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Towards A Contextual Framework For Smart Mobility In Indian Cities

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Abstract
The accelerating pace of urbanization has intensified mobility-related challenges in Indian cities. Smart mobility, as a component of the broader smart city agenda, offers potential solutions by improving transport systems and addressing traffic congestion. As part of India's Smart Cities Mission, urban transport is being reimagined to meet both infrastructural demands and sustainability goals. This study addresses an important research gap by exploring smart mobility indicators through the perspectives of citizen input. Utilizing digital opinion poll data sourced from the MyGov.in platform across multiple Indian cities, the research captures both the priorities of city planners and the experiences of urban residents. Through a systematic analysis of this data, the study identifies six core dimensions of smart mobility: Accessibility, Sustainable Transport System, Efficient Transport, Safety, Digital Readiness and Technology Infrastructure. Indicators within each dimension are further identified using context-specific keywords related to urban transport. Findings reveal that Public Transport emerges as the top priority for development, reflecting shared concerns between administrators and citizens. Conversely, priorities such as Accessibility, Disable Friendly Infrastructure, Green Mobility, Transport Sharing, Sustainable Transport Infrastructure, Smart Fare Collection, Safe Transport System and Development of Roads emerge as low priority indicators. The study emphasizes the importance of integrating citizen voices into transport planning to foster inclusive and context-aware mobility strategies for India's smart urban future.

Keywords: *Citizen engagement, participatory approach, Opinion Poll, smart mobility, Indian context*

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I. Introduction

Urban centres have long served as foundational pillars of human advancement. According to projections [1], by the year 2050, nearly two-thirds of the global population will inhabit urban spaces. Currently, cities are home to over half of the world's population, despite occupying merely 2% of the Earth's surface. This disproportionate concentration of people and activities places immense pressure on finite resources, contributing significantly to environmental deterioration. Urban areas are responsible for generating approximately 80% of global greenhouse gas emissions and for consuming a similar proportion of natural resources [2]. With India poised to overtake China as the world's most populous country by 2025, its cities are likely to face escalating environmental and infrastructural challenges [3] . In response to these concerns, the Indian government's Smart Cities Mission, envisions the development of 100 technologically advanced and sustainably managed urban centers, is a strategic step toward addressing the nation's urbanization crisis [4].

A smart city in the Indian context is defined as a city that provides core infrastructure and gives a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' solutions." However, a deeper analysis into the smart city perspective in the Indian context is derived from official vision statements and citizen preferences [5]. A comprehensive review of 34 global smart city assessment frameworks reveals that over 80% of these frameworks rely predominantly on literature-based or expert-defined indicators [6]. A thorough literature review, establishes that while some efforts have attempted to establish performance evaluation systems tailored for Indian smart cities, these frameworks often neglect the perspectives of citizens and stakeholders [7], [8], [9]. This omission reflects a critical gap in aligning evaluation metrics with the lived realities and policy priorities of those most affected by urban transformation.

To address this gap, our study adopts a novel stakeholder-driven approach to identify performance indicators, placing specific emphasis on the smart mobility component of Indian smart cities. Unlike previous efforts, this research utilizes large-scale online opinion poll data to inform indicator selection, integrating the dual perspectives of municipal decision-makers and residents. The data for 64 Indian smart cities is sourced via the

Smart Cities Mission's official platform, MyGov.in that captures both the infrastructural priorities established by local authorities and the issues citizens deem most pressing within those frameworks. By synthesizing this data, we construct a grounded and participatory basis for selecting indicators specific to Smart Mobility, which is increasingly recognized as central domain to sustainable and efficient urban living [10]. While the methodology has the potential to be applied across various smart city domains, this paper specifically concentrates on smart mobility due to its strategic significance and relatively under-theorized presence in existing performance assessment literature.

II. Background

Participatory Shift in Urban Transformation in India

India's Smart Cities Mission (SCM) marks a paradigm shift in urban governance by placing unprecedented emphasis on public engagement. Smart cities, as a solution for urban transformation, initially came to the fore as part of a political commitment in 2014 when the Ministry of Urban Development (MoUD) invited state governments to nominate existing cities for transformation into smart urban centers guaranteeing at least one smart city per state or UT [11].

