



15th International scientific conference “Underground Urbanisation as a Prerequisite for Sustainable Development”

A focus on the contribution of promoting TOD to increasing Tehran’s public spaces

Mohammad Mahdi Safaee ^{a,*}, Negin Samadi Kafi ^a, Arefeh Torkaman ^a

^a Member of Islamic Azad University (IAU), South Tehran Branch, Iran

Abstract

Development of underground spaces is a modern approach in urban development. Paying due attention to this issue can help improve the quality of life in Tehran’s dense urban areas. A large number of Tehran’s municipal districts lack adequate urban facilities and public spaces. This is while, owning land in these districts has become quite difficult and expensive. Various jobs and a large number of buildings with diverse uses have been created and constructed, respectively, around subway stations, which are centers to which people are attracted and, from which, are scattered throughout the city. Nevertheless, since most of the stations in Tehran are located in urban areas with high-density development, it is quite difficult to provide sufficient public service spaces around or adjacent to them. Transit-oriented development (TOD) is a mixed-use residential and commercial area designed and created around (within a radius of one-quarter to one-half mile from) train or subway stations as well as tram or bus stops to maximize access to public transport and create adequate space at the entrance of subway stations. With an area of 730 square kilometers and a population of about 8 million, Tehran ranks 25th in the world in terms of having the largest population in its metropolitan area. With more than 180 stations and five lines, Tehran Metro ranks 21st in the world in terms of the number of stations and lines. Most of these stations are located in the major urban centers and areas. The present study seeks to stress and clarify the importance and status of TOD approach as an effective strategy to increase Tehran’s underground public spaces. In addition to exploiting Tehran’s underground potentials and capacities, this approach helps resolve a number of the city’s problems, such as lack of public spaces and inefficient public transportation, and improve its quality of life and environmental issues.

© 2016 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the scientific committee of the 15th International scientific conference “Underground Urbanisation as a Prerequisite for Sustainable Development”

* Corresponding author. Tel.: +989155079149

E-mail address: safaee@cectd.com

Keywords: Urban development, transit-oriented development (TOD), underground public spaces, urban centers, Tehran Metro;

1. Introduction

Urban transportation is one of the most fundamental issues in urban planning (Perk & Catalá, 2009). The introduction of the subway system to urban transportation chains, has created substantial changes in the flow of traffic and has consequently affected the attraction of population and the development areas surrounding each station. Among these effects is the citizens' ability to access opportunities related to their occupations of interest, bazaars, commercial regions, educational and recreational facilities (Boucq & Francis, 2008). The high price of land; the vertical development of cities; the abundance of detrimental environmental pollutants; are all influential factors in the importance of the fabric of underground spaces, which through affective planning and management, acts as an intact potential in the improvement of the quality of life. Subway stations are among the most essential driving forces in the process of development since they make the attraction of a large population of people possible on a daily basis, and thus create the potential to optimize the usage of local areas and contribute to urban development.

Development based on public transportation (such as the subway system), is appropriate development, which in addition to augmenting the quality of life and providing a standard of convenience for citizens, contributes to the creation of a variety of resources as it provides an arena for the establishment of station complexes. However, in a city like Tehran, the lack of attention to the dimensions of such development, the absence of correct planning and the structural incompatibility of subway chains with the larger architecture of the city, has made urban subway stations problematic for their local regions. Therefore, not only do stations not possess the ability to turn into active civil and social centers, local citizens believe that these stations have led to a variety of problems such as environmental concerns, shortage of public spaces for the comfort of residents, excessive density of building structures and a sense of imbalance throughout the area.

2. The Definition of TOD

Transit-oriented development includes areas, which are located within a mile or 1/4 mile of public transportation stations and have a variety of functions such as administrative, recreational, retail, and residential. The high level of density, compaction in the urban fabric, open and public spaces and are among the other characteristics of this type of development. Transit-oriented ability has the ability to increase the stability of daily life and consequently reduce the cost of transportation through providing multi-functional facilities for families in addition to reducing the severity of environmental concerns. Spaces that provide diverse facilities encourage residence close public transportation systems and thus decrease the level of dependence on personal automobiles. The core purpose of the development of TOD is the improvement of the quality of life and the creation of livable spaces for individuals in the society (Calthorpe, 1993: 78).

