit serves as a vital link, connecting and integrating distant parts of the city for pedestrians. To be acknowledged under the TOD Standard, access and proximity to high-capacity public transit services, specifically defined as BRT or rail transit, are essential prerequisites. High-capacity public transit assumes a critical role by facilitating highly efficient and equitable urban mobility, while also supporting the development of dense and compact urban patterns. Transit takes various forms to cater to the entire spectrum of urban transport needs, encompassing both low- and high-capacity vehicles, taxis, bi-articulated buses, and trains.

The TOD guidelines stipulate that the maximum recommended distance to the nearest high-capacity transit station is set at 1 kilometer, equivalent to a 15- to 20-minute walk.

Additionally, by constructing at higher densities in close proximity to the transit station, a development can optimize accessibility, ensuring a greater number of people and services can be easily reached within a short walking distance. Metric 4.1 (Walk Distance to Transit) mandates that developments must adhere to this requirement to be eligible for recognition. Table A24 in Appendix A shows the objective of the transit principle which is fundamental and have no points.

5. **Mix Principle**

Creating a harmonious blend of complementary uses and activities within a local area, including a mix of residences, workplaces, and local retail commerce, offers the potential to keep daily trips short and walkable. This diversity of uses, with activities peaking at different times, contributes to vibrant and secure local streets, encouraging walking and cycling. Such a mix fosters a lively and appealing human environment for residents. Metric 5.1 (Complementary Uses) acknowledges and rewards developments that integrate both residential and non-residential uses. Metric 5.2 (Accessibility to fresh food) is not only essential for daily life but also contributes to an improved quality of life by enabling residents to walk to purchase produce and meals.

Moreover, this diversity positively influences commuting patterns, ensuring a balanced flow and thereby improving the efficiency of the transit system. The inclusion of a variety of housing prices within a community enables some workers to live near their jobs, preventing the displacement of lower-income residents -who often rely on more affordable public transit- to outlying areas and potentially reducing their dependence on motor vehicles. Therefore, the two performance objectives for this principle's center around achieving a balanced mix of land uses and a diverse mix of resident income levels. Metric 5.3 (Affordable Housing) provides recognition and rewards for mixed-income developments that incorporate dedicated affordable housing. This metric emphasizes the importance of creating inclusive communities with housing options that cater to individuals across various income levels, promoting socio-economic diversity within the development. Table A25 in Appendix A explains objectives, metrics and points for mix principle.

6. **Densify**

To accommodate urban growth in a compact and concentrated manner, cities must pursue vertical growth (densification) rather than spreading horizontally (sprawl). High urban densities, particularly when geared towards transit, contribute to a transit service characterized by high quality, frequency, and connectivity, while also generating resources for investing in system improvements and expansions.

Transit-oriented density leads to well-populated streets, creating vibrant neighborhoods, and secure station areas that attract residents. Density establishes the customer base necessary to support a diverse range of services and amenities, fostering the prosperity of local commerce. The only constraints on densification should arise from hygiene and human health requirements such as natural lighting, ventilation and good fresh air circulation, parks and open spaces accessibility, preservation of natural systems, and protection of historic and cultural resources.

The performance objective under this principle underscores the importance of both residential and non-residential density in supporting high-quality transit and local services. Metric 6.1 (Land Use Density) provides recognition and rewards for communities that achieve equal or higher densities compared to comparable projects. This metric encourages collaboration between the public and private sectors to enhance allowable residential and non-residential densities. The goal is to promote urban development that is both efficient and aligned with the specific characteristics of the surrounding environment. Table A26 in Appendix A illustrates all details of densify principle including objectives, metrics and point.

7. **Compact Principle**

The fundamental organizational concept behind concentrated urban development is compact development. In a compact city or district, different activities and facilities are strategically situated in close proximity, reducing the time and effort needed to access them and enhancing opportunities for interaction. Compact cities, due to shorter distances, necessitate less extensive and costly infrastructure (although higher planning and design standards are essential) and prioritize the densification and redevelopment of previously used land to preserve rural areas from further development. The Compact principle, when applied at a neighborhood level, fosters

spatial integration through well-connected walking and cycling paths, as well as an orientation toward transit stations. On a citywide scale, being compact involves spatial integration through public transit systems. The two key performance objectives for this principle revolve around the proximity of a development to existing urban activities and minimizing travel time to major destinations in both central and regional areas. two metrics score this principle which are Metric 7.1 (Urban Site) rewards development on sites within or at the immediate edge of an urbanized area. Also, this metric incentivizes development on sites situated either within an urbanized area or at its immediate periphery. Furthermore, Metric 7.2 (Transit Options) measures the availability and proximity of transit stations on different lines since they should be accessible within walking distance. All metrics of compact principle are detailed in Table A27 in Appendix A .

8. Shift principle

When urban centers follow the seven principles mentioned earlier, individual automobiles become largely unnecessary in everyday activities. Walking, biking, and the efficient use of high-capacity public transportation become easily accessible and convenient, supplemented by various intermediate transit options. This transition reduces the need for extensive road networks and parking areas, enabling the conversion of valuable urban spaces for more socially and economically beneficial purposes. The performance objective outlined below underscores these benefits.

Insufficient allocation of off-street areas for parking motor vehicles is acknowledged positively through Metric 8.1 (Off-Street Parking). Metric 8.2 (Driveway Density) assesses the prevalence of driveways violating the protected status of walkways, and encourages minimizing disruptions to the pedestrian network. Metric 8.3 (Roadway Area) incentivizes diminishing the street space occupied by motor vehicles, encompassing both road areas and on-street parking. Table A28 in Appendix A illustrates all details of shift principle including objectives, metrics and point.

3.4 Case Studies Assessment

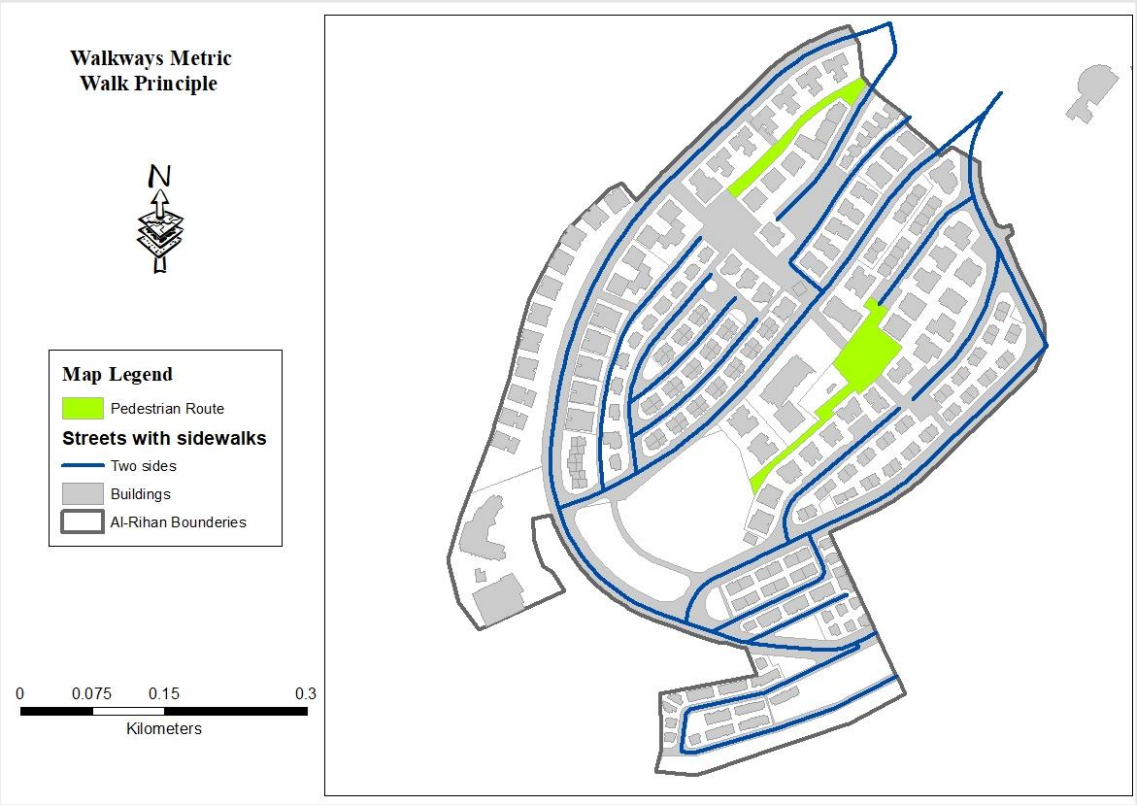
In this sub-section, the results of the evaluation of the two local case studies (Rawabi City and Al-Raihan Suburb) are presented in light of TOD principles to determine the extent to which their spatial planning aligns with TOD principles. The goal was to identify the strengths to enhance and weaknesses to address and avoid later. The objective of this evaluation process was also to study the practicality of this framework and its applicability at the Palestinian local level. Additionally, the significance of this analysis lies in providing assistance in formulating policies and general strategies to achieve TOD objectives.

1. Walk principle

The collected data for walk principle is analyzed for both study areas (Al-Raihan Suburb and Rawabi City) and the data related to walkways metrics is shown separately in Figure 3.1 and Figure B1 in Appendix B, respectively [29, 30].

Figure 3.1

Walkways Metrics for Al-Raihan Suburb



Regarding the walk principle, the overall result in the evaluation was very low in both case studies. This indicates a lack of prioritization for pedestrian facilities in city planning. This is a common issue in most Palestinian cities; however, it is crucial to address and give greater importance to it, especially in newly designed cities and residential neighborhoods. This approach aligns with a modern global trend that emphasizes the significance of prioritizing pedestrian infrastructure to enhance sustainability in urban communities. Table 3.2 shows the evaluation values for each metric related to walk principle for both study areas.

Table 3.2
The Evaluation of Principle 1 (Walk)

Principle 1: Walk			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
1.1 Walkways	3	3	1
1.2 Crosswalks	3	1	1
1.3 Visually Active Frontage	6	0	0
1.4 Physically Permeable Frontage	2	2	1
1.5 Shade & shelter	1	1	1
Total	15	7	4

2. Cycle Principle

For cycle principle, bicycle facilities were virtually nonexistent. There is no integrated network of bike lanes; instead, the cycling infrastructure is limited to internal streets with low-speed limits and high accessibility to private properties and residential buildings as shown in Figure 3.2 and Figure B2 in Appendix B.

Additionally, there are no provisions in the local building codes addressing anything related to bicycle facilities and their parking in public or private spaces. It is essential to emphasize the importance of enhancing the design of internal road networks to facilitate the use of bicycles. Moreover, there is a need to amend the local building code to provide secure bicycle parking in both private and public buildings, as well as at transportation stations, to encourage residents to use bicycles as shown in Figure B3 and Figure B4 in Appendix B.

After reviewing and analyzing the maps, both study areas were evaluated for each metric related to cycle principle. Table 3.3 shows the results related to cycle principle.

Figure 3.2

Cycling Network for Al-Raihan Suburb

Table 3.3

The Evaluation of Principle 2 (Cycle)

Principle 2: Cycle			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
2.1 Cycle Network	2	1	0
2.2 Cycle Parking at Transit Stations	1	0	0
2.3 Cycle Parking at Buildings	1	0	1
2.4 Cycle Access in Buildings	1	0	0
Total	5	1	1

3. Connect Principle

Regarding the connect principle, which aims to enhance the integration between pedestrian pathways, bicycle routes, and vehicular roads, the focus is primarily on block sizes. This principle encourages reducing block sizes to increase pedestrian crossing points. Frequent street corners and narrower rights-of-way, coupled with slow vehicular speed and a high volume of pedestrians, foster street activity and local

commerce. An urban fabric that is more permeable to pedestrians and cyclists than to cars prioritizes non-motorized and transit modes.

In the context of TOD, it is crucial in city planning to prioritize pedestrians over vehicles and increase the proportion of pedestrian intersections compared to vehicle intersections. It is preferable for the ratio to be 2:1, which was actually present in Rawabi City (see Figure 3.4). This is in contrast to Al-Raihan Suburb (see Figure B5 in Appendix B), where most of its streets were dedicated to vehicles without pedestrian crossings. This led to a decrease in the ratio of pedestrian intersections to vehicle intersections (0.2), resulting in a low score in this criterion.

The evaluation result for this principle was better than the preceding principles as Table 3.4 shows, which is noticeable in reality. The predominant character in both case studies is a residential nature, leading to increased internal streets that govern vehicular movement and enhance the density of pedestrian crossing points [29, 30].

