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Integrating Transit-Oriented Development in Historic Urban Districts: Enhancing Mobility and Preservation in ElMosky, Cairo

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Abstract Purpose: This paper investigates the incorporation of Transit-Oriented Development (TOD) concepts inside the historic district of ElMosky in Cairo. The primary objective is to improve urban mobility, conserve cultural heritage, and enhance the overall quality of life in the district. Methodology: This research utilizes a qualitative technique, which involves a combination of literature review, semi-structured interviews, field observations, and document analysis. The literature review encompasses the impacts of urbanization, concepts of TOD, and the most effective approaches worldwide. The case study analysis is based on conducting semi-structured interviews with stakeholders, which provides a deeper understanding of the local mobility challenges and possible solutions. Field observations provide information on traffic conditions, pedestrians, and public spaces. Document analysis includes reviewing existing studies to provide a contextual framework for the findings. Findings: The study reveals major urban mobility obstacles in ElMosky, including traffic congestion, outdated public transportation, and insufficient pedestrian infrastructure. Proposed strategies include pedestrianizing key streets, creating green spaces in underutilized urban pockets, and enhancing transit connectivity through expanded public transportation networks. These strategies were informed by community feedback and observations, ensuring their relevance to ElMosky's unique context. Novelty: This study is one of the pioneering efforts to implement TOD concepts in a historic district in Cairo. It aims to address the intersection between contemporary urban mobility requirements and the preservation of cultural heritage. This study offers a framework for integrating TOD into historic settings, demonstrating how tailored interventions can simultaneously address contemporary urban challenges and protect cultural heritage. The strategy offered is customized to respect ElMosky's distinct cultural and historical setting, while simultaneously advocating for sustainable urban growth.

Keywords Transit-Oriented Development, Urban Mobility, Historic Preservation, ElMosky, Sustainability

1. Introduction

Urban mobility plays a fundamental role in urban planning and has a substantial influence on the quality of life, economic prosperity, and environmental sustainability of cities [1]. Preserving heritage in historic districts becomes more intricate as it requires finding a balance between heritage conservation and meeting modern requirements [2]. Transit-Oriented Development (TOD) is a strategic approach that aims to establish compact, pedestrian-friendly, and diverse neighborhoods that

revolve around well-designed public transportation centers. Transit-Oriented Development (TOD) may effectively tackle issues related to transportation and support the development of cities in an environmentally friendly manner [3] [4].

The cultural importance of historic areas presents both possibilities and obstacles to implementing TOD initiatives. These historic districts frequently face challenges of inadequate infrastructure, traffic congestion, and environmental pollution despite the preservation of historical buildings and the promotion of cultural tourism, which can have a positive economic impact [5] [6]. To improve accessibility and protect the historic urban fabric, urban transport solutions are needed.

ElMosky is a district in Cairo that highlights the complex relationship between urban mobility, modern demands, and the conservation of heritage. ElMosky serves as a historical district and an economic hub, as well. ElMosky suffers from urban mobility obstacles such as traffic congestion, restricted public transportation, and insufficient pedestrian infrastructure. Implementing TOD principles in ElMosky has the potential to enhance the livability and sustainability of the district, while also preserving its historical integrity [7] [8].

This paper investigates TOD application in ElMosky, in order to enhance the urban mobility and quality of life within the district. Both literature review and case study review the global best practices, investigate specific challenges and opportunities in ElMosky, and propose tailored solutions for the local context. This paper aims at creating a sustainable development of historic districts by integrating historical preservation along with modern mobility strategies based on TOD principles. Therefore, this paper follows a qualitative approach, including the literature review on urbanization of existing cities, the effect of urban mobility on quality of life, TOD principles, guidelines for TOD in historic districts, a review of global best practices, and the applicability to the local Egyptian context. On the other hand, the case study relies on three data sources: primarily, semi-structured interviews are conducted with significant stakeholders. The purpose of these interviews is to collect a wide range of viewpoints on current issues related to transportation, possible solutions, and the demands of the community. In addition, the author conducts direct observations to better understand the regular patterns of urban mobility, the condition of traffic flow, and the use of public spaces. These observations provided prompt and significant insights into the actual mobility obstacles inside the district. Finally, this paper illustrates an in-depth review of previous relevant urban planning documents, transportation studies, and historical records. This review provides a foundational understanding of the urban environment, historical development, and past efforts related to urban mobility that were conducted in ElMosky. The results obtained from these qualitative methods are combined and concluded with guidelines and recommendations for urban mobility that are tailored to the specific situation in the local historical context of ElMosky.

2. Literature Review

2.1. Urbanization of Existing Cities

Urbanization is a global phenomenon that is defined by the growing migration of individuals from rural to urban areas. Significant changes in land use, environmental quality, and socioeconomic dynamics within cities have resulted from this shift. The United Nations (2018) projects that 68% of the world's population will live in urban areas by 2050, resulting in worsening problems like noise and air pollution, traffic jams, and restricted access to green spaces. Urbanization frequently leads to the degradation of environmental conditions and a decrease in the quality of life for residents due to increased pollution and limited availability of natural resources [9].

The process of urbanization in historic districts is challenging because it needs to balance modernization with heritage preservation. Integrating modern urban demands into historical urban structures frequently presents difficulties in preserving the architectural and cultural authenticity of these areas. Major challenges encompass the potential for architectural uniformity, loss of cultural distinctiveness, and the constraints of contemporary development that jeopardize the safeguarding of historical assets [5]. Furthermore, the presence of insufficient infrastructure in historic districts, resulting in a lack of modern utilities, might create challenges in the process of urbanization [2]. The presence of social issues such as gentrification and displacement of local populations is notable, as the process of urban renewal can result in higher property values and living expenses, so forcing out existing residents [10]. In addition, the significant challenges of adhering to legislative and financial constraints in the preservation and modernization of historic buildings to comply with contemporary demands are enormous challenges [11]. Community engagement is crucial; however, it is often challenging as it requires the harmonization of diverse stakeholders [12]. The incorporation of advanced technologies such as Building Information Modeling (BIM) and Geographic Information Systems (GIS) is crucial, but it poses a difficulty because it requires certain resources and abilities. Urbanization in historic districts should strive to strike a harmonious balance between development and preservation, ensuring that modernization efforts do not undermine the historical and cultural significance that defines these areas [5]. This method not only protects the historical urban context, but also increases the socio-economic vitality of the city.

2.2. Effect of Urban Mobility on Quality of Life

Urban mobility is essential for the viability of cities. Efficient mobility networks have the potential to improve

the economy, promote social integration, and support the protection of the environment. Nevertheless, numerous cities encounter significant challenges. Factors such as traffic congestion, insufficient public transportation, and inadequately planned pedestrian and bike infrastructure contribute to lower quality of life [13], [1]. Traffic congestion has two adverse effects: it causes longer travel times and raises pollution levels, which have a detrimental influence on public health [14].

The quality of life in historic cities is greatly influenced by urban mobility. Efficient urban transportation options improve the accessibility for both residents and visitors, while also reducing traffic congestion and pollution. A study conducted by [15] emphasizes that sustainable transportation systems, such as pedestrian walkways, cycling routes, and public transit could have a good impact on the quality of life. Such systems are based on reducing dependence on private vehicles, resulting in decreased levels of noise and air pollution. These enhancements are essential in historic districts, where the conservation of architectural authenticity and public areas is of utmost importance.

Furthermore, the improvement of urban mobility through meticulous planning and the development of necessary facilities may promote economic prosperity. An efficient mobility system should facilitate convenient access to commercial and cultural activities, promoting economic expansion while preserving the historical integrity [16]. Nevertheless, inadequately controlled urban mobility can result in negative consequences, such as greater traffic congestion, which affects the historical atmosphere and ease of access in certain districts [17]. Therefore, it is crucial to incorporate mobility solutions that preserve and protect the distinctive attributes of historic cities in order to improve the overall quality of life.

2.3. Transit-Oriented Development

Transit-Oriented Development (TOD) is an urban development approach that focuses on developing dense, pedestrian-friendly areas with a variety of uses, basically centered around designed effective transit stops. The objective of TOD is to decrease the dependence on private vehicles, leading to a reduction in traffic congestion and pollution, while simultaneously improving the quality of urban life [3]. Research conducted by [18] demonstrates that Transit-Oriented Development (TOD) has the potential to enhance public health by encouraging physical activity in pedestrian-friendly areas. Additionally, TOD can boost local economies by raising property values and attracting businesses. When integrating TOD in existing historic districts, it is necessary to adapt the approach in order to respect and preserve the distinctive historical and cultural characteristics of those areas.

The integration of Transit-Oriented Development (TOD) principles in historic urban districts has been an evolving area of study. Foundational works, such as [19], serve as critical starting points. Their research underscores how TOD can be leveraged to address urban mobility challenges while maintaining the integrity of historic neighborhoods. Specifically, they emphasize strategies like the adaptive reuse of historic buildings near transit hubs, reducing reliance on private vehicles, and enhancing pedestrian connectivity as ways to ensure that modernization does not undermine the cultural and architectural heritage of historic districts. This balance is particularly critical in densely built historic areas where space is limited, and traffic often clashes with the need for preservation. The introduction of pedestrian-only zones, such as in Alfama and Baixa, has reduced vehicular congestion while maintaining the vibrancy of these iconic neighborhoods. Public transportation hubs, such as tramlines and metro stations, were strategically designed to ensure accessibility without encroaching on sensitive heritage sites. Balsas highlights how these interventions not only improved mobility but also bolstered tourism and local economic activities, illustrating the symbiotic relationship between TOD and heritage preservation. Furthermore, other research has investigated the crucial link between the mixed-use development within TOD and creation of vibrant cities and lively streets. In his research, [20] developed a critical approach that investigates the built environment attributes that enhance urban vitality.

