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# Sustainable Transit Oriented Development

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**Abstract**—Urbanization has led to horizontal growth of the cities thus creating problems of urban sprawl. This has resulted in increase of trip lengths and higher usage of private vehicles, problems of pollution and increased demand of infrastructure. To address these issues, many cities have strengthened their public transport by developing mass rapid transit systems (MRTS) such as metro rails and Bus Rapid Transit Systems (BRTS). It is however, important to efficiently use these systems by integrating the land use with the transport infrastructure to make the cities livable, healthy and smart. Transit oriented development is a set of transportation and land use planning principles and strategies that are sweeping the nation by connecting communities with vibrant, people-centric places in city after city. The public has embraced the concept, and real estate developers have quickly followed to meet the high demand for quality urban places served by rail systems. This is not only because TOD can offer a higher quality of life, but because it offers a triple bottom line solution to economic, social, and environmental sustainability.

**Keywords**—Environmental Sustainability, Land Use Planning Principles, Transit Oriented Development, Transportation, Urbanization

## I. INTRODUCTION

India is urbanizing at a rapid pace with urban population rising much faster than its total population. Level of urbanisation has increased from 17.29% in 1951 to 31.6 % in 2011.. The urban population in India, which is nearly 377 million is poised to grow to 600 million by 2030. The urban population of India contributes 65% of country's Gross Domestic Product (GDP), which is expected to grow to 75% in the next 15 years. With India witnessing a high economic growth, Indian cities are growing at a rate faster than other cities in the world.

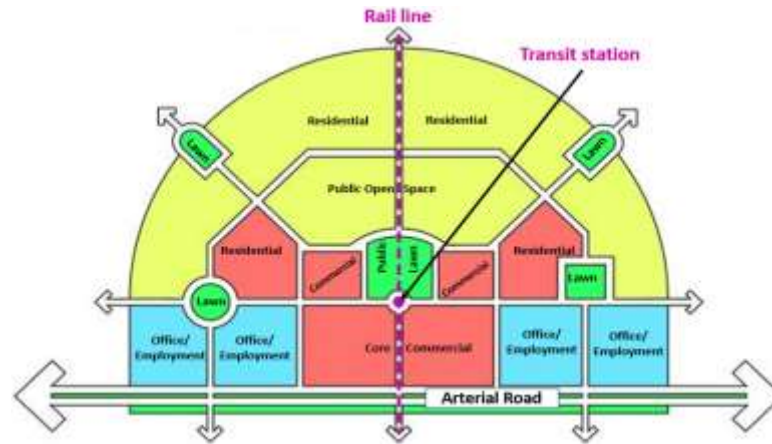
Well-designed TOD allow people with the choice to walk, cycle, or take public transportation to meet their daily needs by providing greater transit accessibility and a mix of uses within the community fabric. This is an urban development response to the congestion, carbon emissions, and inefficiency of single-use, suburban sprawl.

Transit oriented development is an effective strategy for the sustainable and balanced development of metropolitan areas and can be a tool to mitigate the negative externalities of car dependence, urban sprawl and the dispersion of mobility trips in space and time (Banister, 2002, 2008; Cervero, 1998; Meyer & Miller, 2001; TRB, 2004; European Commission, 2007).

Sustainable development seeks to create an urban environment which maximizes economic development and social equity, whilst minimizing negative externalities upon the natural environment. From a land use and transport perspective, this means reducing automobile dependence through mixed use and compact cities with an array of travel alternatives focused on walking, bicycling, and public transport (Newman and Kenworthy, 1999, Banister et al., 2006).

Though, the TOD concept is coined by Calthorpe, its definition has been individualized by different agencies and governments based on their regional and local needs. For example, Bay area Rapid Transit Authority, San Francisco has its own definition of TOD as “ Moderate- to higher-density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment, and shopping opportunities designed for pedestrians without excluding the automobile. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use.” Where as the Regional Transportation Authority of Northeast Illinois (RTA), Chicago has a simple definition as “Development influenced by and oriented to transit service that takes advantage of the market created by transit patrons” (Cervero et al, 2004).

This paper focuses on sustainability, Elements of TOD, Functional Characteristics of TOD, Challenges, Action Plan, Benefits of TOD & sustainable development, conclusion of study.



