An approach to improve land use and urban mobility patterns in Egyptian communities
(Case study of El-Sheikh Zayed city)

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Abstract:

Urban Mobility and Land Use are main challenges facing urban communities nowadays, together with the urge to always improve the quality of life of the communities' residents in line with the increasing pace of urban expansion all over the world. In the recent decades, the dispersed pattern of land use, deterioration of public transportation, and excessive car dependency have been evident in most of the developing countries, thus in Egypt. This in turn affects the different environmental,

social, and economic pillars of the quality of life in these communities and demands alternatives to be able to balance that trend.

This study focuses on the integration between land use and urban mobility in one of Egypt's urban communities, El-Sheikh Zayed city. The city has been chosen as a local case study to discuss the applicability of applying the Transport-oriented development (TOD) principles and standards in the Egyptian context as an approach to improve the status of land use and urban mobility patterns, hence the quality of life of urban communities. Challenges and potentials were identified, and recommendations for El-Sheikh Zayed city and similar urban communities in Egypt and beyond were suggested.

Introduction:

Quality of life is a concept that recently received considerable attention as a result of the many challenges facing urban communities all over the world. Car dependency and the deterioration of public transport in the recent decades have led to increased congestion and traffic volume resulting in increased energy consumption, higher carbon rates and increased greenhouse gas emissions, which in turn affects the quality of life. This has been a challenge that faces Egyptian communities regardless of the governmental investments they receive.

On the other hand, the spatial distribution of land use to accommodate the increasing demand of facilities and services affects the cost of housing, mobility and employment. Poor access to services also can affect the residents' health, financial status, their sense of safety and well-being. That's why the effective planning, adequate designation of land use, together with the integrated urban mobility systems and patterns are among the most important factors that can contribute to an improved quality of life in urban communities.

Transport-oriented development theory (TOD) demonstrates a clear link between land use and public transport planning and non-motorized mobility patterns. TOD is a major solution to the serious and growing problems of climate change and global energy

security. Accordingly, and in order to have vibrant cities that are revitalized, with renewed suburbs and compact walkable neighborhoods, the Institute for Transportation and Development Policy (ITDP) has developed the TOD standard to assess and measure 8 main principles. These principles include walk, cycle, connect, transit, mix, dense, compact and shift. It is worth noting that this standard has been applied to several projects around the world (Busch and Huang 2015).

Research Methodology:

This research tries to understand the relationship between land use and urban mobility and its major interests at different urban levels. It focuses on district and neighborhood urban level as a significance where many challenges and parameters meet, discusses the integration between Land uses characteristics and Urban Mobility patterns such as mix, density, urban form, and design, etc. After that, the research studies the TOD concept as a theory linking land use and public transport planning, explores TOD standards and assessment tool by ITDP. Finally, the research analyzes land uses and urban mobility of the 8th district in El-Sheikh Zayed city as a local case study through the main TOD principles to discuss the applicability of applying the TOD principles and standards in the Egyptian context.

The relationship between Land use and Urban mobility:

Socio-Economic, land use and transportation system factors are three major areas affecting indirectly on travel behavior demand and VMT. This research will focus on Land use as a main factor influencing the overall travel demand as shown in Fig. 1 (Polzin 2004). Setting of urban planning principles cannot work independently on urban Mobility strategies, and vice versa.
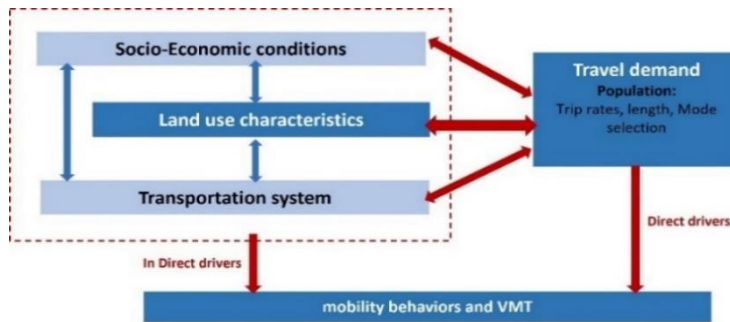
Figure 1: Conceptual model of urban mobility behavior and vehicle mile of travel (VMT), by author adapted from (Polzin 2004)

Demands for mobility derive as results of the demand of particular land use as shown in Fig. 2. In order to reduce traffic congestion, which is brought on by an increase in transportation activity, transportation infrastructures are being enhanced.

The location of urban facilities is impacted by changes in the transportation facility supply. Whenever there was a population growth, urban activity and transportation activity both grew. Many urban problems, such as housing shortages, traffic congestion, and environmental problems, stem from the inability of transportation facilities to keep up with rapidly expanding demand.
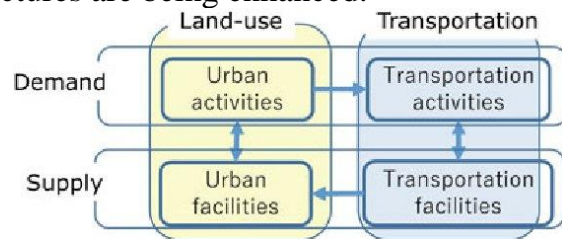
Figure 2: Relation between land use and transportation planning, source: (Morimoto 2021)

The promotion of public welfare and the sustainable growth of cities were the goals of city planning, which can be seen to have focused on finding the optimum way to balance supply and demand between land use and urban mobility. (Morimoto 2021)

Impact of land use on urban mobility at different scales:

The integration between land use with urban mobility are considered at different urban scales including site, Neighborhood and urban area level as shown in Fig. 3. Every urban level has different factors of interest which feature the relation between land use and mobility. (SUTP 2010)

Figure 3: Impact of Land use on urban mobility at different scales, by author.

1. Site level:

It's critical to comprehend how site components and its design aspects affect travel behavior. Trip Generation Manual by ITE* , which compares parcel-level travel demand as determined by daily vehicle trips across various uses for the parcel, is a prime example of site-level descriptive data on the relationship between transportation and land use. Shelter and pedestrian amenities, as well as other site-level transportation features, such as parking supply and cost, are important determinants of mode choice. (Polzin 2004)

2. Neighborhood level:

The development of a neighborhood or station area is significant because it necessitates the integration of land planning with transportation network planning, as well as cooperation between the public and private sectors. The private sector frequently has control over decisions at the site level, while the public sector is responsible for comprehensive land use planning, zoning, and infrastructure provision. Studies on this scope focus on the variety and density of land use, the structure of the road system, and the degree to which design takes advantage of the accessibility of transit services. The concept of transit-oriented development (TOD), which will be thoroughly examined and discussed at a later date, is also receiving a great interest at this scale.

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[1]*The Institute of Transportation Engineers (ITE) is an international membership association of transportation professionals who work to improve mobility and safety for all transportation system users and help build smart and livable communities.

3. Urban area level:

The most comprehensive range of land use characteristics, including size, development density, mix of uses, urban form, urban design, activity scale, and contiguousness of development, are included in this basic urban scale. One of the most significant elements that has an impact on the urban area level is the relationship between jobs-housing balance and reducing travel demand. Other interests at the urban area level have concentrated on topics such as the share of the different modes of transit, concentration of CBDs, urban density, and the intensity of mobility network (Holtzclaw 1990). The relationship between land use and urban mobility will be examined in this study at the neighborhood level.

