

# Analysis of Surat City's Development Strategy towards Sustainable Smart City Infrastructure

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**Abstract**—Surat, in the Indian state of Gujarat, is one of the country's most rapidly increasing and urbanising cities. Surat's road development challenges include insufficient funding, a lack of appropriate technology, poor maintenance, and environmental concerns. Increased investment for road development, adoption of relevant technology such as intelligent transportation systems, regular maintenance and repair programmes, and promotion of environmentally friendly forms of transportation. Our goal for the Surat sustainable transportation infrastructure project is to minimise carbon emissions, reduce reliance on motorised vehicles, and help make sustainable public transportation accessible to all. The research study introduces the Sustainable Urban Transportation Index (SUTI). The index evaluates urban transport systems and services using ten indicators. The goal of this research is to create a new paradigm of sustainable mobility that is designed to address the dynamic and evolving mobility needs of an urban centre, with the sustainability of the economy, the environment, and society as defining pillars. The findings of this study will shed light on the issues that Surat City has in achieving sustainable road development as well as feasible solutions to these challenges. The ultimate goal is to contribute to India's bigger goal of developing smart and sustainable cities.

**Keywords:** Sustainable urban development, Urban transport, Traffic analysis, Urban centres.

## INTRODUCTION

Surat is a rapidly rising city in India's western state of Gujarat. Over the last few decades, the city's population has continuously increased, as has the number of automobiles on its highways. The consequent traffic congestion has posed a significant barrier to the city's long-term development. Surat's traffic congestion is a major issue that negatively impacts the quality of life for its residents. The city's highways are frequently congested, resulting in longer travel times, increased air pollution, and lower productivity. Congestion is especially severe during rush hour, when commuters strain to negotiate the city's tiny and jammed highways. The causes of traffic congestion in Surat are numerous and intricate. They include the city's rapid growth, a lack of efficient public transportation, poor road infrastructure, and an increase in the number of private vehicles on the roadways. Furthermore, the

city's urban planning has lagged behind its expansion, resulting in poorly built road networks that increase traffic congestion.

The negative impact of traffic congestion on Surat's long-term growth cannot be understated. It increases fuel consumption, air pollution, and carbon emissions, all of which are harmful to the environment and public health. Furthermore, traffic congestion impairs the efficiency of the city's businesses and industries, as well as its peoples quality of life. To manage traffic congestion, Surat's government and urban planners must take a comprehensive approach that considers all of the sources of congestion. This could involve making public transportation more efficient, strengthening the road network, boosting non-motorised transportation, and introducing intelligent transportation systems. The difficulty will be striking a balance between the demand for increased mobility and the objective of long-term development so that Surat may continue to grow and prosper in an environmentally and socially appropriate manner.

## Causes of Traffic Congestion in Surat

Surat's traffic congestion is caused by a variety of factors. The situation has been exacerbated by the city's rapid growth and expanding population, as well as poor infrastructure and urban planning. The following are some of the key causes of traffic congestion in Surat:

1. Rapid population growth: The city's population has been rising quickly, resulting in a rise in the number of private vehicles on the roads.
2. Inadequate infrastructure: The city's road network is frequently congested and limited, making vehicle movement problematic. Furthermore, there are few bypass roads or alternate routes, so traffic is obliged to use the same roadways.
3. Surat's urban planning has not kept up with its growth, resulting in poorly built roadways, insufficient public transportation, and a lack of integrated land use and transportation planning.

4. Restricted public transit alternatives: The city's public transportation system is restricted, with only a few options for commuters. This has resulted in a greater reliance on private vehicles, which adds to traffic congestion.
5. Unregulated parking: The city's lack of parking regulations has resulted in illegal parking on city streets, lowering road width, and worsening traffic congestion. Surat is home to several significant enterprises, and the heavy vehicles and freight carriers linked with these companies add to traffic congestion on city roadways.

To summarise, traffic congestion in Surat is a complex issue with multiple contributing aspects. Addressing these issues will necessitate a comprehensive approach that includes infrastructure, public transit, and urban planning improvements, as well as efforts to regulate parking and manage industrial traffic.

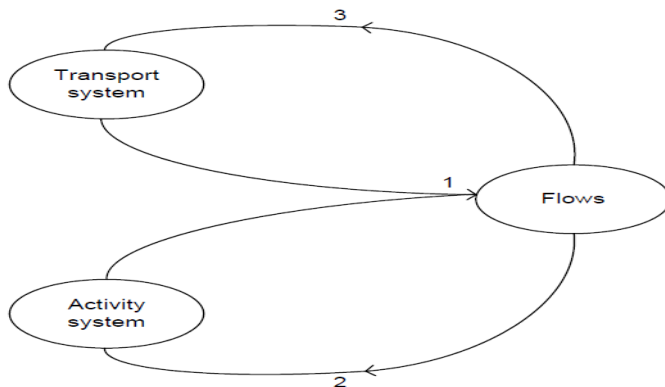


Figure 1.1: Show the relation of transport system analysis.