2.1. *The History and Background to the Creation of TOD*

In the decade of 1960, a number of stations and station complexes were constructed whose sole purpose was to raise the average income made by the selling and renting of local lands. This type of development, which is called "joint development" was oblivious to the relationship between transport and development and did not consider issues such as high density, land use, etc. Since the late nineteenth century until the decade of 1930, the relationship between transportation systems and development was such that transits were used in order to link the center of the city to the outskirts. Nearby stations related to transportation systems, retail spaces, shops, schools, and service areas for passengers had been created. These micro-commercial spaces were the pioneers to new discussions. Residential spaces were more dense along the sides of the streets and were supported through buses and cable cars. During this period, transportation systems were developed in accordance with the methods of urban development. (Still, T, 2002) Peter Calthorpe is one of the most notable faces of new urbanism and was also a founding member of the Congress for New Urbanism in 1992, which was active in the field of the control of the dispersed growth of spaces and the

situation of the principles of new urbanism and transit-oriented development (TOD). In his book *The Next American Metropolis*, he introduces the parameters of transit-oriented development or TOD and provides guidelines for its vast usage. (Calthorpe,1993)

2.2. The Benefits of TOD

TOD can decrease infrastructure costs. Since TOD features more compact development and often results from infill development, local governments can often reduce by up to 25 percent infrastructure costs of expanding water, sewage and roads to local governments.

TOD can increase transit ridership. TOD improves the efficiency and effectiveness of transit service investments.

TOD can help conserve resource lands and open space. Because TOD consumes less land than low-density, auto-oriented growth, it reduces the need to convert farmland and open spaces to development.

TOD reduces air pollution and energy consumption rates. Since TODs provide safe and easy pedestrian access to transit, air pollution and energy consumption rates can be lowered. Also, TODs can reduce rates of greenhouse gas emissions by 2.5 to 3.7 tons per year for each household.

TOD can increase public safety. TOD development results in active places that are busy through the day and evening. Having such activity and lots of people around provides "eyes on the street" and helps increase safety for pedestrians, transit users, and many others. (Allison Bell,2013)

2.3. Main Goals Of TOD

Location Efficiency: Location efficiency is the conscious placement of homes, jobs, civic uses, shopping, entertainment, parks and other amenities close to transit stations to promote walking, biking and transit use.

Rich Mix of Choices: Choice is a defining feature of some of the best and most convenient neighborhoods, and TOD is about expanding housing, transportation and shopping choices

Livability: At its core, transit-oriented development strives to make places work well for people. While to some livability may conjure up the idea of vague and unimportant concepts irrelevant to such "nuts and bolts" issues as prosperity, in fact livability and quality of life are increasingly viewed as closely connected to economic development.

Portal to the Region: A transit station generates activity and is a desirable "place" in which to live, open a shop or locate a workplace. (Dittmar, H. and Ohland G. 2004)

3. Scaling and Zoning of TOD

Three major regions constructing the structure of transit-oriented transportation include: Urban TOD, Neighborhood TOD, and Secondary Area. The difference between these three regions is in their extent of variety of functions, their type of relationship with the public transportation chain, and their density. In general, transit-oriented transportation on an urban and local scale consists of the two core sections of commercial and residential region.

Commercial region: Every developing region consists of a multi-use commercial core, which is located adjacent to the public transportation station. On a micro scale, these cores include retail and local services and on a larger scale include restaurants, commercial services, and even offices with a high density of employees and slight industrial usages. Because of their attraction and mixed applications, these cores can turn into travel destinations and having been located adjacent to public transportation stations, they encourage and promote the use of public transportation.

Residential Areas: These areas include residential units in a suitable walking distance from commercial cores and public transportation stations. (Allison Bell,2013)

3.1. TOD's Principles

Typeset sub-subheadings in boldface italic and capitalize the first letter of the first word only. Number the sub-sub headings systematically, as illustrated. Leave no line space after the sub-headings; leave one space before.