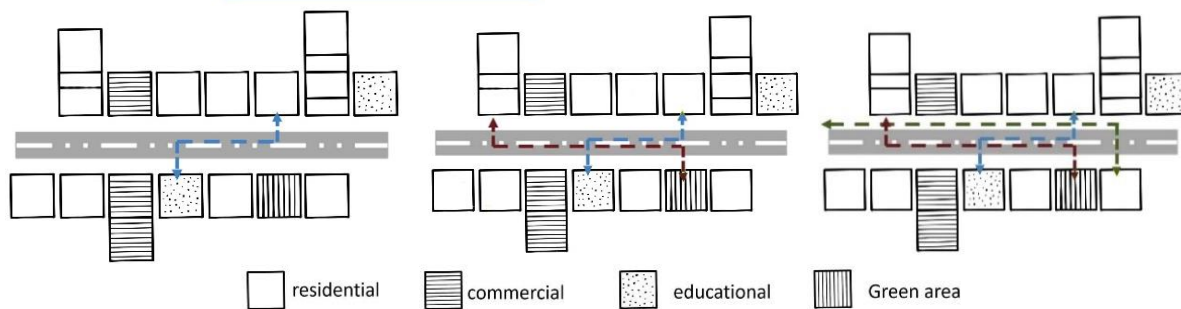## **Integration between Land use characteristics and Urban Mobility patterns:**

The type of land use, it's density and spatial distribution could reflect a specific "travel demand " between them reflecting on Trip distance, rates and mode selection as shown in Fig. 4, Fig. 5.

The travel demand could be classified into the following basic categories of movement: - between home and the workplace.

- between home and other land use such as: daily services and needs.
- Movement between different nonresidential land use and each other.
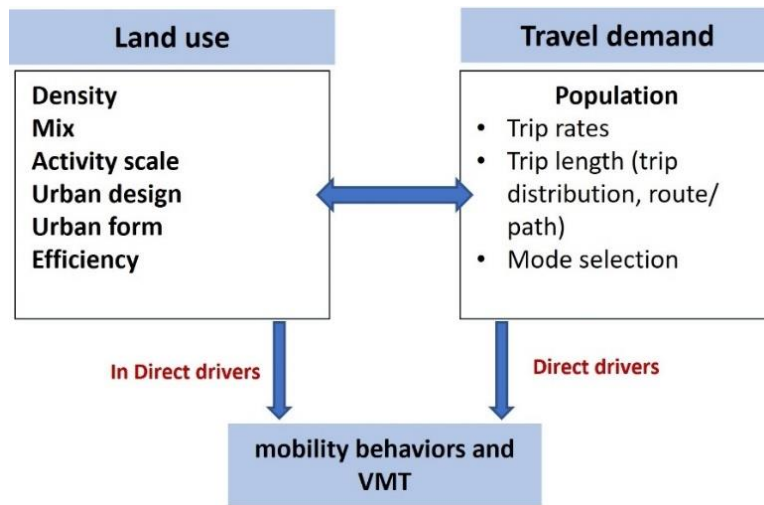
Figure 4: Land use and travel demand affecting on urban mobility behavior and VMT, by author adapted from (Polzin 2004)

Figure 5: Impact of land use on travel demand and urban mobility patterns, by author

In more detailed way to understand the integration between Land use different characteristics including density, mixed uses, urban form and design, activity scale with urban mobility patterns including trip rates and distances, mode selection are discussed as follows: (Polzin 2004)

1. **Development density**: Several measures, such as population or employment density, square footage of development or the intensity of economic activity, are used to measure development density. Higher density raises the overall travel demand from a particular geographic area, but the concentration and high density

of activities enables and encourages shorter motorized trips as well as walking, bicycling, and greater usage of public transportation as shown in Fig. 6.

2. **Mixing compatible land use** enables shorter trips, including shorter motorized trips and more effective transit operations, where biking and walking may be feasible possibilities as shown in Fig. 7.

Figure 6: Low dense V.S high dense land use and mobility patterns
https://www.houseplanninghelp.com/housing-density-conundrum/, access 24 December 2022

Figure 7: mixed land use V.S Separated and mobility patterns
https://vnrc.org/burlington-town-center-redevelopment-can-bring-environmental-benefits/, access 3 January 2023
http://pier70sf.org/dogpatch/dogpatch_history.htm, access 3 January 2023

3. **Activity scale:** The scale of urban activity is determined by business models for the economic functioning of land use at a certain location, and it determines in turn its market area. Larger-scale facilities necessitate larger land parcels and frequently wind up on the outskirts of urban areas. This in turn effects on the high demand of longer trips and discourage walking and cycling modes, resulting in higher VMT compared to daily and weekly trips paid to facilities located in the center of the urban area as shown in Fig. 8.

Figure 8: the effect of activity scale on trip distance and mode selection

https://www.cnu.org/publicsquare/2017/04/27/great-idea-mixed-use-urban-centers, access 24 April 2023

https://neo-trans.blog/2023/01/13/seeds-sprouts-xxv-park-place-tech-stays-lasalle-theater-available-grant-thornton-moving/, access 24 April 2023
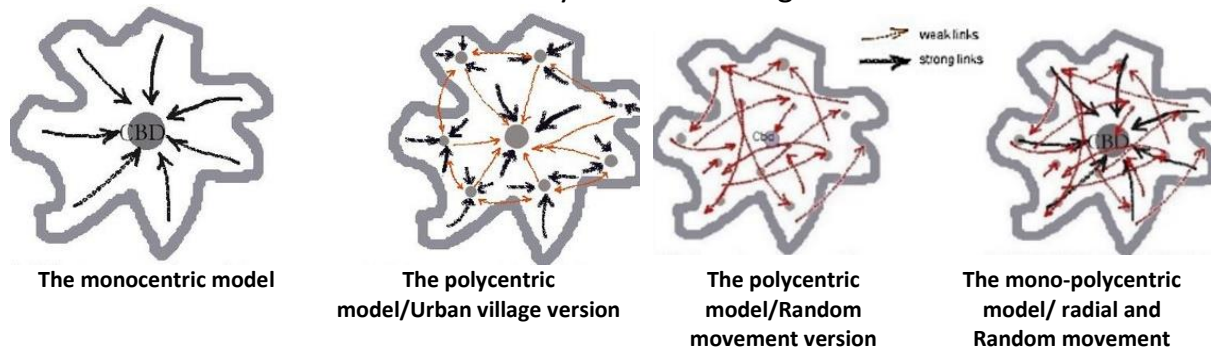
4. **Land Use Efficiency:** It refers to managing and minimizing the land used for road and parking areas, which affects the choice of transportation mode and promotes walking and cycling as shown in Fig. 9. Efficiency also relates to the reuse of Undeveloped areas of brown and grey fields. The scattered undeveloped areas result in increasing distances and accordingly VMT, on the other hand, it discourages non-motorized modes.

Figure 9: Before and after reuse of roads and parking area, Pearl Street Plaza, New York (Barata and Fontes 2017)

5. **Urban Design:** The choice of modes can be influenced by the orientation of the building on the site in relation to the transportation infrastructure (sidewalks, bus stops, parking lots etc.). Site design features like shaded pathways, furniture, and other amenities, can improve the attractiveness, comfort, and safety of different modes. VMT can be decreased when urban design promotes walking and cycling environment integrated with transportation services.

6. **Urban form**: It can affect preference and turning out of one mode of transportation over another and affect overall VMT. For instance, compared to car-oriented districts where residential areas with low density are separated from its centers, pedestrian-friendly employment and activity hubs connected by moderate to higher density corridors can promote walking, cycling, and transit use. Different urban forms and its effect on urban mobility as shown in Fig. 10.