Various cities worldwide have successfully implemented Transit-Oriented Development (TOD), especially in historic districts where the seamless integration of modern transportation options is crucial. An instance of this can be seen in Curitiba, Brazil, where the incorporation of bus rapid transit (BRT) systems into urban planning has greatly enhanced transportation efficiency and reduced traffic congestion [7]. European cities, such as Barcelona, have applied Transit-Oriented Development (TOD) concepts to improve transportation in historic neighborhoods while safeguarding their cultural heritage [21]. These examples demonstrate how concepts of Transit-Oriented Development (TOD) can be adapted for different settings, resulting in cities that are more environmentally friendly and conducive to quality of life.

Within the framework of historic districts, Transit-Oriented Development (TOD) can contribute to urban revitalization initiatives by enhancing accessibility and reducing pressure on historic infrastructure. This is achieved by providing improved public transportation choices and creating a pedestrian-friendly environment [22]. This approach not only conserves the historical integrity of the district but also regenerates the area by enhancing its accessibility and appealing to both inhabitants and visitors.

2.4. Guidelines for TOD in Historic Districts

Implementing TOD principles in historic areas requires a careful approach, taking into consideration the historical and cultural context of the city. A tailored strategy is

necessary to improve urban mobility and livability in the historic urban setting while preserving its valuable heritage. This approach can include the following guidelines:

- Integrated Planning: Create comprehensive urban strategies that integrate land use with mobility planning. To promote the use of public transportation and decrease reliance on private cars, it is recommended to prioritize the development of densely populated areas that combine different types of land use, particularly around transportation hubs like metro and bus rapid transit (BRT) stations [18] [23]. It is important to prioritize the integration of historic sites into these plans in order to ensure their protection and accessibility.
- Pedestrian and Cyclist Infrastructure: Improve pedestrian and cyclist infrastructure to facilitate walking and cycling between transit hubs and nearby communities, with a particular focus on historic districts. Pathways that are safe, easily accessible, and properly maintained promote the use of non-motorized mobility, which in turn helps to decrease traffic congestion and pollution [24] [25]. The inclusion of pedestrian zones can effectively maintain the historical essence of an area while also enhancing its accessibility.
- Community Involvement: Encouraging active participation of local communities in the planning process can ensure the compliance of the developments with the community needs and the preservation of the cultural heritage. Community-driven planning promotes local support for TOD initiatives and fosters social cohesion [26]. Engaging local historians and cultural experts can effectively preserve the authentic character of historic sites [27].
- Smart Technologies: Implementing smart technologies, such as real-time transit information systems, smart ticketing, and integrated mobility apps, can enhance the efficiency and user experience of public transportation [28]. These technologies can be adapted to emphasize and encourage visits to historic places, enhancing the cultural tourist experience.
- Heritage Conservation: Incorporate Transit-Oriented Development (TOD) with the aim of preserving and improving historic districts. The process of adapting historic structures for mixed-use may revitalize these areas by attracting tourists and economic activities while preserving their historical integrity [12]. Preservation policies should aim at ensuring that contemporary developments harmonize with historic structures.
- Policy and Incentives: Implement policies and incentives that promote Transit-Oriented Development (TOD), such as zoning restrictions, tax incentives, and public-private partnerships. These measures aim at encouraging the development of sustainable communities centered around transit hubs [29]. Incorporating the preservation of historic sites and facilitating their incorporation into the TOD framework should be included in policies.

Implementing Transit-Oriented Development (TOD) in historic areas needs a comprehensive approach that maintains the historical setting while simultaneously promoting sustainable urban mobility. Historic districts may enhance the livability of urban environments by integrating land use and mobility planning, improving pedestrian and bike infrastructure, engaging local communities, utilizing smart technologies, and preserving heritage. These guidelines provide a clear plan for improving the quality of life in historic districts by implementing sensitive and sustainable development techniques.

2.5. Review of Global Best Practices

2.5.1. Examples from Developed Cities

Historic districts of well-developed cities provide significant insights into the effective incorporation of Transit-Oriented Development (TOD) principles.

- **Barcelona, Spain:** Barcelona's El Raval district in Spain serves as a prime example of how Transit-Oriented Development (TOD) may be used to improve mobility options while maintaining the area's historical significance. The city adopted a superblock system, which led to a decrease in vehicular traffic and an emphasis on pedestrians and cyclists, which contributed to enhanced air quality and the establishment of additional public areas [30]. In addition, the incorporation of metro lines and bus routes has enhanced the accessibility of the district, benefiting both local inhabitants and visitors [21].
- **Portland, Oregon, USA:** Portland's Pearl District in Oregon, USA, experienced revitalization by applying Transit-Oriented Development (TOD) principles. This approach combines contemporary transit infrastructure with the conservation of historical buildings that were once an industrial district. The expansion of the Portland Streetcar line in the district reduced reliance on private cars and fostered economic development, attracting new companies and residents while preserving the area's historical essence [31].
- **Copenhagen, Denmark:** The Indre by district of Copenhagen demonstrates the effective integration of cycling infrastructure into a historic urban setting. The city's extensive bike infrastructure, along with pedestrian-friendly streets and efficient public transportation, has greatly decreased traffic congestion and pollution, hence improving the quality of life in the historic center [32].

2.5.2. Examples from Developing Cities

Urban centers experiencing development have specific challenges when implementing Transit-Oriented Development (TOD) principles in areas with historical

significance. However, there are significant instances when such efforts have achieved positive outcomes in developing cities.

- **Curitiba, Brazil:** The historic area of Curitiba has experienced positive effects from the city's Bus Rapid Transit (BRT) system. The implementation of effective public transportation in conjunction with pedestrian zones in the historic center has enhanced accessibility, reduced vehicular congestion, and preserved the cultural heritage of the area while enhancing its quality of life [7].
- **Bogotá, Colombia:** La Candelaria district in Bogotá, Colombia demonstrates how Transit-Oriented Development (TOD) may revitalize old urban districts in developing cities. The adoption of the TransMilenio Bus Rapid Transit (BRT) system has enhanced the efficiency of public transportation and reduced traffic congestion. In addition, the implementation of pedestrianization projects has successfully revitalized the historic core, creating it more appealing to both tourists and local businesses [26].
- **Istanbul, Turkey:** The integration of contemporary tram lines in the old Sultanahmet area has resulted in improvements while preserving its cultural and architectural heritage. The implementation of pedestrian-only zones in significant areas surrounding historical landmarks has improved tourism while preserving the historical character of the district [33].

2.6. Applicability to Local Egyptian Context

2.6.1. Adapting Best Practices

Implementing international standards in a local setting needs a delicate approach that acknowledges and values the distinctive historical, cultural, and socio-economic factors.

- **Pedestrianization and Public Space Enhancement:** Taking inspiration from Barcelona's superblocks and Copenhagen's pedestrian-friendly applications, the local community can build pedestrian zones to effectively minimize traffic congestion and pollution in the area. Implementing pedestrian-only routes and increasing the size of green areas can improve the quality of life in the district and draw in a larger number of visitors [30] [32] [34].
- **Integration of Public Transportation:** By incorporating elements from the successful bus rapid transit (BRT) systems in Curitiba and Bogotá, the local setting can improve its public transportation network by combining BRT with the existing urban infrastructure. This strategy has the potential to enhance accessibility and decrease the dependence on personal cars, thereby leading to a reduction in pollution levels [7] [26].
- **Cycling Infrastructure:** Implementing dedicated bike lanes, similar to those in Copenhagen, can enhance sustainable mobility and reduce local traffic congestion. These lanes can be strategically linked to major transit hubs and other attractions within the district. It is essential to promote a transition towards mobility methods that do not involve motor vehicles [32].

2.6.2. Context-Specific Solutions

Adapting TOD concepts to the particular needs of the local setting entails tackling local challenges and capitalizing on distinct opportunities.

- **Cultural and Historical Sensitivity:** The preservation of local historical and cultural assets should be the primary focus of any TOD program. This can be accomplished by applying adaptive reuse for the historic buildings, while also making sure that any new development projects maintain the architectural integrity of the district [35].
- **Community Involvement:** Involving the local community is essential for the success of transit-oriented development. Public participation can facilitate the identification of precise mobility needs and preferences, so ensuring that proposed solutions are well-received and efficient [36].
- **Economic and Social Benefits:** Implementing Transit-Oriented Development (TOD) may provide substantial economic and social advantages within the local setting. Enhanced mobility can improve the accessibility of job opportunities and services, especially for low-income populations and working families. In addition, the revitalization of public spaces can promote social engagement and strengthen communal solidarity, thereby enhancing the overall standard of living [18].