Figure 3.3

Prioritized Connectivity in Rawabi City

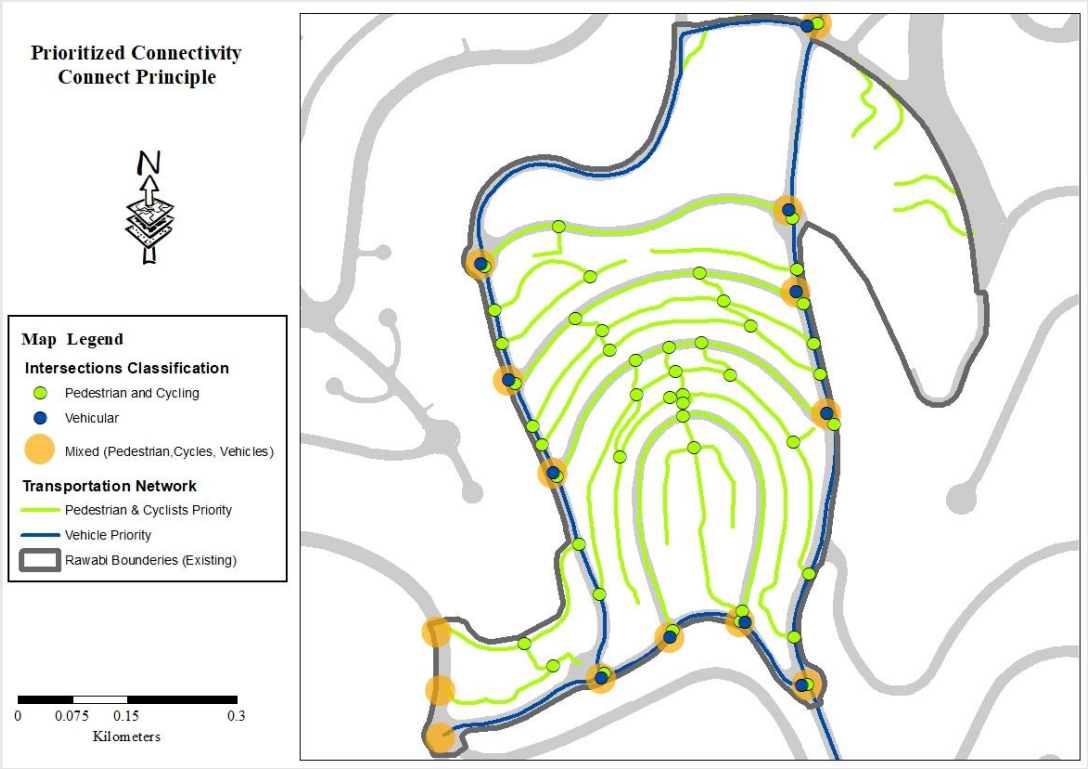


Table 3.4

The Evaluation of Principle 3 (Connect)

Principle 3: Connect			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
3.1 Small Blocks	10	2	6
3.2 Prioritized Connectivity	5	5	0
Total	15	7	6

4. Transit principle

As for the transit principle, the presence of a high-capacity public transport system is a fundamental requirement for this principle due to its essential role in supporting dense and cohesive urban development patterns. It is to be indicated that "high-capacity transit station," means a station defined as BRT, rail, or a station on a direct transit service connecting to high-capacity transit within 5 kilometers. This principle focused on the necessity of having a transit system as a fundamental condition for evaluation. However, this condition was lacking in both case studies, where public transportation was limited to shared taxis and buses serving several surrounding

communities. Both are served by the Birzeit-Bani Zaid Bus Company, specifically through two buses with a capacity of 19 passengers. However, the residents of Rawabi City depend on Ajjol and Arora shared taxi route. It is worth noting that a taxi office was recently licensed to serve the city of Rawabi [31]. The evaluation for transit principle's metric is shown in Table 3.5.

Table 3.5
The Evaluation of Principle 4 (Transit)

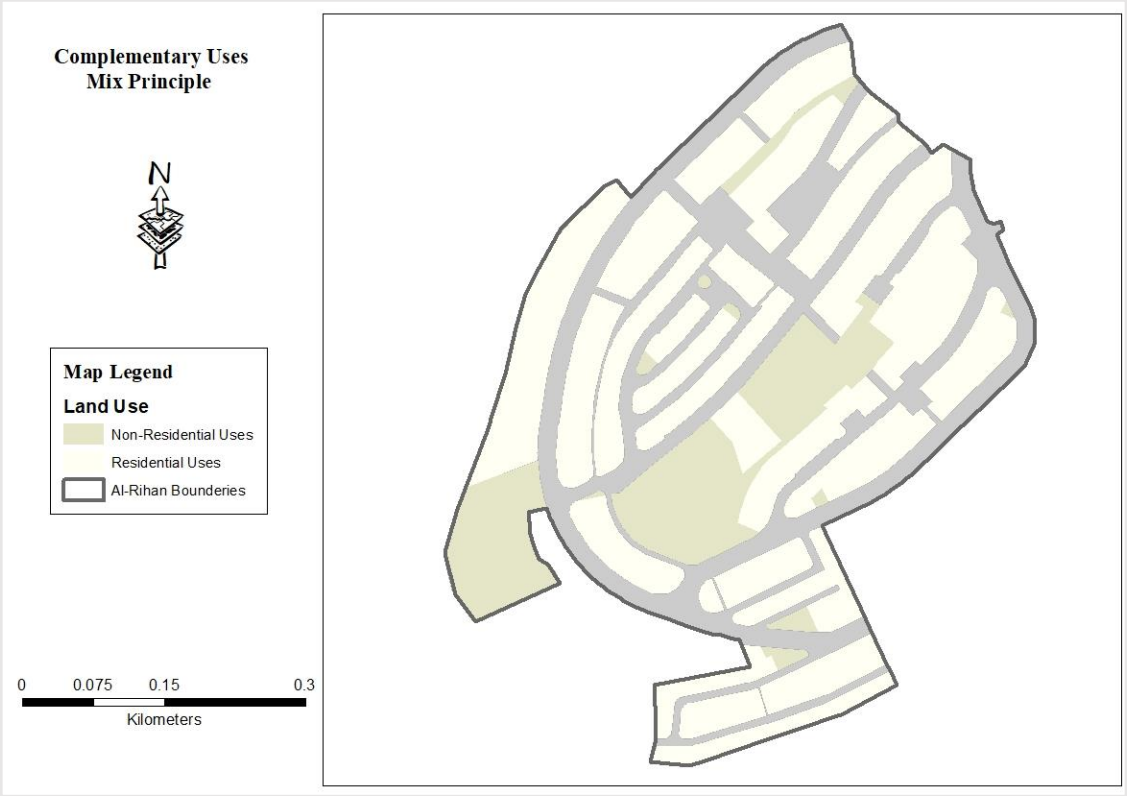
Principle 4: Transit			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
Walk Distance to Transit	Required	Not Available	Not Available
Total	-	-	-

5. Mix principle

The mix principle primarily aims to reduce the distance of daily trips and their frequency for residents by diversifying land uses and enabling residents to meet all their daily needs within an area that is accessible by walking within 5 to 10 minutes. This, in turn, promotes the use of non-motorized traffic and reduces the reliance on vehicles. The principle also aims to enhance the vibrancy of urban areas and ensure more safety for residents. This principle is not limited to land use diversity; it also extends to socio-economic aspects by ensuring diversity in housing options, including affordable housing. The collected data was analyzed for all metrics of this principle. The most tangible metric was (Complementary Uses) that measures residential and non-residential uses combined within same or adjacent blocks is shown in Figure 3.5 for complementary uses in Al-Raihan Suburb, and Figure B6 for Rawabi Planned City, and Figure B7 in Appendix B for Rawabi within existing city boundaries.

Figure 3.4

Complementary Uses in Al-Raihan Suburb



The evaluation process revealed a tangible decrease in the complementary uses' metric for this principle in Al-Raihan Suburb, primarily due to its main function as a residential suburb.

Regarding the food accessibility criterion, the standards stipulate the necessity of having stores or supermarkets within a walking distance not exceeding 15 minutes to provide fresh food (vegetables, fruits, meats, and fish, as well as dairy products) daily. In Rawabi City, Sallati supermarket meets these needs, and there are also several planned stores that have not opened their doors for service yet. Similarly, in Al-Raihan, Al-Mashhadawi supermarket is considered one of the largest in the area and its surroundings. This means that it does not only serve the residents of Al-Rihan but also caters to the residents of the adjacent areas. In this way, both study regions have met the standard related to food accessibility.

Regarding affordable housing, both regions are characterized by high housing prices, making them unsuitable for those with average or limited incomes. This led Rawabi City to reconsider the housing options it offers to the real estate market. The city aims

to provide smaller homes at prices that align with the average income groups in the currently planned neighborhoods. It's worth noting that the target group for this type of housing includes average income groups and young couples. On the other hand, Al-Raihan Suburb is planned and developed to offer various luxurious buildings based on the type of residence. The target group for this project is individuals with higher incomes.

In terms of use diversity (Mix Principle), Rawabi City performed better than Al-Raihan Suburb because it was planned as a self-sufficient city. Table 3.6 shows the evaluation of mix principal metrics for both study areas.

6. Densify principle

The densify principle generally aims to promote density directed towards transit, seeking to increase population density near public transport stations and along their routes. This contributes to the efficiency of the system in terms of frequency and cost. Higher population density also enhances the vitality and activity of the city, significantly impacting the feasibility of various investments in the city, as these residents are the users of the public transport system and the customers and workers of those investments.

Table 3.6

The Evaluation of Principle 5 (Mix)

Principle 5: Mix			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
5.1 Complementary Uses	10	5	0
5.2 Accessibility to Food	1	1	1
5.3 Affordable Housing	4	2	0
Total	15	8	1

The evaluation process for a development's density involves several key steps. Firstly, the average density is calculated using local Gross Floor Area (GFA) standards. Subsequently, the two comparable cases have similar land use regulations, market strength, size, and project type, with a focus on being the densest in the area. The baseline

density determined by averaging the Floor Area Ratio (FAR) of these comparative areas. Finally, the average density for each is compared to this baseline (74.6%), for Rawabi the calculated density (75.3%) is higher than baseline density so it scored 15 points. While Al-Raihan Suburb land use density (73.9%) is within 5% below the baseline density so it scored 7 points.

During the evaluation phase of the sixth principle, it was evident that there is a moderate level of land use intensification in both cases. This can be attributed to the diversity of housing patterns in the region, leading to variations in allowable building ratios according to local building regulations. This principle can be further reinforced by adopting a vertical expansion pattern rather than a horizontal one and adhering to infill development practices. Table 3.7 shows the evaluation of densify principle's metric for both study areas.

Table 3.7
The Evaluation of Principle 6 (Densify)

Principle 6: Densify			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
6.1 Land Use Density	15	15	7
Total	15	15	7

7. Compact principle

The fundamental organizational principle for dense urban development is compact development, where various activities and uses are strategically located together. Therefore, compact principle is measured using to metrics urban site and transit options. The urban site metric aims to encourage densification and the effective utilization of previously undeveloped vacant lots. Urban site metric mainly depends on the percentage of developable sites that are built-up, since this percentage should be more than 60% up to 90% and the points are relative to this percent from 0 to 10. If the percentage of occupied areas in the urban area is less than 60 percent, this means that it follows the horizontal spread pattern and not the compact principle. As the percentage of occupancy increases, its proximity to the compact system increases.

Rawabi City received a score of zero on this scale, because the city is in the development and construction phase, as it has not implemented all its planned stages. The urban site metric is presented in Figure 3.6 for Al-Raihan Suburb, Figure B8 in Appendix B for Rawabi Planned City, and Figure B9 in Appendix B for Rawabi within existing City boundaries. Maps show a difference in this percentage when applying the scale to the planned city boundaries and to the existing boundaries of the built-up area of 4% and 72%, respectively. On the contrary, Al-Raihan Suburb achieved a perfect score (10 points) in this criterion because the percentage of the built-up area exceeded 90% of the developable areas.

The second criterion is the provision of diverse transportation options for users. This metric is evaluated based on the number of different transit options that are accessible within walkable distance from any area in the study area. There was no tangible presence of multiple transportation modes in both study areas such as transit lines, but there is a para transit option for both. Rawabi City had more transportation options than Al-Raihan Suburb, regardless, these options are still planned and aren't implemented. However, Rawabi City plans to provide different mobility options, including shared taxis, buses, and private taxis. The compact principle requires continuous service from 7 am to 10 pm with a maximum headway of 20 minutes, which is difficult to achieve with the current population. Table 3.8 shows the evaluation of compact principal metrics for both study areas.

The principles described, emphasizing compactness, reduced travel time, and efficient land use, align well with the concept of TOD that emphasizes creating compact, mixed-use urban environments with high-density development around transit stations. In the context of TOD, the aim is to reduce dependence on private vehicles, promote walking and cycling, and maximize access to public transportation.

The compactness reduces the need for extensive infrastructure and contributes to efficient land use. In a TOD framework, this would mean that the development is designed to be within easy walking or cycling distance from transit hubs, encouraging residents to use public transportation. This not only reduces the environmental impact but also supports sustainable and vibrant urban communities.

Preserving rural land and limiting expansion align with TOD principles, as TOD encourages development around transit nodes rather than sprawling into rural areas. By ensuring proximity to major urban centers and regional hubs, the development becomes well-connected and accessible, further promoting the goals of TOD. Overall, the described principles of compactness, efficient land use, and connectivity resonate with the core tenets of TOD.

