



A Systematic Process for the Evaluation of Successful Application of TOD in Indian Cities

Deepshikha Jain^{1*}, Bandana Jha², Ekta Singh³, Rashmi Ashtt⁴

¹ Amity School of Architecture & Planning, Amity University, Sec- 125, Noida, U.P., INDIA

² Architecture and Planning Department, Amity University, Sec- 125, Noida, U.P., INDIA

³ Amity School of Design, Amity University, Sec- 125, Noida, U.P., INDIA

⁴ Hindu College of Design, Architecture, and Planning, Sonapat, Haryana., INDIA

*Corresponding Author(Tel: +91-7404245876, Email id:ar.deepshi@gmail.com).

Paper ID: 12A11H

Volume 12 Issue 11

Received 02 June 2021

Received in revised form 09
September 2021

Accepted 15 September
2021

Available online 24
September 2021

Keywords:

Framework design; Indian
Cities; Step by step
approach; Transit-Oriented
Development TOD; City
planning; TOD planning;
Smart Growth
Development

Abstract

As per the literature study, Transit-Oriented Development is a concept that has many definitions and perceptions perceived differently by every author as it varies according to the demand of the situation. Thus, many researchers have been already done to measure the success of Transit Oriented Development around the world, with handbooks and guidebooks on how to plan for TOD and others. Since India is a developing country and there is an urge to make changes in the planning system to achieve sustainable development such that most of the problems can be handled. Thus, this concept is being tried in the Indian government in many cities by this or another way whether it is directly planned as Transit Oriented Development concept, or in the form of mobility in Smart City Mission, or many more. Thus, this paper has developed a step-by-step procedure to evaluate the readiness for the application of a successful Transit Oriented Development through high-quality transport availability with mixed-use development and public space with other important factors for successful application of Transit Oriented Development leading to a healthy, safe, sustainable, and environmentally friendly city or area.

Disciplinary: Transportation Science, City Planning & Sustainable Development.

©2021 INT TRANS J ENG MANAG SCI TECH.

Cite This Article:

Jain, D., Jha, B., Singh, E., and Ashtt, R. (2021). A Systematic Process for the Evaluation of Successful Application of TOD in Indian Cities. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, 12(11), 12A11H, 1-12. <http://TUENGR.COM/V12/12A11H.pdf> DOI: 10.14456/ITJEMAST.2021.239

1 Introduction

Cities in developing countries are increasing at an exceptional rate and it is expected that over upcoming years, the world's population is going to increase at a high rate which will lead to

the rapid increase in automobile ownership thus, becoming the major reason for many problems like traffic congestion, environmental degradation, ill health, insecure places for women to work or travel, accidents, and many more. This will also lead to huge pressure on renewable and non-renewable resources. These problems lead to urbanization and haphazard growth which needs to be tackled in a sustainable manner such that resources can be utilized efficiently. Therefore, after a review of vast literature review, it was identified that Transit-Oriented Development is one such sustainable development strategy where people can afford the cost of travel through the means of mass transit and reside in the affordable housing constructed at a walkable distance from that mass transit and other, day to day facilities required by the individual despite using private modes transport for such needs.

Thus, this research was aimed at identifying the readiness of the Indian cities to apply the concept of TOD for which firstly, we tried to identify the criteria and indicators which are responsible for the success of the Transit-Oriented Development based on the vast literature review and after creating the scale for evaluating the TOD policy (Jain & Singh, 2019). Further, two surveys were done by conducting a structured interview (questionnaire) among the experts of TOD from all over the world especially from seven Indian cities and the general users of Ahmedabad (because this was the only city with implemented TOD in India). Thus, this paper has developed a step-by-step procedure to evaluate the readiness for the application of a successful TOD through high-quality transport availability with mixed-use development and public space with other important factors for successful application of TOD leading to a healthy, safe, sustainable, and environmentally friendly city or area.

2 Literature Review

As per the literature study, TOD is a concept that has many definitions and perceptions perceived differently by every author as it varies according to the demand of the situation. Thus, many researchers have been already done to measure the success of TOD around the world, handbooks and guidebooks on how to plan for TOD, and others. Since India is a developing country and there is an urge to make changes in the planning system to achieve sustainable development such that most of the problems can be handled. Thus, this concept is being tried by the Indian government in many cities in this or another way whether it is directly planned as TOD concept, or in the form of mobility in Smart City Mission, or many more. So, it becomes important to check whether our Indian cities are ready for the TOD to be applied in this situation where the most important aspect of TOD.