3. Case Study: ElMosky; an Old Cairene City District

3.1. About the District

ElMosky is a historic area located in the center of Cairo, Egypt, which is well-known for its historical, and economic significance. This district is characterized by its compact urban context, and dense functions as a dynamic economic center, attracting individuals from various parts of Egypt because of its vibrant commercial activity and advantageous location. ElMosky's historical significance lies in its historic buildings, narrow pathways, and traditional marketplaces, which represent the district's long-lasting past [37]. The district is distinguished by a diverse collection of historic buildings. This district has served as a hub for trade and commerce since the 14th century [38]. The district's architectural setting presents a combination of Islamic, Ottoman, and Mamluk styles, creating a dynamic open urban museum that provides insight into Cairo's architectural development throughout history [39]. ElMosky, despite its historical attractiveness

and economic strength, is confronted with substantial urban issues. The district's infrastructure is unable to keep up with the demands of contemporary urban life. The presence of extensive traffic, the lack of adequate public transportation, and the shortage of pedestrian routes are significant problems that have negative impacts on the residents' quality of life and the general efficiency of the district [40]. The presence of air and noise pollution, along with the lack of green areas, increase the challenges in front of the quality of life in ElMosky. The complex relationship between ElMosky's historical preservation and urban growth requires a deliberate approach to urban mobility and land-use management. Figure 1 illustrates the boundaries of ElMosky district within Cairo.

3.2. Methods

This research is based on thematic analysis to find and analyze patterns in qualitative data obtained from surveys and interviews. This technique facilitates the comprehension of the challenges and opportunities of TOD in historic areas from the perspectives of diverse stakeholders.

3.2.1. Data Collection

The data collection process uses various qualitative techniques to ensure a complete understanding of the mobility problems and potential in ElMosky. The data collection includes:

- **Interviews:** Semi-structured interviews are carried out with the primary stakeholders of the ElMosky district, which include urban planners, local government officials, transportation specialists, community leaders, business owners, and citizens. The purpose of these interviews was to gather information on current urban mobility issues, possible solutions, and community needs. The semi-structured interviews offered considerable flexibility to investigate various themes and perspectives.
- **Observations:** Field observations are conducted to get insight into the everyday patterns of movement, traffic conditions, behavior of pedestrians and cyclists, and the utilization of public places. These observations provide current data on urban mobility concerns and assist in identifying potential areas for improvement.
- **Document Analysis:** Relevant documents, including urban planning documents, transportation studies, and historical records, have been reviewed, analyzed and assessed. The investigation provided a fundamental understanding of the urban context, historical development, and past mobility attempts in ElMosky.

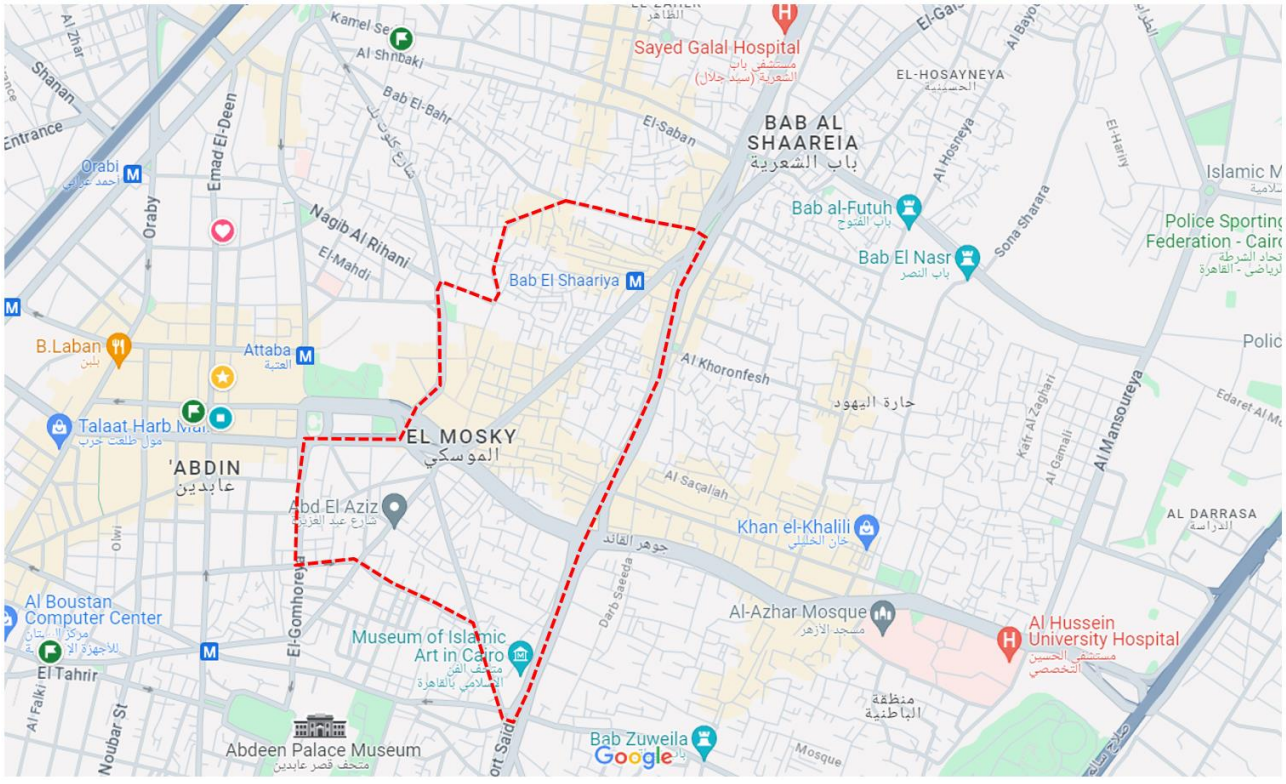


Figure 1. ElMosky Map (Source: Google Maps)

3.2.2. Data Analysis Techniques

The data analysis is performed utilizing the subsequent qualitative techniques.

- **Thematic Analysis:** Thematic analysis is utilized to identify, analyze, and summarize patterns. This process entails encoding the data, classifying the codes into themes, then analyzing the themes to comprehend the fundamental problems and possible solutions.
- **Content Analysis:** Content analysis is the method used to systematically analyze the textual data extracted from documents. The investigation will specifically concentrate on the frequency and context of particular terms, phrases, and concepts associated with urban mobility and transit-oriented development (TOD).
- **Triangulation:** Triangulation is the technique used to validate the data obtained from various sources and techniques. The study demonstrates the reliability and validity of the results by comparing findings obtained from interviews, observations, and document analysis.

3.3. Results and Discussion

3.3.1. Results and Discussion of the Interviews

The semi-structured interviews were carried out with 12 key stakeholders, which included urban planners, local government officials, transportation experts, community leaders, business owners, and residents of ElMosky. It revealed a comprehensive range of insights into the district's current mobility challenges, possible solutions, and community demands. The interviews revealed the following themes:

A. Issues Related to Mobility Challenges

- **Traffic Congestion:** Most participants emphasized the significant problem of heavy traffic congestion, particularly during periods of high demand. The narrow streets and the significant amount of both vehicles and pedestrian traffic worsen this congestion. Table 1 illustrates the traffic flow patterns in ElMosky across weekdays and weekends. During a weekday, the main streets like Portsaid st., Mohamed Ali st., & ElGeish st. get congested starting from around 01:00 PM till night. Sunday can be considered the weekend for this area, as all shops close on Sundays, which makes the traffic flow good to medium during the whole day. The inner streets in the whole area have limited vehicular accessibility.
- **Limited Public Transportation:** Several participants emphasized the insufficiency of the existing public transportation system, emphasizing that the available choices are frequently congested, unreliable, and don't adequately connect the district to the other nearby districts. Figure 2 illustrates the public transportation connectivity of ElMosky to the nearby districts. There are two main metro lines at the north and west of the district which provide limited access to the area by mass transit. The map shows the coverage (500m) of each metro station. However, there are few bus lines connecting ElMosky to other districts; the vehicles themselves are outdated and the system is not reliable. There is no public transportation in the inner streets.

Table 1. Traffic Flow Patterns in ElMosky Across Weekdays and Weekends (Source: Google Maps)