Figure 3.5

Urban Site Metric in Al-Raihan Suburb

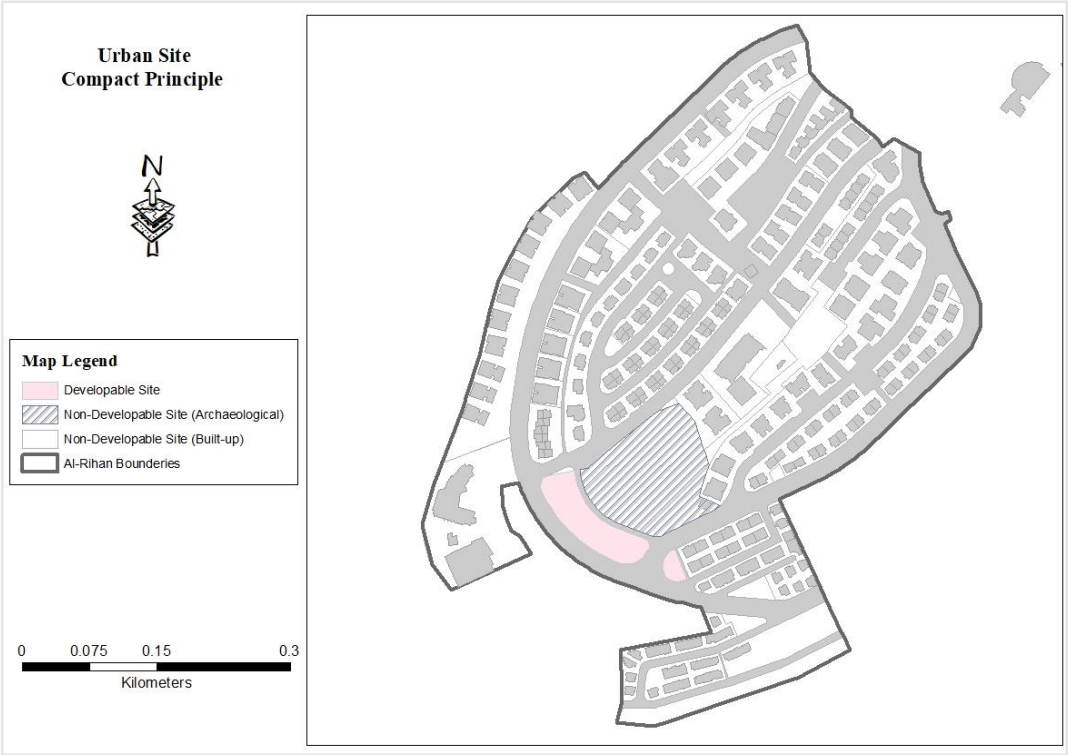


Table 3.8

The Evaluation of Principle 7 (Compact)

Principle 7: Compact			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
7.1 Urban Site	10	0	10
7.2 Transit Options	5	1	0
Total	15	1	10

8. Shift Principle

The shift principle emerges as a confirmed outcome of applying the seven preceding principles, where personal vehicles become largely unnecessary in daily life due to the presence of an urban environment that primarily promotes walking, cycling, and flexible use of high-capacity transportation. This principle was measured through three metrics: off-street parking, roadway area and driveway density that measures the frequency of driveways breaching the protected status of walkways, and pathway density.

The analysis process indicated that both study areas met the standards for parking and pathway density, achieving high scores. However, there was a higher percentage of street area allocation in Al-Reihan Suburb (26%), compared with Rawabi City (16.5%). Table 3.9 that shows the evaluation of shift principle's metrics for both study areas.

Table 3.9

The Evaluation of Principle 8 (Shift)

Principle 8: Shift			
Metrics	Points	Case Studies Assessment	
		Rawabi City	Al-Raihan Suburb
8.1 Off-Street Parking	10	10	10
8.2 Driveway Density	2	2	2
8.3 Pathway Area	8	8	0
Total	20	20	12

3.5 Analysis Results

This part of the research presents the final result of evaluating the consistency of the two local case studies (Rawabi City and Al-Raihan Suburb) with TOD principles. This section focuses on presenting the overall result for each case study individually and providing guidance and suggestions to improve the overall score for each criterion separately, aiming to take a step forward towards TOD.

3.5.1 Rawabi City Analysis Results

The city of Rawabi achieved an advantage in the assessment over its counterpart, Al-Raihan Suburb, which was realistic since Rawabi is the first Palestinian city planned from scratch, while Al-Raihan is a modern suburb within the boundaries of the Ramallah Municipality. Rawabi has an advantage due to its independence as a self-sufficient city aspiring towards inclusivity and sustainability, which is part of its vision. Rawabi City has summarized its vision in three brief words reflect an integrated and comprehensive planning approach, as its vision is (Live, Work, Grow) that could be explained as follows:

- Live: Rawabi is a newly developed city designed to cater to Palestinian families, offering affordable opportunities for home ownership, employment, education, and leisure. Geared towards young Palestinian families, Rawabi provides an attractive and modern living environment.
- Work: Rawabi's central business district stands out as a technologically advanced and investor-friendly commercial hub, boasting amenities unique in Palestine. Presently hosting various companies and startups, its modern technology and cutting-edge infrastructure create an ideal setting for establishing business operations. As anchor investors join and job opportunities grow, the local workforce is expected to gain strength through knowledge transfer and practical experience.
- Grow: Rawabi's holistic development approach prioritizes environmental impact consideration in every phase, integrating eco-friendly features and sustainable building strategies. Construction materials are sourced from natural resources, emphasizing recycling. The self-contained city includes intra-city transportation and essential facilities, making it an ideal and sustainable living environment for generations, supported by robust infrastructure and community values.

After evaluating the city of Rawabi in light of TOD principles, it received an overall score of 59%, which is a relatively low score for a city that aims for sustainability and places it among its top priorities.

Regarding the principle of walking, the city provides a large number of dedicated pedestrian pathways, prioritizing pedestrians over vehicles on internal streets by paving them with tiles instead of asphalt. This design choice reduces vehicle speeds to a minimum, enhancing pedestrian safety considerations.

The city is characterized by wide sidewalks, shaded with trees, along with the shadows of surrounding buildings, creating a conducive environment for walking. The factors that significantly influenced this principle in a negative manner were Visually Active Frontage and Visually Permeable Frontage. Since, visually active frontage refers to the extent of a building frontage along public walkways that is visually transparent and interacts with the surroundings. The low scores in this metric were due to the predominant use of natural stone as a primary building material in the city. This choice is based on the fact that natural stone is the most common building material in Palestine, favored for its thermal insulation properties in various weather conditions and its ability to maintain privacy for residential buildings, reflecting the cultural preferences of the residents. Glass and transparent facades were mainly limited to commercial areas, representing a very small percentage of the buildings in Rawabi.

Physically permeable frontage involves entrances that qualify as openings to storefronts, park and corner plaza entrances, building lobbies, restaurants, cafes, cycle and pedestrian passageways, and active service entrances. Therefore, Rawabi City have highly scored this metric due to the large area of Q-center (CBD of Rawabi), but this was limited in the residential areas.

For cycle principle, it was particularly noticeable during the evaluation of the weakness in the enhanced infrastructure for cycling, such as the provision of exclusive lanes on streets with speeds exceeding 30 km/h or shared lane on streets with speeds (15-30) km/hr. Additionally, there was lack of designated bicycle parking spaces in public buildings at the entrances of larger buildings with an area exceeding 500 square meters or a residential unit count of six or more.

As for the connect principle, the criterion of small blocks significantly influenced its overall score. Rawabi is characterized by relatively long blocks, attributed to the city's morphological characteristics that are closer to a circular shape due to its mountainous terrain. The distance between pedestrian pathways or streets is considered a block, provided that these pathways are open for public use for a minimum of 15 hours per day. The preferred ~~dimension~~ length of a block is 100 meters, with a maximum of 150 meters. However, most blocks in Rawabi exceeded 200 meters. To improve this aspect, it is

recommended to reconsider the pedestrian pathway network and enhance it with additional pathways or crosswalks as needed.

On the other hand, a full score was achieved in the prioritized connectivity scale due to the high percentage of pedestrian intersections, which is more than twice the number of intersections designated for vehicles.

The analysis revealed that there is no intensive public transit stations in the city, defined as either a high-capacity transit station (such as BRT or rail) or a station on a direct transit service connecting to high-capacity transit within 5 kilometers. The city did not meet either of these criteria, which is essential for achieving TOD. Public transportation to/from Rawabi relies on shared transportation mode (shared taxis) like other Palestinian cities. It is important to note that all buildings should be within a buffer zone of 1 km from the main station, unless a subsidiary station leading to the main station within 500 meters for those not served by the main station.

As for the principle of mix, the overall score for the city was moderate, indicating a need to reconsider land use ratios to make the dominant land use (residential) 50%. Regarding affordable housing, the city featured for its high prices, although it did provide few apartments with relatively small areas suitable for young couples. The city also entered into agreements with banks to facilitate installment payments for apartments based on the buyer's income. To improve this criterion, the city should increase the percentage of affordable housing to cater to various economic segments in the community.

The analysis showed a score of zero for the urban site measure in the city of Rawabi. The built-up area of the city does not exceed 5% of the planned city area (reached 2.2%). This means that, at present, it is considered a relatively remote area with lower livability compared to cities connected to adjacent urban areas. To improve this measure, Rawabi should aim to develop the city as quickly as possible and enhance the compact principle to make public transportation routes and commercial and professional investments more viable. This would increase its consistency with TOD principles. Given its current low population, providing transportation options is challenging and not financially viable. The compact principle requires continuous service from 7 am to 10 pm with a maximum headway of 20 minutes, which is difficult to achieve with the current population.

The city performed well in the shift principle, achieving a full score. This indicates the city's inclination towards transitioning from vehicle use to active transportation means such as walking, cycling, and micromobility transportation. This is reflected in the increased width of sidewalks at the expense of space allocated for vehicles, whether for traffic lanes or on street parking.

3.5.2 Recommendations and Guidelines for Rawabi City Based on Analysis

After completing the evaluation process and identifying all the strengths and weaknesses in the city, the following guidelines can be provided for Rawabi to consider in order to increase its alignment with TOD principles and assist in achieving its vision of sustainability:

1. **Increase Visually Active Frontage and Physically Permeable Frontage:**
    - Increase the proportion of transparent and efficient facades by using new building materials such as glass to be mixed with natural stone, enhancing interaction between pedestrians and the internal elements of blocks.

2. **Reallocate Streets Right of Way:**
    - Reallocate right of way elements on city streets to include exclusive lanes dedicated to bicycles, especially on streets with speeds exceeding 30 km/h, or shared lanes on streets with speeds (15-30) km/hr.

3. **Enhance Bicycle Facilities:**
    - Increase the number of bicycle facilities in the city through building code modifications, specifying the provision of secure parking spaces dedicated to bicycles at entrances of large residential buildings exceeding 500 square meters or 6 residential units or more.
    - Provide bicycle rental services throughout the city.

4. **Reallocate Internal Blocks:**
    - Reallocate internal city blocks to be smaller in size (preferably 100 meters in length) by increasing pedestrian walkways and pathways, reducing walking distances between blocks, thus promoting the connect principle in the city.

5. **Provide a Multi-Modal Public Transportation System:**
    - Provide a multi-modal public transportation system that serves all parts of the city.
    - Design stations so that all buildings are within the service range of the main station (1 km) or within 500 meters of a subsidiary station leading to the main station, noting that these distances are not straight-line distance but represent the actual length of roads leading to them.

6. **Reallocate Land Uses:**
    - Reallocate land uses in the city to reduce the percentage of residential use to approximately 50% of the land use plan, ensuring the achievement of the diversity and mix principle as possible. For example, some residential buildings can be converted into commercial shops on the ground floors and offices on the upper floors, with agreements made with residents to facilitate their relocation to residential areas.

7. **Diversity in Housing Options:**
    - Diversify housing options to suit all social classes, with a primary focus on providing affordable housing for those with limited income.

8. **Increase Livability:**
    - Increase livability in the city by completing the development of all its neighborhoods as quickly as possible.

3.5.3 Al-Raihan Suburb Analysis Results

As for the evaluation results of Al-Raihan Suburb in light of TOD principles, the suburb received a very low score (41%) in the overall assessment of principles. This can be attributed, as mentioned earlier, to the fundamental concept behind the development of Al-Raihan as a residential suburb and not as an integrated city. Additionally, it is a relatively isolated suburb from various city functions with some other limited functional characteristics than housing such as Arab American University branch, Istishari Arab hospital, and Lacasa mall.

Regarding the principle of walking, it was found that Al-Raihan Suburb lacks dedicated pedestrian streets or streets that prioritize pedestrians. Pedestrian facilities are limited to a single shared path between pedestrians and cars, in addition to shaded sidewalks with

trees and some paved public squares. The scale that significantly impacted this principle includes Visually Active Frontage and Physically Permeable Frontage. The scores were low due to the predominant use of natural stone as a primary building material in Al-Raihan, similar to other Palestinian cities. However, some glass facades were used in standalone and semi-detached buildings in the suburb, but surrounded by fences that obstruct visibility.

The evaluation also revealed a lack of enhanced infrastructure for bicycle use in Al-Raihan Suburb, resulting in low scores in this criterion. There is no indication of bicycle parking facilities in the suburb, and dedicated separated lanes for bicycles on streets with speeds exceeding 30 km/h are absent, making it unsafe for cycling.

As for the principle of connectivity, it significantly impacted the overall scores, especially with the criterion of small blocks. Al-Raihan Suburb features a variety of block sizes, including large and smaller blocks, to diversify housing patterns and construction. However, all the smaller blocks exhibit high privacy, preventing the presence of public pedestrian pathways between them. This design choice is due to the fact that these smaller blocks are designed in the form of villas and semi-detached buildings.

Similarly, for the prioritized connectivity scale, the absence of pedestrian intersections compared to the significant number of intersections designated for vehicles indicates a prioritization of vehicles over pedestrians in the suburb.

Similarly, concerning the transit principle, the analysis indicated a complete absence of high-capacity transit stations in the city. By "high-capacity transit station," we mean a station defined as BRT, rail, or a station on a direct transit service connecting to high-capacity transit within 5 kilometers. The suburb did not meet either of these conditions, and this requirement is fundamental for achieving TOD. The suburb heavily relies on private vehicles for its residents or taxi services, closely linked to the luxury lifestyle and urban structure of its inhabitants. It is essential that there be a main transit station within 1 km, and in case it does not cover all buildings, a subsidiary station should be provided within a 500-meter service range.

Regarding the mix principle, the suburb received a very low overall score, primarily due to its function as a residential area where the predominant use is residential. As for

affordable housing, the city distinguished itself with high prices, designed to provide luxurious housing for those with above-average income. To improve this metric, the city should increase the percentage of affordable housing to cater to all economic strata in society.

On the other hand, the overall score for the density principle was average because of the low land use density, which is 5% below the standard value. This necessitates a reconsideration of the distribution and intensification of land uses in the suburb. As for the urban site metric, which is part of the compact principle, only 2% of the suburb's land is available for development and construction, earning it a high score in this metric. Conversely, concerning the transit options metric, there are no public transportation options in the suburb, and the only available means of transportation are private vehicles. TOD principles require a permanent public transportation service from 7 a.m. to 10 p.m. with a maximum headway of 20 minutes.