Subsequently, a competitive two-stage processing the form of the Smart Cities Challenge was introduced. In the first phase, states shortlisted potential candidate cities based on predefined eligibility criteria. In the second phase, each shortlisted city submitted a Smart City Proposal (SCP), which formed the basis for securing central funding. These proposals, developed through broad-based citizen consultation, encapsulated localized visions and actionable projects tailored to address specific urban challenges. Collectively, the 100 selected cities proposed 5,151 projects with an estimated investment of ₹2.05 lakh crore over a five-year horizon [12].

Citizen Engagement through Digital Platforms

A defining feature of the SCM is its institutionalized commitment to participatory governance, whereby, a meaningful citizen involvement was a mandatory criterion for evaluating city proposals. To facilitate this, cities employed a variety of Information and Communication Technology (ICT) tools ranging from social media (e.g., Facebook, Twitter), traditional media (radio, television, newspapers), SMS campaigns, infographics, and especially the Government of India's MyGov.in portal [13].

MyGov.in emerged as the central platform for soliciting citizen feedback and crowdsourcing urban development ideas. It offered a diverse set of participatory formats including discussion forums, interactive tasks, digital polls, blogs and virtual town halls. Urban local bodies actively leveraged this interface to gather public inputs for crafting their SCPs. Specifically, in the domain of urban mobility, citizens were invited to evaluate proposed transport solutions and prioritize interventions such as non-motorized transport, smart traffic systems, and public transit enhancements.

In one of its most influential functions, the MyGov.in discussion forum facilitated an online poll wherein a curated list of potential smart city interventions across infrastructure, environment and mobility was presented to the public. Citizens were asked to vote on the most pressing issues and preferred solutions. These inputs directly shaped the composition of project portfolios within the proposals. The platform collected a total of 263,413 responses from 64 cities, offering a substantial data set that captured the dual perspectives of civic authorities and urban residents [14]. This dataset forms the backbone of our analysis of Smart Mobility indicators, as it reflects both the development priorities set by local administrations and the preferences articulated by the public.

Developing a Theoretical Framework

Composite indices offer a methodological solution for quantifying complex, multidimensional constructs that cannot be captured through a single metric. Building an effective composite index begins with a clearly defined theoretical foundation. Ambiguity at this stage often results in unreliable measurements and weak policy insights [15].

A well-structured framework guides indicator selection based on conceptual relevance rather than data availability which enhances both the analytical coherence and practical utility of the resulting index [16]. The theoretical model also informs how different variables such as dimensions, indicators and subcategories aggregate into a unified and interpretable score as seen in Figure 1. Involving domain experts and stakeholders during this process ensures both conceptual soundness and stakeholder buy-in [17].

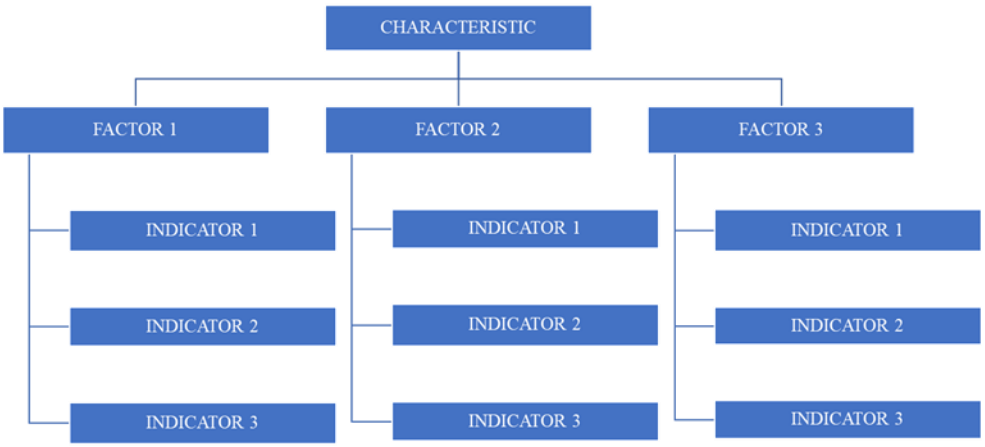

Figure 1. Conceptual Structure for Integrating Dimensions and Indicators [18]

