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Urban Optimization of Transit Oriented Development in Baghdad City

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Abstract
Meeting the demands of the postmodern metropolis requires innovative urban planning approaches to promote a livable and resilient urban fabric. Transit-oriented development (TOD) is one such approach, and promises to add value to all public and private stakeholders. The concept maximizes transit usage, create a sense of place and community, and provide a vibrant mix of land uses that cater to existing and future residents. In general, TOD aims to create vibrant communities which promote walkability and provide attractive choices in employment, housing, and transportation choices. In its theoretical background, the paper attempts to outline the benefits and principles of TOD, and to highlight a number of case studies of cities that have implemented the concept successfully. An overview is presented of the cumulative results achieved by these cities to enhance both the quality of life, and the local economy.This research also tackles the applicability of TOD to the proposed future vision of the city of Baghdad. With its 6.5 million inhabitants, and a forecasted population of 11 million by 2030, the city has a number of shortcomings in providing a livable and efficient urban landscape. Transit, sprawl, excessive use of private cars, inappropriate land use mix and densities, and lack of well-designed urban spaces around transit hubs are among the pressing issues. The hypothesis of this research stresses the need to explore TOD as an urgent planning alternative to address such quandaries. The paper presents an overview of the pending "Baghdad Urban Development Plan 2030", and submits a multi-parameter evaluation of the vision outlined in the plan with regard to transit and circulation problems, and solutions. The preliminary outcomes of the evaluation process indicate an evident deficiency in the utilization of TOD to optimize future urban movement proposals.
Keywords: TOD, urban design, socio-economic growth, urban planning, comprehensive development.

1. Introduction

Transit-oriented development is an innovative concept in urban planning. It has been applied in many cities around the world especially in North America, Europe, and Southeast Asia during the last few decades. The concept aims to minimize the use of private cars through the development of pedestrian-friendly zones, thus mitigating the severity of traffic congestion and the emission of pollutants. A healthy environment can be created as a result, and consequently achieve the best return on investment from public transport by creating a climate that promotes economic activities and employment opportunities that can be easily accessed, thereby adding value to surrounding areas and the urban fabric of such centers. Excellent urban design is necessary for TOD plans in order to coordinate mixed land uses with multi mode transportation systems within a predefined area. TOD may be considered as a strategy to blend mass transit with appropriate land uses to form vibrant and diverse walkable neighborhoods throughout the urban agglomeration (Jacobson, 2008, p. 51).

American architect Peter Calthorpe codified the concept of TOD in the late 1980s. Sacramento County (in the state of California) hired Calthorpe in 1989 to propose a "pedestrian/transit-oriented development" along the County rail stations; it was then that the term was first officially used. Consequently, TOD became a fixture of modern planning when Calthorpe published "The New American Metropolis" in 1993 (Carlton, 2009, p. 17). The TOD concept was an extension of Calthorpe's earlier work on the design of sustainable communities and neighborhoods, which he originally referred to as "pedestrian pockets."

2. TOD Definition:

Proximity to transit stations can be only be achieved through compact to enable potential riders to reach facilities with ease, thus promoting increased ridership by making transit more accessible. TOD can be defined as "Moderate to higher density compact mixed-use development, located within an easy five to ten minute (approximately 400 m to 800 m) walk of a major transit stop. TOD involves high-quality urban development with a mix of residential, employment and shopping opportunities, designed in a pedestrian oriented manner without excluding the automobile". "TOD can be a new construction, or a redevelopment of one or more buildings whose design and orientation facilitate the use of convenient and sustainable modes of transportation, including public transit and active Transportation" (Joshi, 2011, p. 6).

The State of Florida regards TOD as those "designated areas which shall be compact, moderate to high density developments, of mixed-use character, interconnected with other land uses, bicycle and pedestrian friendly, and designed to support frequent transit service operating through, collectively, or separately, rail, fixed

guide way, streetcar, or bus systems on dedicated facilities or available roadway connections. While many developers and governments consider TOD in terms of fixed-rail service, that is not always the case" (Shinkle, 2012, p. 3).

Peter Calthorpe characterized the basic elements of TOD as "a mixed-use community within an average 2,000-foot walking distance of a transit stop and core commercial area. TODs mix residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot, or car" (Carlton, 2009, pp. 21–22).