As for the last principle, shift, the evaluation revealed a significant decrease in dedicated facilities such as off-street parking in Al-Raihan Suburb. This reduction aligns with the shift principle and contributes to its realization. However, there was a notable decrease in the Roadway Area metric, constituting 26% of the total suburb area. To enhance this principle, it is essential to convert several internal streets into pedestrian pathways and to redistribute the right-of-way more efficiently, encouraging the use of public transportation or active modes of transportation.

3.5.4 Recommendations and Guidelines for Al-Raihan Suburb Based on Analysis

After completing the evaluation process and identifying all the strengths and weaknesses in the suburb, sustainable development principles in the suburb can be enhanced through:

1. **Increase the Percentage of Transparent Facades:**
    - Use new building materials, such as glass, to increase interaction between pedestrians and the internal elements of buildings.

2. **Improve Road Network and Speed Limiting:**
    - Re-evaluate the road network and set the speed limit for some internal streets to 30 km/h to convert them into pedestrian pathways and enhance them with necessary pedestrian facilities.

3. **Physical Rehabilitation of Streets:**
    - Change the pavement material in pedestrian-designated streets to tiles instead of asphalt or any traffic calming procedures such as speed tables in order to enhance safety factors.
    - Reallocate the right of way elements in the streets to include exclusive lanes for bicycles.
4. **Increase Bicycle Facilities:**
    - Modify the construction system to provide safe parking spaces for bicycles at the entrances of large residential buildings.
    - Provide bicycle rental services throughout the suburb.
5. **Improve Public Transportation System:**
    - Provide a multi-modal transportation system, including public that provide various options such as BRT and para transit, as well as bicycles, etc.
    - Design transit stations to serve all buildings within their service range.
6. **Expand and Replan the Suburb:**

Create a functional identity for the suburb using the current development potentials to be a college town or medical city, for example, in order to achieve diversity in land use to include more than just housing.

7. **Provide Diverse Housing Options:**
    - Offer affordable housing for low and middle-income groups.
    - Promote the Shift from Vehicle Usage:
    - Design internal streets to encourage active transportation and micro-mobility vehicles.

3.5.5 Proposed Strategic Planning Framework

In this sub-section, a general strategic planning framework for planning new urban developments, or the transformation of existing ones, to be consistent with TOD principles is proposed hereafter. Any strategic planning process comprises three stages: strategy formulation, strategy implementation, and strategy evaluation. As the aim

here is to develop strategic planning framework, the strategy formulation stage is considered here. The strategic planning framework to plan TOD is summarized in Appendix B and presented in details hereafter, including the vision, goals and objectives, and the strategies.

1. **Vision:** Transit Oriented Community

   The vision for transit-oriented community prioritizes connectivity, sustainability, inclusivity, and a high quality of life. By seamlessly integrating transit options with well-designed urban spaces, the community aims to create a model community that sets the standard for 21st-century living.

2. **Goals & Objectives:**

Goal A: Establish a walkable community that prioritize non-motorized transport networks.

Objective A1: Secure and fully equipped pedestrian environment.

Strategies:

- Conduct safety audits to identify and address potential hazards in pedestrian areas.
- Install proper traffic control devices to enhance pedestrian safety.
- Implement traffic calming measures to reduce vehicle speeds in pedestrian zones.
- Develop and enforce strict adherence to sidewalk maintenance and accessibility standards.

Objective A2: Active and livable pedestrian environment.

Strategies:

- Design public spaces with seating, greenery, and recreational amenities to encourage pedestrian activity.
- Organize community events and programs to promote pedestrian engagement.
- Implement pedestrian-friendly infrastructure such as wide sidewalks, pedestrian zones, and public art installations.
- Collaborate with local businesses to create a vibrant and pedestrian-friendly commercial environment.

Objective A3: Comfortable and temperate pedestrian environment.

Strategies:

- Provide shade through the planting of trees and installation of awnings.
- Install benches, water fountains, and public restrooms along pedestrian routes.
- Use environmentally friendly materials for sidewalks and pavement to reduce heat absorption.
- Regularly maintain and clean pedestrian areas to ensure a pleasant walking experience.

Objective A4: Safe and complete cycling network.

Strategies:

- Develop dedicated bike lanes separated from vehicular traffic.
- Connect existing bike paths and trails to create a comprehensive cycling network.
- Install bike-specific traffic control devices (including signals and signage) for safe navigation.
- Educate both cyclists and motorists about road-sharing rules and safety measures.

Objective A5: Abundant and secure cycle parking and storage.

Strategies:

- Implement secure bike parking facilities at key locations, such as transit hubs, commercial areas, and public spaces.
- Encourage businesses to provide bike racks and storage for employees and customers.
- Integrate bike parking with public transportation infrastructure to facilitate multi-modal commuting.
- Implement a bike-sharing program to promote the use of bicycles as a viable transportation option.

Goal B: Establish interconnected networks of streets and pathways

Objective B1: Diverse, concise and straightforward walking and cycling paths.

Pathway Design and Variety Strategies:

- Conduct a comprehensive analysis of the community's layout to identify key pedestrian and cycling routes.
- Design diverse paths that cater to various preferences, such as scenic routes, urban trails, and nature paths.
- Incorporate well-marked and easily navigable pathways to ensure clarity for pedestrians and cyclists.

Accessibility and Inclusivity Strategies:

- Ensure that paths are accessible to individuals with disabilities by following universal design principles.
- Implement ramps, crosswalks, and other infrastructure to enhance accessibility for all users.
- Consider diverse user needs, including families with strollers, elderly individuals, and people of all physical abilities.

Landscaping and Beautification Strategies

- Integrate landscaping and greenery along paths to enhance aesthetics and create a pleasant experience.
- Install seating areas, public art, and informational signage to make pathways more engaging.

Objective B2: Shorter walking and cycling routes in comparison with motorized traffic routes.

Urban Planning and Zoning Strategies:

- Incorporate mixed-use zoning to reduce the need for long-distance travel and promote proximity between residential, commercial, and recreational areas.
- Plan for compact and walkable neighborhoods to minimize the distance between homes, workplaces, and amenities.

Traffic Calming Strategies

- Implement traffic calming measures such as traffic circles, speed bumps, and one-way streets to discourage through-traffic and prioritize local movements.
- Design streets with narrower lanes to naturally slow down motorized traffic and prioritize non-motorized modes.

- **Goal C: Plan and operate transit systems and locate development in close proximity to high quality transit systems in order to enhance density and transit capacity for optimal efficiency**

Objective C1: High quality transit within walkable distance.

Strategies

- Integrate affordable and efficient first- and last-mile transit options, such as shuttle services or bike-sharing programs.
- Upgrade transit stations to include amenities like shelters, seating, information displays, and bicycle parking to enhance the overall transit experience.
- Ensure the safety and accessibility of transit stations for people of all abilities.

Objective C2: Enhance the efficiency of transit system and local services by appropriate residential and job densities.

Density Planning Strategies

- Develop zoning regulations that encourage higher residential and job densities around transit corridors.
- Use TOD principles to guide the density and mix of land uses in different zones.

Mixed-Use Development Strategies:

- Promote mixed-use developments that integrate residential, commercial, and office spaces to create a balanced and dynamic urban environment.
- Encourage developers to include affordable housing options within high-density developments.

Employment Hubs Strategies:

- Identify and develop employment hubs in close proximity to transit corridors to reduce commuting distances and enhance the efficiency of the transit system.
- Encourage businesses to offer flexible work arrangements, such as remote work or flexible hours, to further optimize transit use.

Transit Infrastructure Investment Strategies:

- Invest in transit infrastructure operations and improvements, such as dedicated bus lanes and transit signal priority, to enhance the efficiency and reliability of public transit.
- Collaborate with transit agencies to optimize routes and schedules based on changing population densities.
- **Goal D: Plan mixed-use communities with minimal daily commuting**

Objective D1: Reduce travel distances by incorporating diverse and complementary land uses.

Strategy:

- Implement zoning regulations that promote mixed-use development, allowing a blend of residential, commercial, and recreational spaces in close proximity.

Objective D2: Encourage affordability for lower income groups.

Strategies:

- Establish incentives for Affordable Housing.
- Establish community land trusts to secure land for affordable housing and protect it from market-driven price increases.

Objective D3: Ensure that TOD benefits are distributed equitably across diverse socio-economic groups.

Strategies:

- Conduct extensive community engagement to understand the needs and preferences of diverse socio-economic groups and incorporate their input into the planning process.
- Affordable transit options accessible to all residents, regardless of their socio-economic status.

Objective D4: Prioritize infill development in an existing urban area.

Strategies:

- Identify and prioritize brownfield sites for redevelopment to minimize environmental impact and revitalize existing urban areas.
- Encourage the adaptive reuse of existing structures to reduce demolition and promote sustainable urban development.

Objective D5: Convenient in-city traveling.

Strategies:

- Design streets that accommodate various modes of transportation, including walking, cycling, and public transit, to create a more walkable and bike-friendly environment.
- Implement smart transportation systems that enhance the efficiency of traffic flow, reduce congestion, and provide real-time information on public transportation.

- **Goal E: Enhance modal shift**

Objective E1: Minimum land utilization for motor vehicles

Strategies:

- Promote sustainable transportation modes by invest in public transit and active transportation infrastructure.
- Implement carpooling and ridesharing programs.
- Implement parking management strategies such as reduce parking spaces and dynamic parking pricing where rates are higher during peak hours and lower during off-peak times.

It is worth noting three key issues that must be followed and considered when undertaking the strategic planning process, as they play a crucial role in the success of the planning process. These issues are as follows:

- **Stakeholder Engagement**

  In the formulation of a comprehensive and inclusive TOD strategy, a key issue involves identifying and engaging various stakeholders, such as local communities, government agencies, developers, and the transportation authorities. Subsequently, the emphasis is on fostering collaboration among these stakeholders and gathering their input. This collaborative approach ensures that the TOD strategy is not only having well-informed stakeholders but also to having them well-engaged, taking into account the diverse perspectives and needs of all involved parties.

- **Development of Implementation Plans**

  To effectively bring the TOD strategy to fruition, a critical aspect involves developing a phased implementation plan (action plan) that carefully considers both short-term and long-term goals. This plan serves as a roadmap, outlining the steps and milestones required for successful execution.

  Simultaneously, it is imperative to identify funding mechanisms to support the necessary infrastructure development. Exploring public-private partnerships emerges as a viable strategy to secure the financial resources needed for the implementation of actions to achieve TOD. These partnerships can foster collaboration between public entities and private investors, ensuring sustainable funding and efficient implementation of the infrastructure components integral to the TOD vision**.**

- **Arrange for Proper Monitoring and Evaluation**

  To gauge the effectiveness and success of the TOD strategy, it is essential to establish key performance indicators (KPIs) that allow for systematic monitoring of progress. These KPIs serve as measurable benchmarks, helping to assess the strategy's impact on various facets.

  Furthermore, a continuous evaluation process is crucial to understanding the influence of TOD on transportation patterns, land use dynamics, and overall urban development. Regular assessments ensure that the strategy remains adaptive and responsive to evolving urban needs, fostering a dynamic and sustainable urban environment.

  It's important to note that the specific details of the TOD framework will depend on the unique characteristics and challenges of the location in question. Adjustments and customization are essential to ensure the framework aligns with the local context and goals.

Chapter Four

Conclusions and Recommendations

4.1 Introduction

This research has been prepared with the aim of understanding the principles and elements of TOD for the preparation of a general strategy for existing and emerging Palestinian cities, and adopting it as a planning direction for new Palestinian cities as an effective step towards sustainable urban growth. Based on the fundamental principles and criteria of TOD were identified by reviewing numerous literary studies in this field, eight essential elements were identified, denoted as Walk, Cycle, Connect, Transit, Mix, Densify, Compact, and Shift.

After identifying the fundamental principles and criteria for TOD, Rawabi City and Al-Raihan Suburb were selected as local case studies to be evaluated in light of the identified TOD principles and metrics. The evaluation process was done in order to assess to what extent modern local planning models align with TOD principles. The evaluation process helped in identifying the strengths and weaknesses in the principles and planning visions of the case studies. In an attempt to enhance the opportunities and overcome the challenges, a set of recommendations was proposed for each case study based on the evaluation results, hoping that they would be taken into consideration for progressing towards TOD.

The study and analysis of global and local case studies also helped in realizing and understanding the strategies for achieving TOD. Consequently, a general strategy for Palestinian cities has been formulated, which planners can adopt as a key step in sustainable physical planning.

4.2 Conclusions

The conclusions from the results of the study are summarized hereafter:

1. TOD encompasses various elements that aim to create sustainable, vibrant, and efficient urban environments centered around public transportation and with less motorized vehicle dependency.
2. The key principles of TOD imply, among others, having walkable environment enhanced with pedestrian-friendly urban design, bicycle infrastructure, mixed-use development, density and compact design with proximity to transit stations.
3. TOD aligns with smart growth principles, emphasizing sustainable development, minimizing environmental impact, and promoting efficient land use.
4. There is potential to enhance the satisfaction of TOD system requirements at the local level, particularly for Rawabi City, where it has achieved a score of 59%, categorizing it as bronze- standard according to the TOD standards stipulated by the ITDP. That indicates Rawabi City satisfies a majority of the objectives of best practice in transit-oriented urban development. Therefore, specific actions were proposed for this purpose.
5. Al-Raihan Suburb has a lower chance compared to Rawabi City in achieving TOD currently. This was attributed to the implementation of the whole suburb plan, but it is possible to develop its future expansion in light of the TOD guidelines and the recommendations for the suburb that were mentioned previously. Therefore, specific actions were proposed for this purpose.

