A Study Exploring the Status of Governance of Varanasi Smart City

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Abstract

The fast-evolving pace of urbanisation across the world has effectively enveloped the concept of smart cities. The emergence of smart cities has introduced a more efficient way of living in urban areas, facilitating the most necessary requirements with utmost ease. One such smart city in India is Varanasi, which has been investigated in this study to understand the institutional component of liveability standards. Governance is the backbone of smart city development, which needs to be examined to understand the gap between the top-rated and least-rated smart cities. Nine selected indicators have been incorporated to evaluate the Governance Index using the Ministry of Urban Development's Methodological Framework. For this, a total of 400 primary respondents were surveyed proportionally across the eight municipal zones and four social strata, using a 5-point Likert scale questionnaire. Citizen perception has been assessed using one-way ANOVA with post-hoc analysis providing a spatial and social evaluation of governance effectiveness. Substantial zone-based and strata-based correlations highlight political stability as the best-performing indicator, with Sarnath emerging as the most well-governed zone. In addition, the upper strata exhibit better performance compared to the others. The tax collection shows a positive trend, with almost half of the capital expenditure based on spending. The city also needs to increase awareness of online citizen services; the grievance redressal process requires improvement, with a significantly shorter turnaround time. Additionally, the effectiveness level needs to be increased, along with higher accountability levels and lower corruption levels. The study provides key insights into governance efficiency in Varanasi, offering a comprehensive perspective for policymakers to enhance urban liveability.

Keywords: Liveability; Urbanism; Citizen Perception; ANOVA; Varanasi; India

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Introduction

The world today is rapidly moving ahead with its different innovative measures that facilitate every stakeholder in the situation (Hsueh et al., 2022). Governance plays a pivotal role in shaping sustainable urban environments, public participation, and ensuring efficient service delivery. India is promoting governance-driven urbanism with programs like the Smart Cities Mission (Das, 2020), strives to enhance urban liveability by leveraging technology, infrastructure, and citizen-centric policies (Ogutu et al., 2014; Riegger et al., 2021). These changes have improved not only the quality of life but also introduced challenges in achieving optimal liveability. Issues include growing populations, poor waste management, and energy inefficiency (Ali et al., 2023; Chin et al., 2019). As the world shifts toward smart cities, addressing key concerns is crucial. According to Statista (2024), smart city revenue is projected to reach US$104 billion in 2024, growing at 12.1 per cent annually until 2028. It is essential to assess how global developments affect liveability and the outcomes of smart city growth. Liveability results from the interplay of various elements in a place (Kutty et al., 2022). It highly determines the urban quality of life, especially in the current time of industrialisation, where the factors existing in the surroundings are not exactly safe and healthy (Kim et al., 2020; Marsal-Llacuna et al., 2015).

European smart city liveability measurements show London as the top city for resilience, liveability, and sustainability (Kutty et al., 2023). The need for a quick decision-making process is crucial when addressing resilience, sustainability, and liveability in smart cities. The liveability and sustainability aspects can contribute to prosperity not only in the technological sphere but also in societal, financial, ideological, and governance concerns (Mittal & Sethi, 2018). The impact on overall happiness can be both significant and direct, stemming from reduced urban pollution, the expansion of green spaces, and the cultivation of a more robust culture of recycling (Chen, 2023).

Smart, liveable spaces enhance accessibility, functionality, interaction, and community building, thereby improving the quality of life with increased safety and security (Abdelkarim et al., 2023). The future outcomes of designing smart cities can range from creating a better future for its residents to making it more difficult by not prioritising liveability or sustainability (Sabri, 2021). This creates a challenging situation for productivity as a smart city if the basics of liveability are not delivered through the project. The study by Gupta & Hall identifies key concerns for Indian urban residents as value-based living, mobility, economic factors, and environmental issues (Gupta & Hall, 2017). City size influences both citizen and official expectations. Environmental concerns are significant, prompting efforts to improve liveability. For instance, Bhopal's smart city evaluation highlighted transportation, governance, and urban informality as significant determinants of liveability (Vinod Kumar, 2020).