3.1.1. *Mix of Uses*

Diverse and complementary high-activity uses, such as retail, professional services, housing and employment, within the central area of a TOD and adjacent to transit.

Creating a Destination Magnet: Complementary land uses that work together to make a “neighborhood” focus

3.1.2. *Pedestrian Oriented*

Attractive pedestrian environment, with street-facing buildings and a network of pedestrian-scaled streets connecting the transit stop or station with the TOD's commercial, civic and residential areas. Creating an Attractive Setting: Design, scale and quality of buildings, streets and landscaping

3.1.3. *Transportation Interfaces*

Parking to accommodate transit users and TOD customers.

Transit Stops and Stations: Central location in a TOD, designed various ways to meet different needs

Range of Transit Facilities. Transit Stop and Station Design

3.1.4. *Compact Development*

Transit-supportive development: medium- to high-density housing and employment.

TOD locations within comfortable walking distance of transit station or stop (about one-quarter mile).

3.1.5. *Manage Parking*

Even though TOD lessens the need for automobiles in a station area, accommodating vehicles with convenient parking and drop-off zones is critical to the success of a vibrant TOD district. (Ian Carlton, 2007)

4. Case study: Investigate Underground spaces in Tehran

Underground development, includes a variety of different spaces in urban applications, particularly urban foundations which include: the subway chain (tunnels and subway stations); underground commercial centers; underground cultural and social centers like museums and auditoriums. The city of Tehran has not yet used any of its underground spaces. However, the need for underground spaces in Tehran is due to the lack of sufficient public space in Tehran and also in order to meet urban needs and to provide space for commercial units, service areas, parking lots, and recreational areas for means of entertainment. The creation of an underground city has been successful in the metropolises of China, Japan, Singapore, Canada, and Spain. For Tehran in which horizontal development (increasing the area and price of land) and vertical development (increasing the density of buildings) are impossible, transferring a portion of the land uses to the underground as a third route for the development of the capitol has been on the agenda of the municipality. In recent years, the establishment of the 4 tunnels of Tohid, Amir Kabir, Niyayesh, and Resaslat has been auspicious in the process of providing access to underground spaces. Currently, the highway chains of the city of Tehran add up to a total of 550 kilometers and will be complete with the construction of an additional 50 kilometers. Tehran currently does not have the capacity for highway development more than 600 kilometers on the surface and has to resort to underground spaces. In this regard, the development of the subway station is one of the first steps in the development of underground spaces. This shows that the lack of needed public spaces in Tehran can be replaced in underground spaces in certain areas of Tehran. The creation of

underground spaces in these areas is determined based on the two indicators of “access to the main subway stations” and “the high potential of the region for commercial investing.” It is important to note that in order make the concept of underground spaces effective the related prerequisites and foundations have to be available.

4.1. The role of the subway system in the public transportation of Tehran

The introduction of the subway system to urban transportation chains, has created substantial changes in the flow of traffic and has consequently affected the attraction of population and the development areas surrounding each station. Among these effects is the citizens' ability to access opportunities related to their occupations of interest, bazaars, commercial regions, educational and recreational facilities (Boucq & Francis, 2008) The city of Tehran has a railroad transportation system in the form of the subway, which with a distance of 152 kilometers has the 21st rank in the subway systems in cities around the world. Until the September of 2015, these trains are active in five main lines (1,2,3,4 are intercity and 5 is intra-city between Tehran and Karaj). Until the end of the September of 2015, the number of wagons in the Subway of Tehran is more than 1000, which transport more than 1.8 million people on a daily basis.(www. wikipedia.org/wiki/Tehran_Metro)