The monocentric model | The polycentric model/Urban village version | The polycentric model/Random movement version | The mono-polycentric model/ radial and Random movement

Figure 10: Schematic representation of trip patterns observed in different urban forms (Bertaud 2001)

Interaction between Land use, Urban Mobility patterns and Quality of life:

Urban quality of life is the outcome of the integration between numerous dimensions including environmental, physical, mobility, psychological, social, economic and political quality of life, which differentiate at different communities and societies. Urban quality of life cannot be dependent on particular dimension without the others, but rather through the interactions between all of dimensions.

Fig. 11 illustrates how these dimensions are interconnected and dependent on one another. And it emphasizes the significance of the fact that numerous disciplines are engaged in achieving urban quality of life. (Elariane 2012)

In this research we will focus on Land Use and Urban Mobility patterns and their effect on the other dimensions as critical factors in creating more livable communities

and improving urban quality of life on the environmental, social, economic and psychological quality of life as shown in Fig. 12.

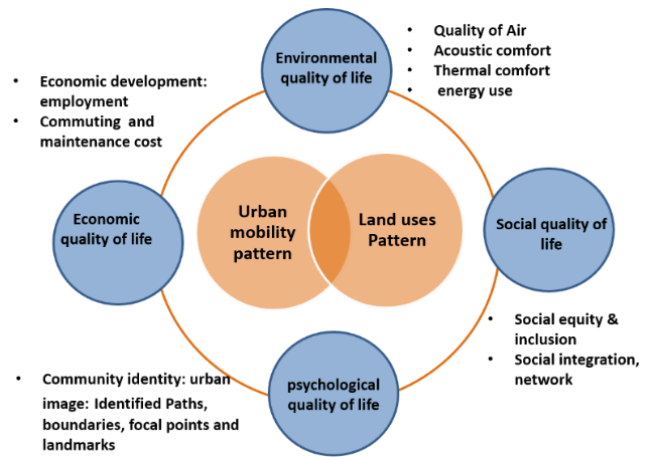**Figure 11: Urban quality of life dimensions (Elariane 2012)**

Figure 12: Interaction between Land use, urban Mobility patterns and Quality of life, by author

Transit oriented development (TOD) linking of land use and public transport planning:

Peter Calthorpe codified the idea of Transit-Oriented Development (TOD) in the late 1980s, and when Calthorpe released "The New American Metropolis" in 1993, TOD became a mainstay of contemporary planning. TOD is characterized as a mixed-use community that promotes individuals to live near transit facilities aiming to increase public transit ridership, and to reduce their dependence on private motorized mode as shown in Fig. 13, Fig. 14. (Ibrahim 2019)

It is a significant response to the grave and growing crises of global energy security and climate change, it also has the potential to address a wide range of current social and economic challenges affecting the urban quality of life.

Figure 13: TOD concept,
https://www.transformative-mobility.org/wp-content/uploads/2023/03/Transit-Oriented-Development_2021-09-08-070826_eqbq-x0C9wK.pdf, access 12 March 2023

bus stop every 1/8 mile

Light rail stop every mile
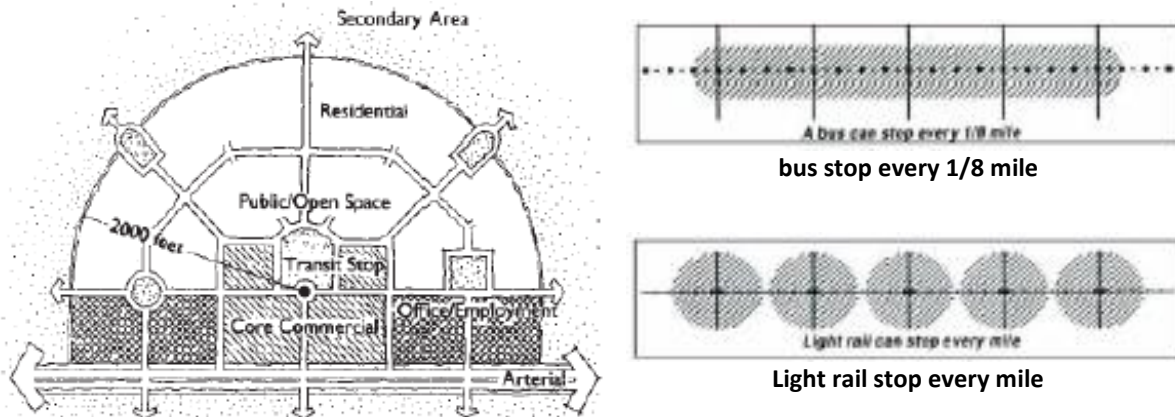
Figure 14: land use distribution in atypical TOD node and theoretical planning of nodes along a transit line (Ibrahim 2019)

TOD scoring system by The Institute for Transportation and Development Policy (ITDP):

A transit-oriented development (TOD) standard reflecting the 8 Principles which has been created by the Institute for Transportation and Development Policy (ITDP)* . The

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[2]*The Institute for Transportation and Development Policy (ITDP) has been working to promote environmentally sustainable and equitable transportation in cities worldwide Since 1985, guided by Eight Principles for Better Streets and Better Cities**.**

ITDP's TOD standard uses a scoring system to award gold, silver, or bronze ratings. This is comparable to the LEED program, which awards points to buildings based on their energy efficiency.

This TOD standard has been used by ITDP in numerous cases all over the world. The projects must be completely built and within 500 meters of a line that directly serves a high-capacity public transit corridor such as bus rapid transit, rail, etc., or within one kilometer from the high-capacity transit corridor itself (Busch and Huang 2015).

The primary purpose of TOD Standard assessment tool and its metrics, developed by ITDP, was to assess development projects as the fundamental elements of urban expansion and the primary targets of investment decisions, coordinated plans, land use and design regulations, and other procedures and frameworks of urban development. (ITDP 2017).

Table 1: TOD Scoring by ITDP in detail (ITDP 2017)

WALK   Principle 1 I 15 points

DEVELOPING NEIGHBORHOODS THAT PROMOTE WALKING

OBJECTIVE A. The pedestrian realm is safe, complete, and accessible to all.	6 points 8 points 1 point
OBJECTIVE B. The pedestrian realm is active and vibrant.	
OBJECTIVE C. The pedestrian realm is temperate and comfortable.	

CYCLE   Principle 2 I 5 points

PRIORITIZE NONMOTORIZED TRANSPORT NETWORKS

OBJECTIVE A. The cycling network is safe and complete.	2 points 3 points

OBJECTIVE B. Cycle parking and storage is ample and secure.

CONNECT	Principle 3 I 15 points

CREATE DENSE NETWORKS OF STREETS AND PATHS

OBJECTIVE A. Walking and cycling routes are short, direct, and varied. 10 points

5 points
OBJECTIVE B. Walking and cycling routes are shorter than motor vehicle routes.

TRANSIT	Principle 4 I TOD REQUIRMENT

LOCATE DEVELOPMENT NEAR HIGH-QUALITY PUBLIC TRANSPORT

OBJECTIVE A. High-quality transit is accessible by foot. (TOD Requirement)   ----

MIX	Principle 5 I 25 points

PLAN FOR MIXED USES, INCOME, AND DEMOGRAPHICS

OBJECTIVE A. Opportunities and services are within a short walking 12 points
distance of where people live and work, and the public space is activated
over extended hours.

13 points

OBJECTIVE B. Diverse demographics and income ranges are included
among local residents.