Among the tools available for capturing public perspectives, opinion polling stands out for its accessibility, cost-effectiveness and operational simplicity [19]. These polls often reflect varying levels of public concern across thematic areas and contribute meaningfully to shaping representative indicators. When integrated into the framework, they offer a participatory dimension that strengthens the social legitimacy and policy relevance of the index.

The process of framework development includes defining the underlying concept, organizing its constituent elements, and establishing the selection criteria for indicators. These indicators not only function as metrics but also serve as conceptual anchors that transform abstract ideas like smart mobility into tangible components of urban policy.

Perspective on Smart Mobility

Smart mobility plays a central role within the broader smart city framework and consistently appears as a key component in more than half of global performance evaluation models for smart cities [20]. Despite its prominence, smart mobility remains a complex and context-sensitive concept with diverse meanings. Scholarly discourse portrays it through varying lenses ranging from cleaner energy integration in transportation to expansive public transit networks.

This diversity in interpretation highlights the limitations of a standardized model. While sustainability, safety and digital integration often emerge as guiding principles for urban mobility, they do not uniformly represent its 'smartness.' For instance, indicators assessing environmental impact or user safety reflect transport efficiency rather than the intelligence of the system. Likewise, ICT infrastructure availability is more indicative of overall digital access than of smart transportation per se. Truly smart mobility involves the targeted deployment of ICT tools tailored to mobility systems such as real-time traffic data collection, dynamic route planning, and vehicle tracking technologies [21], [22]. These solutions transform conventional transit systems into adaptive and intelligent mobility ecosystems.

III. Methodology

A citizen-centric approach was adopted to identify indicators for assessing the performance of Indian smart cities. The procedure for identifying relevant dimensions and indicators is illustrated in Figure 1. To incorporate public perspectives into the assessment process, a content analysis was conducted on online citizen survey data available on the MyGov.in platform [23]

Data from 64 Indian smart cities were extracted, detailing development priorities identified by city officials alongside corresponding citizen votes for each area. This dataset highlighted the most pressing development concerns as perceived by the public in each city. The information was compiled in Microsoft Excel for systematic classification.

Priority areas were then categorized into nine predefined smart city components: Smart Environment, Smart Economy, Smart People, Smart Mobility, Smart Living, Smart Governance, Smart Energy, Smart

Infrastructure and Smart Technology [10]. These classifications were informed by a comprehensive literature review of smart city assessment frameworks, which also guided the identification of relevant dimensions and indicators.

For this study, attention was confined to the Smart Mobility component. Each priority area was treated as a potential indicator and was manually color-coded to match its corresponding smart city component. Classification was primarily guided by keywords derived from existing assessment frameworks. In instances where a city grouped multiple smart mobility priorities under the same category (e.g., "Public Transport and Walkability"), the combined phrase was disaggregated into individual keywords and the total number of votes was evenly divided between the resulting categories. To maintain consistency, the vote counts were rounded up.

For example, the category "Public Transport and Walkability" with 64 votes was split into two indicators— "Public Transport" and "Pedestrian accessibility"—each receiving 32 votes.

Given the interpretive nature of categorization, subjectivity involved in the process was acknowledged. To enhance consistency and minimize bias, the first and third authors independently coded and classified the indicators twice, allowing for iterative refinement and error correction [24] .

Once categorized, indicators were standardized in language and organized by dimension. Separate Excel sheets were created for each smart city component. The present analysis focuses solely on the Smart Mobility category.