3 Criteria and Indicators

After grounding a whole lot study, five main parameters have been enumerated having additional significance to measure TOD defining compactness, mixing of land uses, and encouraging populace to cycle and walk through urban design, concurrently the safety of people as well as concentrating on economic development is also taken into consideration. Within those criteria, subsequent indicators are accredited as an amalgamation of spatial and non-spatial, to

evaluate the numerous aspects of this concept adequately although being measurable and even quantifiable at the same time.

The characteristics of TOD are multi-dimensional and influence various stages of planning, implementation, assessment, or evaluation(Thomas & Bertolini, 2017). The study of TOD made, lead to a large set of indicators that must require. Each dimension act as a criterion for successful TOD planning (Singh, 2015). Distinct indicators can evaluate each criterion. This study considered 5 criteria each with 4 indicators, making it to 20 indicators for calculating the success of TOD in India.

4 Methodology for Framework Design

To design a framework to evaluate the success of TOD in India, the importance of all the five criteria with 4 indicators each was evaluated on the three scales of TOD levels in India based on the policies studied of all the TOD in the Indian cities as mentioned in Jain et al., 2021 and Jain et al., 2020, questionnaire survey done amongst the experts of those cities and even survey done with users of Ahmedabad. Figure 1 shows the framework designed where the links of all the three TOD’s are understood with all the five criteria and 20 indicators individually.