DENSITY	Principle 6 I 15 points

OPTIMIZE DENSITY AND MATCH TRANSIT CAPACITY

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OBJECTIVE A. High residential and job densities support high-quality transit, local services, and public space activity   15 points

COMPACT	Principle 7 I 10 points

CREATE REGIONS WITH SHORT TRANSIT COMMUTES

OBJECTIVE A. The development is in, or next to, an existing urban area.   8 points

OBJECTIVE B. Traveling through the city is convenient.   2 points

SHIFT	Principle 8 I 15 points

INCREASE MOBILITY BY REGULATING PARKING AND ROAD USE

OBJECTIVE A. The land occupied by motor vehicle is minimized.   15 points

The Case study:

- ## El-Sheikh Zayed, Giza, Egypt

El-Sheikh Zayed is a new community located in Giza governorate, Egypt with area of 10.4 thousand acres (NUCA 2023). Every district and neighborhood in the city have a central service area, Residential areas are separated, with low density and many open spaces. Besides the vast area of El-Sheikh Zayed city and its similar Egyptian new communities, the separation of land use generate long distances and trips. This affects dependency of car uses more than public transit and non-motorized modes even in internal trips. Traffic volume and Level of crowdedness in the city roads by cars, and other problems related   directly and indirectly to transportation, are expected to increase till reach the city's targeted population. (Elserafi 2019).

El-Sheikh Zayed City is one of the most recent communities with a keen interest in enhancing urban mobility. This has been represented in many current, ongoing, and futuristic transportation projects in El-Sheikh Zayed city including:

- The monorail project (ongoing), linking El-Sheikh Zayed and 6th October city with downtown.
- "MWASLAT MISR" bus station with park and ride services providing internal PT network and linking El-Sheikh Zayed to 6th October city and downtown.
- Extending cycling and pedestrian network with designated bike paths in main streets (currently and ongoing),
- Bike share station, Multi story parking (futuristic measures).

To analyze urban mobility and land use pattern in El-Sheikh Zayed city, the 8th district has been chosen as case study, as shown in Fig. 15.
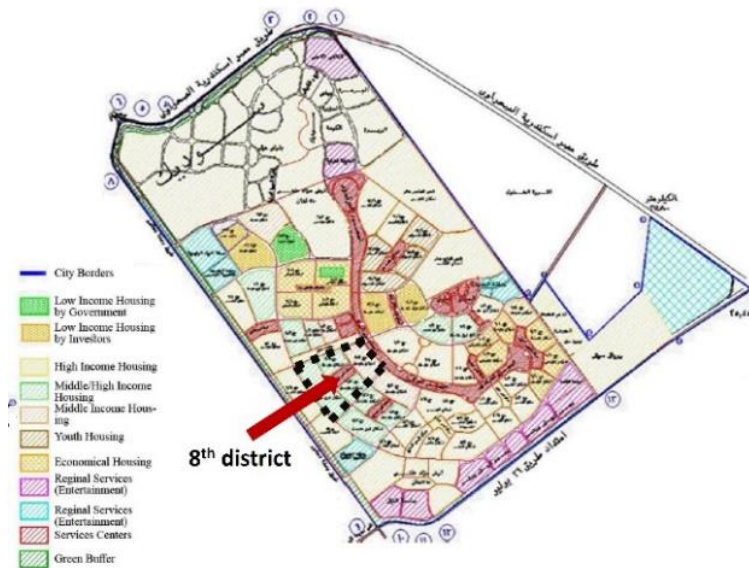
Figure 15: El-Sheikh Zayed city and the study area (8th district), adapted by author from:
http://www.newcities.gov.eg/know_cities/Sheikh_Zayed/default.aspx, access 1 March 2023

<u>Land use and mobility pattern in 8th district, El-Sheikh Zayed city:</u>

In this study, the 8th district is chosen as a case study to analyze its urban mobility and land use pattern as it's a popular and repeated model with common social, economic, climatic and environmental parameters in El-Sheikh Zayed city's districts and in similar Egyptian new communities as well. The 8th district represents a district with medium and above medium class, surrounded with main streets from all sides and located near "Gate Plaza" one of the main and most popular squares in El-Sheikh Zayed. This will be furthermore explained later below.

The 8th district contains 4 neighborhoods and a district center. Every NH has a services center containing daily needs, educational and religious uses. Residential and service areas in NH1 are almost completed. The service centers of NH2, NH3, NH4 have built mosques and the rest areas are unbuilt. The district center has a completed church and school, some areas have been converted to residential use and the others are still unbuilt. The 8th district has scattered open spaces and most probably located in the street's intersections through residential areas. Residents of the 8th district also depends on services from surrounding areas such as the mixed uses in the other side of El-Amal street at the 10th district as shown in Fig. 16 below. Residential density are differentiating in the four NHs, as shown in Table 2 below.

Table 2: Description of 8th District, El-Sheikh Zayed City (NUCA 2023)

Total Area	1.2 km2/285.6 feddans
Population	Current population is 12,000 residents Target population is 29,863 residents*
Residential Density	NH1: 140 (Person/feddan), NH2: 90 (Person/feddan) NH3: 90 (Person/feddan), NH4: 90 (Person/feddan) District center: 90 (Person/feddan)

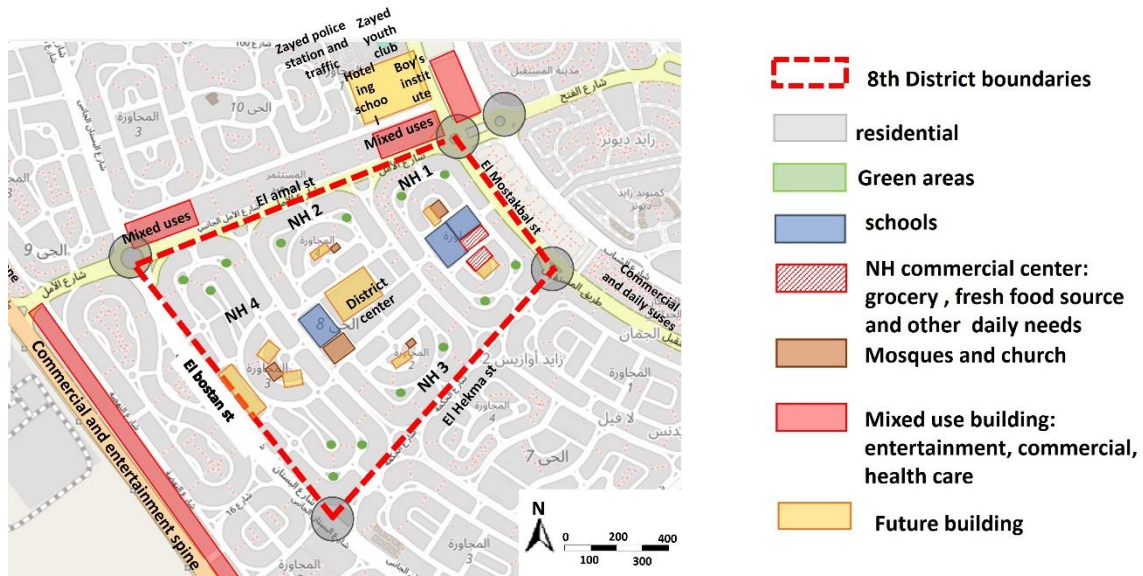[3]* This Population number is according to latest update till June 2022.