All definitions seem to share a common vision and emphasize the idea that a successful TOD will reinforce the community's economic prospects as well as the transit system. Such reinforcement emanates from a multitude of factors, most notably the creation of mixed-use facilities that are easily accessible—within close enough proximity to satisfy nearly all needs—and thus promote activity around the clock.

3. TOD implementation advantages:

Empirical evidence from many North American cities indicates significant gains to residents, and communities as well. Such gains came primarily as a result of appropriate investments in land use projects and transportation facilities. The recent enthusiasm that is generated by TOD may not be attributed to financial gains alone. The approach has proven to present a number of benefits beyond the anticipated increase in land value. "The last decade saw subtle but promising shifts in the landscape of transit and development, with the convergence of a number of trends: growing transit ridership, increased investment in transit (even in traditionally auto-dominated cities like Los Angeles and Dallas), frustration with congestion and sprawl, the smart growth and new urbanism movements, and generally greater recognition of the advantages of linking development and transit "(Belzer, 2002, p. 6).

Implementation of TOD can offer and support a wide range of opportunities to residents of diverse background and age. It enables inhabitants to commute, live, shop, learn, and play near each other. Shorter trip distances makes it easier to accomplish more with less time which enhances safe accessibility to daily activities such as employment, education , exercise , commercial and social services. Shorter trips improves the environment , leads to more efficient land uses and alleviate pressure on existing infrastructure. The extent of advantages is dependent on the unique characteristics of the TOD and the nature of transportation modes available.(Joshi, 2011, p. 10).

Low to moderate income segments of the community gain the most from the proximity to TOD hubs due to the low rates of car ownership among these segments. This fact emphasizes the attention needed to the creation of affordable housing within the TOD zone of influence. (Jacobson, 2008, p. 54)

The motivation to use public mass transit has increased significantly due to an increase in the mobility choices. Linking "activity nodes" by transit, TOD provides much-needed mobility options. A 2003 study indicated that inhabitants of TODs were more inclined to use public transit for commutes in comparison to non TOD areas .The difference in usage rates could reach 500%. In the San Francisco Bay Area, Cervero (1994) found that, "on average, residents living near stations were five times as likely to commute by rail transit as the average worker living in the same city, and in some cases as much as seven times as likely". Decreasing the use of private vehicles is a byproduct of increasing land-use mix and transit utilization. Frank and Pivo (1994, p. 51) have indicated that employment density and land-use mix were both significantly related to the relative usage rates of single occupant vehicles (SOV), transit, and walking. In a study of "103 TOD areas across twelve regions in the United States found that, on average, residents were 2–2.5 times more likely to commute on transit compared to the average resident of the region" (Renne, 2009, p. 118). The health gains are a byproduct of a modified infrastructure which enables a multitude of physical activities that promote walking and cycling in a safe environment with access ease to mass transit (Joshi, 2011, p.8)

Increased land value is a noticeable economic advantage to TOD, which tends to encourage higher densities and ultimately fosters higher growth rates and economic incentives. Significant increases in land values can be observed in areas close to transit hubs compared to areas away from transit stations. Urban land use is greatly enhanced due to the compressed, sustainable urban pattern. TOD often uses Greenfield, Brownfield sites and infill to redevelop and increase the density of existing urban areas. A byproduct of this process is enhanced local economic development. TOD, along with more efficient and sustainable infrastructure, is exploited to invigorate aging neighborhoods and main street vitality.

4. TOD Principles:

Almost all principles guiding the design and implementation of TOD zones directly impact the urban pattern which includes the performance of activities, land use and the circulation hierarchy. Any development cannot be effective unless it is forged by transit rather than just being in close proximity. TOD includes the entire area within a radius of 400 to 800 meters from a transit stop (Joshi, 2011, p. 16). The zone of influence of a TOD is comprised of three distinct but overlapping zones. The "core zone" is the immediate area surrounding public

transit facilities that can extend up to 200 m; the core is surrounded by a "central zone" extending to nearly 400 m and encircled by an outer "edge zone" up to 800 m, thereby constituting the TOD area of influence. Figure (1) illustrates the concept.

Design features of efficient TOD projects may include some or all of the following principles:

A: Development density higher than prevalent: Generally, cities with higher populations and development densities have proved the wealthiest, most dynamic, innovative, diverse, and ecologically sustainable (Roberts, 2007, p. 721). The density-dynamism duality, however, is not universal, and should be deliberated on a case-by-case basis. Density objective is always to build consolidated walkable areas to achieve higher transit ridership. (Joshi, 2011, p. 17).