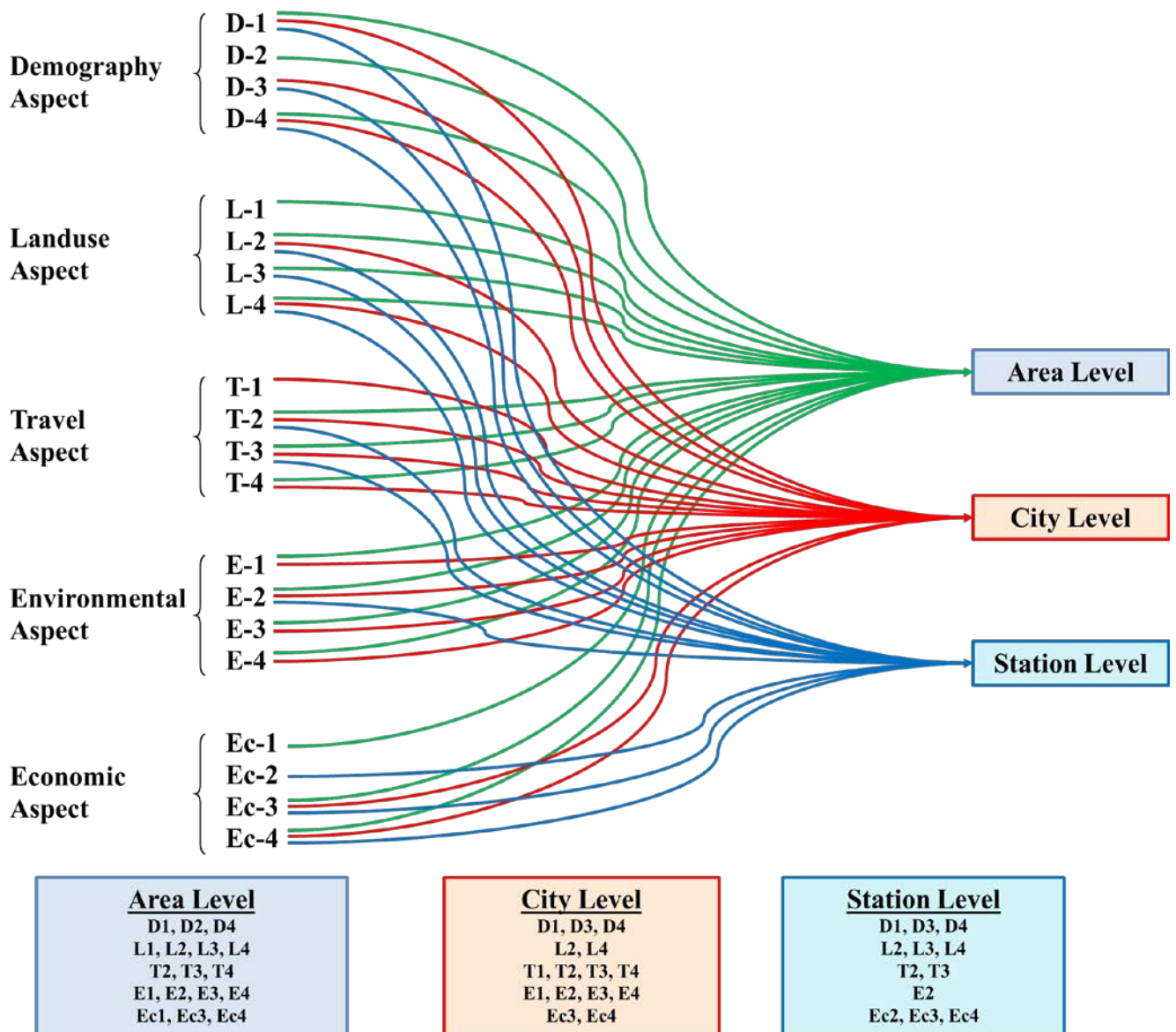


Figure 1: Framework Design for the Success of TOD in India.

Figure 1 clearly states that experts, stakeholders, and policymakers of Area level TOD give importance to D1, D2, and D4 indicators of Demography aspect which depicts *Residential mass, Commercial mass and Charisma- Urban Design, building footprint density*. Similarly, the importance of other indicators are identified likewise all the indicators of Land use and Environmental aspect are taken into consideration and 3 indicators are considered more important each for Travel and Economic aspect in Area level TOD i.e. *on-street parking density- for commuters, residents, and shared parking, mode of connections to a transit station (Non- motorized and walkable environment and road density leading to last-mile connectivity and employment density, private venture and tax earnings of municipalities* are given more importance respectively. Likewise, important indicators are evaluated for the other two TOD levels i.e. City and Station level.

This whole process framework evaluation leads to the calculations of the elements of TOD which could lead to smart growth development of the cities in India. The important indicators identified through the above-mentioned process from all the five criteria could act as the elements for the TOD in Indian cities. Those indicators are *Residential mass and Amount of mixed-use planning* from the Demography aspect, *diversity of land uses- location efficiency, affordable housing, planning schemes and design based planning* from Land use aspect, *on-street parking density- for commuters, residents, and shared parking, mode of connections to a transit station (Non-motorized and walkable environment and road density leading to last-mile connectivity* from Travel aspect, all indicators from Environmental aspect i.e. *sensitivity of security, comfortable access to transit modes by walking and cycling, connectivity to non-motorized transport mode, pedestrianization and feature of good atmosphere, fitness* and finally from the last criterion i.e. indicators from Economic aspect are *private venture and tax earnings of municipalities*.