Governance models in the Global North emphasise transparency, sustainability, and participatory decision-making. In contrast, cities in the Global South, including Varanasi, face socio-economic disparities, political complexities, and challenges related to fast-paced urbanisation. A successful governance-oriented smart urbanism model is presented by Singapore, where policies are integrating AI and optimising ICT with public participation to improve urban administration (Chang & Das, 2020). The city exemplifies this by integrating AI and optimising ICT to achieve liveability and sustainability (Lim et al., 2020). In a similar vein, Singapore's *Smart City Plan* enables participatory governance through open-data initiatives and digital feedback mechanisms (Das & Zhang, 2021).

However, governance in cities like Jakarta and Manila struggles due to informal settlements, bureaucratic inefficiencies, and inconsistent policy enforcement. The Smart Cities Mission in India has faced criticism for prioritising infrastructural spectacle over inclusive governance (Datta, 2015). Similarly, Das (2020)

underscores the fragmentation of governance in Indian cities, where policy implementation and citizen engagement remain inconsistent. Varanasi attempts community participation through digital feedback portals, yet challenges persist due to socio-economic disparities and limited awareness.

Inclusive governance deficits are most evident in high-density zones, informal settlements, and historic markets, where marginalised populations often experience inadequate service delivery (Datta, 2015). In cities like Mumbai and Kolkata, governance frameworks often overlook these communities due to their weak legal recognition and limited access to technology.

The review reveals that studies on liveability in smart cities vary widely by country, expanding such studies to Varanasi is crucial to assess its relevance for contemporary liveability and sustainability, given its significance to the country. For cities like Varanasi, striking a balance between modern governance frameworks and cultural preservation remains a significant challenge. The following objectives would be investigated as a part of this study- (a) to determine the institutional aspect of city liveability standards of Varanasi, (b) to evaluate the governance index for estimating its role in enhancing the city liveability standards of Varanasi, (c) to understand the differences in institutional liveability standards based on the zone and social class of the residents of Varanasi. To fulfil the above-mentioned objectives, an ANOVA (Games-Howell post hoc test) was conducted to reveal spatial and strata-based variations in the level of governance. To derive a composite governance score, the methodological framework for liveability standards in cities, developed by MoUD, has been adopted.

Varanasi, a historic city in Uttar Pradesh, India, is renowned for its rich heritage, spiritual significance, and cultural importance. It began its smart city project in 2016. Situated 80.71 meters above sea level, it is a major tourist destination featuring the famous ghats along the River Ganga. The city's tropical climate experiences temperatures ranging from 5°C in winter to 45°C in summer, with annual rainfall between 680 mm and 1,500 mm, primarily from July to September (JNNURM, 2021). As one of the world's oldest continuously inhabited cities, Varanasi's smart city initiative must address liveability and sustainability, with a particular focus on the institutional component of the liveability index.

The study begins with a discussion on methodology. Following this, the study's results are discussed. It then proceeds to discuss the findings critically.

Methodology

The study employed a mixed-methods approach, combining quantitative surveys with qualitative Focus Group Discussions (FGDs) to assess governance as a key parameter of liveability in Varanasi. While the survey provided measurable data across selected indicators, FGDs enriched the findings with grounded perspectives from 20 purposively chosen participants, including policymakers, administrators, civic activists, local business owners, and community leaders. This integration of qualitative and quantitative methods allowed for a holistic evaluation of governance performance in the city. This consists of two key stages: (i) selection of indicators, and (ii) data collection, computation, and interpretation.