Figure 16: Land use plan of the 8th District, by author

The 8th district is surrounded with main streets of El-Amal, El-Mostakbal and El-Bostan where routes of Public transit buses are running with distrbuted Bus stops along these main streets. The gate plaza square at the intersection of El-Amal with El-Mostakbal street represents a main terminal of on demand transit services including Suzukui cars and private comapany's shuttles such as Uber and Swvl. A designated bike path is integrated within El-Amal road space, extended to the eastern side of El-Sheikh Zayed city, as shown in Fig. 17. Local streets divide the 8th district longitudinally, they are just accessible by Suzuki cars which are not allowed to enter NH internal streets.
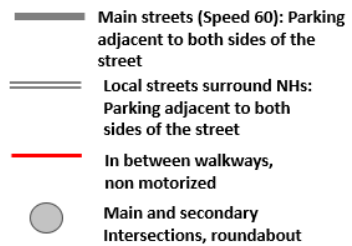
Figure 17: Map of 8th district's urban mobility network, by author

Applicability of TOD 8 principles at the 8th district, El-Sheikh Zayed city:

This study has proposed an approach to discuss the applicability of applying the TOD 8 principles at 8th district, in order to understand existing land use characteristics and urban mobility patterns, determine its challenges and opportunities to improve urban quality of life in these communities, as shown in the table below:

Table 3: Applicability of TOD 8 principles at the 8th district:

WALK	Principle 1
DEVELOPING NEIGHBORHOODS THAT PROMOTE WALKING	

Streets in residential NHs of 8th district are designed just for cars and parking uses, with no obvious or continuous area for walkways and sidewalks. Sidewalks are not achieving their minimum width (1.5m) as they are partially or completely occupied with decorative planting due to design conflicts in separating private and public property. This reflects on Zoning conflicts between the different uses of the sidewalks such as pedestrian flow and footpath furniture. The inconsistent level of sidewalks

surface which is sometimes are very high and not comfortable for pedestrian movement.

The dominance of residential use with gated buildings, the absence of shades and other pedestrian features are not providing suitable walkable environment. Neither a pleasant walking experience nor adequate social and active urban space are provided by the 8th district landscape design as shown in Fig. 18. However, non-motorized in between walkways (intermediate spaces between buildings) are found linking residential buildings with service centers and main streets.

This deters people from walking or cycling and frequently forces them to use private vehicles as alternatives for short distance and intra district trips. Walking and cycling on roadways have not yet experienced serious challenges till now as the incomplete population target and resulting parking needs. In addition, streets have an organic design that requires low speeds.
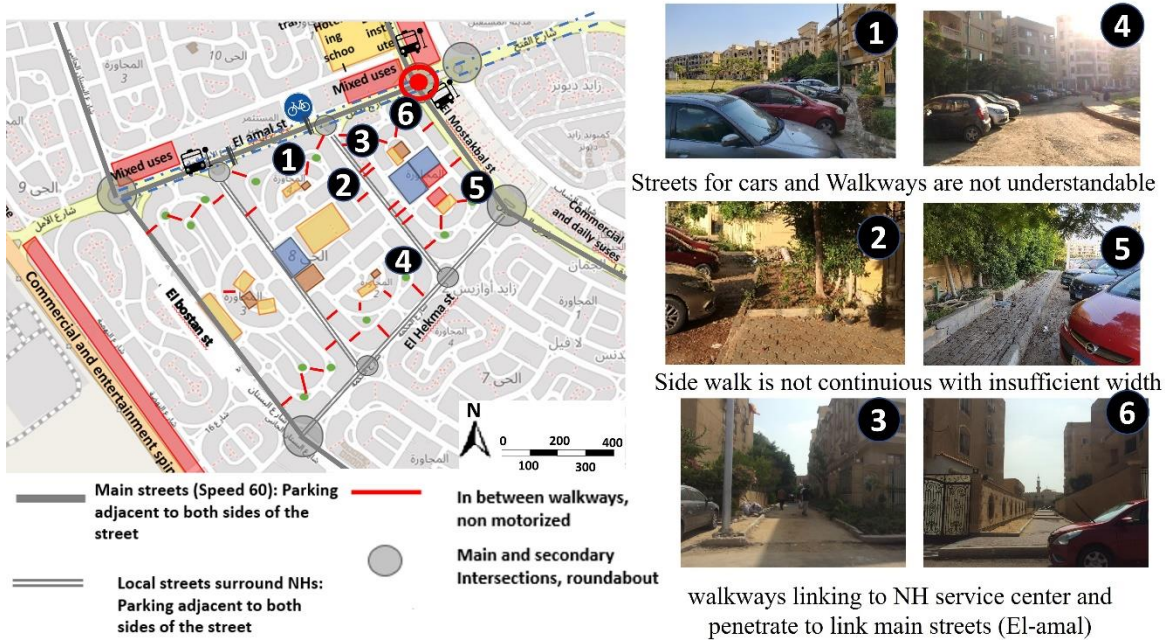

Streets for cars and Walkways are not understandable

Side walk is not continuious with insufficient width

walkways linking to NH service center and penetrate to link main streets (El-amal)

Figure 18: sidewalks and intermediate walkways in 8th district NHs , by author
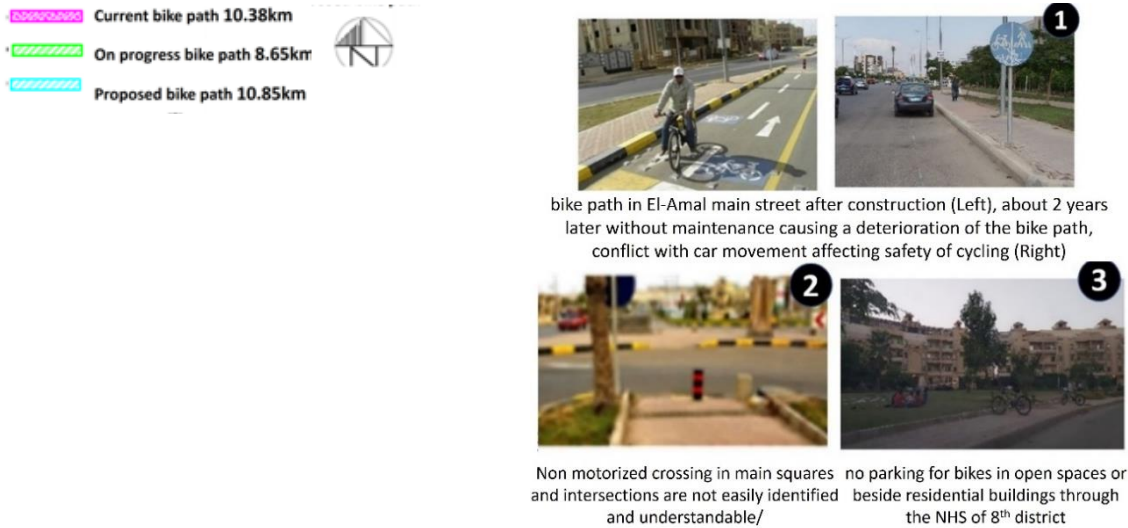
CYCLE Principle 2

PRIORITIZE NONMOTORIZED TRANSPORT NETWORKS

There is a great interest directed to non-motorized mobility especially cycling in El-Sheikh Zayed city. It is obvious in constructing and proposing new designated bike paths along El-Sheikh Zayed city main roads, as shown in the following Fig. 19.

The existing designated bike path in EL-Amal main street adjacent to 8th district, which is extended to link the eastern side of El-Sheikh Zayed city, is comprehensible and invisible for cyclists to cross, especially at street intersections, in addition to making it unsafe for residents.