B: Walkability: An essential determinant to creating pedestrian friendly districts is the level of accessibility to transit stations. Accessibility coupled with the ability to reach shops, jobs and other services is a vital dualism to promoting walkability (Thorne, 2011, p. 21).

C: Mixed use: A creative mix of uses within close proximity to transit is vital to attract riders and community in general. TOD is often referred to as "place-making" or the creation of "transit villages"—livable places where people reside, work, shop, obtain services, go to school, use the library, and have fun. The full menu of activities need not be found at every station, but a lively mix of uses strengthens the link between transit and development (Metropolitan Atlanta Rapid Transit Authority, 2010, p. 10).

D: TOD Forecasted Demand and Dynamic communities: Attracting "new development is a crucial way to improve the dynamism of station districts and corridors, but the potential to attract private investment is clearly dependant on both neighborhood market conditions and regional market demand for more-compact housing types" (Thorne, 2011, p. 21).

E: Superior Pedestrian-Friendly Circulation: Pedestrians are attracted to lively and energetic districts regardless of transit availability. Sophisticated elements directed at creating attractive surroundings for pedestrians incite people to walk. Streets can be calmed by limiting speed of traffic so as to make walking safe and appealing (Joshi, 2011, p. 21).

F: Aptly Delineated Center: Creating "a dense mix of land uses adjoining transportation hubs is important to creating a center, but it must also have a sense of place and community so that residents elect to congregate there" (Joshi, 2011, p. 23).

Transit is particularly fruitful in communities and neighborhoods that have designated centers, creating an 18-hour place by presenting multiple features and reasons for pedestrians to frequent the area for the duration of the day and evening.

G: Dependable secure Transportation: Population in areas with abridged dependence on motor vehicles owns fewer cars and uses them infrequently. This crop multiple advantages, including more durable transportation costs, higher household disposable incomes, reduced need to expand freeways, healthier population as a result of more physical activity, and more stable and sustainable transit ridership (Thorne, 2011, p. 25).

H: Well designed Parking Scheme: "Parking in a TOD should consider four fundamental components: size, location, design, and management" (Joshi, 2011, p. 25). One of the most challenging elements of any TOD development is the smart design of parking options to complement transit. Well managed, well positioned parking options are conducive to invigorating TOD zones. Moving away from surface parking toward on street or underground parking structures will encourage shoppers, and residents to walk within these zones.

I: Economic Prosperity: Developments that take advantage of integrated and broad transit systems caters for a wide range of economic opportunities. "Recent trends indicate that workers increasingly prefer to live near where they work and to enjoy a higher quality of life free from the strains of traffic and congestion, making jobs and housing near transit increasingly popular choices" (Thorne, 2011, pp. 21–22).

J: Public Leadership: Public leadership is essential to successfully transform an area into TOD. Leadership is needed in the planning and implementation phase of the process and should continue throughout the life span of process in order to meet challenges presented by numerous stakeholders. Utilizing public private partnership approach is more enticing for private sector involvement in TOD projects, and proven to be a more flexible than joint development arrangements (Reconnecting America, 2013, p. 13).

K: Aesthetic Zoning: The magnetism and charm of urban centers "are defined by the sum of its public spaces. Emphasizing form over use to create human-scale places, most U.S. cities regulate conventional codes, focus on the architectural and urban "form" of the conventional or Euclidean built environment, and regulate key zoning aspects such as building heights in order to segregate incompatible land uses and accommodate the movement and storage of vehicles" (Reconnecting America, 2013, p. 11).

L: Community Participation: Community participation is essential to building a vibrant, inclusive neighborhood that is safe and equitable. Inspiring community involvement will forge a balanced, stable and equitable interaction amongst various groups within the community. A higher share of residents participating in local cultural, and economic activities is a direct outcome of respecting the unique identity of local communities' and ultimately will generate a sense of acceptance and ownership of the place (Zottis,2015)

4.1 Location Determinants of TOD Hubs

The process of selecting transit hubs to be developed as TOD zones hinges on existing as well as proposed urban development schemes. The potential of a successful selection depends largely on the characteristics of the transit station's immediate and surrounding area.

To optimize transit-oriented development, conceptual transit stations plans should be developed to determine what public infrastructure is needed around transit stations or along the desired mix of uses. "There is some variation in what these plans contain, but they all lay out basic elements such as zoning, design standards, parking requirements, and information about transit access, and bicycle and pedestrian infrastructure" (Reconnecting America, 2013, p. 3).