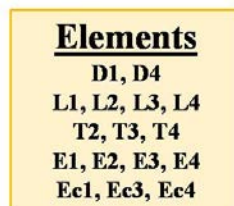
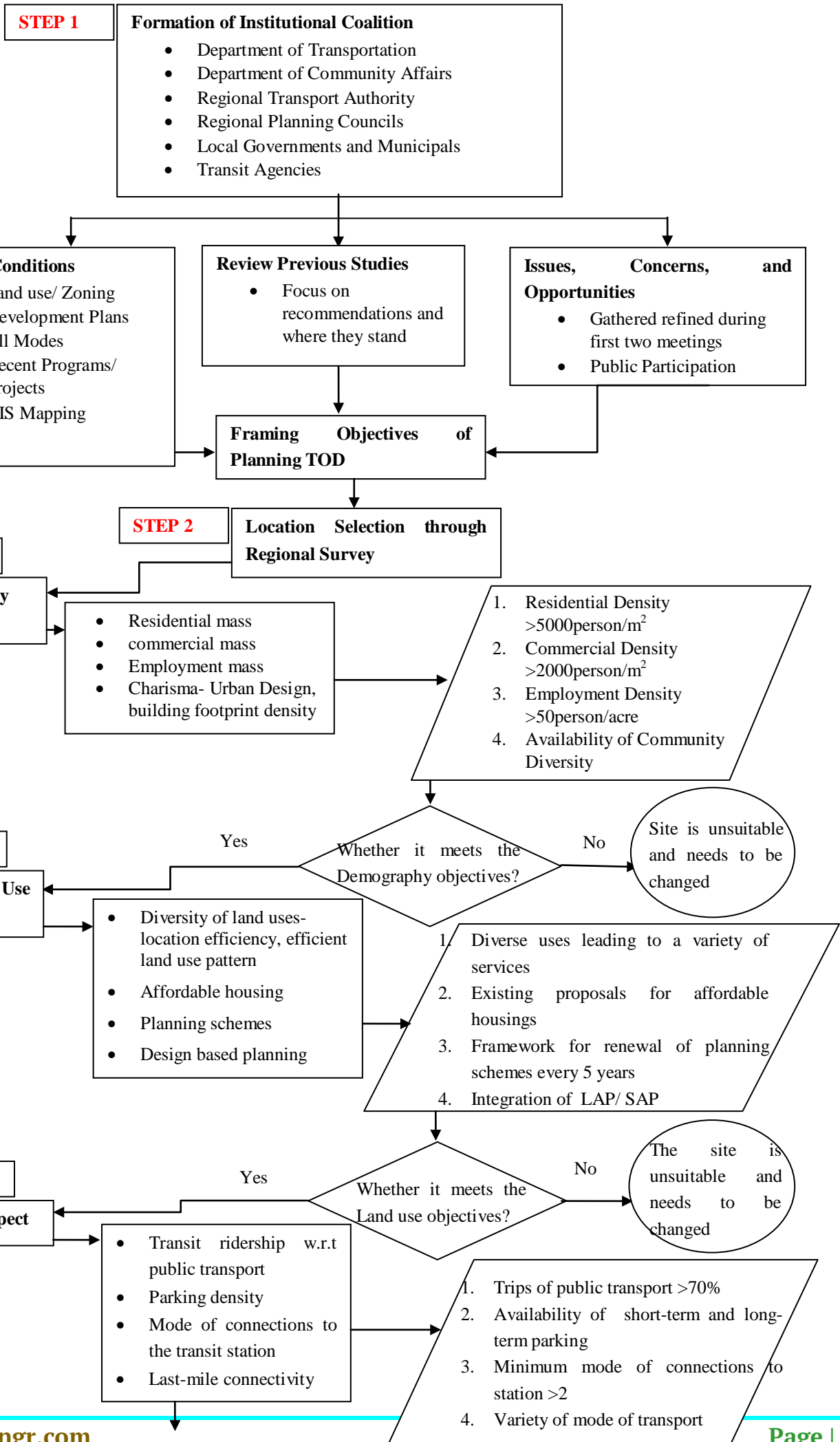


Figure 2: Elements of Smart Growth Development

5 Strategic Planning Process for the Evaluation of a Successful Application of TOD

The above framework design describes everything about the important elements that have to be present to make any development a smart growth. Now the question arises about the strategic planning process using the above-mentioned elements that can be used as a tool for the successful planning and finally implementation of a successful TOD especially in Indian cities. Therefore, below a flow chart is shown which has been developed using all the answers received from surveys and the analysis done during this whole project.