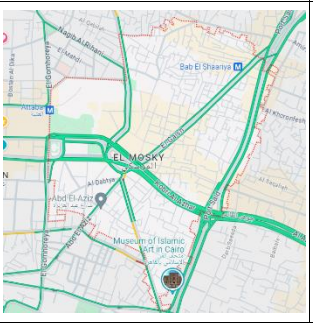
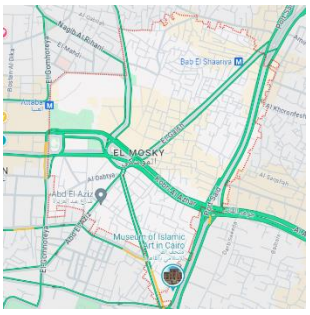
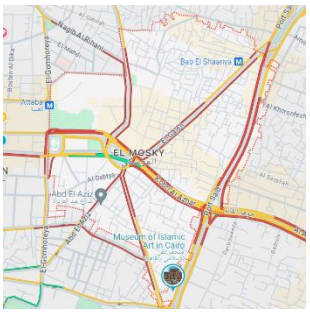
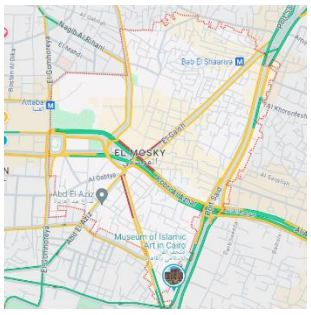
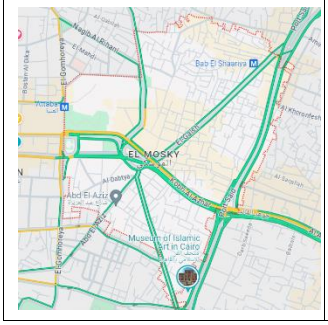
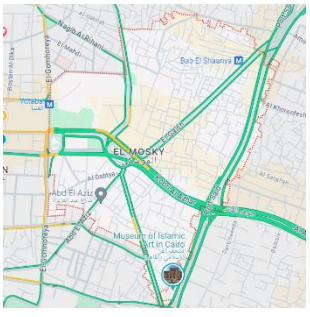
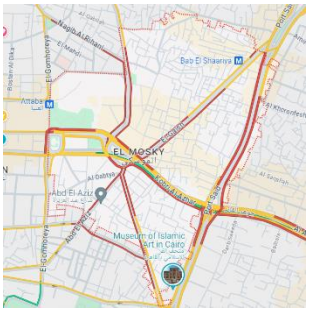
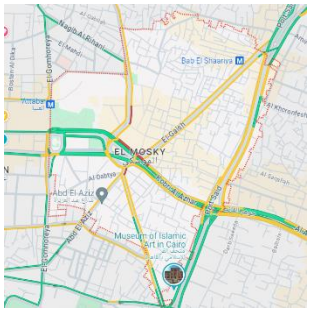
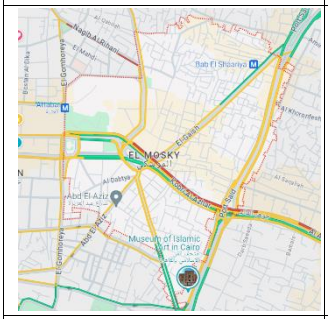
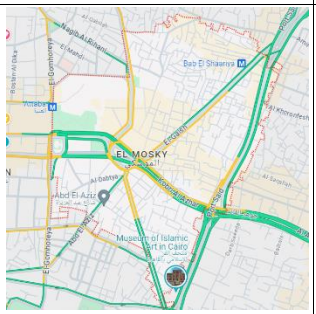
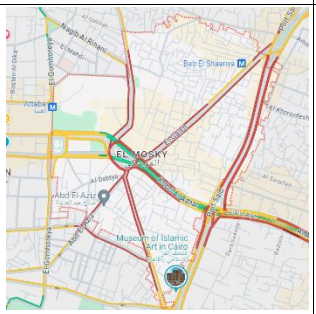
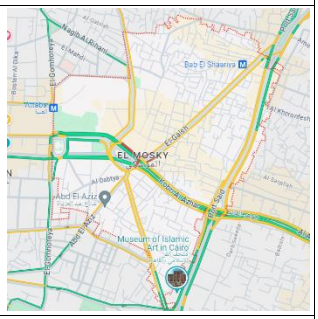
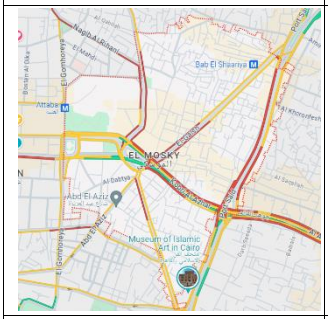
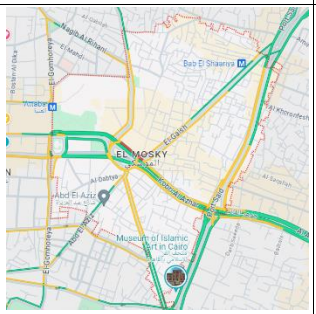
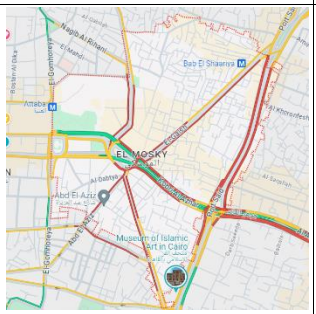
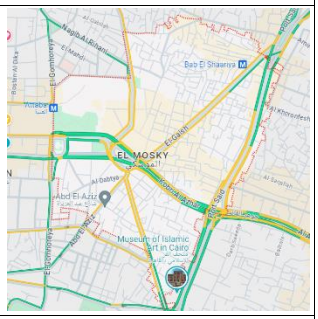
Weekday	Weekend (Sunday)	Weekday	Weekend (Sunday)
07:00 am	**07:00 am**	**05:00 pm**	**05:00 pm**
			
09:00 am	**09:00 am**	**07:00 pm**	**07:00 pm**
			

Table 1 continues

11:00 am	11:00 am	09:00 pm	09:00 pm
			
01:00 pm	**01:00 pm**	**11:00 pm**	**11:00 pm**
			
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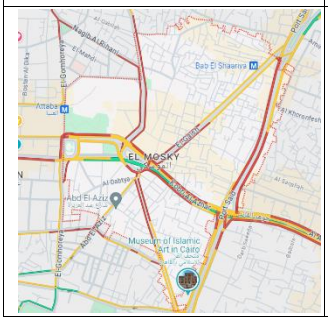
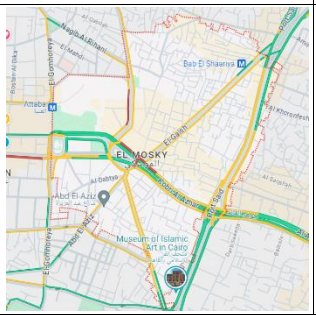
			

Figure 2. Connectivity of ElMosky District to the rest of Cairo by Public Transportation System (Source: [41])

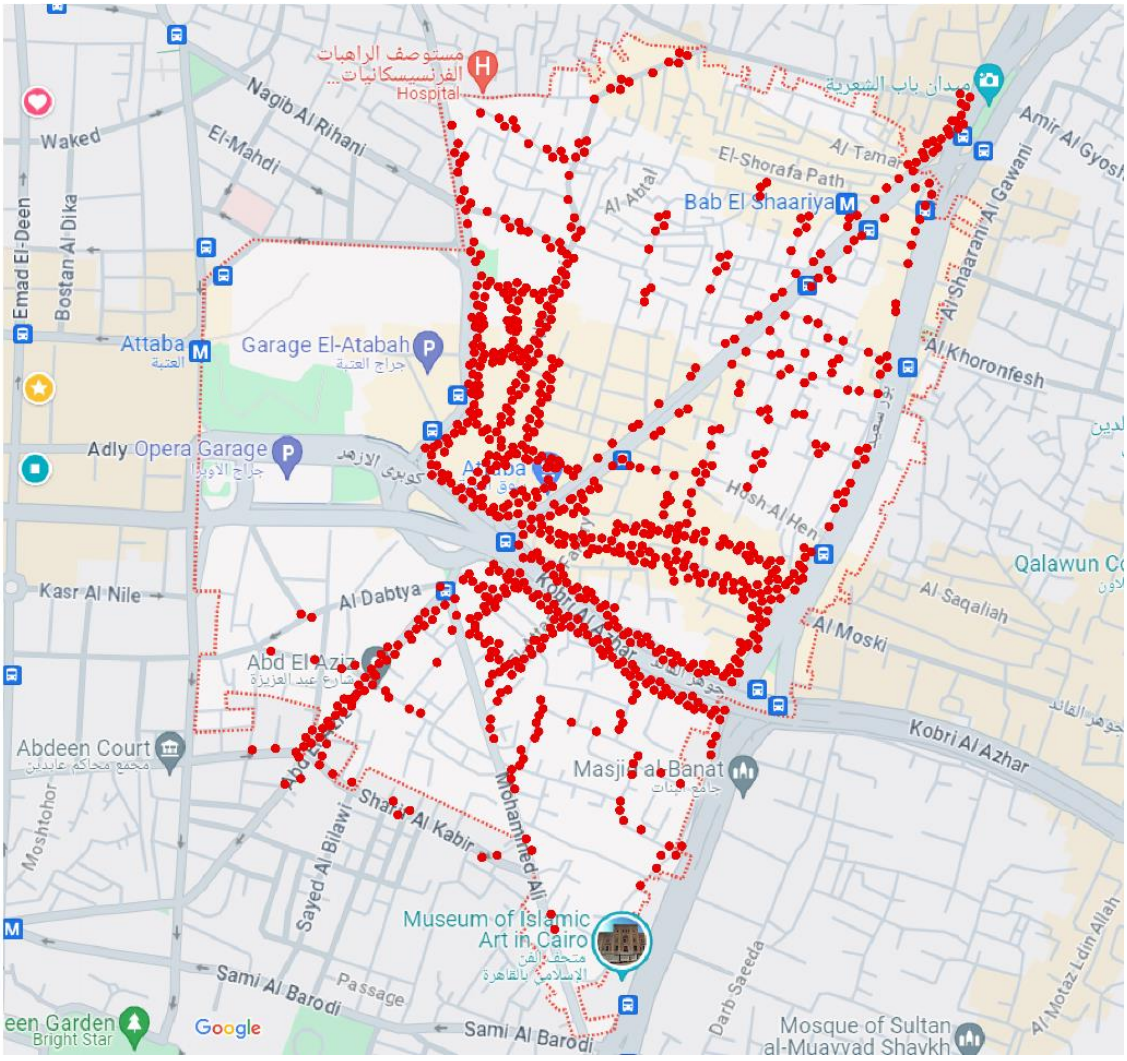


Figure 3. Street Vendors Intensity in ElMosky. (Source: Author, Basemap: Google Maps)

- **Pedestrian and Cyclist Safety:** There is a major concern regarding the safety of pedestrians and cyclists. The absence of designated lanes and the invasion of street vendors onto sidewalks force pedestrians to walk onto the roadways, hence increasing the risk of accidents. Figure 3 illustrates the intensity of the street vendors in the area. It is noticed that the street vendors are spread all over the area, but they are more concentrated in ElMosky, ElGohary, AlRowiaai, AlEsielli, ElAttar and AbdelAziz streets. This concentration of street vendors is due to the concentration of the retail shops on the same streets.
- **Pollution:** Many stakeholders highlighted air and noise pollution, linking these issues to the huge flow of traffic and the use of outdated and inefficient vehicles. Moreover, the noise levels are too high, especially in the main streets and squares like AlAzhar Street or Attaba Square. The noise pollution has not only resulted from the moving traffic, but also from the loud street vendors.