Developing a master plan of the station district must incorporate a vision on how to create a walkable area. This process must be refined in the early stages of formulating the plan with clear set of ground rules, responsibilities and roles. Certain aspects should be included in the final plan. Urban design protocols, car parks and circulation, parks and open space, appropriate land uses including mix and density, implementation strategies along with a distinct community vision must all be incorporated.

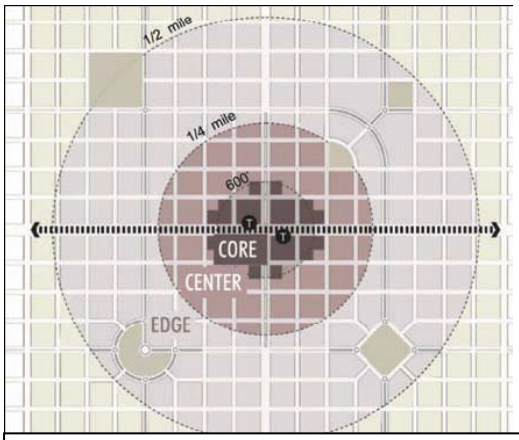

Figure (1) TOD Zone of Influence Source: (Transit - Oriented Development, New Haven Hartford Springfield Rail Program, www.nhhsrail.com)

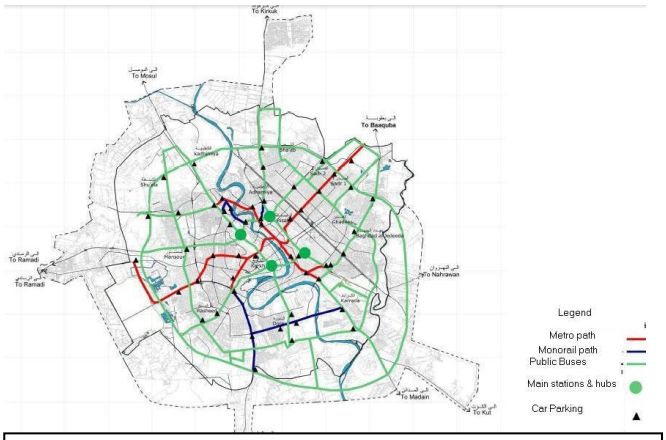

Figure (2) Baghdad transportation network and main stations and hubs. Source: Baghdad Comprehensive City Development Plan 2030, (Qateb & Alame, 2014)

4.2 Nature of Projects within a TOD

The decision to select a project to be a part of a TOD development must be appraised against its design criteria and how it fits the general TOD master plan. As a general rule key sites must be designated for transit friendly uses and densities (walkable, mixed-use, and not dominated by activities with significant automobile use). Preferably, transit-friendly land uses should be permitted outright without requiring special approval.

Proximity to major transit stations within a radius of 800 meters is a prime location determinant of TOD projects. Other issue to be considered is whether higher densities are allowed near transit facilities. It is highly recommended that street level uses are "active" and pedestrian friendly with a mix of uses generating pedestrian traffic and positioned within a walking distance of stations. Motor vehicles tailored uses are permitted but should be discouraged with access limitations. A final consideration is the zoning status of the proposed TOD; where pre-zoning is implemented, the path is paved for a go-ahead (Joshi, 2011, p. 34).

5. Successful TOD Projects:

Measuring the success of TOD project can be a complex task. Expected outcomes of one project vary substantially from others based on the development's design characteristics and scope. One project may succeed in increasing ridership but lacks in entertainment choices. Another may create high density affordable housing while it fails to provide adequate shopping opportunities. In addition, conceptualizing a high spectrum of TOD objectives for a single development may complicate matters. The city of Perth has established an ambitious broad list of TOD objectives which render measuring achievement levels a matter of perspective. Planners in Perth perceived TOD as crucial for "increasing transit ridership, spurring economic development, increasing housing choices, reliving traffic congestion, reducing sprawl, creating a diverse community, improving neighborhood quality, and increasing political support for transit" (Renne, 2009, p. 117). Regardless, a number of case studies of urban centers that utilized TOD were investigated to draw lessons as well as to probe the validity and success of the concept.