### Effects of Traffic Congestion in Surat

Traffic congestion in Surat has several negative effects on the city's environment, economy, and society. Some of the main effects are:

1. Air pollution: Traffic congestion increases air pollution because vehicles emit more pollutants when they are stopped in traffic. This can have major effects on public health, leading to an increase in respiratory infections and other health issues.
2. Reduced productivity: Because traffic congestion decreases the efficiency of transportation and logistics, it can have a negative impact on businesses and the economy. This might result in delivery delays and decreased productivity for enterprises.
3. Increased fuel consumption and carbon emissions: Congestion increases fuel consumption and carbon emissions, both of which contribute to climate change and environmental deterioration.
4. Reduced quality of life: Congestion in the city can make it difficult for people to get around, leading to increased

tension, irritation, and worry. This can have a negative impact on citizens' quality of life.

5. Traffic accidents: congested roadways increase the likelihood of traffic accidents because frustrated and aggressive drivers become more likely. This can result in property damage, injuries, and even death.
6. Inefficient mobility: Congestion affects transportation efficiency, making it more difficult for individuals to access essential services and facilities such as healthcare and education.

To summarise, traffic congestion in Surat has a number of detrimental consequences for the city's ecology, economy, and society. Addressing the issue would necessitate a multifaceted approach that includes infrastructure, public transit, and urban planning improvements, as well as steps to regulate parking and manage industrial traffic.

### Role of Urban Planning and Transportation Policy

Surat's sustainable growth is dependent on urban planning and transportation policies. The city's rapid growth and expanding population have put enormous strain on its transportation infrastructure, necessitating a comprehensive approach by urban planners and lawmakers to address the issues. To ensure that the city's transportation infrastructure is adequately conceived and implemented, effective urban planning is required. A comprehensive urban planning strategy can aid in the identification of the optimum routes for new roads, the improvement of the current road network, and the creation of better public areas for walkers and bicyclists. This technique can also aid in the integration of transportation systems with land use planning, making it easier for citizens to access critical facilities and services.

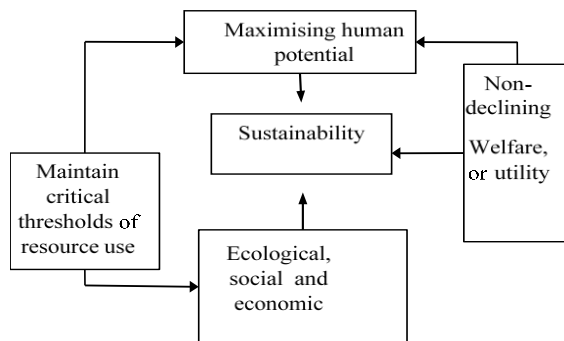
Transportation policy is very important for encouraging sustainable transportation in Surat. Effective transportation policies can help to reduce traffic congestion and air pollution while also improving the inhabitants' quality of life. One strategy is to promote non-motorised transportation, such as cycling and walking. This could include establishing safe cycling and walking lanes as well as promoting cycling as a mode of transportation.

Another method that Surat might use is to promote public transit. The city might invest in more efficient public transportation, such as bus rapid transit (BRT) or light rail. A system like this may provide inhabitants with a faster, cheaper, and more sustainable method to get around the city.

Transportation policy can help reduce carbon emissions and air pollution in addition to supporting sustainable transportation. Implementing legislation and incentives to encourage the use of electric vehicles, promoting carpooling and ride-sharing, and expanding the use of public transit might all be part of this.

Finally, to meet the issues of sustainable transportation in Surat, urban planning and transportation policy are crucial. The city must take a comprehensive approach that considers

all of the issues that contribute to traffic congestion, air pollution, and carbon emissions. Surat may become a more sustainable, livable, and wealthy city for its residents by doing so.