For each component, a matrix was created (see Table 1) with rows representing dimensions and indicators, and columns representing cities. An inductive content analysis of the color- coded data was then carried out. Beginning alphabetically with Agartala, indicators were added

city-wise, with new entries included only when absent from the existing matrix. Terminological variations were consolidated to prevent duplication—for instance, terms like 'waste to energy' and 'waste to compost' were unified under 'Scientific disposal of solid waste for conversion to energy or compost.'

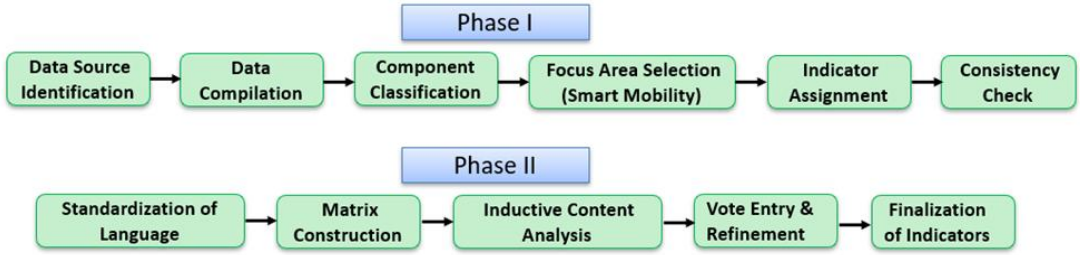

Figure 2. Stepwise methodology

Following the organization of indicators, the corresponding citizen votes were recorded. This step both documented the data and allowed for minor corrections in indicator classification across cities. Once indicators were grouped by shared features within dimensions, the matrices were finalized.

The total votes received by each indicator across all cities were then aggregated. Finally, the percentage coverage of each indicator was calculated as:

$$Coverage_i = \frac{n_i}{N} \times 100 \qquad (1)$$

Where, n_i denotes the number of cities where indicator i is mentioned and N is the number of cities in the study present in totality, in this case 64 cities in total. This led to the subsequent development of a Smart Mobility theoretical framework for Indian cities, which encompassed a balanced representation of the dimensions and indicators identified through deep analysis of citizen participation in the online polls for smart city development.

IV. Results And Discussions

The online citizen survey for smart city development reveals the number and percentage of votes for each priority area, with higher percentages indicating greater citizen relevance. Although the Smart Cities Mission emphasizes participatory planning, poll data is available for only 64 of the 100 selected cities, raising concerns about transparency in the selection process. Globally, open data is vital for interpreting urban complexities and interlinkages among development indicators. The absence of poll data for over a third of the cities, therefore, limits the ability to formulate a truly citizen-driven vision for urban transformation. However, the available responses offer meaningful insights into shared priorities between citizens and city authorities.

Table 1 presents the outcomes of a content analysis conducted on online poll data, outlining the key dimensions and indicators that structure the Smart Mobility domain in Indian smart cities. The analysis identifies six overarching dimensions: Accessibility, Sustainable Transport System, Efficient Transport, Safety, Digital

Readiness and Transport Infrastructure. Each dimension comprises a distinct set of indicators, with the number and distribution of these indicators varying across the 64 cities included in the study.

Dimensions such as Accessibility, Sustainable Transport System, Efficient Transport and Technology Infrastructure feature a broader range of indicators—covering aspects like green mobility, shared transport, parking availability, road development, public transport, pedestrian accessibility, disable friendly infrastructure Intelligent transport system and smart fare collection