4.3 Proposed Policy and Regulatory Framework and Recommendations

4.3.1 Proposed Policy and Regulatory Framework

A comprehensive Policy and Regulatory Framework for TOD should encompass a range of guidelines and measures to promote sustainable, well-planned, and integrated urban development. An outline of key components is presented hereafter.

1. Zoning and Land Use Policies:

- Develop and implement zoning regulations that encourage mixed-use developments around transit nodes.
- Establish density bonuses or incentives for developers who incorporate affordable housing within TOD projects.

- Define permissible land uses and building heights to optimize the efficiency of the transit system.
- Coordination between the MOLG and relevant stakeholders to ensure the update of the Urban Planning Manual in a manner that reflects the vision and strategies of sustainable and TOD as a recommended approach for planning as appropriate.

2. Transportation Planning:

- Develop guidelines to integrate TOD principles into broader transportation planning strategies.
- Develop guidelines to prioritize pedestrian-friendly infrastructure, including sidewalks, bike lanes, and safe crosswalks.
- Coordination between the MOLG and transportation agencies to ensure seamless connectivity between different modes of transit.

3. Affordable Housing Mandates:

- Develop and enforce policies requiring a percentage of housing units in TOD projects to be designated as affordable housing.
- Explore inclusionary zoning measures to promote socioeconomic diversity within transit-accessible areas.

4. Public-Private Partnerships (PPP):

- Develop regulations to encourage and facilitate PPPs to attract private investment for TOD projects.
- Establish clear guidelines for collaboration between public entities and private developers in the planning and implementation phases.

5. Community Engagement and Participation:

- Develop mechanisms for meaningful community involvement in the TOD planning process.
- Require developers to conduct community impact assessments and incorporate feedback from residents.

6. Environmental Sustainability:

- Implement green building standards and environmental impact assessments for TOD projects.

- Promote energy-efficient and sustainable design practices within transit-oriented developments.

7. Parking Policies:

- Implement parking management strategies, including reduced parking requirements in areas with robust transit options.
- Encourage the development of shared parking facilities which refer to parking areas that are designed to serve multiple uses and users within a transit-oriented environment, in order to optimize the use of parking spaces by accommodating the needs of various activities and users, ultimately promoting the efficiency and sustainability of the TOD.

8. Transit Infrastructure Investment:

- Allocate funds for the expansion and improvement of public transit infrastructure in alignment with TOD goals.
- Establish mechanisms for ongoing maintenance and upgrades to support the long-term viability of transit systems.

9. Incentive Programs:

- Introduce financial incentives for developers who adhere to TOD principles, such as tax credits or expedited permitting processes.
- Create bonus programs for projects that enhance public spaces, green areas, or cultural amenities within TOD zones.

4.3.2 Recommendations

Based on the outcome of the study, and the proposed strategic framework, the research recommendations are summarized as follows:

1. Adopting the proposed strategic planning framework and the proposed policies and regulations concerning TOD.
2. Directing relevant authorities -particularly the Ministry of Local Government and Municipalities - on the necessity of integrating land use planning and transportation planning, given their significant role in the success of the TOD by updating work procedures to incorporate TOD principles, through urban planning guidelines and enhancing staff skills.

3. Encouraging the development of compact, mixed-use urban form, with emphasis on the planning and operation of transit services with proper transit stations.
4. Prioritizing public transportation systems during the planning of urban communities to fulfill the fundamental condition of TOD through investing in high-quality and efficient public transportation systems.
5. Involving the community in the planning process to gather diverse perspectives and consider local needs and preferences when designing considering TOD.
6. Developing relevant policies including zoning and land use policies, transportation planning, affordable housing mandates, environmental sustainability, parking policies, and transit infrastructure investment as proposed previously.
7. Adopting financial incentives to encourage the development of new communities or the transformation of existing ones.
8. Regularly evaluate the success of the TOD plans and make adjustments as needed and adapt to changing demographics, transportation trends, and community needs.

4.4 Limitations

The limitations of this study can be summarized as follows:

- Lack of accurate and sufficient data for analyzing the current situation through more advanced methods, relying on specialized tools in spatial analysis programs such as GIS.
- Non-existence of previous local studies in the field of TOD.
- The absence of local models of Palestinian cities to be adopted as case studies.

List of Abbreviations

Abbreviation	Meaning
BRT	Bus Rapid Transit
GeoMOLG	Ministry of Local Government's Geographic Information System
GIS	Geographic Information System
ITDP	Institute for Transportation and Development Policy
KPIs	Key Performance Indicators
MIA	Museum of Islamic Art
MOLG	Ministry of Local Government
MOT	Ministry of Transportation
NMT	Non-Motorized Travel
PIF	Palestinian Investment Fund
PPP	Public Private partnership
QNM	Qatar National Museum's

References

[1]. AlKhereibi H, Onat N, Furlan R, Grosvald M, Awwaad Y. Underlying mechanisms of transit-oriented development: a conceptual system dynamics model in Qatar. Designs. 2022;6(5):71.

[2]. Calthorpe P. The next American metropolis: Ecology, community, and the America dream. Princeton Architectural Press. 1993.

[3]. Ercan T, Onat C, Tatari O, Mathias D. Public transportation adoption requires a paradigm shift in urban development structure. Journal of Cleaner Production; 2017: 142,1789-1799.

[4]. Rawabi Website. Overview. 2023. Avaliable from: https://www.rawabi.ps/en/overview.

[5]. Rawabi Website. Master Plan. 2023. Avaliable from: https://www.rawabi.ps/en/masterplan.

[6]. ITDP. Publications. 2017. Avaliable from: https://www.itdp.org/publication/tod-standard/. (Need to change this ref, as it does not have relevant text)

[7]. Zou M, Lin X, Mao C, Zhang K, Li M. Review on the theory and planning principle of transit-oriented development. 2014; In CICTP 2014: Safe, Smart, and Sustainable Multimodal Transportation Systems (pp. 3532-3547).

[8]. Calthorpe P. 1993; The next American metropolis (Vol. 23). New York: Princeton Architectural Press.

[9]. Bernick M, Cervero R. Transit Villages in the 21st Century. McGraw-Hill; 1997. Available from: http://worldcat.org/isbn/0070054754

[10]. Freilich R.. Land-Use Implications of Transit-Oriented Development: Controlling the Demand Side of Transportation Congestion and Urban Sprawl. GP Solo & Small Firm. 1999: 16, 50.

[11]. DittmarH, Ohland G..The new transit town: best practices in transit-oriented development. 2003; Island Press.

[12]. . Ma Q. Recent studies on transit-oriented development in North America. Urban Planning International. 2003; 45-50.

[13]. . Renne J, Wells J. Transit-oriented development: Developing a strategy to measure success. 2005; (No. 294). Transportation Research Board.

[14]. . Cervero R, Kockelman K. Travel demand and the 3Ds: Density, diversity, and design. Transportation research part D: Transport and environment, 1997; 2(3), 199-219.

[15]. Zhao J.. Study on Planning Methodology of TOD for Chinese Cities. 2008; (Doctoral dissertation, Master's thesis. Tsinghua University, Beijing, China).

[16]. Menendez M, Ambühl L. Implementing Design and Operational Measures for Sustainable Mobility: Lessons from Zurich. Sustainability; 2022:14(2),625.

[17]. Marshall E, Ferenchak N. Why cities with high bicycling rates are safer for all road users. Journal of Transport & Health; 2019:13,100539.

[18]. Reck J, Haitao H, Guidon S, Axhausen W. Explaining shared micromobility usage, competition and mode choice by modelling empirical data from Zurich, Switzerland. Transportation Research Part C: Emerging Technologies; 2021:124,102947.

[19]. Reinvent Phoenix. Transit Oriented Development Strategic Policy Framework. 2018.

[20]. Serge S, Gerald O. Transforming the Urban Space through Transit-Oriented Development: The 3V Approach. World Bank, Washington, DC; 2017. Avaliable from: http://hdl.handle.net/10986/26405

[21]. ULI Case Studies. King's Cross. 2014. Available from: http://casestudies.uli.org/kings-cross/.

[22]. Argent St. George. A Framework for Regeneration. 2002.

[23]. EDAW. Townshend Landscape Architects, General Public Agency, Access Design Consultants for Argent, London & Continental Railways and Excel. King's Cross Central Public Realm Strategy. 2004. Available from: https://www.kingscross.co.uk/media/35-PublicRealm-Strat.pdf

[24]. Suzuki H, Murakami J, Hong H, Tamayose B. Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries. Urban Development. Washington, DC: World Bank; 2015.

[25]. Al-Harami A, Furlan R. Qatar National Museum-Transit oriented development: The masterplan for the urban regeneration of a 'green TOD'. Journal of Urban Management; 2020:9(1),115-136.

[26]. Abu Dhabi Municipality. Department of Transport. Surface Transport Master Plan: A Vision for Connecting Abu Dhabi. 2009.

[27]. Anwar Uddin M, Tamanna T, Adiba S, Bin Kabir S. Revolutionizing TOD Planning in a Developing Country: An Objective-Weighted Framework for Measuring Nodal TOD Index. Journal of Advanced Transportation; 2023:9911133.

[28]. Abdi M, Lamíquiz-Daudén P. Transit-oriented development in developing countries: A qualitative meta-synthesis of its policy, planning and implementation challenges. International Journal of Sustainable Transportation; 2023:16(3),195-221.

[29]. Ramallah Municipality. GIS Portal. 2023. Avaliable from: https://ramallah-gis.ps/.

[30]. Ministry of Local Governorment. GeoMOLG. 2023. Avaliable from: https://geomolg.ps/L5/index.html?viewer=A3.V1.

[31]. Ministry of Transportation. General Administration of Traffic Control. Unpublished study of transportation lines in the northern governorates in Palestine. 2023.

Appendices

Appendix A

Tables Related to TOD Standards & Metrics Evaluation

Based on ITDP Standards [6]

Table A1

Standard Values for Metric 1.1 Walkways Evaluation

Walkways	**Points**
100% or more of the walkway network is complete	3
95% or more of the walkway network is complete 2	2
2 90% or more of the walkway network is complete	1
Less than 90% of the walkway network is complete	0

Table A2

Standard Values for Metric 1.2 Crosswalks Evaluation

crosswalks	**Points**
100% of intersections have complete crosswalks	3
95% of intersections or more have complete crosswalks	2
90% of intersections or more have complete crosswalks	1
Less than 90% of intersections have complete crosswalks	0

Table A3

Standard Values for Metric 1.3 Visually Active Frontage Evaluation

Visually Active Frontage	**Points**
Visually active frontage segment percentage is 90% or more	6
Visually active frontage segment percentage is 80% or more	5
Visually active frontage segment percentage is 70% or more	4
Visually active frontage segment percentage is 60% or more	3
Visually active frontage segment percentage is 50% or more	2
Visually active frontage segment percentage is less than 50%	0

Table A4

Standard Values for Metric 1.4 Physically Permeable Frontage Evaluation

Physically Permeable Frontage	**Points**
Average number of entrances per 100m of block frontage is 5 or more	**2**
Average number of entrances per 100m of block frontage is 3 or more	**1**
Average number of entrances per 100m of block frontage is less than 3	**0**

Table A5

Standard Values for Metric 1.5 Shade and Shelter Evaluation

Shade and Shelter	**Points**
75% or more of all walkway segments have adequate shade/shelter amenities	**1**
Less than 75% of all walkway's segments have adequate shade/shelter amenities	**0**

Table A6

Standard Values for Metric 2.1 Cycle Network Evaluation

Safe and Complete Cycle Network	**Points**
Maximum walk distance to safe cycling streets is less than 100m	**2**
Maximum walk distance to safe cycling streets is less than 200m	**1**
Maximum walk distance to safe cycling streets is more than 200m	**0**

Table A7

Standard Values for Metric 2.2 Cycle Parking at Transit Stations Evaluation

Cycle Parking at Transit Stations	**Points**
Multi-space cycle racks are provided within 100 meters of all transit stations	**1**
Multi-space racks are not provided, or are provided at only some transit stations.	**0**

Table A8

Standard Values for Metric 2.3 Cycle Parking at Buildings Evaluation

Cycle Parking at Buildings	**Points**
95% or more of buildings have ample secure cycle parking	**1**
Less than 95% of new buildings provide ample secure cycle parking	**0**

Note: This metric applies to buildings greater than 500 square meters of floor area, or six residential units or more. However, Cycle parking at buildings should be located within 100 meters of the entrance and located outside pedestrian or vehicle circulation areas, publicly provided cycle parking facilities and those provided in garages are included.