Stage 1

It considers the liveability standards from the Ministry of Urban Development (MoUD) (2019), which are categorised into four dimensions: institutional (25 per cent weight), social (25 per cent weight), economic (5 per cent weight), and physical (45 per cent weight). The institutional dimension, encompassing governance, is the primary focus of this study, as discussed in detail in Figure 1 and Table 1.
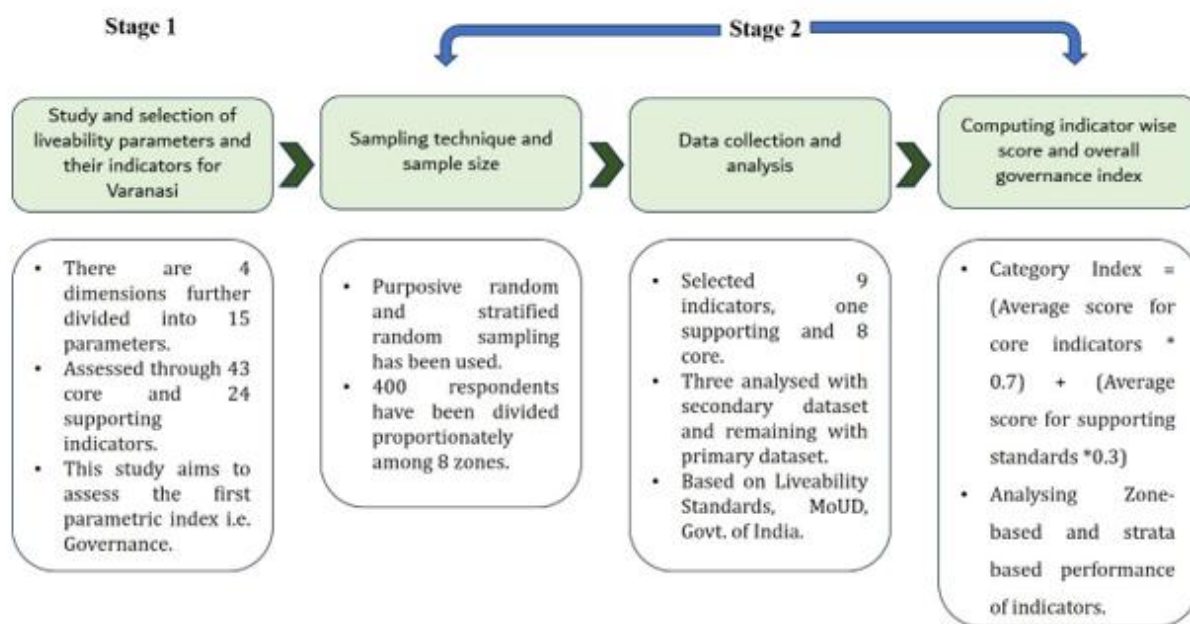
Figure 1: Key Stages for Evaluating the Governance Index of Varanasi
Source: Designed by the Authors based on Liveability Standards Assessment by the Ministry of Urban Development, Government of India

Table 1: Indicators and their Mode of Data Collection				
Dimension	**Parameter**	**Indicators**	**Core Indicator or Supporting Standard**	**Mode of Data Collection**
Institutional	Governance	Online Citizen Services (I-1)	Supporting	Primary
		Grievance Redressal (I-2)	Core	Primary
		Voice and Accountability (I-3)	Core	Primary
		Political Stability (I-4)	Core	Primary
		Effectiveness (I-5)	Core	Primary
		Control of Corruption (I-6)	Core	Primary
		Tax Collection (I-7)	Core	Secondary
		Capital Spending (I-8)	Core	Secondary
		Citizen Participation (I-9)	Core	Secondary
Source: Based on Liveability Standards in Cities by the Ministry of Urban Development, Government of India, 2017				

Stage: 2

Sampling Technique and Sampling Size:

The study deploys purposive, random, and stratified sampling, dividing the city into municipal zones and selecting a proportionate number of respondents from each zone. Based on the (Krejcie et al., 1970) the formula, the minimum required sample size is 384. To achieve this, we selected 400 respondents and proportionally divided the samples among the

strata based on their population, as shown in Table 2.

Table 2: Zone-Wise Population Sample Distribution					
Zone	Population	Sample Size	Zone	Population	Sample Size
Dashashwamedh	**233820**	**57**	**Ramnagar**	**69440**	**17**
Adampur	**246611**	**60**	**Rishi Mandawi**	**219576**	**54**
Bhelupur	**241663**	**59**	**Sarnath**	**224361**	**55**
Kotwali	**192553**	**47**	**Varunapar**	**208635**	**51**
Source: Calculated by the Authors Based on Population Survey Data Obtained from Varanasi Municipal Corporation					

Data Collection and Analysis

Secondary data on tax collection, capital spending, and citizen participation were gathered from annual government reports. Primary data was collected from residents of Varanasi using a structured questionnaire, employing a 5-point Likert scale. The questionnaire was distributed both online and offline for respondents' convenience.

There are two sets of data to be analysed using both primary and secondary resources to evaluate the performance of Varanasi based on 9 indicators (MoUD, 2019). In the first section of this analysis, the three components calculated using secondary data sources are evaluated.

Tax Collection (I-7)

The first indicator analysed is the projected tax collection for Varanasi Smart City based on the revised 2023-24 budget. Although the new tax collection method has not yet been applied, the forecast estimates a total collection of INR 840.5 million (NNVNS, n.d.), including property and pilgrimage taxes. Since the tax system is not yet fully established, the analysis uses the percentage growth in tax collection over the last three years, up to the 2023-24 fiscal year.