Table 1. Distribution of Smart Mobility Indicators Across 64 Indian Smart Cities

CONTEXT	HARMONIZED KEYWORD	AGARTALA	AGRA	AHMEDABAD	AIZAWL	ALIGARH	ALLAHABAD	AMRAVATI	AURANGABAD	BAREILLY	BHAGALPUR	BHUBHANESHWAR	BHARSHARIF	BILASPUR	CHANDIGARH	CHENNAI	COIMBATORE	DAHOD	DHARAMSHALA	ERODE	FARIDABAD	GANDHINAGAR	GUWAHATI	GWALIOR	ITANAGAR	JALANDHAR	JAMMU	JHANSI	KAKINADA	KANPUR	KARIMNAGAR	KALYANDOMBIVILI	KARNAL
Accessibility	Accessibility				Y																	Y		Y					Y				
	Public Transport	Y	Y	Y	Y	Y	Y	Y		Y					Y	Y			Y		Y	Y	Y		Y	Y	Y	Y	Y			Y	Y
	Pedestrian accessibility	Y	Y		Y		Y		Y	Y	Y	Y	Y		Y			Y			Y					Y		Y		Y			Y
	Disable friendly infrastructure															Y										Y							
Sustainable Transport System	Green mobility								Y					Y								Y										Y	Y
	Transport sharing				Y		Y																										
	Sustainable transport infrastructure	Y	Y				Y		Y				Y	Y		Y					Y								Y				Y
Efficient Transport	Efficient Transport			Y	Y			Y		Y	Y	Y	Y	Y	Y				Y				Y				Y	Y				Y	Y
	Parking availability		Y	Y				Y				Y	Y		Y	Y												Y				Y	Y
	Development of Road	Y									Y											Y			Y				Y				Y
Safety	Safe transport system																																
Digital readiness	Digital Readiness	Y		Y									Y		Y		Y			Y	Y				Y				Y				
Technology Infrastructure	Technology Infrastructure	Y			Y		Y			Y	Y		Y	Y	Y			Y	Y			Y					Y						Y
	Smart Fare collection																					Y											
	Intelligent Transport system	Y			Y	Y	Y		Y		Y		Y	Y		Y	Y	Y		Y				Y				Y		Y	Y		Y

Table 1. (*continued)* Distribution of Smart Mobility Indicators Across 64 Indian Smart Cities

CONTEXT	HARMONIZED KEYWORD	KOHIMA	LUCKNOW	LUDHIANA	MANGALORE	MORADABAD	NAMCHI	NDMC	NEWRAIPUR	NEWTOWNKOLKATA	PANAJI	PASIGHAT	PATNA	PUDUCHERRY	RAJKOT	RANCHI	ROURKELA	SAGAR	SAHARANPUR	SHILLONG	SHIMLA	SHIVAMOGGA	SOLAPUR	SURAT	THOOTHUKUDI	TIRUCHIRAPALLI	TIRUPATI	TIRUPPUR	UDAIPUR	VARANASI	VELLORE	VIZAG	WARANGAL
Accessibility	Accessibility	Y																Y		Y							Y				Y		
	Public Transport	Y	Y	Y	Y					Y	Y	Y		Y	Y				Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y
	Pedestrian accessibility	Y	Y		Y		Y			Y	Y	Y							Y	Y	Y	Y							Y				
	Disable friendly infrastructure																																
Sustainable Transport System	Green mobility	Y																Y															
	Transport sharing																																
	Sustainable transport infrastructure	Y		Y	Y							Y								Y		Y						Y					
Efficient Transport	Efficient Transport	Y		Y		Y	Y		Y				Y		Y		Y	Y		Y	Y						Y				Y	
	Parking availability	Y		Y			Y										Y				Y					Y	Y	Y				Y	
	Development of Road	Y	Y		Y									Y	Y						Y				Y		Y	Y			Y		
Safety	Safe transport system	Y																			Y												
Digital readiness	Digital Readiness		Y	Y	Y		Y			Y	Y			Y											Y	Y	Y	Y				Y	Y
Technology Infrastructure	Technology Infrastructure							Y				Y				Y			Y		Y						Y			Y	Y		
	Smart Fare collection																																
	Intelligent Transport system																																