Table A9

Standard Values for Metric 2.4 Cycle Access in Buildings Evaluation

Cycle Access in Buildings	**Points**
Cycle access is required by building codes or bylaws	**1**
Cycle access is not required by building codes or bylaws	**0**

Table A10

Standard Values for Metric 3.1 Small Blocks Evaluation

Small Blocks	**Points**
90% of blocks within the station area are less than 110m in length	**10**
90% of blocks within the station area are less than 130m in length	**8**
90% of blocks within the station area are less than 150m in length	**6**
90% of blocks within the station area are less than 170m in length	**4**
90% of blocks within the station area are less than 190m in length	**2**
More than 10% of blocks within the station area are over 190m in length	**0**

Table A11

Standard Values for Metric 3.2 Prioritized Connectivity Evaluation

Prioritized Connectivity	**Points**
Prioritized connectivity ratio is 2 or higher	**5**
Prioritized connectivity ratio is 1 or higher	**3**
Prioritized connectivity ratio is 0.5 or higher	**1**
Prioritized connectivity ratio is lower than 0.5	**0**

Table A12

Standard Values for Metric 4.1 Walk Distance to Transit Evaluation

Walk Distance to Transit	Points
Maximum walk distance is less than 1 kilometer to a high-capacity transit station, or less than 500 meters to a direct service station	**TOD Standard requirement**
Maximum walk distance is more than 1 kilometer to a high-capacity transit station, or more than 500 meters to a direct service station	**Does not meet TOD Standard requirement**

Table A13

Standard Values for Metric 5.1 Complementary Uses Evaluation

Complementary Uses	Points
The predominant use in the station area occupies 50% or less of the total floor area	**10**
The predominant use in the station area occupies 70% or less of the total floor area	**5**
The predominant use in the station area occupies 80% or less of the total floor area	**2**
The predominant use in the station area occupies 90% or less of the total floor area	**1**
The predominant use in the station area occupies more than 90% of the total floor area	**0**

Table A14

Standard Values for Metric 5.2 Accessibility to Food Evaluation

Accessibility to Food	Points
80% or more of buildings are within walking distance to a source of fresh food	**1**
79% or less of buildings are within walking distance to a source of fresh food	**0**

Table A15

Standard Values for Metric 5.3 Affordable Housing Evaluation

Affordable Housing	**Points**
30% or more of all residential units are affordable	**4**
25% or more of all residential units are affordable	**3**
20% or more of all residential units are affordable	**2**
15% or more of all residential units are affordable	**1**
Less than 15% of all residential units are affordable	**0**

Table A16

Standard Values Metric 6.1 Land Use Density Evaluation

Land Use Density	**Points**
Land use density is higher than the comparable baseline density	**15**
Land use density is the same as, or within 5% below, the comparable baseline density	**7**
Land use density is lower than the comparable baseline density by more than 5%	**0**

OR

Population, Job, and Visitor Density	**Points**
Total residential population, jobs and visitors is higher than the baseline density	**15**
Total residential population, jobs and visitors is the same as, or within 5% below, the baseline density	**7**
Total residential population, jobs and visitors is lower than the baseline density	**0**

Table A17

Standard Values Metric 7.1 Urban Site Evaluation

Percentage (area) of developable sites that are built-up	**Points**
More than 90%	**10**
Up to 90%	**6**
Up to 80%	**3**
Up to 70%	**1**
Less than 60%	**0**

Table A18

Standard Values Metric 7.2 Transit Options Evaluation

Transit Options Add all applicable points up to a maximum of 5 points	**Points**
Each additional high-capacity transit line (Rail, BRT, etc)	**2**
Applicable bike share system	**2**
Each regular transit line/route	**1**

Table A19

Standard Values Metric 8.1 Off-Street Parking Evaluation

Off-Street Parking	**Points**
Non-essential parking area is equivalent to 10% or less of site area	**10**
Non-essential parking area is equivalent to 15% or less of site area	**5**
Non-essential parking area is equivalent to 20% or less of site area	**4**
Non-essential parking area is equivalent to 25% or less of site area	**3**
Non-essential parking area is equivalent to 30% or less of site area	**2**
Non-essential parking area is equivalent to 35% or less of site area	**1**
Non-essential parking area is equivalent to more than 35% of site area	**0**

Table A20

Standard Values Metric 8.2 Driveway Density Evaluation

Driveway Density	**Points**
Average driveway density is 2 or less driveways per 100m of block frontage	**2**
Average driveway density is more than 2 driveways per 100m of block frontage	**0**

Table A21

Standard Values Metric 8.3 Roadway Area Evaluation

Roadway Area	**Points**
Motor vehicle area is 15% or less of site area	**8**
Motor vehicle area is 20% or less of site area	**5**
Motor vehicle area is more than 20% of site area	**0**

Table A22

Objectives, metrics and points for cycle principle

Cycle Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (The cycling network is safe and complete)	Cycle Network	Percentage of total street segments with safe cycling conditions.	2
Objective B (Cycle parking and storage is ample and secure)	Cycle Parking at Transit Stations	Secure multi-space cycle parking facilities are provided at all high-capacity transit stations	1
	Cycle Parking at Buildings	Percentage of buildings that provide secure cycle parking	1
	Cycle Access in Buildings	Buildings allow interior access for cycles and cycle storage within tenant-controlled spaces.	1
		Total	**5**

Table A23

Objectives, metrics and points for connect principle

Connect Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (Walking and cycling routes are short, direct and varied)	Small Blocks	Length of the longest block (long side)	10
Objective B (Walking and cycling routes are shorter than motor vehicle routes)	Prioritized Connectivity	Ratio of pedestrian and cycle intersections to motor vehicle intersections	5
		Total	**15**

Table A24

Objectives, metrics and points for transit principle

Transit Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (High quality transit is accessible by foot)	Walk Distance to Transit	Walk distance (meters) to the nearest transit station	**Fundamental**
			Fundamental Requirement

Table A25

Objectives, metrics and points for mix principle

Mix Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (Trip lengths are reduced by providing diverse and complementary uses)	Complementary Uses	Residential and nonresidential uses combined within same or adjacent blocks	10
	Accessibility to Food	Percentage of buildings that are within 500 meters radius of an existing, or planned, source of fresh food	1
Objective B (Lower income groups have short commutes)	Affordable Housing	Percentage of residential units provided as affordable housing	4
		Total	**15**

Table A26

Objectives, metrics and points for densify principle

Densify Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (Residential and job densities support high quality transit and local services.)	Land Use Density	Average density in comparison to local conditions	15
		Total	**15**

Table A27

Objectives, metrics and points for compact principle

Compact Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (The development is in an existing urban area)	Urban Site	Number of sides of the development adjoining existing built-up sites	10
Objective B (Travelling through the city is convenient)	Transit Options	Numbers of stations on different transit lines that are accessible within walking distance	5
		Total	**15**

Table A28

Objectives, metrics and points for shift principle

Shift Principle			
Objectives	**Metrics**	**Metrics Definition**	**Points**
Objective A (The land occupied by motor vehicles is minimized)	Off-Street Parking	Total off-street area dedicated to parking as a percentage of total land area	10
	Driveway Density	Average number of driveways per 100 meters of block frontage	2
	Roadway Area	Total road area used for motor vehicle travel and on-street parking as percentage of total land area	8
		Total	**20**

Appendix B

Figures Related to TOD Metrics Analysis

Figure B1

Walkways Metrics for Rawabi City

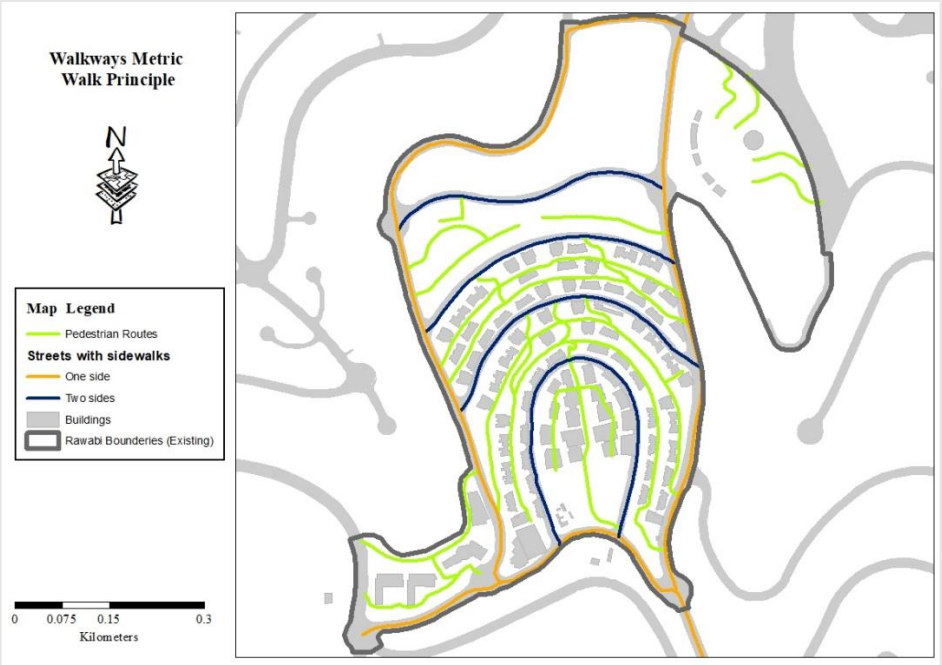


Figure B2

Cycling Network for Rawabi City

Figure B3

Buildings that provide secure Cycle Parking in Al-Raihan Suburb

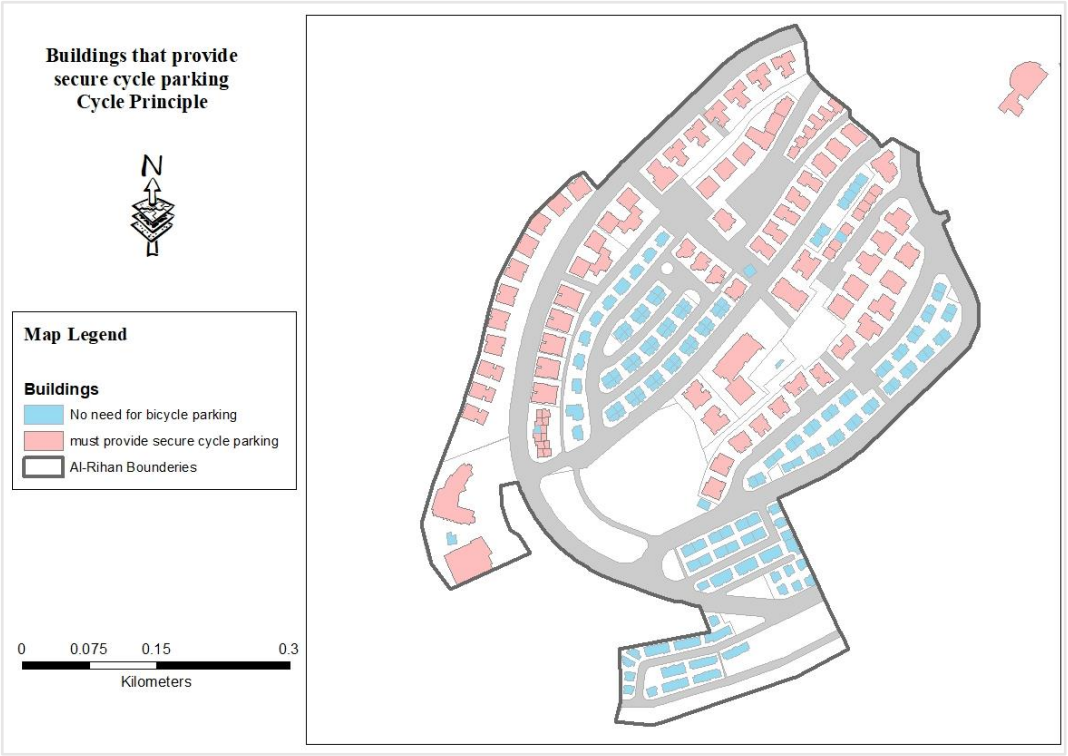


Figure B4

Buildings that provide secure Cycle Parking in Rawabi City

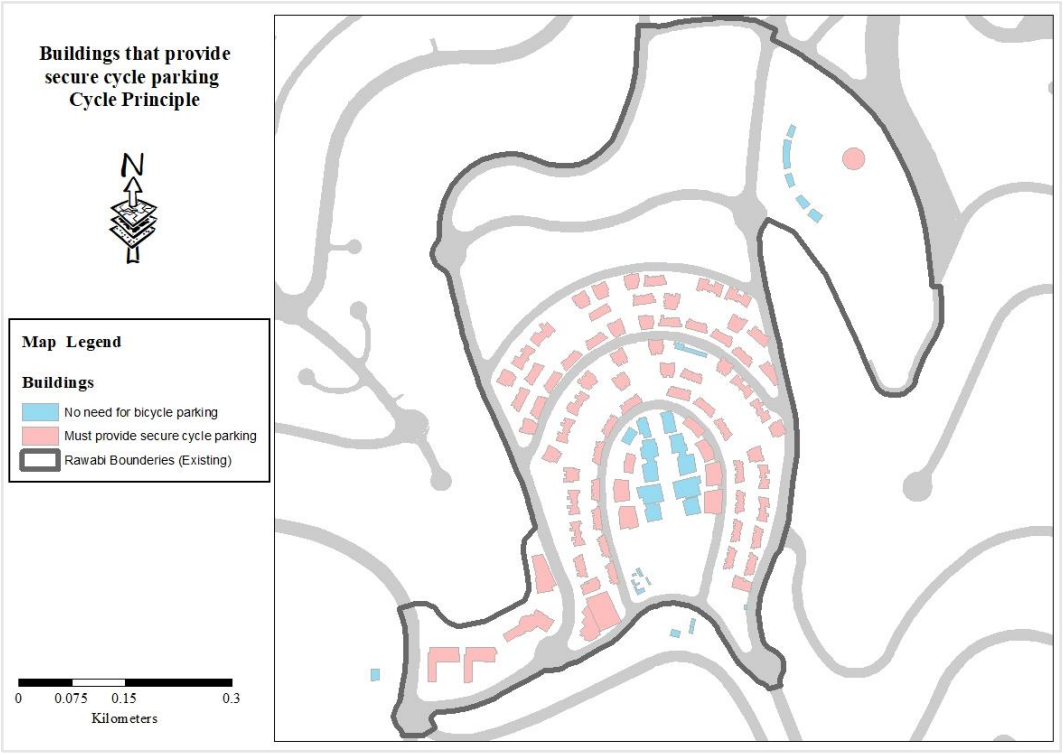


Figure B5

Prioritized Connectivity in Al-Raihan Suburb

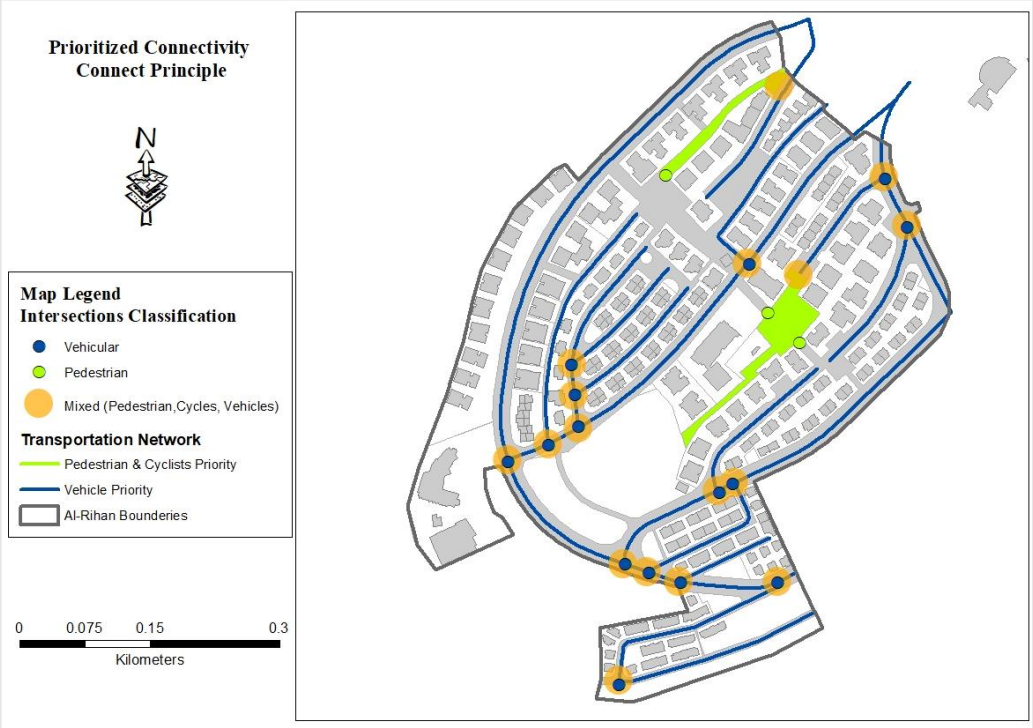


Figure B6

Complementary Uses in Rawabi City (Planned City)