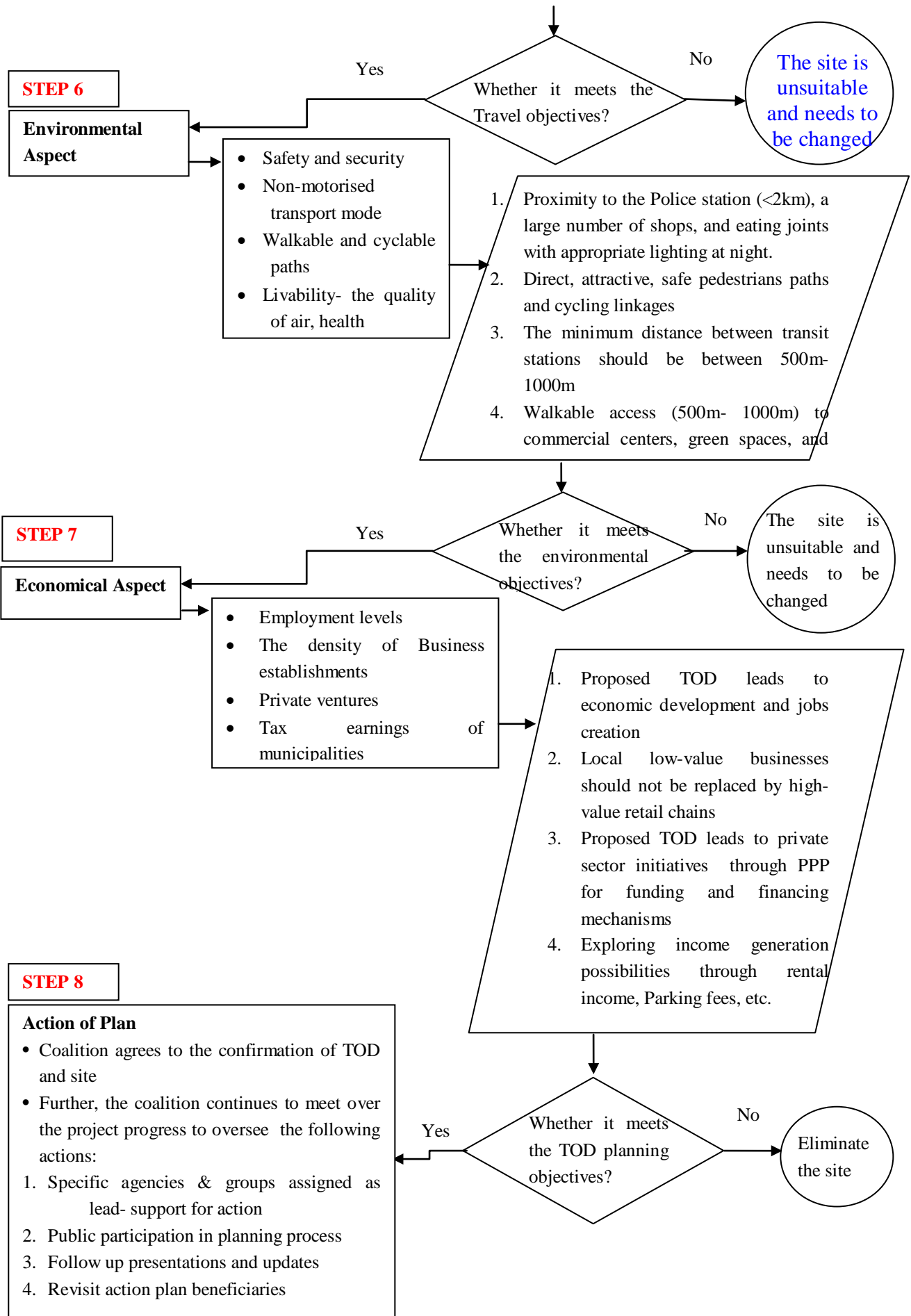


Figure 3: Strategic Planning Process for a Successful TOD.

Successful implementation of Transit-Oriented Development faces major problems especially having a vigorous process that leads to the development. The above flow chart explains the strategic planning process for the success of TOD in Indian cities which offers a potentially workable process toward TOD project development. Following are the steps to be taken:

Step 1: Launch of the Institutional Coalition

The institutional framework is very essential as it supports TOD projects in every path (Dittmar & Ohland, 2004). Successful TOD projects require a stronger and more flexible framework of institutions especially in India due to the variety of existing situations in all cities that cannot be considered or developed similarly. Initially, there is a need to identify the list of a diverse range of experts and departments to be involved with their role in the project planning and development which can further lead to the establishment of the forum for the coordination of those stakeholders in maintaining the stability in the development and execution process.

Different departments playing different roles in the making and development of the TOD projects are to be coordinated with each other to make it a success. These departments include “*Department of Transportation*”, “*Department of Community Affairs*”, “*Regional Transport Authority*”, “*Regional Planning Councils*”, “*Local Governments*”, “*Transit Agencies*”, “*Municipals*”, and so on.

“The initial challenge is the development of a clear and supportive institutional framework for TOD and this section includes the establishment of agreed criteria for TOD project selection” (Hale, 2007). The process of selection of project TOD should be in the light of identified objectives and the establishment of the structure should be flexible and open to adapt and even change for the betterment.

Step 2: Selection of Location and Framing Objectives

The next step is to identify the potential location for the execution of a successful TOD i.e. that fits the policies, paths, and criteria identified for the project selection. For this firstly, a range of available locations are identified for the application of TOD using the information received by going through the existing conditions, previous studies and issues, concerns, and opportunities related to that location. Likewise, this information is collected from the detailed study of Land use/ Zoning Plans, Development Plans, or other modes like recent programs or projects in those areas and maybe through GIS mapping. Similarly, this process of identification of location continues with the understanding of previous studies done on those sites i.e. the recommendations and their existing situation.