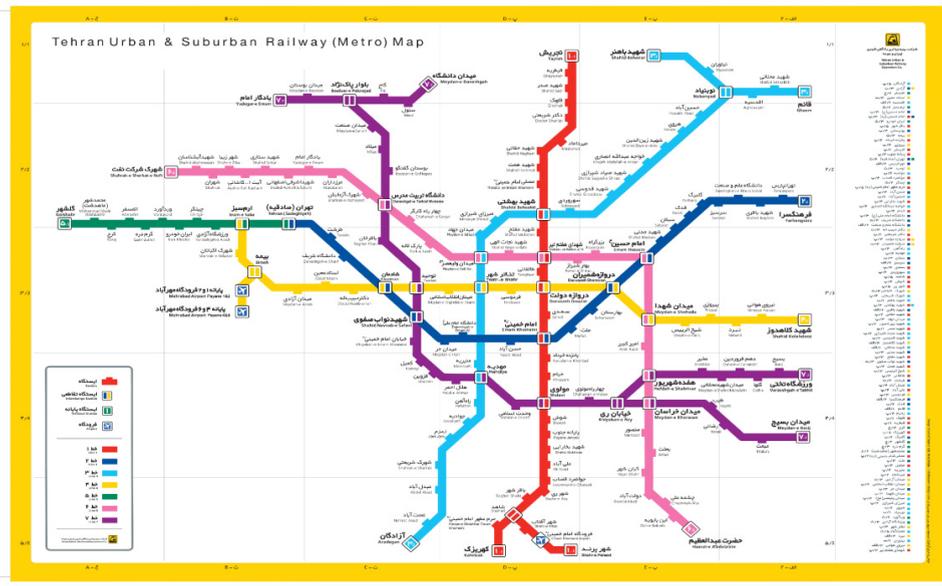


Fig. 1. The map of the lines of the subway system of Tehran and outskirts.(Source: The Authors).

4.2. Proposed usage of TOD in Tehran

Various applications of TOD could be exist in Tehran include;

- The subway chain (tunnels and subway stations)
- Underground commercial Centers
- Underground cultural and social centers like museums and auditoriums
- Office and Working spaces
- Sports and Swimming Complexes
- Public Parking

4.3. The zoning suggestion of TOD in the underground public transportation chain of Tehran

Considering the map of subway stations in Tehran, the suitable situation for TODs in Tehran is with regard to their urban map in the region of the main subway stations in Tehran.

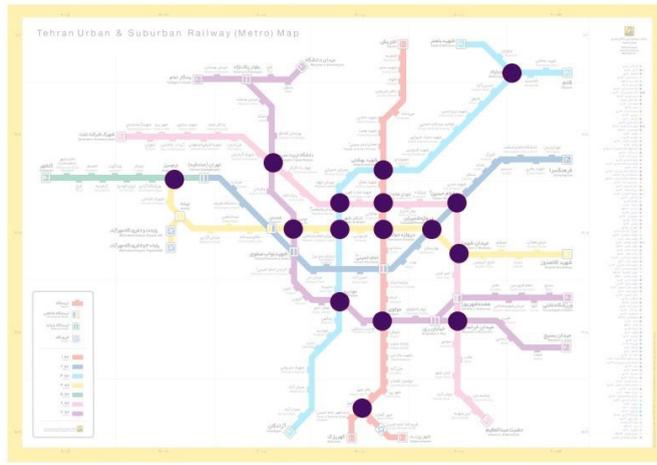


Fig. 2. The suggested arrangement of TODs.(Source: The Authors).

4.4. The Benefits of TOD in the Urban Transportation of Tehran

Tables (see Table 1).

Table 1. The benefit of TOD in the urban transportation of Tehran.

1. Appropriate Accessibility	<ul style="list-style-type: none"> • Providing the ability for transportation with the sole purpose of transportation • Lack of bicycle routes and amiable spaces for walking • The increase in the number of passengers using public transport • The incorrect design of the public transportation system and the inefficient location of the stations
2. People's ability to perform various activities	<ul style="list-style-type: none"> • The lack of functional variety (residential, commercial, administrative, cultural, social) • The absence of resting and comfort facilities such as chairs • Lack of places with the flexibility to perform various activities in different timeframes. • The absence of satisfaction of daily and monthly needs of all social groups in the subway
3. Comfort and the creation of a pleasant mental image	<ul style="list-style-type: none"> • Reduction in the use of automobiles, relative absence of noise and congestion and the creation of public comfort • The promotion of public health and air quality because of the reduction in automobile usage • The lack of active dynamic public spaces and the decrease in societal security • The absence of satisfactory walking routes and the lack of encouragement for such activities • Lack of attention to desirable feature upgrades
4. Having Sociability and Dynamics	<ul style="list-style-type: none"> • The absence of an desirable mental image due to the inexistence of attractive • The lack of public spaces surrounded by buildings and therefore the lack of social identity and vitality • The lack of public spaces active 24 hours a day and the reduction of public supervision and societal security • Women's reluctance to use the subway during the nighttime due a sense of insecurity

Considering the indicators of quality in public spaces and transportation centered on the subway system, subway stations act as an urban foundation responsible for public service, and having the potential for "transit-oriented development with a focus on the metro" and the ability to benefit from its advantages, the city of Tehran can be effective in the creation of attractive and human-oriented spaces.