**FIGURE 1:A basic structure of the TOD community**

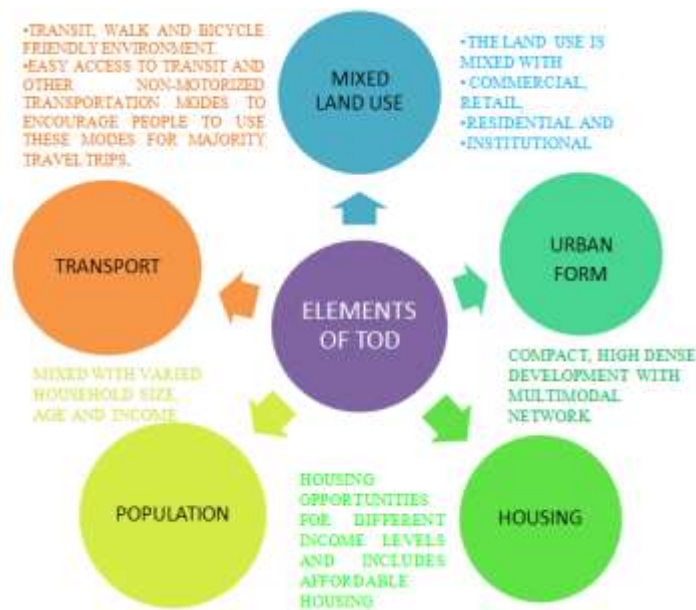
## II. SUSTAINABILITY

The operational definition of sustainability is a mean of developing civilization and human activity to meet the demand of human society In an economically feasible way without hampering the biosphere and ecology. Sustainability means to achieve economic growth and developing simultaneously in an eco-friendly way.

According to UN conference (WCED,1987)sustainable development means a development that meets the needs of present without compromising the ability of future generation to meet their own need.

## III. ELEMENTS OF TOD

Though, some of the elements of TOD might overlap with Smart Growth characteristics, the TOD has an additional goal to encourage people to use transit. Therefore, the characteristics include the combination of these two key objectives. The below characteristics are essential to recognize a place to be a TOD.



**FIGURE 2:Elements of TOD**

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#### IV. FUNCTIONAL CHARACTERISTICS OF TOD

It is important to note that the TOD has a comprehensive approach towards its goal. It needs to be flexible to adapt to different situations, look beyond creating compact physical form and should measure success rate at regional level. It is necessary to see the following three functions are considered when visioning the TOD. Belzer and Autler (2002) have formulated the following as important functional characteristics of TOD.

##### *4.1 Adaptability in different situations and places:*

Not any two locations are same geographically or socially. And any place may change with itself in a given period of time. For this reason, the TOD guidelines are flexible to adapt the requirements and issues in its solutions for the given location or situation.

##### *4.2 Functionality:*

It is important to note that the TOD is a concept and the outcomes should be measured from the functionality of the development rather than with just fixed amount of density or the number of passengers using the transit station. The characteristics of TOD do not end with the providing physical form, but in fact compliment the development to achieve its primary goal i.e. reducing auto dependent travel behavior.

##### *4.3 Continuum success:*

Not all TODs can provide all the characteristics that are defined for TOD with a hundred percent success rate. The outcomes may vary depending upon the geographical location, size of the development, quality of the project, role of the stakeholders and the time of implementation. The measure of success should include various levels such as local, regional, social and economical success.

#### V. CHALLENGES

From the concept vision to implementation of TOD, one may face many challenges. The following are some the challenges to address for a TOD to implement efficiently.

##### *5.1 Land Use/ Zoning regulations*

Land use/ Zoning regulations are very complex and critical part of the plan proposal. Land uses of the selected area depend on the specific land use/ zoning regulations (Cervero et al, 2004, Boarnet&Compin, 1999). If the TOD proposal is not matching with the local land regulations, it is necessary to see that the related regulations being amended (Report to Congress by FTA & HUD, 2008)

##### *5.2 Coordination of Stakeholders/ Bringing Awareness*

TOD is a complex concept that includes various stakeholders from local to regional governments, transportation agencies, interest groups such as bicycle groups, and the public. Coordination between various stakeholders and awareness of the development proposals by them is critical to realize a TOD (Cervero et al, 2004, Boarnet&Compin, 1999).

##### *5.3 Local Economy & Financing the Development*

Since TOD is a comprehensive development, it requires large scale investments. Public funds may not be sufficient to finance the whole project and may need to share the burden with private partnerships (Cervero et al, 2004) or use other fund generating techniques. Sometimes, despite the intentions of stakeholders to implement the TOD, the local economy may not be suitable to implement it (Boarnet&Compin, 1999).

##### *5.4 Implementation*

Along with all the above hurdles, there might be other practical issues may come up in the implementation level. They may be such as political changes, or social and demographic changes due to long time lapse between the conceiving the TOD plan and the actual implementation. As long as there is flexibility in the concept, these hurdles may be overcome.

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## VI. ACTION PLAN

An action plan helps to formulate the framework and methodology for the given goals and objectives of the plan proposal. It also helps to check the feasibility of the goals to achieve. Preparing a proper action plan would help a TOD to get over the hurdles mentioned above and implement the plan proposal smoothly. The following action plan is a general outline and may include other tasks as needed, based on project specific requirements.