Experience from numerous cities demonstrates that utilizing TOD can bear tangible gains to a wide

range of stakeholders including residents, communities, and in certain cases whole regions. (New Haven-Hartford Springfield Rail Program, n.d.).

Fruitvale (located in Oakland, California) exemplifies the pivotal role of transit in rejuvenating districts going through economic decline. Fruitvale was considered as one of the city's impoverished areas; it has gone through a period of urban abandonment and decline during the 60s and 70s of the last century. "Fruitvale Transit Village, a $100 million, 20-acre development project, received praise as an example of how to integrate transit concerns with community and economic development" (Jacobson, 2008, p. 68). The development is centered on the Fruitvale station of the Bay Area Rapid Transit system, and it features neighborhood retail, affordable housing, and places for community interaction on land that had previously been used for parking lots.

Rosslyn (Virginia) is another example of a successful economic metamorphosis resulting from taking advantage of transit hubs. The primary objective of "the Rosslyn Sector Plan was economic development; transit became the basis of the plan, not because of its potential to improve air quality or mitigate metropolitan sprawl, but for its economic possibilities. Capitalizing on the Metro system allowed for greater densities—and thus for higher returns from commercial property taxes—than would have been possible if, for example, a quarter of the buildable land been reserved for thoroughfares and parking" (Jacobson, 2008, p. 62).

The village of Arlington Heights, located west of Chicago (Illinois), has incorporated TOD as a fundamental instrument in its innovative plans to rejuvenate the historic downtown area. The plan stipulated the creation a redesigned center comprised of a cultural center, a new high density housing project, commercial buildings, a new transit station, and public parking. "By 2000, the numbers had jumped to 2,200 residents and 1,500 units. Since 1997, a public investment of $27 million has leveraged some $225 million in private investment" (New Haven-Hartford Springfield Rail Program, n.d.).

Other cities in the United States, such as Denver (Colorado) and Portland (Oregon), have provided further evidence that TOD is an excellent tool to revitalize communities. The city of Portland is widely regarded as a model for creating an integrated system of mass transit for its inhabitants (Thorne, 2011, p. 25). In Portland, large scale development in the downtown district was oriented transit. Two large parcels of unused industrial sites in the north and south of the city were linked by a streetcar. An agreement was reached between the city and the owner of the northern site where the city would build the streetcar past his property if the owner would rezone his property from 15 to 125 dwelling units per acre (Du/A). This type of arrangements were not common during the 1990's when the project was proposed, however, the area has transformed into of the "city's densest neighborhood, and at completion will be home to 10,000 residents and 21,000 jobs. The streetcar runs to the second vacant parcel (the south waterfront), where an even more ambitious redevelopment undertaking is ongoing" (Center for Transit-Oriented Development, 2007, p. 14).

The innovative and successful implementation of mixed-land-use development in TOD projects is best embellished in the city of Denver. Up to "2004, ten years after opening its 20-mile starter rail system, the city still really had only one TOD "project" – a strange and wildly successful one. The 10-acre Englewood City Center, in a suburb several stops out of downtown, was built to accommodate a good mix of usual TOD ingredients, including 450 housing units, a library, a park, a museum, open spaces, and a street grid—plus a Wal-Mart department store and other big box retail" (Ohland, 2004, p. 12). Parking ratios in the area was approximately similar to those of suburban districts. Nonetheless, this relatively low parking ratio did not impede the success of the project for it was celebrated nationally for revitalizing a low income community using a lifeless shopping mall.

6. Baghdad Comprehensive City Development Plan 2030:

In response to the request of the Mayoralty of Baghdad, Khatib & Alami consulting firm and Mebex Consultants have prepared a technical proposal to guide urban development for the next fifteen years. The report is termed the "Baghdad Comprehensive City Development Plan 2030" (referred to in the rest of the article as "BCCDP 2030"). The proposal examines urban planning and design issues in the context of Baghdad (Qateb & Alame, 2014, p. 1).

Baghdad has many comparative advantages. Historically, the city was one of the leading cultural centers in the region, and it has for centuries been the center of Iraq's commercial and financial operations. It is rich in historical sites and natural resources. However, due to wars, sanctions, and rapid growth, the local authorities today are challenged to provide much-needed services to citizens and investors and to formulate and implement effective, sustained urban development strategies.

The city of Baghdad and its surrounding areas have changed significantly since the 1970s. Trends in demographics, the scope and pace of urbanization, urban fabric and services, commerce, and industry have changed significantly since the implementation of Baghdad's previous master plan formulated by the Polish firm Polservice in 1973. The plan's planning period expired in 2000.