In addition, there are no facilities on the bike route; over time, it has been transformed into areas for automobile parking and garbage bins. It also not linked to walkways or sidewalks inside NHs streets. There are no spaces for bikes to park even in entrances of residential buildings or in open spaces through NHs and also no bike parking or public ride share system is available beside bus stops in El-Amal main street. Eventually, private services of bike maintenance and facilities are rarely found inside NHs.
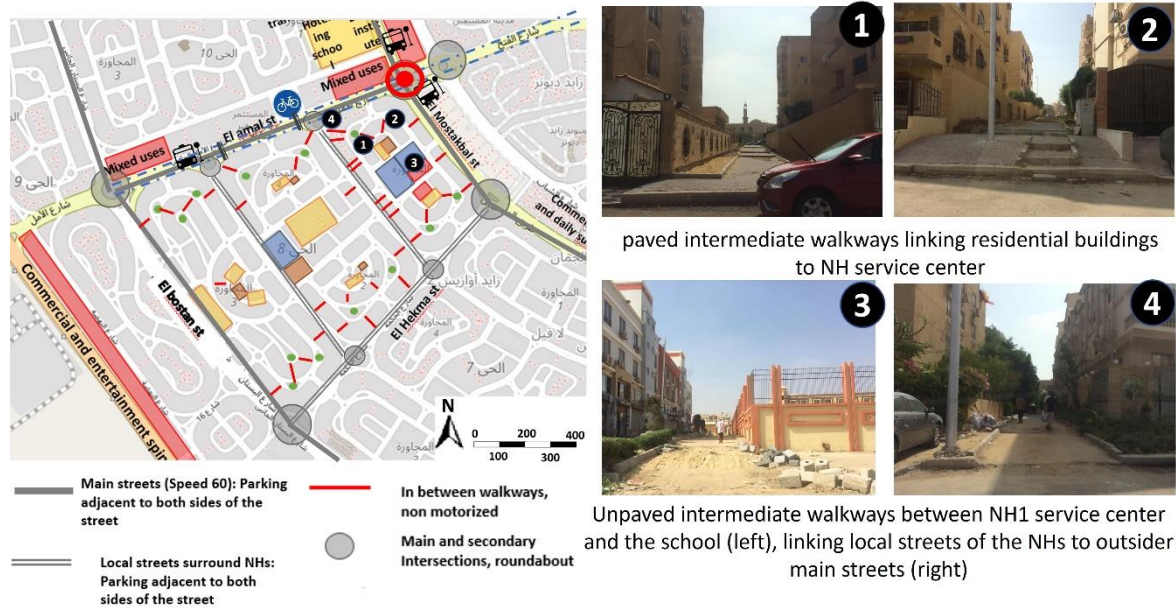
Current bike path 10.38km

On progress bike path 8.65km

Proposed bike path 10.85km

bike path in El-Amal main street after construction (Left), about 2 years later without maintenance causing a deterioration of the bike path, conflict with car movement affecting safety of cycling (Right)

Non motorized crossing in main squares and intersections are not easily identified and understandable/

no parking for bikes in open spaces or beside residential buildings through the NHS of 8th district

Figure 19: Current, on progress and proposed bike paths in El-Sheikh Zayed city at main streets, by author

CONNECT
Principle 3

CREATE DENSE NETWORKS OF STREETS AND PATHS

Good and organized distribution of buildings with medium and small block sizes ranging between (50-70 meters by 150-200 meters) in residential areas provide the potential of using the intermediary spaces between them as a pedestrian-only network. However, they are not continuous and do not clearly connect to one another or to the sidewalks, making it difficult for pedestrians to recognise, comprehend, and access them, as shown in Fig. 20.

paved intermediate walkways linking residential buildings to NH service center

Unpaved intermediate walkways between NH1 service center and the school (left), linking local streets of the NHs to outsider main streets (right)

Figure 20: intermediate walkways not connected with each other's or to other sidewalks, pedestrian networks are not easily identified or accessed, by author

TRANSIT
Principle 4

LOCATE DEVELOPMENT NEAR HIGH-QUALITY PUBLIC TRANSPORT

Public transit including NUCA buses, Suzuki car and private on demand shuttles (like Uber, Swvl, etc.,) pass through the 3 main streets surrounding the 8th district. NUCA buses and Suzuki car connect passengers to local destinations besides transit hubs including hyper one, Mowasalat Misr stations and the Monorail station (on progress hyper one monorail station), which in turn link El-Sheikh Zayed to 6th of October and downtown. Besides, on demand private shuttles only have external trips linking El-Sheikh Zayed with Giza and downtown Cairo. Most of bus stops are within walking distances from most of residential buildings, however these stops are just signs without shelters or other facilities like NUCA buses, and sometimes depend

on word of mouth or just located on online maps without any identified signs in case of Suzuki cars and private on demand shuttles, as shown in Fig. 21.
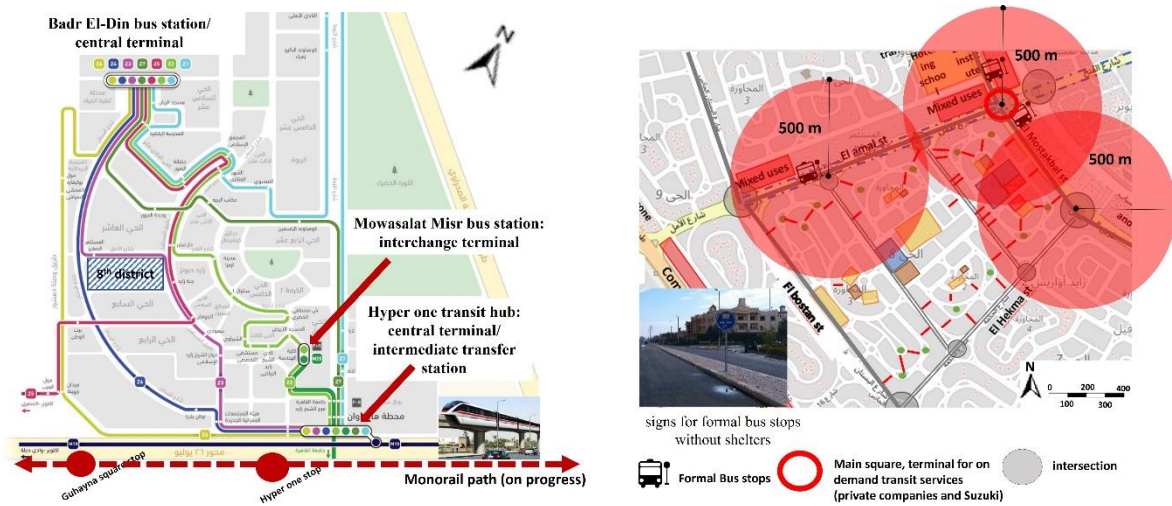
Figure 21: Main bus stations and the on progress monorail project in El-Sheikh Zayed city (left), walking distance from bus stops and terminals in 8th district (right), by author adapted from: https://mwasalatmisr.com/ar/portfolio/sheikh-zayed-city/