The data collected through the interviews emphasizes the crucial connection between urban mobility, environmental quality, and the general quality of life in ElMosky. Major traffic congestion and restricted availability of public transportation not only hinder the urban mobility but also increase the air and noise pollution, subsequently affecting the quality of life. Transit-Oriented Development (TOD) concepts can help solve these problems and create a sustainable framework for urban growth.

Improving public transportation and encouraging active modes of mobility like walking and cycling are essential for minimizing traffic congestion and decreasing pollution. The promotion of pedestrianization and the establishment of dedicated cycling infrastructure reveal an increasing awareness of the advantages of non-motorized mobility. Implementing these strategies, which are essential to Transit-Oriented Development (TOD) principles, can enhance the district's accessibility, promote healthier lifestyles, and improve its environmental sustainability. TOD prioritizes the development of highly populated areas that combine several types of land use, such as residential

and commercial, close to public transportation hubs. The aim is to promote the use of public transportation and decrease the dependence of private vehicles.

B. Community Needs

- **Improved Public Spaces:** Residents and community leaders expressed a passionate interest in additional green open spaces for social gatherings and activities. Those open spaces can be located in some urban pockets inside the urban fabric such as the open space at AlArman Church st. or the space at Darb AlGanena st.
- **Economic Opportunities:** However, the area is very condensed with many economic activities. Some shoppers would prefer to get their needs from another area due to the poor accessibility to the area. Thus, business owners emphasized the necessity for initiatives that would boost the local economy, such as improved infrastructure to attract a larger number of visitors and shoppers. Figure 4 shows the poor infrastructure and organization of the economic activities in ElMosky.
- **Inclusive Planning:** Several participants underlined the significance of engaging the local community in the urban development procedures to ensure that development projects adequately address the demands of every stakeholder involved.

ElMosky's sustainable development relies on the crucial integration of economic and environmental factors. Enhancing public areas and infrastructure may boost local businesses by attracting a wider range of people and providing a more pleasant environment. Meanwhile, implementing environmental initiatives such as encouraging the use of electric vehicles and increasing the size of green areas could assist in reducing the negative impacts of urbanization. The goal of TOD is to establish vibrant pedestrian-friendly districts that boost local economies while minimizing environmental impacts.

The need for inclusive planning emphasizes the necessity of integrating the local community in urban development through participatory approaches. Involving the community in the planning process ensures that the proposed solutions are not only technically effective but also socially acceptable and tailored to the specific needs of the local community. This can result in more community support and more durable results.

C. Potential Solutions

The interviews included the suitability of implementing global best practices in Transit-Oriented Development (TOD) within the specific context of ElMosky. Stakeholders highlighted the significance of modifying these techniques to suit the local context of the area, taking into consideration its distinct historical, cultural, and socio-economic attributes. This entails tailoring solutions to suit the current urban environment and ensuring that they are in line with the community's demands and goals. Experiences from successful Transit-Oriented Development (TOD) projects in other historic districts emphasize the significance of maintaining historical authenticity while encouraging contemporary mobility options. This includes:

- **Enhanced Public Transportation:** The area can be more accessible, if it is well connected with current public transportation in Cairo. The enhancement of the metro connectivity to the bus rapid transit (BRT) systems and monorails was suggested by urban planners and transportation specialists.

Figure 4. Informal Economic Activities on Streets (Source: Author)

- **Pedestrianization and Cycling Infrastructure:** The concept of pedestrianization and the development of dedicated cycling infrastructure obtained broad support from participants. The pedestrianization approach can be applied in the narrow streets inside the urban blocks such as ElMosky, Hosh ElHen, ElGohary, and ElRowiaai streets. This approach aims to enhance safety and reduce traffic congestion by creating pedestrian-only zones inside the urban blocks and implementing dedicated cycling lanes in the main streets.
- **Smart Traffic Management:** The implementation of intelligent traffic management technologies was proposed to enhance traffic flow efficiency. The current traffic lights at the main intersections in Attaba and Bab ElShareya squares are operated in a manual way. This method is not demand-responsive and leads to insufficient traffic flow on the main streets. This approach involves the execution of advanced traffic signals and the continuous monitoring of traffic in real time.
- **Environmental Measures:** Recommendations were made to implement activities aimed at reducing pollution, such as the adoption of electric vehicles and improving the quality of green areas. Additionally, the local community awareness should be raised through urban campaigns.

Finally, the interviews brought up many challenges and possible solutions for ElMosky's urban mobility issues. The data collected will be used to create guidelines that are tailored to the specific setting and utilize Transit-Oriented Development (TOD) principles. These guidelines aim at improving the district's quality of life, environmental sustainability, and economic prosperity, while preserving its valuable historical heritage.

3.3.2. Results and Discussion of the Observations

The field observations in ElMosky concentrated mainly on the daily patterns of movement, the condition of traffic, the behavior of pedestrians and cyclists, and the use of public areas. These observations revealed current information on the district's mobility challenges and facilitated the identification of prospective intervention areas. The observations were conducted over a period of three weekdays and two weekends, with observations taken every two hours throughout the day from 7am to 1am. The subsequent major findings arose from these observations:

A. Daily Patterns of Movement

- **High Volume of Mixed Traffic:** Observations indicated a consistent and significant amount of mixed traffic, including private vehicles, buses, taxis, and motorbikes. The traffic flow is extremely dense during the peak time starting from 01:00pm, leading to considerable congestion. Figure 5 shows the current traffic volumes in one of the main streets in ElMosky district.

Figure 5. High Traffic Volumes (Source: Author)

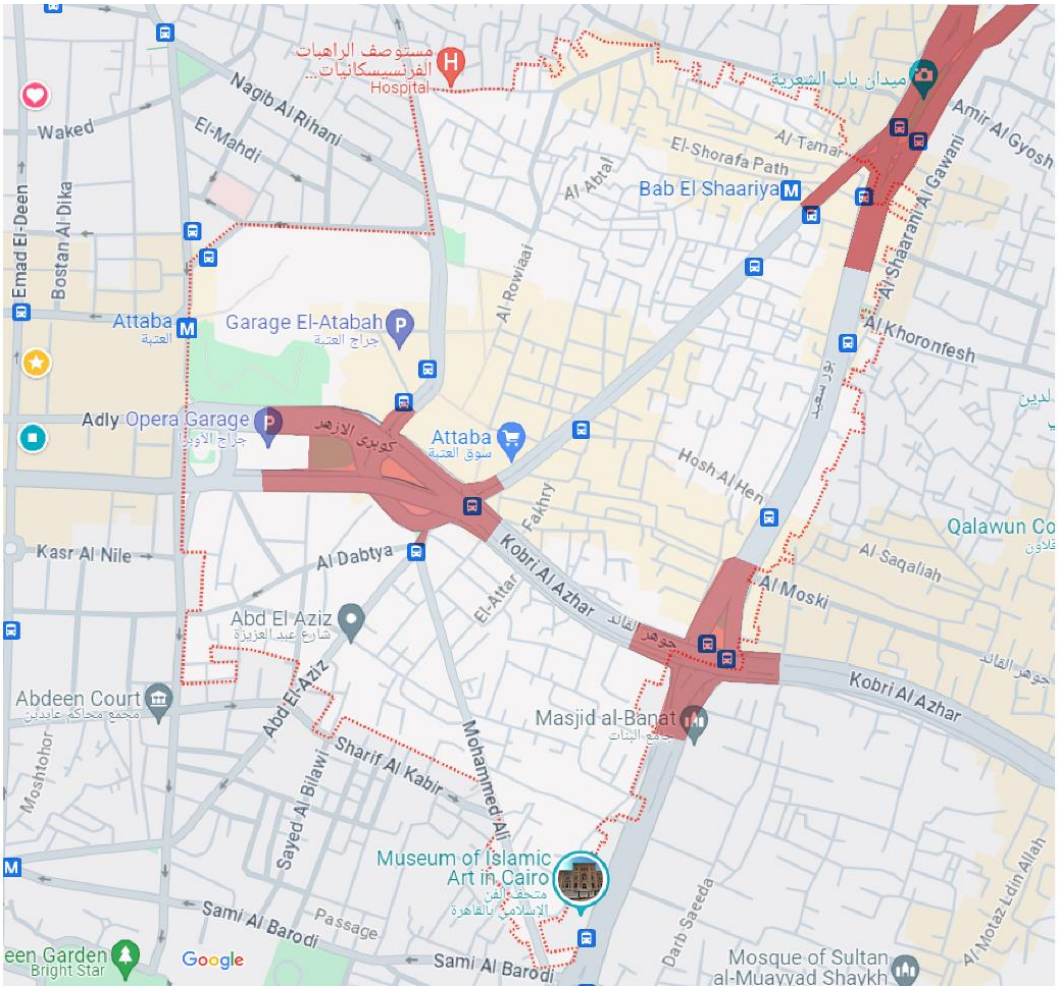


Figure 6. Congested Intersection in ElMosky. (Source: Author, Basemap: Google Maps)

- **Pedestrian Movement:** A significant volume of pedestrians have been observed throughout the day, particularly in proximity to commercial hubs and marketplaces in Attaba square, ElMosky st. and AbdelAziz st. A significant number of pedestrians felt obligated to walk on roads as a result of the invasion of street vendors over the sidewalks. The pedestrian flow increases during the afternoon till night.