Capital Spending (I-8)

The next indicator considered is the total capital expenditure for the smart city of Varanasi, as well as the total revenue and capital expenditure, according to the 2023-24 budget. The calculation as per the formula given in the methodological framework of MoUD is as follows:

Capital spending as a percentage of total expenditure =

$$\frac{\text{Total capital exp during a year}}{\text{Total exp (rev \& capital) in the same year}} \times 100$$

Citizen Participation (I-9)

The third indicator calculates the total population that the ward committees cover. The formula involved here is:

Percentage of population under ward committees =

$$\frac{\text{Population under ward com/ area sabhas}}{\text{Total population of the city}} \times 100$$

In the next section, the primary datasets are evaluated in terms of the required components. The samples are divided across the zones in the same order as described in Table 2. The divisions based on the social class strata are shown in Table 3.

Table 3: Frequencies of Strata			
Strata	% of Total		Cumulative %
Lower	**129**	**32.3 %**	**32.3 %**
Middle	**104**	**26.0 %**	**58.3 %**
Slum	**87**	**21.8 %**	**80.0 %**
Upper	**80**	**20.0 %**	**100.0 %**
Source: Based on Primary Survey by the Authors			

The frequency shows that the highest group of respondents belong to the lower class with 32.3 per cent, followed by the middle class with 26 per cent. The remaining respondents include 21.8 per cent who belong to slums, and 20 per cent of them are from the upper class.

Indicators with Likert Scale Questions

The components considered for primary data analysis are online citizen services, grievance redressal mechanisms, voice and accountability, political stability, effectiveness, and control of corruption. The evaluation of the questions was conducted as part of a smart city development initiative involving various stakeholders across multiple sectors, as follows.

The data collected has been analysed to arrive at the creation of the category index, which in this case is the governance index, following the formula below:

> Category Index = (Average score for core indicators * 0.7) + (Average score for supporting standards * 0.3)

Results

Tax Collection (I-7)

Table 4 shows the tax collected (in INR) for the past five years, as provided below, based on data available from the Varanasi Municipal Corporation.

Table 4: Tax Collection in Consecutive Financial Years	
Year	Tax Collected
2022-23	1,155.33 million
2021-22	561.38 million
2020-21	592.32 million
2019-20	592.06 million
2018-19	457.79 million
Source: Records available from Nagar Nigam Varanasi (NNVNS, n.d.)	

Percentage increase in Tax Collected = 60.37 per cent

The calculation shows a 60.37 per cent increase in tax collection for Varanasi over the last five years, indicating a growth in the governance pattern.

Capital Spending (I-8)

The data collected showed that the total capital expenditure for the year 2023-24 was 4,165.01 million INR, and the total expenditure, including revenue and capital, was 8,488.115 million INR (NNVNS, n.d.). Thereby, the calculation based on these values has resulted in the following capital spending.

Capital spending as a percentage of total expenditure = 49.06 per cent

Citizen Participation (I-9)

The total population of Varanasi city in 2024 is 170,1000 (Varanasi Municipal Corporation Survey Record, 2024).[1] However, it has been found that in the case of the smart city project in Varanasi, no ward committees or area sabhas have been established. It is seen to follow the calculative measures of the Indore smart city (MoUD, 2019); hence, the calculation for this index, with the numerator being 0, would be null.

Figure 2 shows the trend analysis of I-7, I-8, and I-9 in the six consecutive years from 2018 to 2024.

The mean score analysis for the items across all dimensions is presented in Table 5, with explanations provided below.

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[1] Personally collected from the office.

Figure 2: Trends in Tax Collection and Capital Spending Over Time
Source: Budget and Balance Sheets from Varanasi Nagar Nigam