It has become more essential than ever for BCCDP 2030 to present sustainable urban development strategies to guide urban growth, encourage reinvestment, regenerate and revitalize the city, ensure its prosperity,

and enhance the many attractive and beneficial attributes of the community and its neighborhoods (Qateb & Alame, 2014, p. 1).

The purpose of these strategies is to positively relate changes to the existing built fabric and to future development throughout all neighbourhoods by creating an attractive and healthy city. These efforts will be closely coordinated with economic analyses to ensure the plan's financial success (Qateb & Alame, 2014, p. 26).

6.1 Evaluation of BCCDP 2030 as it relates to TOD principles:

The process of evaluating a plan which incorporates a vision to develop TOD districts is to examine the transportation and circulation system. The future vision of public transportation in Baghdad is ambitious, and it requires extensive and costly infrastructure. The BCCDP 2030 outlined a number of transit modes to cater to the growing demand for transit. An underground subway system, elevated trains, and a rapid bus system have all been proposed, but they have yet to be implemented in a manner that complements each other. The public transit stations will be served (in certain locations) by park-and-ride facilities. The proposed integrated transit network is outlined in Figure (2).

The proposed plan did not overtly submit TOD as a strategic option to transform the urban structure over the plan's lifespan. The authors nonetheless have undertaken an analysis to evaluate the BCCDP 2030 policy guidelines as they relate to TOD design principles. A three-level scoring framework (strong, moderate, and low) is used to measure the BCCDP 2030 guidelines' conformity to TOD design principles. The overall scores indicate moderate-to-low applicability and compliance to those principles. The outcome of the analysis is somehow promising for the adaptation of TOD as a valid strategy to reinvigorate Baghdad's urban economy and fabric. Detailed discussion and analysis is presented in Table (1).

Table (1) Analysis of BCCDP 2030 guidelines' conformity to TOD principles (Based on Qateb & Alame, 2014)

TOD Principle	Baghdad Comprehensive City Development Plan 2030 Guidelines	Level of conformit
Development density higher than prevalent	Ensure the provision of sufficient services for all residents and visitors, and ensuring the efficient utilization of infrastructure and public services already in place. Ensuring that citizens and residents reasonable access to education, transportation, health care, housing and other services.	**Moderate**
Walkability	The study of circulation focuses on the Major pedestrian ways, as an ease, efficiency, and facility of getting around once one is there. Moreover, the variety of modes of circulation, pedestrian, vehicular, and the synergy between them can be directly linked to the level of activity in the domains of commercial centers, as well as cultural, social and recreational activities.	**Low**
Mixed use	Promote a balanced mix of land uses to ensure a harmonious and conforming built city. Maintain policies to enhance and perpetuate quality options in employment, housing, and public service in a manner where residents can utilize in an accessible, affordable, and sufficient for all.	**Strong**
Future Demand for TOD & Vibrant Communities	Baghdad shall be transformed into a metropolitan city with an integrated mixed land use to contain office and residential buildings, parking, retail and such other appropriate uses in a setting that facilitates pedestrian movement at street level among office/residential buildings, parking garages, transit stations and shopping areas.	**Moderate**
Compact, High Quality Pedestrian Oriented Environment	The Distribution and alignment of existing and proposed routes; trip generation factors for present and potential major land uses along the route, as compared to present capacity; land use limitation; and the requirements for implementing new linkage corridors (i.e. Right of Way).	**Low**
Aptly Delineated Center	It will analyze the suitability of the existing points of access to the city such as Baghdad International Airport, as well as the suitability and efficiency of access points on the national/local scale such as existing and planned city gateways on the existing road network, train station location, etc.	**Low**
Safe, Reliable Transportation	. Develop a comprehensive transportation management strategy in close coordination with land use policies, and the stratification of transportation needs. Create an integrated and efficient transportation network to provide access for all residents and businesses.	**Strong**