MIX
Principle 5

PLAN FOR MIXED USES, INCOME, AND DEMOGRAPHICS

The single residential use is the most dominant use in the 8th district. Mixed used buildings only found in NH centers like Lazourdi mall in 1st NH, which serve daily need services. There is a mosque in each NH and a church in district's central area and it also contains two schools: "EL-Nile" school in1stNH - "Wise" school in district center. Unused green spaces are found scattered in every NH as aesthetic appearance and rarely as a play area in large and medium size areas. Some areas of the district center, which was planned as service area, have been converted to residential areas

according to balance the growing service areas. Therefore, the 8th district residence depends on the mixed use buildings in EL-Amal Street in the adjacent 10th district like entertainment services, health care services, supermarkets, etc. Some dispersed and scattered uses appear informally in residential building like beauty salons and clinics in the basement level and rarely in upper floors as shown in Fig. 22.
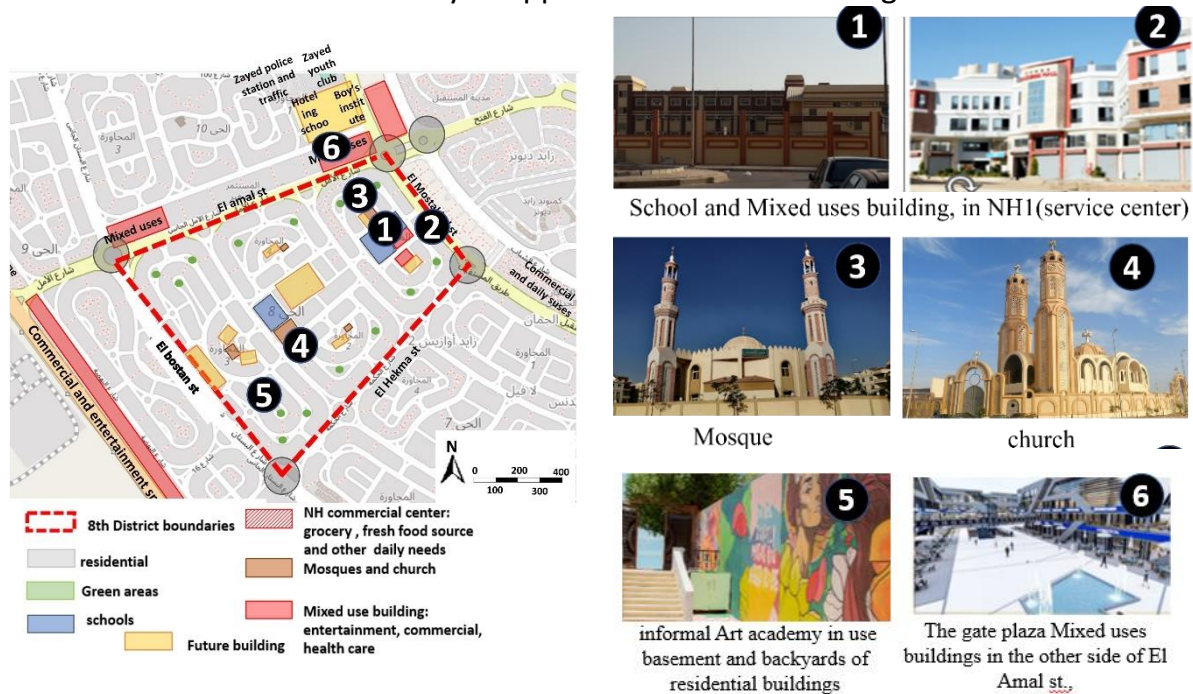

Figure 22: Residential and mixed uses in 8th district, by author

DENSITY
Principle 6

OPTIMIZE DENSITY AND MATCH TRANSIT CAPACITY

The floor numbers in the 8th district residential buildings are between ground + 4 floors including the roof level like NH1 buildings and ground +2 in other NHs. As mentioned above in Table 2, Residential density is 140 person/ feddan in NH1 which presents the highest residential density in the district and 90 person/ feddan in NH2,

NH3, NH4 and district center. Hence, the 8th district in general provides medium residential density and medium density of buildings adjacent to the main streets with public transit routes. However, more dense buildings (ground+5) are found in the other side of El Amal street belonging to the 10th district as shown in Fig. 23.
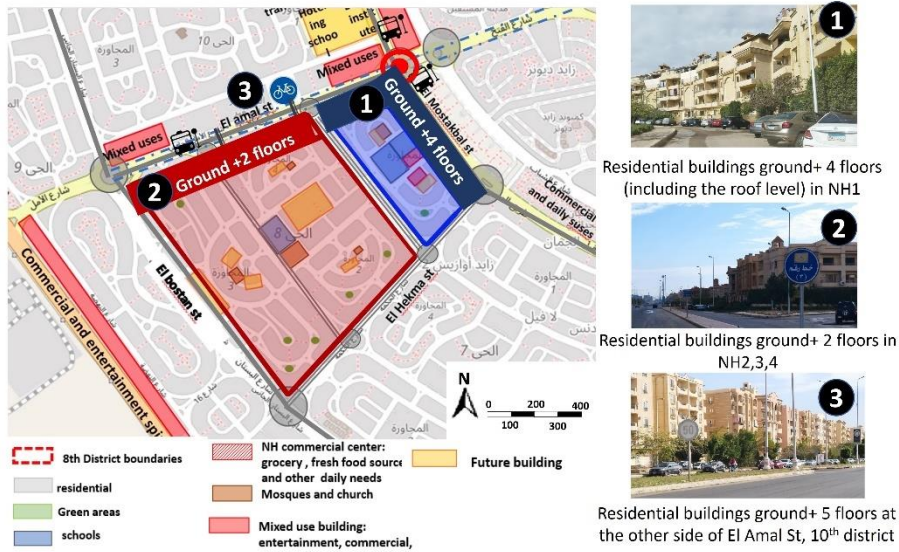

Figure 23: Residential density in 8th district, by author

COMPACT   Principle 7

CREATE REGIONS WITH SHORT TRANSIT COMMUTES

El-Sheikh Zayed city location is 28 km from El-Tahrir square and 20 km from Lebanon square (downtown Cairo). The 8th District is located about 3.5 km from the monorail and main bus stations including Mwasalat Misr and Hyper one station which in turns links to the city center (Cairo downtown and Giza), as shown in Fig. 24.
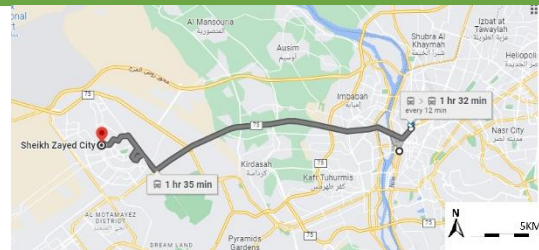

Figure 24: El-Sheikh Zayed city location from Cairo city center,

google maps, accessed at March 2023

SHIFT	Principle 8

INCREASE MOBILITY BY REGULATING PARKING AND ROAD USE

Roads in the 8th district and its NHs are entirely dedicated for car use, therefore cars have access to the local NH streets from any of the NH entrances and in any direction, in addition to the unmanaged parking (first adjacent then angular) which some kind start to be problematic after the population growth, and expected to increase after reach the population target and occupation ratios.

Although there are underground parking garages in many buildings, the district as a whole has not yet utilize them. And that's because residents choose not to purchase parking spaces in order to avoid paying additional fees on top of the cost of their housing unit, and the presence of parking spaces in the roadways.

Also, some owners of private real estate are freezing the use of underground parking in order to change its use in the future and reap greater financial rewards as shown in Fig. 25. Ride sharing system is available only through private companies such as Uber, Swvl, etc., with very high cost beside rare and unpopular services of car sharing.

Angular parking adjacent to residential buildings (left) , adjacent to walkway on both street sides (right) conclude flow of mobility through long term

On street parking and Walkways around the school

sidewalks around NH1 service center illegally occupied with trucks and service car

Figure 25: Cars parking and access to all the district streets, by author

Discussion:

Applying the TOD 8 principles to the 8th district of El-Sheikh Zayed city has revealed a set of challenges, the most evident of which is car dependency – even in short and intra trips. In addition to the deteriorated bike paths and walkways, as well as poor transit facilities. If the 8th district pattern of land use and urban mobility continue unchanged, which is a repeated pattern in Sheikh Zayed City and other Egyptian new cities, the urban quality of life will be affected negatively across its environmental, economic, and social dimensions. Moreover, the district's expected urban and population growth adds more pressure to the challenges that face its urban quality of life.