Finally, this process comes up with answers to the issues, concerns, and opportunities on that identified site which is shortlisted in the first two meetings of the department concerned as well as adding up of the recommendations and suggestions through public participation which can lead to the framing of the objectives for the planning of TOD in that location which could make it a success.

As TOD theory tells us that locations selected for the TOD projects should be well served with a high capacity and frequent transit to make it successful (Hale, 2007). Understanding Land use/ Development plans assure the potential of the land in terms of its adequacy for new construction. Thus, the site offering high-frequency transit service with multi-modal connections to reach the concept of last-mile connectivity creates strong patronage for potential locations.

Step 3: Context Review Based on Demographic Aspect

After the selection of the location, it becomes important to find out the contextual and planning issues to make the project successful for which as per the above listing of five aspects following with 20 indicators, it has to be answered. Thus, starting from the Demographic Aspect point of view, a detailed analysis of its 4 indicators i.e. *residential mass, commercial mass, employment mass, and Charisma- urban design, and efficient land use pattern* are required to acquire background information on which afterward project actions can be taken.

Therefore, a list of questions that need to be answered likewise “Residential Density >5000person/m²”, “Commercial Density >2000person/m²”, “Employment Density >50person/acre” and “Presence of the landmark of national importance which promotes community activity”. Generalized data could be gathered to understand the existing scenario of that location in terms of demographics and employment characteristics as well as the upcoming or the existing developments of that location. An early estimate of the floor space and number of residences that might be constructed in the future is also an important aim to be identified.

Thus when the answers to the above-mentioned questions are achieved and if they meet the objectives of the Demographic aspect then another step could be taken else it can be said that the site is unsuitable for the success of the TOD project or some further changes according to the situation can lead to the achieving the objectives and henceforth to the next step.

Step 4: Context Review Based on Land Use Aspect

A mix of uses and local serving stores provide an opportunity to reduce travel by internalizing trips and also supports a high degree of walking and cycling. It creates livelier, safer, and vibrant areas with increased interaction among the people (Maheshwari, 2019). Thus, the more diversity in and within the land uses including the affordability for the people who are majorly subjected to walking and cycling by adding a planning scheme of affordable housing can add to the success of TOD.

This criterion includes four indicators “*Diversity of land uses- location efficiency*”, “*Affordable housing*”, “*Planning schemes*” and “*Design-based planning*”. For contextual assessment process, a few questions need to be analyzed to check on the efficiency of the location which is “*Diverse uses leading to a variety of services*”, “*Existing proposals for affordable housings*”, “*Framework for renewal of planning schemes every 5 years*” and “*Integration of LAP/ SAP*”.

Thus, a generalized identification of the above-mentioned answers is, to identify to analyze the existing situation of the location such that how much diversity is present and how much more

is to be achieved to make the project successful. The affordable housing scheme is really important for the success of TOD to make it affordable for the users and similarly with other schemes to make it more sustainable. Similar to the method used in the above step, if all the criteria meet the objectives of the Land-use aspect leads to another step that could be taken else it can be said that the site is unsuitable for the success of the TOD project or some further changes.

Step 5: Context Review Based on Travel Aspect

Comfortable traveling by commuters i.e., transit ridership is found by many authors as one of the vital aspects of TOD planning as it defines the transit service level by gazing at the enlargement of transit users and thus, its consumption as development in terms of TOD cannot be designed for those of saturated stations, hence, it should have optimum level utilization of transit station by users. An adequate area under roads is required to ensure comfortable movement of people and vehicles in an urban setting thereby ensuring connectivity (Maheshwari, 2019).

TOD encourages the use of public transport or non-motorized transport where the quality of transit system contributes significantly (Renne, 2007a), (Newman, 2009). Intersections at a regular distance ensure a reduction in the speed of the vehicles and signalized intersections would create safer streets by reducing conflicts between the road users. Thus, leading to indicators like “*transit ridership with respect to public transport*”, “*parking density- for commuters, residents and shared parking*”, “*mode of connections to transit station*” and “*last mile connectivity*”.

Therefore, this involves understanding of the frequency of service, operating hours, current and projected capacity, connectivity through “*Trips of public transport >70%*”, “*Availability of short-term and long-term parking*”, “*Minimum mode of connections to station >2*” and “*Variety of mode of transport*”. Similar to the above two context review of the two aspects, in this aspect also after achieving the objective of travel aspect leads to the next step of context review concerning Environmental aspect else failure in achieving this proves the unsuitability of the site and hence if some changes can improve it then also next step could be taken.