**Figure 1.2: A schematic representation of sustainable development**

## RESEARCH STUDIES RELATED TO TRAFFIC CONGESTION

Several research studies have been conducted on traffic congestion in Surat, providing valuable insights into the causes, effects, and potential solutions for managing the problem. Here are brief summaries of ten research studies related to traffic congestion:

The concept of sustainable development has received a lot of attention in academic circles. The Brundtland Report (1987) defines sustainable development as "development that meets the needs of the present without jeopardising future generations' ability to meet their own needs." Road development has been an important issue in urban planning, and various studies have highlighted the challenges involved. (Shah *et al.*, 2021) [1] for example, proposed that road development should be built on three pillars: environmental, social, and economic. They also highlighted various barriers to sustainable road development, including a lack of money, land acquisition concerns, and a lack of community involvement. S.R. Karthik and S.K. Bhargava's [2] "Sustainable Urban Transportation Planning and Development: A Case Study of the BRTS Project in Ahmedabad, India." The obstacles involved with the development of the BRTS project in Ahmedabad, India, are examined in this study, which emphasises the necessity of involvement in the community and the involvement of stakeholders. P. V. Shrivastava and A. Singh's [3] "Challenges in Sustainable Urban Transport: A Case Study of the Delhi Metro." The issues involved with the development of the Delhi Metro are examined in this study, including funding and financing, site acquisition, and stakeholder participation. D. Bannister and M. B. Kennedy's [4] "Sustainable Transportation: A Review of International Trends in Policy and Planning." This article examines international trends in sustainable transportation policy and planning, such as the significance of sustainable urban mobility plans, the integration of land use and transportation

planning, and advancing the use of non-motorised modes of transportation. J. K. Nayak and P. R. Panchamukhi's [5] "Sustainable Transportation: A Review of Concepts and Research." This article examines sustainable transportation principles and research, such as the necessity of participation by stakeholders, the integration of land use and transportation planning, and the enhancement of non-motorised modes of transportation. M. Beuthe, M. Jourquin, and P. R. Panchamukhi's [6] "Transport Infrastructure and Sustainable Development: A Review of the Literature." This study evaluates the research on infrastructure for transport and sustainable development, emphasising the necessity of including sustainable travel modes, such as public transit and cycling, in transportation system planning. C. Nash's [7] "Sustainable Transportation: The Challenges Ahead." This article looks at the issues of sustainable transportation, such as the need for more integrated and sustainable transportation systems, the necessity of behaviour changes and public participation, and the role of legislation in encouraging sustainable transportation. According to Gupta, U. *et al.* (2009) [8] infrastructure enhancement initiatives are underway in Delhi. Rather, an increasing number of cars and motorized two-wheelers urge the development of a huge number of flyovers and grade separators to allow motorized vehicles to travel freely, putting pedestrians at risk. This research describes the statistical examination of pedestrian risk-taking behavior while crossing the road before and after the building of a grade separation at a Delhi crossroads. Many pedestrians are willing to accept risks in both before and after scenarios. However, after the grade divider is built, additional factors become important in influencing pedestrian risk-taking behavior. K. Ramachandra Rao and R. V. Ravindrachary's [9] "Challenges in Sustainable Urban Transport in India." This article investigates the issues of sustainable urban transportation in India, such as inadequate infrastructure, an absence of public transportation, and heavy traffic. R. B. Bhagat and A. Singh's [10] "Sustainable Transport and Urban Development: The Indian Experience." This study investigates India's experience with sustainable transportation and urban growth, focusing on the issues associated with rapid urbanisation, poor infrastructure, and a lack of public transit.

## RESULT AND ANALYSIS

**Case Studies:** To illustrate the challenges associated with the sustainable development of roads in Surat city, we analyzed three case studies:

1. The Gujarat Industrial Development Corporation (GIDC) initiated the project, which was carried out by the Surat Municipal Corporation (SMC) [11]. Several obstacles arose throughout the project's implementation, including issues with land acquisition, environmental effects, and funding. Despite these obstacles, the project was finished in 2018 and has had a favourable economic impact on the community.

2. Surat City's Bus Rapid Transit System (BRTS) [12] is a sustainable transportation option that aims to reduce traffic congestion and air pollution. The BRTS system includes dedicated bus lanes, low-emission buses, and additional amenities such as pedestrian crossings, cycling lanes, and parking facilities. The system went live in 2009. The BRTS system has also had financial difficulties, with implementation and maintenance costs frequently exceeding anticipated levels. Despite these obstacles, the BRTS system has had a good impact on the city's transportation network,
3. The Surat Outer Ring Road (SORR) Suresh Sharma, Pankaj J. Gandhi and Anil Kumar Roy, 2017) [13] Project is a major infrastructure development project in Surat, Gujarat. The project's goal was to build a bypass around the city to relieve traffic congestion and improve connectivity to the neighbouring districts. The project's land acquisition was a big difficulty. Despite these obstacles, the SORR project was finished in 2017 and has improved the region's transportation network.