Therefore, and as per the observed challenges, potentials are proposed to improve land use and urban mobility patterns in the 8th district:

Table 4: Challenges & Potentials of applying the TOD 8 Principles to the 8th district, El-Sheikh Zayed city		
principle	Challenges	Potentials
WALK	● Most of the district area is for residential and road use. non-motorized walkways are very limited. ● The built environment and poor pedestrian infrastructure often forces to walk on roadways or use private cars as alternatives for short distance and intra district trips. ● Reaching population target will increase walking and cycling challenges	● Enhancing the existing public and open spaces with shading trees and other pedestrian features including seats, lighting, etc., could create a pleasant walking environment. ● Extending the in-between walkways to cross open spaces and streets through NHs, to be more identified and accessed by pedestrians.
CYCLE	● Disconnected bike paths, and lack of paths' maintenance. Bike paths are missing the link to streets inside NHs. ● Lack of bike parking spaces within the residential area. ● No public bike sharing system at nearby public transit stops and terminals or through NHs inner streets. ● Absence of bike maintenance and repair facilities, no community store that offers free labor on bicycle repairs.	● The existing designated bike path in EL-Amal main street, and the opportunity to link it with other proposed bike paths through El-Sheikh Zayed. That could be a perfect start for a fully-fledged cycling network. ● The availability of free spaces to integrate new bike paths, use as bike parking and/or sharing stations. Providing bike parking in green spaces inside NHs. ● The NHs streets with its curved design can slow traffic flow, which in turn creates a safe cycling environment.
CONNECT		

	● The intermediate walkways (In between buildings) are not connected, accordingly not understandable and easily accessed	● In-between walkways can provide a parallel non-motorized network.
TRANSIT	● Bus stops are rarely sheltered, most of the time, it is only signs besides the long distances between bus stops of the same route.	● The location of Bus stops along El-Amal main street with wide roadway enables establishing sheltered bus stops with transit facilities which are linked with the mixed used services on the other side of the street.
MIX	● Residential use is the most dominant use, NH1 has the only established service center providing daily needs, other NHs and district centers are under construction and some of them have been converted to residential centers. ● Absence of retail shops, service outlets and other uses which promote walking. ● Informal mix, there is a tendency to informally house non-residential uses in some residential buildings. This takes place mostly in basement and ground floors, and it may encourage a pattern of informal mix of incompatible uses if it isn't managed. ● Residential areas are fenced and gated, lacking the necessary	● The unbuilt areas in NH and district center. ● The considerably large green spaces at streets' intersections. ● The mixed-use side of El-Amal street (in the 10th district), which provides entertainment, health care services and others.

	integration between them and the ability to form/contribute to the public space.	
DENSITY	● buildings of NH2, NH3, NH4 which are adjacent to El-Amal, El-Mostakbal streets with its public transit routes and stops are not considering the high dense principle in the best way	● The availability of increasing number of Building's floors in some areas of NH2, NH3, NH4 and district center, especially near main streets.
COMPACT	● Located 3.5 km of the main transit hubs, the district is not within walking distance of the monorail station (on progress) and the main bus stations.	● The growth of local CBD in El-Sheikh Zayed city, providing more Job opportunities may reduce distances between Home-work trips
SHIFT	● Unmanaged road parking is the norm. Car dependency is very high, almost 100% of the trips are made by cars, even those that are short and characterized as intra trips. ● Cars' access and parking are allowed in all roads (parallel and angular). ● Increased cost of ride/car sharing services.	● The use of the existing underground parking facilities.

Recommendation:

Based on the previous analysis and taking into consideration the similarities shared between the 8th district, the rest of El-Sheikh Zayed city's districts, and many of Egypt's new urban communities, this paper proposes some specific recommendations to

integrate the land use and urban mobility patterns on both scopes of districts and NHs of the 8th district, and other general recommendations that can be put to use in multitude of similar districts/cities.

Recommendations for 8th district of El-Sheikh Zayed city:

Urban mobility networks and infrastructure / land use characteristics:

- Enhancing existing open and green spaces through the 8th district to promote pleasant walking environment besides re-considering of the existing intermediate walkways pavement, maintenance, lighting, and the overall landscape design to help provide an overall safe environment.

- Connecting the in-between walkways to form a parallel identifiable and understandable pedestrian network away from motorized mobility to induce more dependency on active modes of transit, especially for intra-district trips. A pedestrian-only network can also provide multi-use spaces for social activities and safe children playing areas.

- Linking the existing designated/marked bike path in El-Amal main street to new proposed ones integrated through NHs inner streets.

- Regulating bike parking spaces in central service areas, schools, and the entrances of residential buildings and the intermediate open spaces between them. In addition to providing bike sharing stations and bike related services and facilities.

- Promoting public transit and providing identified, understandable, and sheltered bus stops along El-Amal street with intermodal features e.g., bike parking. bike or ride sharing service and considering the appropriate distances between every bus stop and the next one.

- Dedicating future land use in the 8th district to compatible services encouraging walkability (either as part of the ground floor only or throughout the whole building) and Constraining future land use for residential purposes.

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- Efficient use of existing underground car parking lots/garages for car parking, especially at the 8th district's boundaries to set up parking zones.

- Introducing specific car-free areas/days with no car parking nor bypass allowed.

- Facilitating affordable car sharing/pooling solutions to reduce the demand of car ownership and/or parking.

- Enhancing the direct transit routes linking the 8th district to the monorail station (on progress) and other main bus stations with high quality bus service or on demand shuttles, promoting park and ride service with affordable prices and other intermodal features in main transit hubs.

General recommendations:

Urban mobility networks and infrastructure/ land use planning and characteristics:

- As cycling is more convenient alternative than walking in most of Egyptian new communities because of long distances, climate conditions, wide urban spaces and roadways (so that it suitable to integrate cycling lanes and facilities), significant interests will be directed to promote cycling in these communities including the establishment of new integrated cycling lanes and bike parking facilities on most of the streets to act as a network connecting the city's diverse activities to its residential blocks.

- Re-designing the streets' intersections to give priority to both pedestrians and cyclists and make it safer for them.

- Facilitating the establishment of reliable bike or/and ride sharing systems through easing the issuance of permits that allows for such activity as an example. This could be achieved through the cooperation of local authorities, and other forms of government support.

- Establishing a reliable public transportation system that focuses on inter-connecting the different parts of the city, besides connecting the city to other metropolitan centers.

- Connecting the before mentioned public transportation system to the pedestrian and cycling networks and other points of interest in the city. This could be achieved through setting up multiple-use bus shelters at bus stops with adequate space for bike parking or/and sharing, carpooling or/and sharing to encourage inter-modal mobility.

- Re-distributing of services across neighborhoods; It is postulated that a mixed-use model arises where the walking distances are too long to the service centers.

- A more compact fabric is strongly advised to be considered while developing new cities

- There is a crucial need for maintenance of public spaces. So it is advised that more attention is paid to not only that, but also to the training and coaching of the local authorities' representatives responsible for the planning and follow-up on the execution of that maintenance.

-Encouraging The growth of local central business district (CBD) in new urban communities, providing more Job opportunities. This may reduce distances between Home-work trips and provide more compact and complete urban areas.

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