B. Traffic Conditions

- **Congested Intersections:** ElMosky had severe congestion at key junctions, causing gridlock during peak hours. The absence of efficient traffic control systems resulted in prolonged periods of delays. Figure 6 illustrates the location of the main three congested intersections at Attaba Square, Bab ElShareya Square, and the intersection of Gawhar ElQaed st. and PortSaid st. The three intersections are in pivot locations between the district and the nearby quarters. Moreover, it was noticeable that there was huge crossing traffic through those intersections.
- **Parking Issues:** The increased number of illegal parking and double-parking on main streets such as ElGeish st. has increased traffic congestion and decreased the amount of available road space. The existence of the Opera garage at the west entrance of the district encourages people to reach the area by their private cars and then move on foot to the nearby streets.

The existence of a large number of various types of traffic and crowded intersections emphasizes the need for enhanced traffic management technologies. Introducing smart traffic signals and improving the implementation of parking regulations can effectively reduce traffic congestion. In addition, improving the public transportation system through the enhancement of bus frequency and reliability, as well as the implementation of additional transit lines, may reduce reliance on private vehicles and reduce traffic congestion.

C. Pedestrian and Cyclist Behavior

- **Unsafe Conditions for Pedestrians:** Pedestrians regularly maneuvered through moving cars, indicating a deficiency in safe and designated pedestrian routes. Figure 7 illustrates some of the pedestrians are walking on the vehicular pathway. This situation is very typical in Attaba square and near all entrances of the inner commercial streets such as ElGohary st. entrance from

AlBostah st. The risk of accidents is high, especially for children and the elderly.

- **Cycling Challenges:** The lack of designated bicycle lanes and the hazardous traffic conditions discourage cyclists. All streets in the ElMosky district, either main streets or narrow allies, do not have any cycling lanes. People who were engaged in cycling were exposed to substantial threats posed by motorized vehicles.

The dangerous conditions and the challenges encountered by pedestrians and cyclists emphasize the need for appropriate infrastructure. Implementing actions such as establishing car-free areas, expanding sidewalks, and constructing dedicated bike lanes can enhance safety and promote walking and cycling. TOD relies on these actions as they are crucial in creating walkable settings and decreasing reliance on cars.

D. Use of Public Spaces

- **Underutilized Green Spaces:** The presence of green areas was limited, and the existing green areas were not fully utilized, primarily because of inadequate management and accessibility problems. Figure 8 illustrates the limited green areas available in Bab ElSherya st. This poor provision of green areas leads to higher air pollution and a less shaded pedestrian friendly environment.
- **Social Activity Areas:** The public open places are not that often in the area, but the few designated spaces for social activities were densely populated, however, a significant number of these locations were in a condition of decay, without sufficient seats, shade, and amenities.

The lack of green spaces and the insufficient condition of social activity areas indicate the need for regeneration. Improving open spaces through the addition of better facilities, regular maintenance, and improved accessibility can enhance their appeal and functionality for the community. TOD promotes the creation of dynamic public spaces that facilitate social interactions and community activities, hence enhancing the overall quality of life.

Enhancing mobility and communal areas could provide huge ecological and financial advantages. By mitigating traffic congestion and advocating for non-motorized mobility, it is possible to decrease levels of air and noise pollution, so enhancing the overall health of urban environments. Improved public spaces and enhanced mobility alternatives can have a positive impact on local businesses by attracting a larger number of visitors and creating a more pleasant retail and living environment.

Finally, the field observations revealed significant current data regarding ElMosky's problems and potential for mobility. The results endorse the implementation of Transit-Oriented Development (TOD) principles to improve the quality of life, security, and environmental friendliness of the district. To enhance ElMosky's vibrancy and accessibility as an urban district, it is essential to improve the traffic management, construct better infrastructure for pedestrians and cyclists, and revitalize public areas.

Figure 7. Pedestrian Moving Between the Vehicular Traffic. (Source: [42])

Figure 8. Green Areas in One of the Main Streets in ElMosky. (Source: Author)

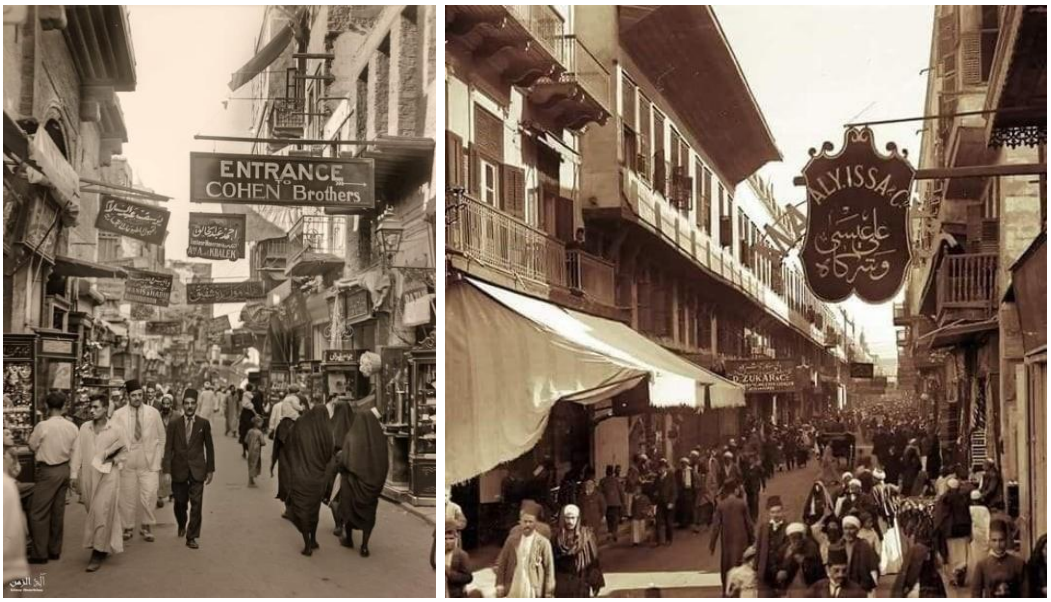


Figure 9. Historical Photos in ElMosky. (Source: [43])

3.3.3. Results and Discussion of the Document Analysis

The document study included an in-depth review of relevant urban planning reports, transportation studies, and historical records related to ElMosky. This investigation revealed useful insights into the urban setting, historical development, and past mobility initiatives of the district. The subsequent major findings came out:

A. Urban Context and Historical Evolution

- **Historical Significance:** ElMosky has significant historical importance, as historical records demonstrate its cultural heritage and its transformation from a mediaeval trading city to a modern urban hub. The district used to host all international brands in the former time during the Khedivial period. The district's historical architecture and traditional markets have played a crucial role in defining its identity [38]. Figure 9 shows some historical essence of the area.
- **Urban Growth:** Urban planning reports suggest that ElMosky has experienced rapid urbanization in recent decades, resulting in a substantial increase in population density. The historic compact urban fabric was preserved over the years, but the densification of activities in the area was great. The densification happened due to two reasons; first, the change of the upper floors uses of the existing buildings to commercial and administrative instead of residential, and second, the replacement of short buildings with new higher buildings. This densification and vertical expansion have placed significant pressure on the

current infrastructure and have worsened problems related to mobility [40].

- The diverse historical background of ElMosky, marked by its traditional markets and medieval buildings, poses distinct problems and opportunities for urban mobility. It is important for any TOD project to respect and incorporate the historical elements of the district. This involves the conservation of historical sites while also improving connectivity and accessibility.

B. Previous Mobility Initiatives

- **Public Transportation Projects:** Various transportation studies have highlighted attempts to improve public transportation in ElMosky. These incorporate suggestions for extending bus lines, creating dedicated bus lanes in ElGeish st. and incorporating innovative transit systems. Nevertheless, some attempts encountered difficulties in the execution as a result of financial limitations and administrative obstacles. Moreover, the government has implemented some actions in the past that have discouraged the public transportation use by removing the tram lines in Attaba square, which used to be one of the central tram stations in Cairo [44].
- **Pedestrian and Cycling Infrastructure:** Policy documents indicate efforts to enhance pedestrian and cycling infrastructure. Although certain initiatives have been implemented, such as the establishment of pedestrian zones and bike lanes in the nearby district in Downtown Cairo, including a bike sharing system. The effectiveness of those initiatives has been restricted due to inadequate management and monitoring [37].

Prior mobility initiatives have encountered substantial obstacles. Common challenges often encountered include inadequate financial resources, bureaucratic inefficiencies, and limited involvement of key stakeholders. To tackle these difficulties, a synchronized strategy is necessary, involving all relevant stakeholders. Previous research has suggested that improved public transit networks are essential, but they require stronger support and well-defined implementation techniques.

C. Policy and Regulatory Framework

- **Zoning Regulations:** Urban planning documents emphasize the significance of zoning restrictions in influencing land use and development trends in ElMosky. The changes in the laws allow commercial and admin. Uses in the upper floors of the buildings in ElMosky have led to the densification of activities. On the other hand, the lack of regular enforcement and the presence of obsolete policies have frequently hindered sustainable development initiatives [40].
- **Environmental Policies:** The primary source of PM2.5 air pollution in the greater Cairo is the transportation, which is 33%. This is a result of outdated private cars and taxis accounting for 80% of the extreme congestion problem. Traffic volumes in Cairo reach 7,000 vehicles per hour per lane, which is higher than the maximum theoretical flow of 1,900. Mass transit options are among the poorest for a megacity. It is only 4 kms of metro per 1 million people. The government until now has not taken any serious action towards the promotion of public transportation and the discouragement of private cars use. The transport costs have risen significantly, disadvantaging low-income people [45]. Environmental policy documents emphasize initiatives that minimize pollution and improve green areas. These strategies, although well-intentioned, have had varying degrees of success due to difficulties in coordinating and allocating resources [46]. Figure 10 and Figure 11 illustrate the poor air quality level in the ElMosky area during both normal weekdays and weekends. It is noticeable that during the day with more volumes of traffic, the air quality is poor, however, during the night, it gets a bit better and can be considered as a fair level.