Indicators (I)	N	Mean	Median	SD	Min.	Max.
Table 5: Descriptive Analysis of Responses Showing Agreement to Different Factors						
1. Online Citizen Services						
The overall ease of use of the online citizen services	400	3.30	3.50	1.27	1.00	5.00
Satisfaction with the accessibility of information on the online citizen services platform	400	3.00	3.00	1.42	1.00	5.00
Rating of the online citizen services meets your needs	400	3.30	3.00	0.90	2.00	5.00
Rating of the overall quality of the services provided through the online platform	400	3.20	3.00	1.08	1.00	5.00
Recommendations for the online citizen services to others	400	2.70	3.00	0.90	1.00	4.00
2. Grievance Redressal						
Satisfaction with the ease of accessing the Grievance Redressal facility	400	2.70	2.50	1.49	1.00	5.00
Satisfaction with the responsiveness of the Grievance Redressal officials	400	2.70	3.00	1.35	1.00	5.00
Satisfaction with the clarity of information provided during the Grievance Redressal process	400	2.60	3.00	1.20	1.00	4.00
Satisfaction with the timeliness of the Grievance Redressal process	400	2.20	2.00	1.17	1.00	4.00
Satisfaction with the overall effectiveness of the Grievance Redressal facility	400	2.50	3.00	1.12	1.00	4.00
3. Voice and Accountability						
Voice heard by the local government authorities	400	2.70	3.00	1.19	1.00	5.00
Satisfaction with the opportunities provided to participate in decision-making processes	400	2.80	3.00	1.33	1.00	5.00
Transparency of the local government in its actions and decisions	400	2.90	3.00	0.95	2.00	5.00
Accountability of the local government officials for their actions	400	2.60	2.50	1.20	1.00	5.00
Feeling of being empowered to express your opinions on public issues	400	2.80	2.50	1.40	1.00	5.00
4. Political Stability						

Concern about the threat of government destabilisation by unconstitutional or violent means in your city	400	3.10	3.00	1.14	1.00	5.00
Effectiveness of the legal and judicial system in addressing and preventing government destabilisation	400	2.00	2.00	0.78	1.00	3.00
Awareness towards specific legal measures enacted to prevent government destabilisation	400	1.50	1.50	0.50	1.00	2.00
Effectiveness of efforts to prevent radicalisation, extremism, or violent ideologies	400	2.20	2.00	0.75	1.00	3.00
Agreement that any attempt to destabilise the government through unconstitutional means is unacceptable	400	3.80	4.00	0.87	2.00	5.00
Concern about the potential impact of violent actions on government stability	400	3.80	4.00	0.87	2.00	5.00
Feeling safe from threats to government stability	400	3.90	4.00	0.83	3.00	5.00
Trust in the government to protect itself against destabilisation attempts	400	3.80	4.00	0.75	3.00	5.00
Importance of citizens actively opposing attempts to destabilise the government	400	3.80	4.00	0.75	3.00	5.00
5. Effectiveness						
The public services received are of high quality	400	2.90	3.00	1.05	1.00	5.00
Civil servants demonstrate professionalism in their work	400	3.10	3.00	1.14	1.00	5.00
Policies formulated by the government are well-thought-out and effective	400	3.00	3.00	0.78	2.00	4.00
Satisfied with the level of transparency in public service delivery	400	2.70	3.00	0.90	1.00	4.00
The civil service effectively addresses the needs of the citizens	400	2.90	3.00	1.05	1.00	5.00
6. Control of corruption						
Public officials often abuse their power for personal gain	400	3.20	3.00	1.08	1.00	5.00
The influence of wealthy individuals and corporations on policymaking is concerning	400	3.40	3.50	0.92	2.00	5.00
There is a significant risk of state capture by elites	400	3.20	3.00	1.08	1.00	5.00
The public sector is often used for private interests rather than the public good	400	3.40	3.50	0.92	2.00	5.00
Corruption is a major issue in public administration and policymaking	400	3.20	3.00	1.08	1.00	5.00
Source: Prepared by the Authors Based on Primary Data Observations						

Online Citizen Services (I-1)

In the survey, forty per cent of the respondents claimed familiarity with online services, fifty percent were unaware, and ten per cent struggled to understand them. When asked about the services they use or might consider, filing complaints and grievances emerged as the most common, with thirty per cent focusing solely on this. Paying utility bills was also a popular choice. Regarding the usability of the website and online platforms, forty per cent were neutral, forty per cent found them user-friendly, and twenty per cent considered them not user-friendly. Using a 5-point Likert scale, the mean score analysis revealed that the ease of using online services scored the highest at 3.30, while recommending them to others scored the lowest at 2.70. This suggests a reluctance among Varanasi residents to adopt these online services fully.