Step 6: Context Review Based on Environmental Aspect

The station environment is very important for the success of TOD which targets the locations with high quality or those with expecting renovations or replacements i.e. strong opportunities for change (Hale, 2007). This encouragement of a pedestrian-friendly environment around the TOD area will not improve the health and finally, the environment but will also increase the footprints on road leading to the safety of people by making people aware of their surroundings. This aspect covers indicators like “*Safety and security*”, “*Non-motorised transport mode*”, “*Walkable and cyclable paths*” and “*Livability- the quality of air, health*”. “Our investments in transit must be supported by land-use patterns which put riders and jobs within an easy walk of stations” rightly said by Calthorpe, (1993). Since walkability is an essential element for high TOD levels and it should be measured as it can be chiefly developed through city development through planning and diverse land use.

Therefore, the question that arises to check the coverage of Environmental aspects in the TOD project is “Proximity to the Police station (<2km), a large number of shops and eating joints with an appropriate lighting at night”, “Direct, attractive, safe pedestrians paths and cycling linkages”, “Minimum distance between transit stations should be between 500m- 1000m” and “Walkable access (500m- 1000m) to commercial centers, green”. These are the important aspects to validate the presence of the present criteria. Therefore absence or incompleteness of any aspect leads to the unsuitability of the site for the TOD else meeting the objectives leads to the final step important aspects to be considered i.e. Economic Aspect.

Step 7: Context Review Based on Economic Aspect

Most of the studies have mentioned the importance of financial development as an important aspect of TOD. Some of the authors have mentioned this criterion in other terms like financial returns by Belzer & Autler, (2002), property value by Renne, (2007b), Tax Revenue by TRB (2005), and many more. According to them, TOD is all about engaging people in the surrounding area itself for the various activities which will lead to better economic development, and areas with higher economic development or tax returns will be having higher TOD levels which replicate the elevated journey of people and even elevated stage of the success TOD in that neighborhood. Thus, this criterion has been shorted down to four indicators together with “*employment density*”, “*density of business establishments*”, “*private venture*” and “*tax earnings of municipalities*”.

For the contextual assessment process, a few questions need to be analyzed to check on the efficiency of the location which is “*Proposed TOD leads to economic development and jobs creation*”, “*Local low-value businesses should not be replaced by high-value retail chains*”, “*Proposed TOD leads to private sector initiatives through PPP for funding and financing mechanisms*” and “*Exploring income generation possibilities through rental income, Parking fees, etc*”.

These questions are framed to check the level of achieving or achieved objectives for the Economic aspect and fulfilling of these answers the meeting of the TOD planning objectives or the site should be eliminated for TOD project. Urban planning concerning the transport requires proper balance in Economic respect which has to be maintained and reviewed to lift outcomes as make improvements in the site selected as major TOD activities involves a noteworthy height of alterations with growth away from the present conditions thus leading to the final step.

Step 8: Plan of Action

A development plan or the plan of action shall be organized and lodged as soon as possible involving work details for further development and planning process for which important points which are to be taken into considerations is “*Coalition shall agree to the confirmation of TOD and site*”. Further, the *coalition continues to meet over the project progress* to oversee the following actions:

1. Specific agencies & groups assigned as lead- support for action
2. Public participation in the planning process

3. Follow up presentations and updates

Finally, *revisiting the action plan beneficiaries* is important to make the TOD project a real success. As Dittmar & Ohland (2004) has that “Entitlement risk is the risk associated with securing the approvals, zoning and permits critical for the project to build and occupied.”

6 Conclusion

The survey with experts has led to many questions being answered and it has been identified that TOD is misinterpreted as a device to increase Floor Surface Index (FSI). Master Plan lacks dynamism which often dissociates themselves with ground realities makes TOD a failure, therefore, design may not be enough to implement TOD on the ground. Even the availability of multidisciplinary stakeholders with diverse interests’ i.e. inadequate transit agencies increases the chances of failure of TOD. Thus, the lack of coordination between the regional governmental coordination and the lack of collaboration and coordination between the development and real estate communities leads to the failure of viable TOD.

Thus, this paper has developed a methodology to develop the process for the successful TOD through high-quality transport availability with mixed-use development and public space with other important factors for successful application of TOD leading to a healthy, safe, sustainable, and environmentally friendly city or area.