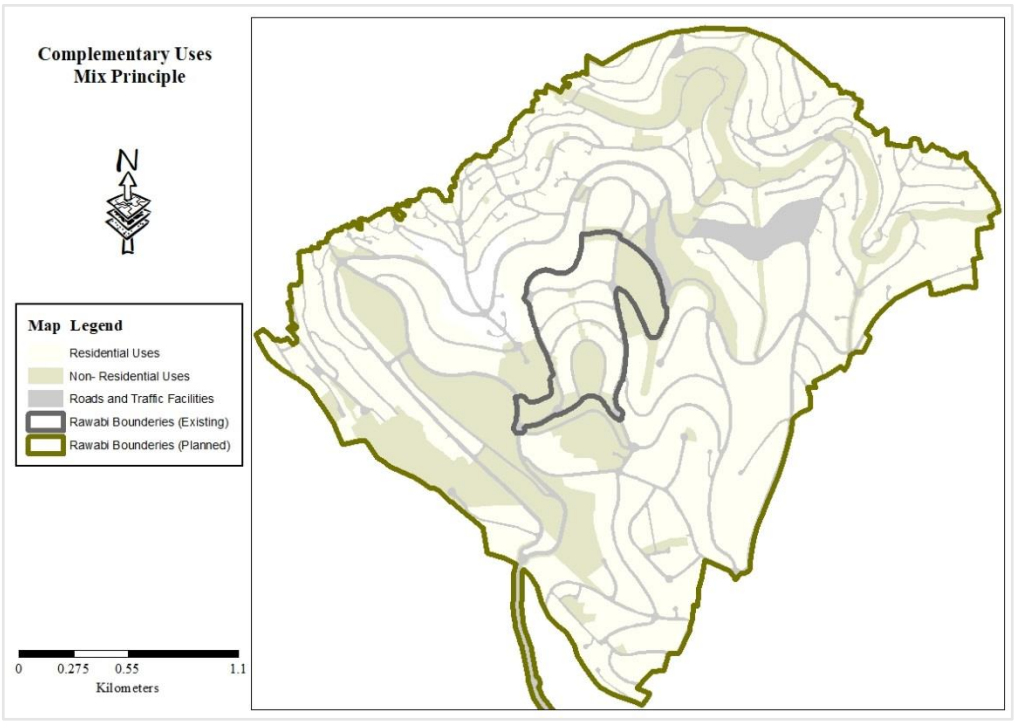


Figure B7

Complementary Uses in Rawabi City (Within Existing City Boundaries)

Figure B8

Urban Site Metric in Rawabi City (Planned City)

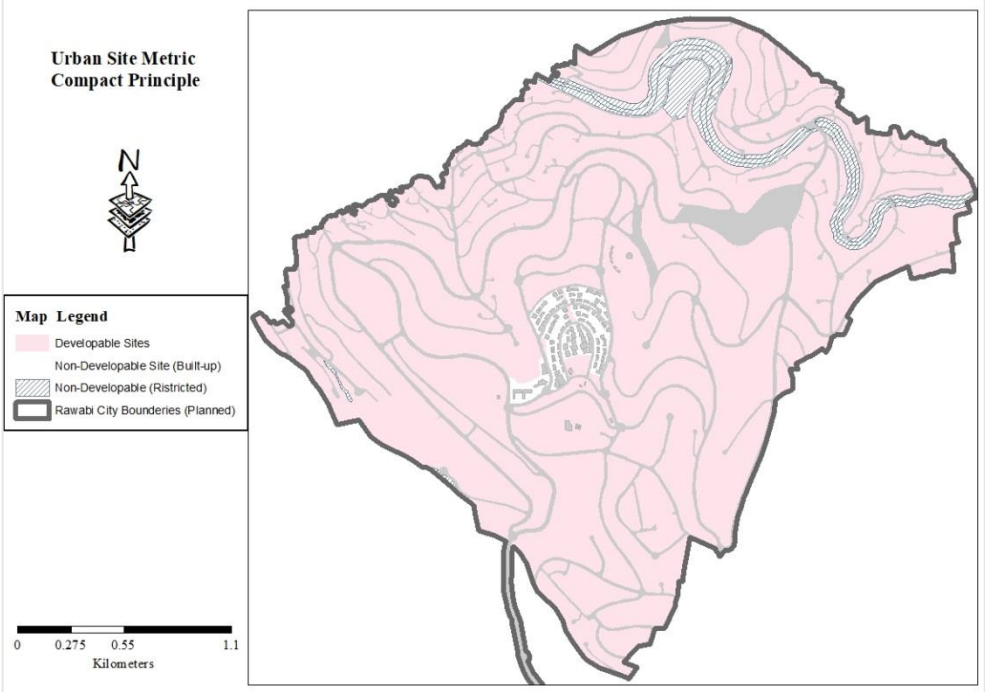
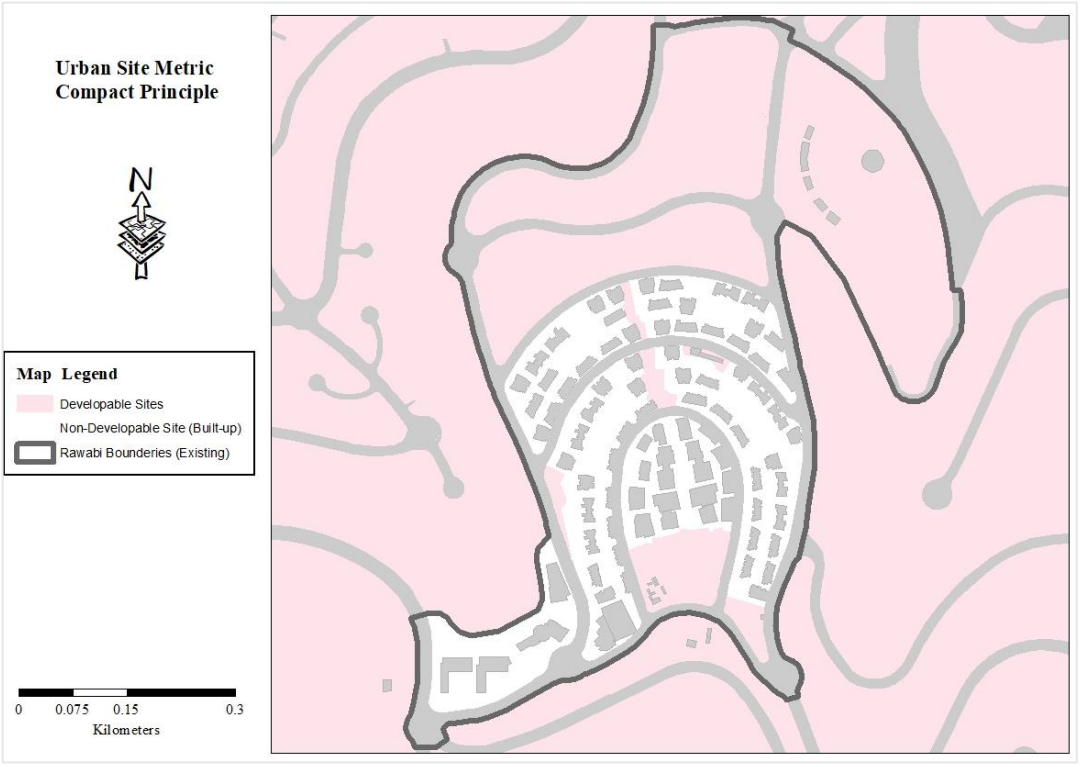


Figure B9

Urban Site Metric in Rawabi City (Existing City Boundaries)