Table 2. Suggesting Guidelines

Indicator	Guideline	Conclusion
Convenient Access	Increase in the attractiveness and security of sidewalks adjacent to the subway stations	Minimizing the number of inter-city travels
	Providing bicycle routes and desirable walking paths	Reduction of the negative effects subway stations on their local area
	Appropriate of transportation systems and logical locating of dependent stations in order to provide convenient access	Increase in security throughout the area along with the improvement in pedestrian access to the stations roadway traffic."
The ability for people to participate in a variety of activities	Correcting the pattern of land use	Increase in vitality and quality of ambiance
	Transferring certain land uses to the underground	Increase in sense of identity in the subway area
	Increasing diurnal and nocturnal security	Creation of an amiable environment for pedestrians and bicycle riders
	Correction and improvement of existing spaces surrounding the subway station	Increase in motivation for human interaction
Comfort and the creation of a pleasant mental image	Reduction in the use of personal automobiles, reduction in noise and congestion and increase in public comfort	Increase in sentimental attachment to the environment
	Promotion of public health and air quality due the reduction in automobile usage	Increase in public health and comfort
	Providing places and public locations active 24 hours a day and promotion of societal security	Increase in quality of life
Having Sociability and Dynamics	Conservation and promotion of natural factors conducive to the creation of identity	Promotion of sense of security through the establishment of facilities active 24 hours a day
	Providing the arena for the presence various social groups through the creation of recreational facilities	Securement of social justice through the establishment of appropriate recreational facilities for all users (particularly vulnerable social groups such as: the elderly, women, the disabled...)
	The design of public spaces surrounded by buildings and therefore the lack of social identity and vitality	

5. Discussion and Conclusion:

Development of underground spaces is one of the necessities of urban development in Tehran. Since the subway has a significant potential and can contribute to public dynamics and vitality, the promotion of the quality of life, creation of public transportation facilities and convenient accessibility, promotion of air quality and public health, it can be of utmost importance; thus, the development of public underground spaces as a subsidiary of urban development acts as intact potential for the use of various public needs and applications and can provide diverse facilities in order to satisfy public need. Moreover, it can also provide contribute to solving certain urban problems such as congestion and the lack of adequate space, urban development, promotion of health, and the promotion of the quality of public spaces.

Please adhere to the submission schedule for best results to ensure your paper is published.

References

- [1] H. Dittmar, and G. Ohland, *The New Transit Town: best practices in transit-oriented development*, Island Press, Washington, D.C., 2004.
- [2] A. Bell, *This TOD Strategic Action Plan was developed through extensive collaboration with Metropolitan Council staff, local government partners and other stakeholders.* (2013).
- [3] Calthorpe Associates in association with Minter Associates, *Transit-Oriented Development Design Guidelines for Sacramento County.* Sacramento county planning & community development department. (1993).
Information on <http://www.mrsc.org/govdocs/m58catodguidelines.pdf>
- [4] T. Still, *Transit-Oriented Development: Reshaping America's Metropolitan Landscape, On Common Ground*, Winter, 2002.
- [5] I. Carlton, *Histories of Transit - Oriented Development : Perspectives on the Development of the TOD Concept.* (2007).
Information on https://en.wikipedia.org/wiki/Tehran_Metro
- [6] E. Boucq, P. Francis, *Assessment of the Real Estate Benefits Due to Accessibility Gains Brought by a Transport Project: the Impacts of a Light Rail Infrastructure Improvement in the Hauts-de-Seine Department, Trasporti Europei.* 40 (2008) 51-68.