

Evaluating Readiness for the Application of Tod as a Remedy for Healthy Indian Cities

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ABSTRACT

India's changing economic growth with passing years has lead to an unexampled rate of globalization which is the root of many problems like unstructured growth of the cities, traffic congestion, and congestion at nodal points which leads to need of a strategy to decongest and make people walk to improve their healthfor which TOD has been acknowledged widely as a solution. Even this concept is taken into consideration by Indian government by proposing National TOD policy and TOD policies at different levels like area, city and station level. Thus, there is an urge to assess the readiness of the cities for the application of TOD which could act as a remedy for healthy Indian cities and improve the immunity of the people to fight against the pandemic situation created. Therefore, this paper is based on a validated structured questionnaire consisting of the questions related to the aspects like demography, land use, social, environmental and economic, to find out the relation between them which could be used further.

KEYWORDS

Transit Oriented Development, Indicators, Aspects, Score, Healthy cities, etc.

INTRODUCTION

Transit and transit-oriented developments (TODs) are achieving impetus all over the earth to increase transit sustainability which acts as a remedy for healthy Indian citiesand improve the immunity of the

people to fight against the pandemic situation created. Much like western countries, Indian cities like Delhi, Ahmedabad, Mumbai, Pune, New Raipur, etc., are also focusing on the concept of TOD portrayed by compact planning by densifying inner areas where major activities are concentrated to make people walk and avoid use of their private vehicles. Therefore, there is an urge to focus on the policies of TOD in detail.

Indian cities have done considerable savings in construction of metro systems, with a small number of cities operating full-fledged metro. Likewise in Bengaluru, the invasion of community savings on transit and encouraging zoning enticement are attracting and a small portion of housing savings in transit-oriented developments (TODs).

CALCULATED ASSESSMENT PROCESS FOR EVALUATING SUCCESS OF TOD WITH CRITERIA AND INDICATORS

A lot many studies have been acknowledged by numerous authors, categorizing the pointers to estimate the success of TOD in any area. Thus, rendering from the literature above, five main aspects and succeeding indicators have been computed which gives a supplementary meaning, to measure TOD such that they cover the different features of TOD. Thus, the lists of criteria are listed below which would be used for quantifying the success of TOD in Indian studies.

- i. Demographic Aspect
- ii. Land Use Aspect
- iii. Travel Aspect
- iv. Environmental Aspect
- v. Economic Aspect

Furthermore, these aspects acting as criteria to calculate the success of TOD in cities are followed by 20 indicators in total under the heads of individual criteria which are listed as

List of ideal indicators with their criteria

CRITERION	INDICATORS
DEMOGRAPHY ASPECT	• Residential and commercial mass • Charisma- Urban Design, building foot print density • Diversity of land uses- location efficiency, efficient land use pattern • Amount of mixed use planning

LAND USE ASPECT	• Land use planning • Affordable housing • Planning schemes • Design based planning
TRAVEL ASPECT	• Transit ridership- comfortable ride through signalised intersection • On- street parking density- for commuters , residents and shared parking • Mode of connections to transit station (Non- motorized and walkable environment) • Road Density- Last mile connectivity
ENVIRONMENTAL ASPECT	• Safety and security perception • Frequency of non- motorised transport mode • Walkable and cyclable paths • Livability- quality of air, health
ECONOMIC ASPECT	• Employment levels • Density of Business establishments • Private ventures • Tax earnings of municipalities

DETAILS OF THE SURVEY CONDUCTED WITH EXPERTS OF TOD

The present study was a survey based study, mainly aimed to investigate and assess the readiness of the cities for the application of Transit oriented Development (TOD). The main objective of the study was to identify several critical factors pertaining to planning and implementation of TOD projects. Thus, for this, several tools were used like Chi- Square Test (for occupation and organizational role), Sample *t* Test (for the 6 aspects i.e. Demography aspect, Land use aspect, Travel aspect, Environmental aspect, Economic aspect and Gaps aspect), Pearson's Correlation, ANOVA Test (for comparing all the seven cities individually), Friedman's Test (for intra- group comparisons) and finally, Cronbach's Alpha Test (for reliability of questionnaire).

A structured validated questionnaire consisting of the questions related to the role of organization, demography, land use, travel aspects, environmental aspects, economic aspects, gap perspective etc separately for India and Ahmedabad city was included in the study. The questionnaire at Pan Level i.e. for the experts at India and outside India has undergone in three sections where Section 1 contains the role

played by the expert and its organization in planning, executing and implementation of TOD; Section 2 understands the perception of the experts on the basis of the 5 aspects evaluated above i.e. Demography, Land use, Travel, Environmental and Economic Aspects; and finally, Section 3 evaluates the Gaps in planning, executing and implementation of TOD.

The purpose of this questionnaire was to understand the perspective of the experts all round world about this concept. Thus, the following section presents the comparative statistical analysis along with interpretation of the available data between all India and Ahmedabad respondents groups. The comparison of distribution of categorical data is done using Chi-Square test and the statistical comparison of distribution of means of continuous variables is done using independent sample t- test and Analysis of variance (ANOVA). The details of the test and the software used are presented in statistical methodology section separately.