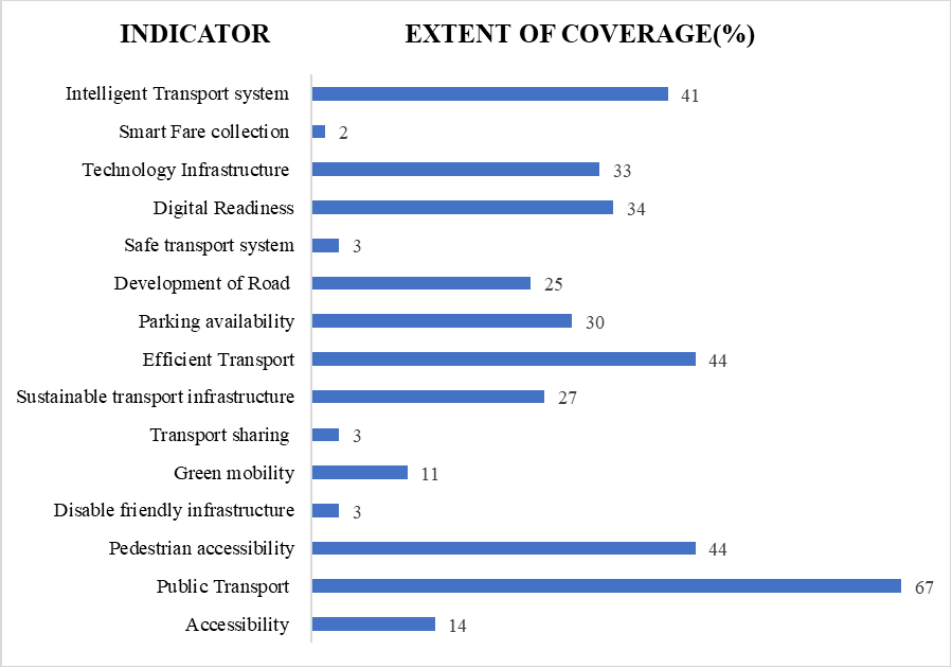

Figure 3. Extent of Inclusion of Smart Mobility Indicators Across 64 Cities

In contrast, dimensions such as Safety and Digital Readiness include fewer but highly specific indicators. This variation in indicator distribution reflects the diverse mobility priorities and challenges specific to each city. Dimensions with more indicators signal both greater relevance and planning complexity, as indicated by the high volume of citizen votes. These findings are consistent with previous studies emphasizing the importance of multi-dimensional performance indicators in smart city frameworks [25].

Figure 3 illustrates the percentage of cities incorporating each mobility indicator. Indicators with broader coverage—those appearing in a greater number of cities—tend to be viewed as more impactful by local officials and thus receive more strategic focus. Public Transport and Efficient Transport emerge as the most frequently represented indicators, included in the polls of 43 and 28 cities, respectively. These two also attract the highest total votes, exceeding 17,000 and 18,000 votes, affirming their perceived significance in urban mobility transformation.

In contrast, indicators such as Transport Sharing, Safe Transport System, disable friendly infrastructure and Smart Fare Collection appear in only one or two cities and cover less than 5% of the sample. Their limited presence likely reflects local constraints, emerging infrastructure or nascent application. For instance, Transport Sharing features only in Aizawl and Allahabad, suggesting localized interest shaped by specific travel patterns or evolving transport ecosystems.