7 Availability of Data and Material

Data can be made available by contacting the corresponding authors.

8 Acknowledgement

The authors appreciate the financial supports from the Double Twin Foundation, under the contract number FG2021-987.

9 References

- Belzer, D., & Autler, G. (2002). *Transit-Oriented Development: Moving From Rhetoric to Reality* (Issue June). The Brookings Institution Center on Urban and Metropolitan Policy.
- Calthorpe, P. (1993). *The Next American Metropolis: Ecology, Community, and the American Dream - Peter Calthorpe* - Google Books. 175. https://books.google.com.my/books?hl=en&lr=&id=WtKU5L0ajA8C&oi=fnd&pg=PA9&ots=Fzv11CxpFQ&sig=wyschKR5oVhzYIDCQgUW1d34W5k&redir_esc=y#v=onepage&q&f=false
- Dittmar, H., & Ohland, G. (2004). *The New Transit Town* (H. Dittmar & G. Ohland (eds.)). Island Press.
- Hale, C. (2007). A Step-by-Step Approach to Transit-Oriented Development Project Delivery. June, 24–28.
- Jain, D., Jha, B., & Singh, E. (2020). Evaluation of Measuring Criteria for the Success of Transit-Oriented Development. *Solid State Technology*, 63(December), 4147–4159. <http://solidstatetechnology.us/index.php/JSST/article/view/6153>
- Jain, D., Jha, B., Singh, E., & Ashtt, R. (2021). Evaluating Readiness for the Application of Tod as a Remedy for Healthy Indian Cities. *Annals of Romaninan Society for Cell Biology*, 25(6), 7255–7262. <https://www.annalsofrscb.ro/index.php/journal/article/view/6876>
- Jain, D., & Singh, E. (2019). Transit oriented development in india: A critical review of policy measures. *International Journal of Recent Technology and Engineering*, 7(6).

- Maheshwari, R. (2019). Evaluating Local Area Plans and Their Effect on Transit Oriented Development (Issue February). University of Twente.
- Newman, P. (2009). Planning for Transit Oriented Development : Strategic Principles. In C. Curtis, J. L. Renne, & L. Bertolini (Eds.), *Transit Oriented Development: Making It Happen* (pp. 13–22). Ashgate Publishing Limited. DOI: 10.4324/9781315550008
- Renne, J. L. (2007a). Evaluating Transit-Oriented Development Using a Sustainability Framework : Lessons from Perth ' s Network City 6 Evaluating Transit-Oriented Development Using a Sustainability Framework : Lessons from Perth's Network City. *Transit-Oriented Development and Sustainability*, 115–148.
- Renne, J. L. (2007b). Measuring the Performance of Transit - Oriented Developments in Western Australia. June.
- Singh, Y. J. (2015). *Measuring Transit-Oriented Development (Tod) At Regional and Local Scales – a Planning Support Tool*. Dissertation, University of Twente. DOI: 10.3990/1.9789036539982
- Thomas, R., & Bertolini, L. (2017). Defining critical success factors in TOD implementation using rough set analysis. *Journal of Transport and Land Use*, 10(1), 139–154. DOI: 10.5198/jtlu.2015.513
-



Ar. Deepshikha Jain is an Architect- Planner and an Associate Professor at Hindu College of Design, Architecture and Planning, Sonapat. She is a PhD student at Amity University, Noida. She got a B. Arch as well as her post-graduation in Urban and Rural Planning from DCRUST, Murthal. She has acute interests in the Sustainable Growths of Cities.



Prof. Dr. Bandana Jha is a Professor, Artist, Architect, Project Manager and Green Building Consultant. She holds an M-Tech & a PhD from IIT Delhi with a Gold Medal in Bachelors of Architecture from Institute of Environmental Design, Gujarat. She was Dean of the Institute of Design, Engineering and Architecture at Rai University, Delhi. Her research encompasses Energy Retrofit of Buildings.



Prof. Dr. Ekta Singh is Director at City Dialogue, Amity University Uttar Pradesh. She is an architect.



Prof. Dr. Rashmi Ashtt holds a Ph.D. in Urban Planning. She is Director of Hindu College of Design, Architecture and Planning, Delhi NCR. She has won many awards including 'Proud to be an Indian Woman Award' by Saanwari Women Power Club.