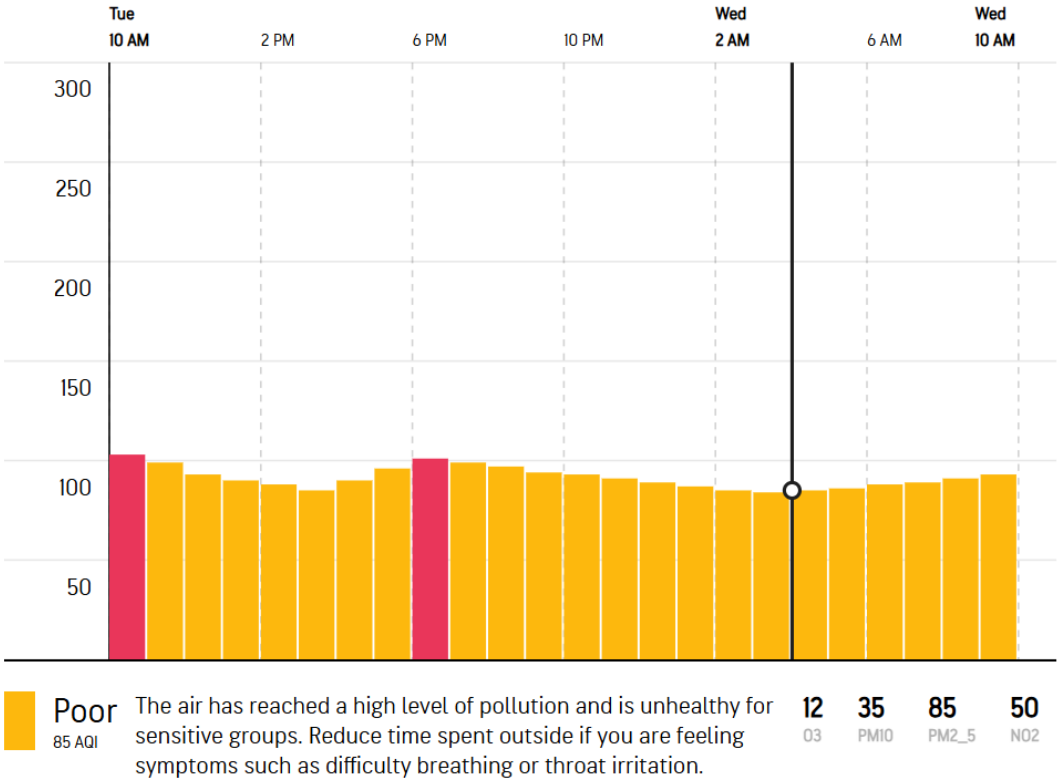
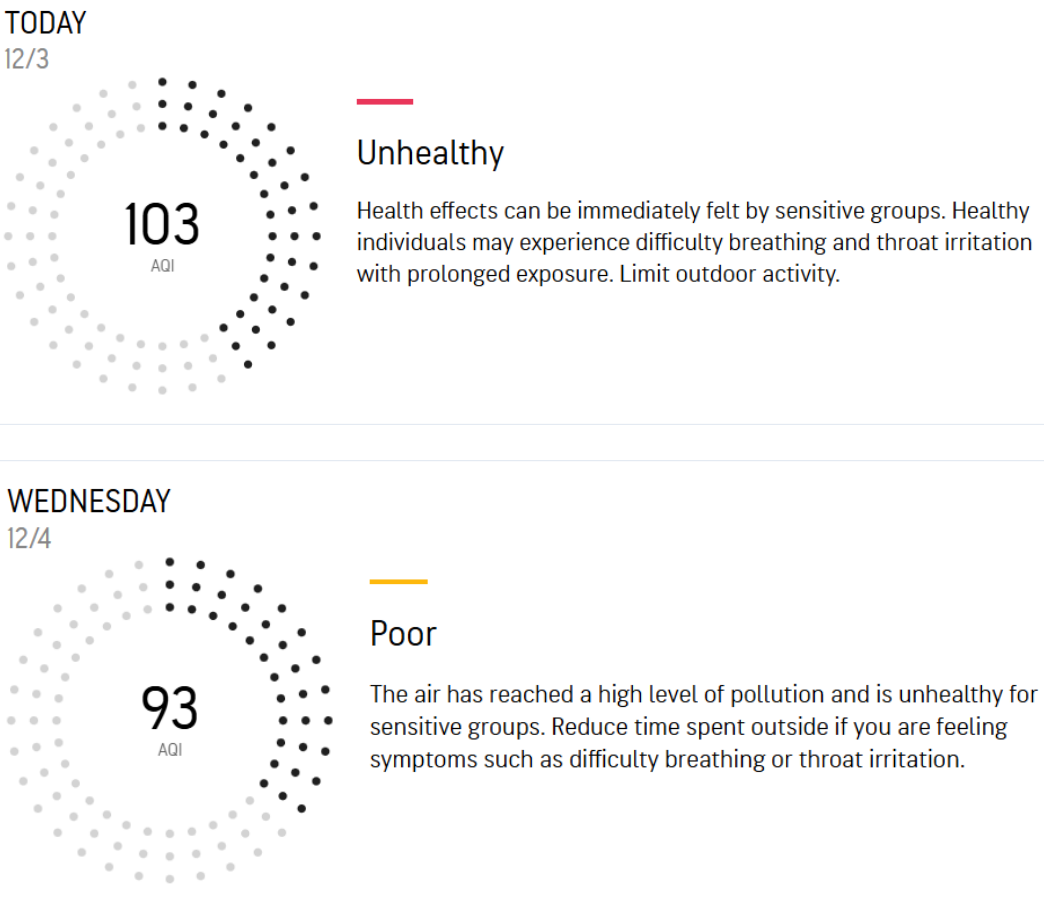


Figure 10. Air Quality in ElMosky During a Weekday on 03.12.2024 (Source: [47])



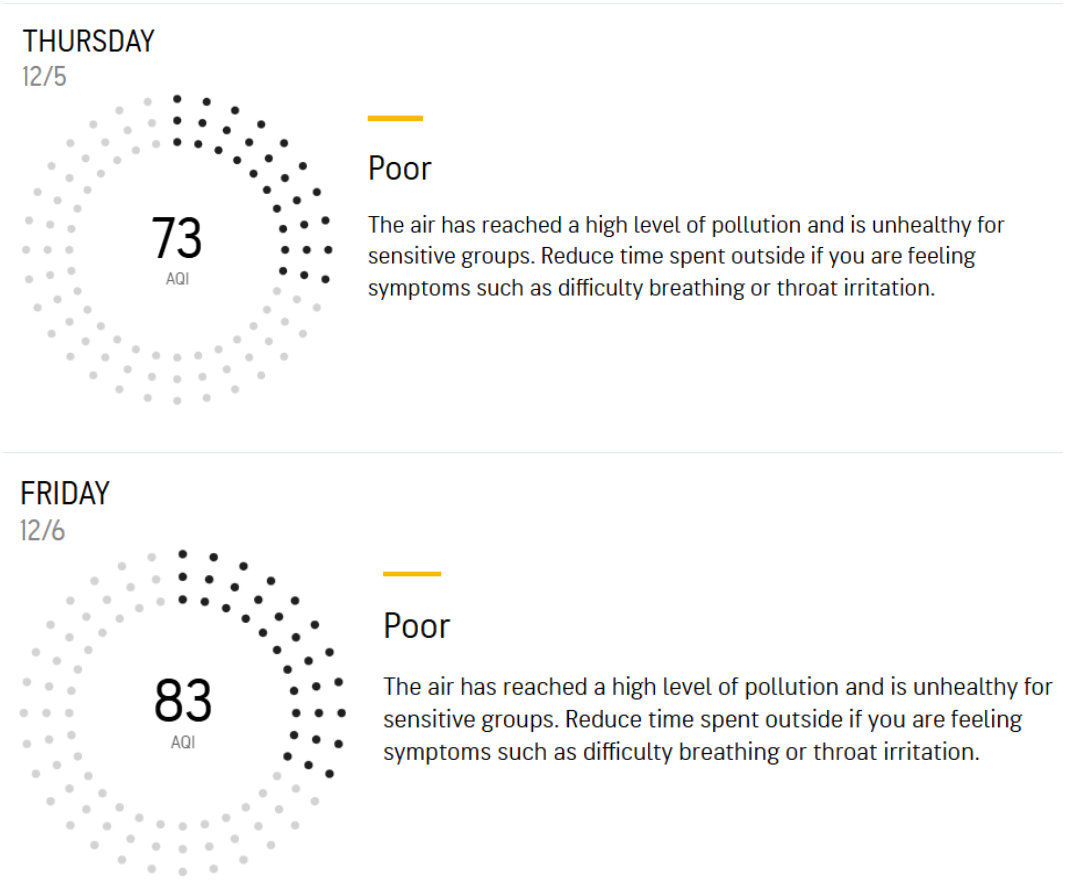


Figure 11. Air Quality in ElMosky in the period from 03-06.12.2024. (Source: [47])

The investigation uncovers substantial deficiencies in infrastructure and the execution of policies. The effectiveness of pedestrian and bicycle infrastructure has been limited due to inadequate maintenance and enforcement, despite efforts to improve it. The concepts of Transportation-Oriented Development (TOD) prioritize the requirement for properly maintained, easily accessible, and secure infrastructure to promote mobility methods that do not rely on motorized vehicles. To address these gaps, it is necessary to revise zoning regulations and ensure consistent enforcement in order to encourage sustainable land use and development.