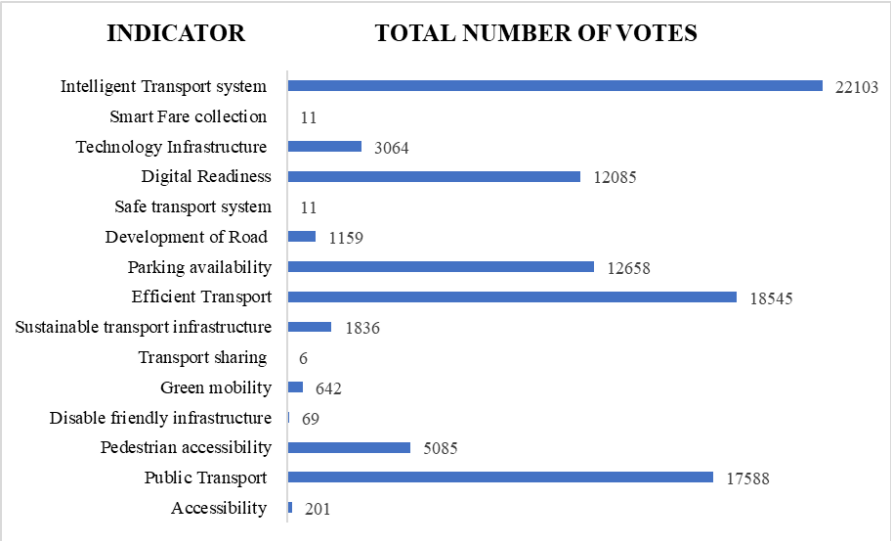

Figure 4. Indicator-wise Voting Patterns Across the 64 Smart Cities

Such cases highlight the influence of regional context in indicator adoption. Low-coverage indicators like Disable-Friendly Infrastructure and Smart Fare Collection may hold high relevance for specific urban contexts. Disable-Friendly Infrastructure, for example, appears exclusively in Chennai and Jalandhar—perhaps due to targeted local initiatives or stronger

advocacy for inclusive design. These instances affirm that regional distinctiveness plays a critical role in shaping smart mobility agendas. On average, each mobility indicator is present in 14 cities. Moderate coverage is observed for indicators such as Parking Availability, Pedestrian Accessibility, Technology Infrastructure, and Sustainable Transport Infrastructure, which appear in 17 to 28 cities. Their intermediate representation may reflect gradual institutional recognition, or challenges related to technological readiness and inter-agency coordination.

Indicators like Intelligent Transport Systems (ITS) and Digital Readiness show widespread adoption—appearing in over 26 cities and receiving more than 12,000 and 22,000 votes respectively. These trends highlight the growing emphasis on real-time data, automation and integrated digital platforms in urban transport planning. While several cities adopt a comprehensive set of smart mobility indicators, others display limited or selective inclusion. by referencing limited number of Smart Mobility indicators in their citizen polls, suggesting gaps in public awareness or municipal planning frameworks, such as cities like Coimbatore, Erode, Guwahati, Gwalior, Kanputr, Karimnagar, Moradabad, Solapur, NDMC, New Raipur, Patna, Ranchi, Rourkela, Surat, Solapur, Udaipur and Warangal, that show 2 or less mobility indicators. The citizen poll data emphasize the critical role of public engagement in determining smart mobility priorities. As shown in Figure 4, Public Transport, Efficient Transport and Intelligent Transport System receive the highest number of votes, signalling widespread public demand for reliable, affordable, accessible and state-of-the-art mobility options in Indian cities.

Conversely, indicators such as Transport Sharing, Disable-Friendly Infrastructure, Safe Transport System and Smart Fare Collection attract fewer than 100 votes each. This limited response may result from a lack of citizen familiarity, lower visibility of such solutions or a stronger focus on addressing conventional transport challenges. These patterns suggest that citizens in many Indian cities prioritize foundational improvements over advanced or niche mobility interventions.

The contrast with developed countries is notable. In many global North contexts, citizens widely support shared mobility, inclusive design, and smart fare systems. In India, however, these innovations remain less prominent, reinforcing the view that smart city development in the Global South follows differentiated trajectories shaped by local constraints and priorities, rather than mirroring Euro-American models.