Well designed Parking Scheme	Vehicular, pedestrian and transit options will be investigated along with the various alternatives studied. Parking shall be so planned and located so as to provide a linkage to the economic benefit of the City. Parking needs and desirable locations for major facilities.	**Low**
Economic Prosperity	Support basic economic sectors namely commerce and industry to create strong employment opportunities sectors ,and enhance Baghdad's foreseen role on the national, regional and international stage.	**Moderate**
Public Leadership	Competitive business environment providing a supportive framework for productive firms, to promote buoyant, broad-based growth of employment, incomes and investment. The international competitiveness of Baghdad today is directly bound to the improvement of the quality of life of its inhabitants. Well governed and managed local government to fulfill public responsibilities and foster interaction between local government and residents in participatory planning and budgeting.	**Low**
Aesthetic zoning	Increased funding for an open space system including river banks, and implementing conservationist policies to preserve Baghdad's rich cultural and historical heritage. The emphasis is on protecting and enhancing the residents quality of life, and promoting the unique status of the city	**Low**
Community participation	Preservation and improvement of the housing inventory. Maintaining adequate supply of affordable housing promotes gratifying and harmonious sentiments amongst the population, thus creating a larger incentive to own the place. City housing policies should ensure the elevation of living conditions and property values and ensure that Baghdad's residents have access to proper housing regardless of income level, physical ability and age.	**Moderate**

6.2 Evaluation of Al-Alawee Hub as a TOD Zone

Al-Alawee hub has been selected to further explore the possibility of transforming major transit hubs into a future TOD zone within the city of Baghdad and specifically to investigate the existing potential to meet location criteria for a successful TOD hub. The hub's current function, its multiple transit modes, and its mixed land uses are elements in favor of this selection, as shown in Figure (3).

Figure (3) BCCDP 2030 Proposed public transit modes. Source: Baghdad Comprehensive City Development Plan 2030, (Qateb & Alame, 2014)

Figure (4) Zone of Influence of Alawee TOD main hub in Al Karkh and reflection of TOD principles Source: Authors based on Google map

BCCDP 2030 envisioned the Al-Alawee hub as a major urban and regional transportation node serving Baghdad and major urban centers in the central and southern governorates of Iraq. Within the hub's core zone (0 m – 200 m), the largest train station (labeled the "International Station") is situated to provide rail lines to the north and south of Iraq. In the past, this station ran rail service to Istanbul, Turkey. The Al-Alawee core is also the current location for two regional intercity micro- and mini-bus stations serving southern urban centers. The National Museum, government administrative offices, a medical hospital, and a portion of the largest public park in Iraq (Al-Zawra'a) can all be found within the hub's central zone (200 m – 400 m). The edge zone (400 m – 800 m) contains a multifamily housing complex, a large portion of Al-Zawra'a Public Park, a portion of a large vacant land parcel (which was once part of the old airport), and an old neighborhood consisting mostly of

dilapidated housing units. An aerial view of the Al-Alawee TOD Zone of Influence can be seen in Figure (4).
Analysis of the Al-Alawee hub's main characteristics as they relate to TOD pinpoints a number of indicators:

- Land-use density in general is below the desired medium-to-high density of development required for a TOD zone of influence.
- A pedestrian-friendly circulation network is not in place. Numerous vehicular junctions constitute obstacles to a walkable community.
- The proposed future land-use mix within the hub's zone of influence provides for a multitude of functions that can be an asset to any TOD. Commercial, residential, recreational, administrative, and medical land-use functions, plus a central bus station, metro station, museums, and religious uses can all be found within the hub. Some functions are in need of more efficient spatial design and more intense utilization (New Haven-Hartford Springfield Rail Program, n.d.).
- Introducing TOD principles and development approaches can provide a framework to create a livable and vibrant community within the hub. However, this was not taken into consideration. The proposed vision for this hub is below TOD standards.
- A compact urban structure and a high-quality pedestrian network would focus mainly on the relationship between the main train station and the main bus station and neglect the pedestrian streets and alleys in the surrounding urban fabric.
- An active hub center is not defined. The boundaries of the historic district adjacent to the hub are also not clearly defined in order to avoid areas of conflict between historic preservation and new development.
- Safe, reliable transportation systems may present a plan to solve many problems in the area through integrated transportation and urban development interaction.
- Innovative parking strategies should be developed to comply with the fundamental design criteria of non-intrusive automobile usage.
- Economic activities within the zone of influence do not promote the level of socioeconomic improvement needed to revitalize this area.
- Public leadership is crucial to achieve effective urban management and realize the full potential of TOD implementation. The current leadership structure should be developed to encourage public-private partnerships.
- The aesthetic zoning of the hub is underdeveloped and does not reflect sound principles of attractive spatial design and place making. Proper urban design schemes are needed to optimize the richness of the diverse cultural and historic opportunities present in the area.
- Community Participation focuses on competitive social interaction and neglects the cooperative community characteristics that the traditional urban community was based upon.
- Transforming Al-Alawee hub into a functioning TOD area requires the formulation of a defined master plan that takes into consideration the drawbacks of the zone of influence. The development of a planning matrix focuses on issues of priority and concentrates on both pressing issues and planning objectives. It provides measures to achieve these objectives based on the unique characteristics of the area. See Table (2).