Implementing environmental policies that target pollution reduction and the expansion of green spaces is crucial for enhancing the quality of life in ElMosky. Nevertheless, the varying degree of success of various initiatives highlights the importance of improved coordination and allocation of resources. Transit-Oriented Development (TOD) policies, which prioritize the development of communities that are pedestrian-friendly, environmentally friendly, and easily accessible by public transportation, can be in line with environmental objectives to establish a more sustainable urban setting.

Therefore, the findings from the qualitative analysis highlight the complex interplay between urban mobility, heritage preservation, and community needs in ElMosky. Interviews with stakeholders revealed a critical demand for improved pedestrian infrastructure and public transportation options. Residents expressed significant concerns about safety, particularly for pedestrians navigating crowded streets occupied by both vehicles and informal vendors. Business owners highlighted the negative impact of poor accessibility on customer footfall, emphasizing the economic implications of current mobility challenges. Field observations corroborated these concerns, identifying key bottlenecks in traffic flow at major intersections like Attaba Square and PortSaid Street. The lack of designated pedestrian pathways and the encroachment of street vendors onto sidewalks forced pedestrians onto vehicular roads, increasing accident risks. Document analysis contextualized these findings, illustrating how ElMosky's historical urban layout contributes to mobility constraints but also offers opportunities for adaptive reuse of its compact urban fabric.

The incorporation of Transit-Oriented Development (TOD) principles provides a comprehensive solution to the identified mobility difficulties in ElMosky. These principles support the implementation of densely populated, diverse developments near transportation hubs, encouraging the use of public transportation, and decreasing dependence on private vehicles. By adopting international models and customizing them to correspond

with ElMosky's particular needs, Transit-Oriented Development (TOD) has the potential to improve connectivity, decrease traffic congestion, and improve the environment. Additionally, Transit-Oriented Development (TOD) can enhance economic growth by increasing the appeal of the neighborhood for both enterprises and visitors. These principles can include:

- **Enhancing Public Transportation:** Expanding public transit options, such as integrating bus rapid transit (BRT) systems and improving metro connectivity, emerged as a critical strategy. Improving the public transportation connectivity and accessibility at Attaba Square and Bab AlShareya is very essential to reduce the heavy reliance on private vehicles, exacerbating congestion.
- **Pedestrianization and Non-Motorized Transport:** A key takeaway from interviews and field data is the need for pedestrian-friendly infrastructure. Pedestrianizing key streets like ElMosky Street, ElGohary Street and Hosh ElHen Street could significantly enhance safety, accessibility, user experience and walkability. Observations further supported the idea of implementing dedicated cycling lanes along main streets like Portsaid street and ElGeish street, following successful TOD applications in cities like Copenhagen and Bogotá. The idea of the cycling lanes in these areas is to support the connectivity of the districts and the surrounding areas while giving direct links to the commercial hubs in ElMosky.
- **Creation of Green and Public Spaces:** Field observations revealed underutilized urban pockets that could be transformed into green spaces. These areas can function as social activity hubs while mitigating air and noise pollution. For example, the vacant space at Darb AlGanena Street offers the potential for a landscaped area to accommodate community gatherings. AlArman Church Street Open Space can be converted into a green park, serving as a pedestrian-friendly recreational space. Bab ElShareya Square could incorporate greenery and public seating to balance its bustling transit activity with community-focused spaces. Attaba Square, while serving as a busy transit hub, can include shaded pedestrian paths and small green areas to improve its usability.
- **Traffic Management Systems:** The implementation of smart traffic management systems can significantly improve mobility within ElMosky by addressing congestion at key intersections. Attaba Square, one of the busiest nodes in the district, experiences severe traffic delays due to the convergence of multiple vehicles and pedestrian flows. This can optimize vehicular and pedestrian movement by dynamically adjusting signal timings based on real-time traffic data. These systems can incorporate sensors and AI algorithms to monitor congestion levels, prioritize public transportation, and provide safer crossings for pedestrians. Similar upgrades at other critical junctions, such as PortSaid Street Intersection and Bab ElShareya Junction, could further enhance traffic flow.

In summary, the document analysis emphasizes the historical importance, urban development, and difficulties related to mobility in ElMosky. The results emphasize the need for comprehensive, durable, and community-oriented solutions. Implementing Transit-Oriented Development (TOD) principles can effectively tackle these difficulties by advocating for the development of urban mobility that is efficient, easily accessible, and environmentally sustainable, all while preserving the district's valuable cultural history.

4. Conclusions

Transit-oriented development (TOD) has the capacity to revolutionize urban regions on a global scale by fostering sustainable, easily reachable, and pleasant communities. TOD may effectively tackle various issues related to fast urbanization, including traffic congestion, air pollution, and social inequality, by giving importance to public transportation, creating pedestrian-friendly spaces, and promoting mixed-use developments. When implemented with careful consideration and inclusivity, the concepts of TOD can improve the overall quality of life in cities around the world, making them more resilient and better equipped to handle future difficulties. The following international recommendations serve as a guide for communities seeking to include TOD into their urban planning strategies:

- Urban areas should establish comprehensive public transportation systems that prioritize accessibility, efficiency, and sustainability. By implementing bus rapid transit (BRT) systems, improving metro connectivity, and creating pedestrian and cycling infrastructure, urban mobility can be greatly enhanced and the dependence on private vehicles can be reduced.
- It is essential to actively involve local communities in the process of planning and carrying out TOD projects. Public participation guarantees that development aligns with the specific demands of communities, promoting social unity and local endorsement.
- In historic areas, it is necessary to adjust TOD in order to show respect for and save the distinctive cultural and architectural heritage. To preserve the historical integrity of these regions, it is crucial to strike a balance between adapting historic structures and incorporating modern infrastructure.
- Smart technology, such as real-time transit information systems and integrated mobility apps, can improve the efficiency and user experience of public transportation, making it more appealing.

This research on the implementation of TOD concepts in the historic area of ElMosky has uncovered numerous significant findings at the local level. The major findings

emphasize notable urban mobility obstacles, such as substantial traffic congestion, restricted public transportation alternatives, and insufficient pedestrian and bike infrastructure. The historical and cultural importance of ElMosky adds complexity to the execution of contemporary urban development schemes, requiring a delicate equilibrium between conservation and modernization.

Key findings highlight significant challenges such as traffic congestion, outdated public transportation, and insufficient pedestrian infrastructure. Interviews revealed strong community support for pedestrian-friendly streets and better transit options, while field observations identified traffic bottlenecks at intersections like Attaba Square and PortSaid Street. Document analysis provided historical context, emphasizing the need for interventions that align with ElMosky's heritage. Interviews with important stakeholders emphasized the necessity for enhanced public transportation and the establishment of exclusive lanes for pedestrians and cyclists to improve mobility and decrease pollution. These difficulties were verified by observations, which revealed a significant amount of traffic congestion and hazardous situations for non-motorized mobility. The review of the previous documents gave historical context and emphasized earlier activities related to mobility, further underscoring the necessity for sustainable and contextually appropriate solutions.

Implementing TOD in Egypt, namely in historic areas such as ElMosky, offers a distinct chance to combine contemporary urban mobility solutions with the conservation of cultural heritage. In the Egyptian context, which is marked by a significant historical aspect and a fast-growing urban population, it is necessary to develop specific solutions that may effectively tackle current urban difficulties while also preserving the historical heritage. The following strategies can be implemented to align with the local context:

- Enhanced Public Transportation in ElMosky: Enhance the existing public transportation network in ElMosky by connecting it to the Bus Rapid Transit (BRT) systems and monorail and upgrading metro services. This measure will effectively mitigate traffic congestion and offer more dependable transportation alternatives for both residents and visitors.
- Pedestrianization and Cycling Infrastructure: Implement pedestrian zones and dedicated bike lanes to encourage the use of non-motorized mobility. Implementing this measure can mitigate vehicle congestion and pollution, therefore enhancing the district's accessibility and safety for pedestrians and bicycles.
- Public Space Enhancement: Increase the number of green spaces and public areas to enhance the well-being of people and attract tourists. Improving public places might additionally promote local enterprises and promote community involvement.
- Policy Support and Incentives: Establish favorable policies and incentives to promote Transit-Oriented Development (TOD), such as implementing zoning rules, providing tax incentives, and fostering public-private partnerships. These methods can promote sustainable urban development and guarantee the conservation of ElMosky's historical and cultural assets.

By enacting these suggestions, ElMosky can become a model for incorporating Transit-Oriented Development (TOD) concepts in historic neighborhoods. This will improve urban mobility, conserve cultural heritage, and advance sustainable development. These attempts not only enhance the standard of living for present inhabitants but also guarantee that the historic area continues to be a lively and easily reachable component of the city for future generations. The delicate equilibrium between contemporary elements and the conservation of historical features is essential for the sustainable progress of metropolitan places with historical significance worldwide.

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