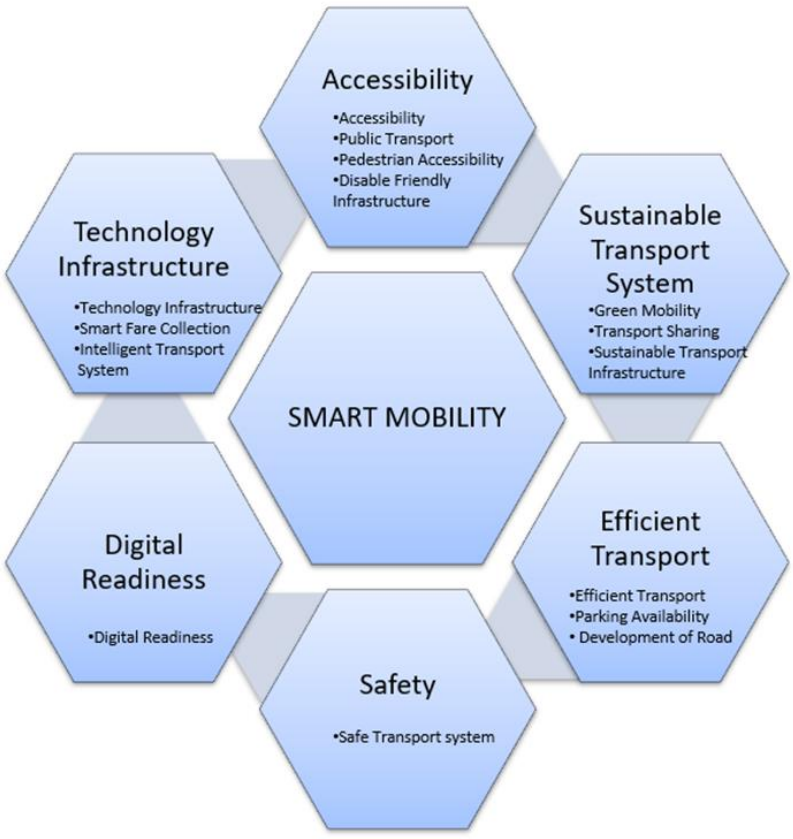

Figure 5. Smart Mobility Dimensions and Indicators for Indian Context

Indicators like Intelligent Transport Systems and Digital Readiness still receive significant citizen support, suggesting increasing awareness of the value of technology-driven mobility. Citizens appear to recognize the benefits of real-time information systems, digital integration, and data-informed governance in improving transport efficiency. On the other hand, indicators like Safe Transport System and Disable-Friendly Infrastructure receive low vote counts, which could either indicate limited public knowledge or undervaluation of safety and inclusivity in current transport discourse. However, in some cities, localized needs drive strong support for specific indicators. For instance, Pedestrian Accessibility garners substantial votes in Kanpur and New Town Kolkata, possibly due to local issues related to walkability and pedestrian infrastructure in dense or poorly designed areas. These observations underscore the necessity of context-sensitive indicator selection in smart mobility planning as represented in the theoretical framework for smart mobility in the Indian context in Figure 5. The varied citizen responses reflect the need for city-specific strategies that align with existing infrastructure, public expectations, and local socio-economic realities.

V. Conclusion

This study offers a citizen-led perspective on what smart mobility should look like in Indian cities. By analyzing large-scale digital opinion poll data from the MyGov.in platform, the study identifies six core dimensions that citizens prioritize: Accessibility, Sustainable Transport Systems, Efficient Transport, Safety, Digital Readiness and Technology Infrastructure. These dimensions capture not just the ambitions of city planners but also the everyday mobility needs and frustrations of urban residents. Public Transport, Efficient Transport and Intelligent Transport Systems clearly emerge as top priorities, while other issues like Smart Fare Collection or Disable-Friendly Infrastructure receive far less attention, indicating that these are either undervalued or not well understood by the public as a lack of awareness.

This imbalance points to a reality many Indian cities face, where foundational issues still dominate the conversation, there's a growing awareness of smarter, more inclusive mobility options. The differences across cities also reflect how regional context—local infrastructure, civic engagement, or planning capacity—shapes what people see as important. The study highlights that if India wants truly smart cities, mobility strategies must be rooted in local realities and informed by those who live and move through these spaces every day.

This study takes a step toward building a theoretical model that reflects the unique challenges and opportunities of Indian urban life. Rather than applying one-size-fits-all global models, the framework developed here draws from real-world citizen input to structure smart mobility into dimensions and indicators that are both meaningful and actionable.

By placing public voices at the heart of smart city planning, this study argues for a more grounded, participatory, and adaptable approach. The framework can serve as a foundation for future benchmarking tools, policy design, and deeper research into how Indian cities can move—not just faster or greener, but smarter. Future research may expand upon this framework by integrating temporal analyses, qualitative insights and assigning resource-based variables for quantifying the indicators to allow a more meaningful comparison across cities. Overall, the study deepens the understanding of evolving smart mobility needs in the Global South.

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