Appendix C

TOD strategic planning framework – Summarized

Figure C1

TOD strategic planning framework – Goal A

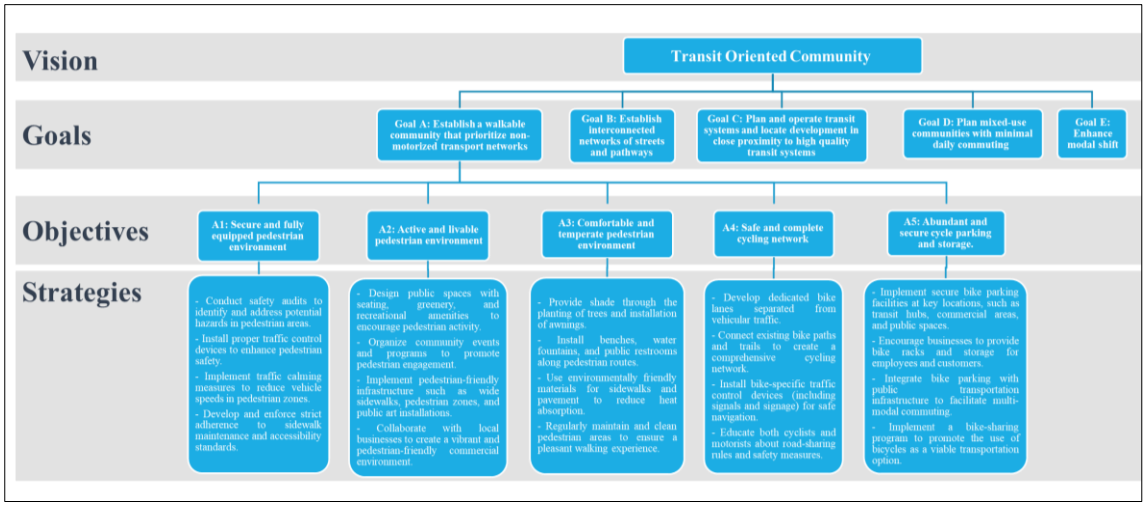


Figure C2

TOD strategic planning framework – Goal B

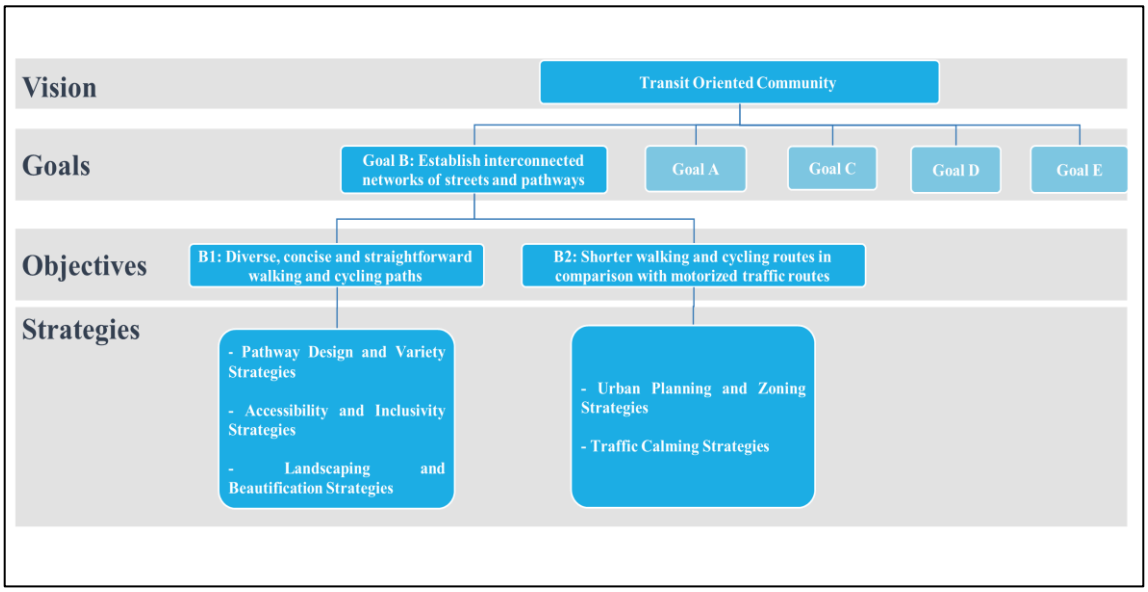


Figure C3

TOD strategic planning framework – Goal C

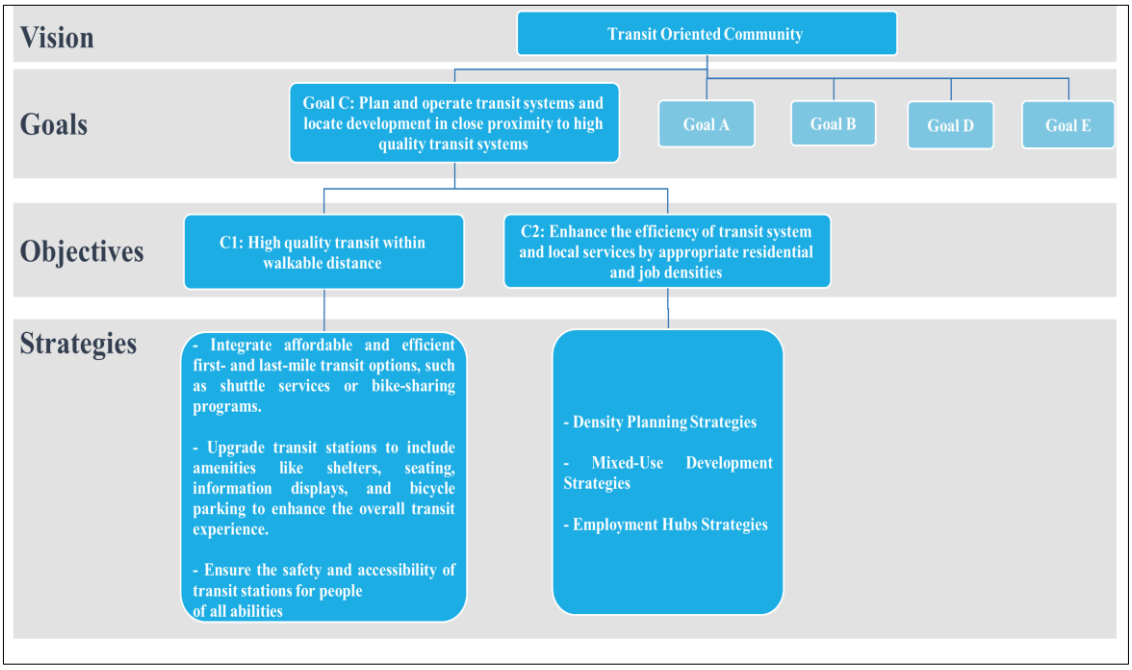


Figure C4

TOD strategic planning framework – Goal D

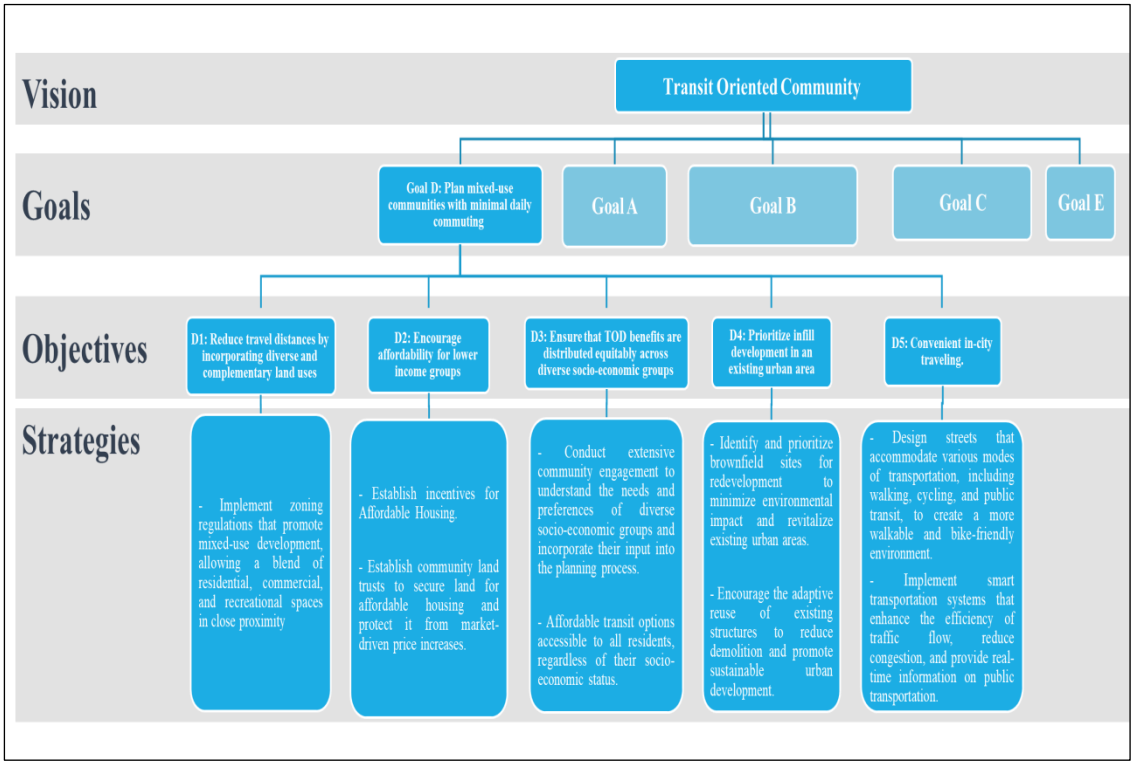
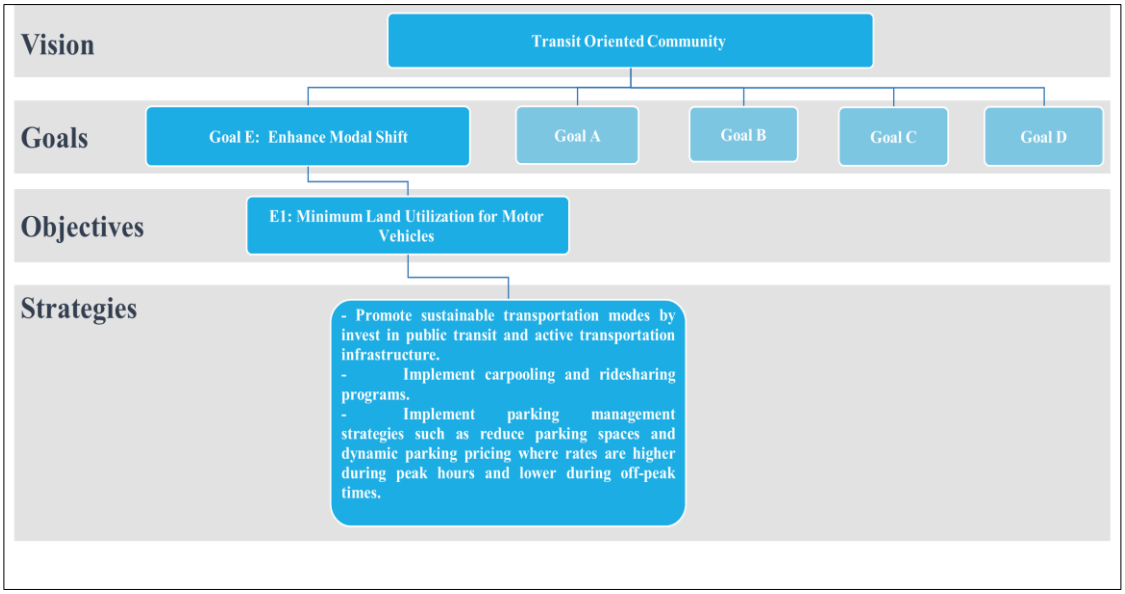


Figure C5

TOD strategic planning framework – Goal E



جـامعـــة النجاح الوطنية

كليـــة الدراســـات العليـــا

النقل الحضري المستدام من منظور التطوير الحضري الموجّه نحو النقل الجماعي – دراسة رائدة في تخطيط المدن الفلسطينية

إعداد

شفاء وائل محمد مشاقي

إشراف

أ.د. سمير أبو عيشة

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في هندسة الطرق والمواصلات، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

2024

النقل الحضري المستدام من منظور التطوير الحضري الموجّه نحو النقل الجماعي –

دراسة رائدة في تخطيط المدن الفلسطينية

إعداد

شفاء وائل محمد مشاقي

إشراف

أ.د. سمير أبو عيشة

الملخص

خلفية الدراسة: ظهر مفهوم التطوير الحضري الموجّه نحو النقل الجماعي (TOD)، إلى جانب توفير خدمات ملائمة للنقل الجماعي كأسلوب جديد في التطوير الحضري في العقود الأخيرة. ويتميز المفهوم بتصميم حضري يتسم بكثافة نسبية مرتفعة، ويتضمن استخداماً متنوعاً للأراضي، إلى جانب وجود بيئة حضرية صديقة للمشاة وراكبي الدراجات. ويعتبر هذا البحث محاولة لاكتساب المعرفة فيما يتصل باستخدام الممارسات الجيدة المتعلقة بتطوير المدن بشكل يتكامل مع التنقل الحضري المستدام، مما يؤسس لصياغة خطط وسياسات توجيهية من منظور التطوير الحضري الموجّه نحو النقل الجماعي لتخطيط مدن فلسطينية قابلة للعيش وقادرة على الصمود.

أهداف الدراسة: الهدف الرئيسي للدراسة هو تقييم مدى أخذ التنقل المستدام بعين الاعتبار في الخطط الحضرية المحلية من خلال تقييم حالات دراسية في فلسطين. كما تهدف الدراسة لتحديد استراتيجيات التنقل المستدام والتنمية المتكاملة التي يمكن تطبيقها على مستوى المجتمع المحلي. وبناءً على ذلك، تقدم الدراسة سياسات واستراتيجيات موصى بها لتحقيق التطوير الحضري الموجّه نحو النقل الجماعي، بالإضافة إلى مؤشرات قابلة للقياس لتقييم تأثير تنفيذ هذه الاستراتيجيات.

المنهجية: تم اتباع منهجية بحث تسلسلية لدراسة التطوير الحضري الموجه نحو النقل الجماعي كنهج مستدام للتنقل في فلسطين. بدأ العمل بإعداد استعراض للأدبيات وفحص التجارب الدولية والاقليمية في هذا المجال، وقد أسفر ذلك عن استخلاص مبادئ ومؤشرات قياس لـ TOD. تضمنت المرحلة الثانية اختيار منطقة الدراسة،

حيث تم اختيار حالتين تمثلان واقع التطوير الحضري في فلسطين. ثم تم جمع البيانات الضرورية من مصادر موثوقة لتحليل الوضع الحالي وتجهيزها للانتقال إلى مرحلة بلورة النتائج لكل منطقة دراسية. اختتمت هذه المرحلة بالتوصيات التي تم اقتراحها للسلطات المحلية والمؤسسات ذات العلاقة. بالإضافة إلى ذلك، تم بلورة إطار استراتيجي عام للتأسيس لـ TOD كنهج تخطيطي في المدن الفلسطينية الناشئة.

نتائج الدراسة: أظهرت النتائج أن مدينة روابي تحقق غالبية أهداف أفضل الممارسات في التطوير الحضري الموجه نحو النقل الجماعي حيث حصلت على درجة 59%، والذي يعني أنَّ تصنيفها برونزي وفقاً لمعايير TOD. وبالتالي، هناك إمكانية لتعزيز نظام TOD على المستوى المحلي من خلال إجراء بعض التعديلات على سياسات المدينة واستراتيجياتها، والتي تنعكس بدورها في المخطط الهيكلي لها. أما بخصوص ضاحية الريحان فقد بيّنت النتائج أنها لا تلبّي معايير التطوير الحضري الموجه نحو النقل الجماعي المقبولة، حيث حصلت على درجة 41%، لذلك هناك فجوة بين التوجه التخطيطي الخاص بالضاحية ومبادىء التطوير الحضري الموجه نحو النقل الجماعي، مما يتطلب إعادة عملية تخطيط الضاحية وفقاً للإرشادات الموصى بها من أجل المواءمة مع المبادىء. كما تتضمن نتائج الأطروحة تقديم إطار تخطيط استراتيجي مقترح لتخطيط مناطق التطوير الحضري الجديدة، أو تحويل المناطق الموجودة، لتكون متوافقة مع مبادئ TOD، بما في ذلك الرؤية والأهداف والغايات والاستراتيجيات.

الاستنتاجات من الدراسة: تضمن التطوير الحضري الموجه نحو النقل الجماعي مكونات متنوعة لتعزيز الوصول لبنية حضرية مستدامة وديناميكية وفعالة تتمحور حول وسائل النقل العام، مع تقليل الاعتماد على السيارات. ومع ذلك، فإن العناصر الأساسية لـ TOD تشمل القرب من محطات النقل، والتطوير متعدد الاستخدامات، والكثافة العالية، والتصميم المدمج، والبنية التحتية الملائمة للمشاة، والإسكان الميسَّر. علاوة على ذلك، تتوافق الـ TOD مع مبادئ التطوير الذكي، مع التركيز على التنمية المستدامة، وتقليل التأثير البيئي، وتشجيع الاستخدام الفعال للأراضي. وتشمل التوصيات تشجيع التطوير الحضري المدمج ومتعدد الاستخدامات،

مع التركيز على تخطيط وتشغيل أنظمة النقل العام مع التخطيط لمحطات النقل المناسبة، وإعطاء الأولوية لهذه الأنظمة أثناء تخطيط المجتمعات الحضرية لتحقيق المبادئ الأساسية لـ TOD.

الكلمات المفتاحية: التنقل المستدام، التطوير الحضري الموجه نحو النقل الجماعي (TOD)، النقل الحضري، التطوير الحضري المتكامل، التخطيط الاستراتيجي، فلسطين.