Table (2).Planning objectives Achievement Matrix (Al Alawee Hub), (Authors)

TOD Objective	Program	Project	Action
Increased Land Use Density	Rezone Hub As A TOD Zone	High Rise Residential Blocks	Prepare Area Land Use Master Plan
Diverse Land Use Mix	-Special Zones For Housing, commercial, Educational, Cultural, And Health Facilities	-Use Land Portion Of Old Airport As High Rise Residential	Incorporate New Land Uses Into Area Master Plan
Defined TOD Core Zone	Placement Of Transit Stations And Commercial/Housing Uses In Core Zone	-High Rise Housing Buildings -Commercial Activities At Street Level	Rezone Core Area To Allow All Day/Night Activities
Aesthetic Spatial Deign	-Develop Green Open Space System -Incorporate Place Making Design Principles	-Create Green Park At Center Of Core -Create Central Plaza Connecting Transit Stations -Introduce Public Art Features -Introduce Water Features -Introduce Green Shaded Walkways And Seating Areas	Allocation of leisure static public space land area
Innovative Parking Strategies	-Distribution of parking facilities throughout TOD Area -Introduce smart underground parking facilities	-Multi Story Car Parking Connected To Transit Stations -Develop underground parking below Public spaces	-Close Core Area To Private Cars -Utilize underground space beneath central plaza to incorporate smart parking facility
Integrated Transit Modes Within Zone Of Influence	Close Proximity Of Transit Stations Within Core Area	-Link Tod zone with street level tram system	-Redesign Circulation Network
Promote Walkabilty	-Establish Continuous Pedestrian Side Walk network	-redesign Side Walk to prevent cross circulation -Elevated And Underpass Walkways -Link Core To Al Zawra Park With Elevated Walkway	-Redesign Circulation Network In Favor Of Pedestrians -Incorporate Complete Street Design Principles

7. Conclusion

Metropolitan cities are constantly searching for new approaches to optimize the urban form through efficient interaction between space and community. TOD presents an opportunity to optimize existing community assets and reconfigure the urban landscape to create a livable city. The design of transit facilities in Baghdad should conform to the special character of the expansive urban pattern, and ensure efficient connectedness to surrounding districts. The future explosive demographic picture of the city requires innovative transit solution and the formulation of a distinct a future urban vision that will chart the course for the long haul. Transportation facilities can serve as a catalyst to transform the future of urban centers and revitalize their economy.

The TOD design outlook seeks to intensify Baghdad's mass transit infrastructure, rider's needs, community adaptability, and future development opportunities. Such development is needed on a multitude of levels.

Through analysis of one of the main transit hubs in Baghdad (Al-Alawee), it became evident that this area is applicable for development as a TOD despite the fact that future development plans neglected to incorporate this vital tool into the city's future vision. Indicators reveal that certain intrinsic characteristics of the area are in line with TOD design principles but that others need to be developed further to optimize the city's urban form.

8. Recommendation

The transit-oriented development concept is a viable tool to promote smart growth, especially for Baghdad's future development. Integrated transit hubs will provide Baghdad with a much-needed transformation from its current urban form. From an economic perspective, implementing TOD will broaden the tax revenue base, expand investment opportunities, create much-needed jobs, and increase disposable income through savings to residents (via efficient proximity and land-use diversity). These hubs will be a catalyst for bringing life back to

central districts, restoring all-day activity, and limiting urban sprawl. Cities such as Baghdad may not, and should not, continue to do business as usual. Explosive population forecasts indicate that the city's infrastructure and community assets are about to reach their carrying capacity. The future vision of Baghdad, as articulated in the BCCDP 2030, has provided a conceptual framework to overcome some of the quandaries facing the city, but it has neglected to utilize TOD as an approach to attain smart growth. Cities do not prosper through good infrastructure alone but by creating a livable, attractive, and resilient urban fabric. TOD can open a window to achieve such an ambitious vision.

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