### *6.1 Coordination between different stakeholders*

It is necessary to bring awareness of the goals and objectives of the TOD project from the initial stages of the proposal so that there is a coordinated effort to bring the best results at the implementation level. Develop different approaches based on the need to coordinate with different groups (Report to Congress by FTA & HUD, 2008).

### *6.2 Develop TOD characteristics, indicators and Performance measurements*

It is important that the intended TOD has its own characteristics that include the general characteristics discussed above. To preserve the uniqueness of the area, develop a site specific, location specific characteristics for the selected development.

Indicators help to identify the goals of the plan. Develop TOD indicators related to transportation, built form, economic development, social structure, and environmental protection/ improvement. (Rene & Wells, 2005)

Develop performance measurements such as number of transit users, available transportation modes, traffic congestion, density, available housing choices (Cervero et al, 2004, Report to Congress by FTA & HUD, 2008), infrastructure facilities, land and housing values, mixed uses etc.

### *6.3 Develop Best Practices to promote, implement and update TOD*

Develop ideas to reach the public and different stakeholders involved in the TOD (Report to Congress by FTA & HUD, 2008).

Develop procedures to implement the plan without any constraints.

Develop a system and methodology for plan update.

### *6.4 Regulatory Constraints*

Check the local, regional and state regulations to see if the TOD proposal fits in to these regulations. If there are any changes need to be made to the plan or need to amend the regulation, it should be done at the initial stage of development proposal (Report to Congress by FTA & HUD, 2008).

### *6.5 Data collection and analysis, policy research and guidelines*

For proper policy research, it is necessary to have appropriate and complete data. Formulate a methodology to collect data from different resources (Report to Congress by FTA & HUD, 2008).

Formulate policy guidelines based on the policy research and data analysis.

### *6.6 Plan, Design and Implementation*

Develop databases for various information needs. It is important to see what the existing land uses in the areas of TOD proposal are, and whether they are fitting in the plan proposal.

Develop alternatives with positive and negative attributes of each alternative.

### *6.7 Review, Evaluation and Update*

Review TOD plans periodically and evaluate the impacts and benefits the developments (Cervero et al, 2002). It is important to feed the information in to the plan updates for accurate results.

## VII. BENEFITS OF TOD & SUSTAINABLE DEVELOPMENT

- Environmental benefits, reduced social and economic isolation has made TOD a sustainable development concept. TOD is applied for in-fill development in suburban area. So, it is a mean of achieving compact development.
- Low and moderate income TOD housing ensures available supply of labour. Besides, TOD provides an efficient transportation system. These two factors attract more investment on employment generation activity in the area and pave the way for economic revitalization.
- TOD increases profit for the businessman and so the tax paid to government. Efficient communication system increases land value which increases local government revenue. So, government can easily regain money spent for development.
- So, TOD is an economically feasible planning procedure. It reduces household fuel cost associated with heavy auto use. As all the necessary service and facilities are located within easily accessible walking distance, transportation cost of LMI people decreases. They can use this saved money for food, education and other necessity to gain a better living standard. This accelerates the process of attaining social equity.
- Rails and buses are more convenient mode of transportation than automobile considering cost and service. Bus provides services to more people than an automobile at a time at very cheap rate and rail never falls in traffic jam.
- TOD ensures inter-generational equity. Reduced car parking space provides more spaces for affordable housing and providing more development opportunity to meet present demand or for future expansion. In the distant places from the TOD station density is kept low which also keeps a room for future development.
- Pollution is resisted and air quality is improved by implementation of TOD as emission of green house gases from automobiles gets reduced. Preservation of open spaces keeps the ecology sustainable
- Pedestrian friendly environment increases social interaction and creates a community sense for achieving a sustainable community.
- Pure air and movement of pedestrian in walkways make people healthy and make their life sustainable.
- With reduction of parking space, urban water run-off also decreases. So, infiltration increases and ground water table is recharged and soil erosion decreases.

All above stated benefits of TOD makes it a strategy of sustainable development.

## VIII. CONCLUSION

TOD is a best solution to cater to high density development with provision necessary services. Design criteria of TOD suggest the way towards a sustainable development in terms of affordability, social equity, economical feasibility and balanced ecology. Living and working near transit not only increases transportation options, it can also increase housing choices, broaden work opportunities, and reduce household cost. Transit-oriented development represents one form of "sustainable urban development," achieving twin benefits in energy-efficiency by virtue of both the building envelope and location. To meet the increasing housing demand of cities, TOD can be a successful planning approach by the mean of provision of high density housing in suburbs of cities. TOD is the exciting, fast grown trend in creating vibrant, livable and sustainable communities

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