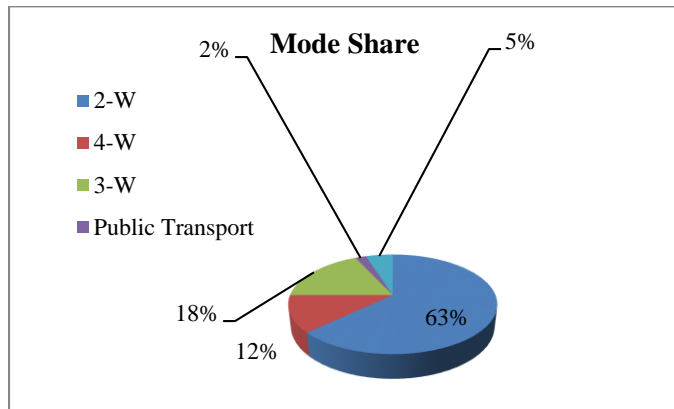


Figure 3.1: Mode share -without walk trips

Fig 4. Shows that travel characteristics such as trip rate, mode share, trip length, and so on, may be defined. The total number of trips made per capita each day is described as the trip rate. For the research area, the per capita trip rate (PCTR) is 0.95. Two-wheelers are the most common means of transportation in Surat, accounting for 63% of all trips (excluding walk trips). The percentage of trips on public transportation is extremely low, at 2% (excluding walk trips). Currently, Sitalink Ltd., an SPV under SMC, operates the city bus services (CBS), bus rapid transit services (BRTS), and high mobility corridor (HMC) in Surat on a gross cost basis.

– Air quality (PM10)

Table 3.1: Indicator – Air Quality (PM 10)

STATION	LOCATION	PM 10 (yearly mean)	Population within the area	Population
1.	SVR College	85	796138	15.3
2.	GIDC Pandesara	100	766524	14.7
3.	BRC, Udhana(Darshan Processors)	100	766524	14.7
4.	Air India Building	96	961413	18.4
5.	Delhi Gate Police Chowki	102	961413	18.4
6.	Hi-Choice Processers, Sachin	105	961413	18.4

Table 3.2: Overall result as per Indicator

Table 3.2: SUTI for SURAT City

S.NO	INDICATOR	SUTI Value
1.	Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	93.75
2.	Modal share of active and public transport in commuting	23.71
3.	Convenient access to public transport service	90.70
4.	Public transport quality and reliability	91.85
5.	Traffic fatalities per 100.000 inhabitants	86.90
6.	Affordability – travel costs as part of income	93.42
7.	Operational costs of the public transport system	21.42
8.	Investment in public transportation systems	65.67
9.	Air quality (pm10)	36.96
10.	Greenhouse gas emissions from transport	93.29
T	Geometric Mean – Total	61.1

The data source for the Gujarat Pollution Control Board (GPCB) report 2016–17, which considers PM10 levels from six air monitoring stations inside the SMC

Surat has a score of 61.1 on the SUTI (Sustainable Urban Transport Index). Surat's yearly mean air quality value for PM 10 is 36.96. With an annual mean value of PM10 of 372, Ahwaz, Iran, replaces the worksheet's minimal value of 150, which is lower than the PM10 number for Surat (WHO, 2020). Because trip lengths are shorter, the contribution from the transportation sector is modest. Electric mobility is being introduced in the city. GHG emissions from the transportation sector are low due to shorter motorised journeys and a higher share of active mobility excursions.

CONCLUSION

Sustainable road development is a major challenge in urban planning and development. According to the poll results and statistical analysis, traffic congestion, a lack of pedestrian and cycling infrastructure, a lack of public transportation, poor road quality, and a lack of funding are all issues. The BRTS and elevated road case studies highlighted the obstacles connected with sustainable road development in the city, such as a lack of community involvement, insufficient money, and land acquisition issues.

To address these issues, the following solutions can be implemented:

1. Putting in place a comprehensive traffic management strategy that includes steps to reduce traffic congestion and promote the use of public transportation, cycling, and walking.
2. Improvements to current public transportation infrastructure and the introduction of new modes of public transit, such as electric buses and trams.
3. Creating appropriate pedestrian and cycling infrastructure, such as dedicated bike lanes and pedestrian walkways.
4. Improving road quality through regular maintenance and repairs and the use of high-quality materials in road construction.
5. Investigating alternate funding sources, including public-private partnerships, to finance the long-term development of Surat's roadways. To summarise, sustainable road development in Surat necessitates a holistic approach that addresses the difficulties of traffic congestion, insufficient public transportation, poor road quality, and a limited budget. Surat can establish a sustainable and efficient transportation system that serves both its residents and the environment by applying the measures outlined above.

#### ACKNOWLEDGEMENTS

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