SCRUTINY OF THE SURVEY CONDUCTED

Questionnaire for experts was run for seven Indian cities as per the case study evaluated and to understand the prospects of successful implementation of TOD across India, it was also circulated in cities like Texas and Netherlands. Therefore, responses from 250 experts were recorded. Of 250 respondents participated in the study, 50 were from Ahmedabad, 22 were from Andhra Pradesh, and 23 were from Bhopal, 57 from Delhi, 21 from Haryana, 38 from Mumbai, 24 from New Raipur, 10 from Texas and 5 from Netherlands. Thus the tale below shows the number and percentage of responses recorded for the perceptions of experts. These experts belonged to various departments who are responsible for the planning and implementation of TOD across India. These departments were TCPO, DDA, UTTIPEC, SBDS, PETRAM, ACRO VENTURES, WRI, DIMTS from Delhi, NICMAR, MMRDA from Mumbai and various Municipal Corporations from Bhopal, Faridabad, Ahmendabad and many more.

The distribution of the occupation of the respondents and their role in planning and implementation of TOD was evaluated using the analysis tool called Chi- Square test has been undertaken to check out the statistical significance of the different occupations. While sample *t* test method was used to evaluate two groups individually i.e. all India (data from experts of various cities) and Ahmedabad and finally it was compared for another two groups i.e. National and International level, such that to understand the importance of each aspect on each group

After going through a rigorous analysis of Friedman's Test and ANOVA Test, a Pearson's Correlation Coefficient Test was conducted to check the linear relationship of all the parameters because this test is

considered the best method of measuring the association between variables of interest because it is based on the method of covariance. In this section, linear relationship between all the aspects has been checked out.

Pearson's correlation analysis (to assess the linear relationships) of various scores of application of TOD in Indian cities

	Demography Aspects Score	Land Use Aspects Score	Travel Aspects Score	Environmental Aspects Score	Economic Aspects Score	Gaps Score
Demography Aspects Score		R-value (0.446) P-value (0.001 ^{***})	R-value (0.407) P-value (0.001 ^{***})	R-value (0.308) P-value (0.001 ^{***})	R-value (0.383) P-value (0.001 ^{***})	R-value (0.487) P-value (0.001 ^{***})
Land Use Aspects Score			R-value (0.569) P-value (0.001 ^{***})	R-value (0.437) P-value (0.001 ^{***})	R-value (0.305) P-value (0.001 ^{***})	R-value (0.409) P-value (0.001 ^{***})
Travel Aspects Score				R-value (0.613) P-value (0.001 ^{***})	R-value (0.428) P-value (0.001 ^{***})	R-value (0.530) P-value (0.001 ^{***})
Environmental Aspects Score					R-value (0.441) P-value (0.001 ^{***})	R-value (0.434) P-value (0.001 ^{***})
Economic Aspects Score						R-value (0.603) P-value (0.001 ^{***})
Gaps Score						
Correlation by Pearson's method. P-value<0.05 is considered to be statistically significant. ***P-value<0.001.						

LINEAR REGRESSION ANALYSIS

Finally, a linear regression analysis was done to evaluate the mathematical equation which could finally deal with the evaluation process for the determination of the readiness of the application for TOD in Indian cities which is described in detail as below.

Linear regression analysis between various scores

Variables in the model	Beta	T-value	P-value
Constant	1.126	5.840	0.001***
Demography Aspects Score	0.151	3.951	0.001***
Land Use Aspects Score	0.044	0.883	0.378 ^{NS}
Socio Aspects Score	0.172	3.454	0.001***
Environmental Aspects Score	0.029	0.585	0.559 ^{NS}
Economic Aspects Score	0.303	7.377	0.001***
Dependent variable – Gap Score. ***P-value<0.001, NS – Statistically non-significant.			

The variables such as Land Use Aspects Score and Environmental Aspects Score were statistically non-significant in the linear regression model when used as the predictors of Gap score. Hence a new model was constructed without including these variables, shown as below.

Variables in the model	Beta	T-value	P-value
Constant	1.232	7.320	0.001***
Demography Aspects Score	0.160	4.381	0.001***
Socio Aspects Score	0.203	5.072	0.001***
Economic Aspects Score	0.309	7.763	0.001***
Dependent variable – Gap Score. % Adjusted R ² value = 48.7%, ***P-value<0.001			

The linear regression shown above used Gap score as a dependent variable and the variables such as Demography Aspects Score, Socio Aspects Score and Economic Aspects Score as the independent

variables and all these variables were statistically significant in a regression model. The overall % adjusted R^2 value as a coefficient of determination of the model was 48.7%. Hence the mathematical equation that can be used to predict the Gap score based on Demography Aspects Score, Socio Aspects Score and Economic Aspects Score is as follows:

$$\text{Gap score} = 1.232 + 0.160 \times \text{Demography Aspects Score} + 0.203 \times \text{Socio Aspects Score} + 0.309 \times \text{Economic Aspects Score}.$$

CONCLUSION

Thus, the goal of the paper was to develop an equation to measure the readiness of the Indian cities for the application of the upcoming concept called TOD to make people healthy and such that to utilize the effectiveness of function of the concept which will act as a sustainability framework for future healthy cities and finally, lay ahead a pitch relating to the supreme hierarchy for further study and even give a way to the growth of positive approaches, so that a healthier pace could be taken in the direction of sustainable growth by making people healthy and increase their immunity for the occurring pandemic situation and finally, implementation of this framework with logical steps leading to rigorous decision-making.

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