Grievance Redressal (I-2)

Sixty per cent of respondents are aware of dispute resolution and redressal processes, while forty per cent are not. Interestingly, all 400

respondents had submitted grievances in the past year: forty per cent online, thirty per cent in person, twenty per cent by mail, and ten per cent by phone. As for the timeline of grievance resolution, thirty per cent are still unresolved, another thirty per cent took over six months, twenty per cent took 3-6 months, and ten per cent each took less than a month or 1-3 months. The mean scores are all below 3, with the highest at 2.70 for ease of access and satisfaction. In contrast, timeliness received the lowest rating at 2.20, indicating a need for improvement.

Voice and Accountability (I-3)

Eighty per cent of respondents believe they have the right to vote independently, while twenty per cent do not. When asked about responding to political and social views, thirty per cent were negative, thirty per cent chose not to respond, and forty per cent were unsure. None reported facing restrictions on freedom of expression, and only ten per cent are members of political or social organisations. All respondents stated they had no difficulty associating with such groups. Regarding press freedom in Varanasi, forty per cent were neutral, while thirty per cent each rated it as good or poor. Eighty per cent had heard of media censorship. Mean scores were low, with the highest at 2.90 for government transparency and the lowest at 2.60 for holding local officials accountable, indicating low levels of voice and accountability.

Political Stability (I-4)

In a survey conducted in Varanasi, thirty per cent of respondents expressed no concern about government destabilisation, twenty per cent reported being somewhat concerned, 10 per cent said they were very concerned, and the remaining ten per cent were unsure of their views. Regarding the legal system's ability to address such issues, forty per cent lacked confidence, thirty per cent believed in its ability, and thirty per cent partially agreed. Only fifty per cent of the respondents were aware of legal measures, such as anti-terrorism laws or emergency powers. When asked about the effectiveness of efforts to prevent radicalisation, forty per cent disagreed, twenty per cent

agreed, and forty per cent partially agreed. The mean scores were high, with 3.90 for feeling safe from instability and 3.80 for trust in the government's actions, indicating a strong belief in the city's political stability.

Effectiveness (I-5)

Survey responses in Varanasi revealed that forty per cent of the respondents rated healthcare, education, and transportation services as good, another forty per cent were neutral, and twenty per cent rated them as poor. Similar ratings applied to the effectiveness of government employees. Only thirty per cent believed government policies were well-formulated, while fifty per cent disagreed, and twenty per cent were unsure. On government transparency and accountability, forty per cent were neutral, twenty per cent agreed they were transparent, and thirty per cent found them lacking. Regarding access to government information, twenty per cent felt informed, forty per cent disagreed, and forty per cent were unsure. Participation in public consultations was low, with eighty per cent not involved. The highest mean score was 3.10 for civil servants' professionalism, while the lowest was 2.70, indicating low satisfaction with public service transparency, suggesting a need for significant improvements in governance.

Control of Corruption (I-6)

Corruption significantly impacts Varanasi's liveability, with forty per cent of residents rating it as high, twenty per cent rating it as very high, thirty per cent rating it as moderate, and ten per cent rating it as low. Half of the respondents reported no personal encounters with corruption, while the other half were unsure. Only twenty per cent believed that the local government effectively controls corruption, forty per cent disagreed, and forty per cent were unsure. Awareness of anti-corruption initiatives is low, with forty per cent unaware, forty per cent unsure, and ten per cent aware. Regarding public power used for private gain, fifty per cent were unsure, forty per cent did not respond, and ten per cent disagreed. The highest mean score, 3.40, suggests that wealth has a significant influence on policymaking. Overall, the mean

scores indicate that corruption is a significant concern that requires attention, with political stability scoring the highest at 3.82 and grievance redressal scoring the lowest at 2.57.

Calculation of Category Index

The Governance Index has been computed by aggregating the scores of eight core indicators and one supporting standard, comprising three percentage-based indicators and six Likert-scale indicators. The weightage is provided to neutralise the values deduced for the components in different units.

Average Score for Core Indicators = 17.82

Average Score for Supporting Indicators = 3.10

Category Index = 17.83*0.7 + 3.10*0.3 = 12.474 + 0.93 = **13.404**

Discussions

Based on the primary and secondary data, Varanasi's governance index, measured by the institutional component of liveability standards, is 13.404.

The study identifies potential differences in the implementation of new measures under the smart city initiative, particularly across social strata and geographical zones (Shaikh & Pathak, 2017). Individuals' behaviour and perceptions are shaped by their social class and the areas they inhabit, influencing their social circles, education, and occupations. These factors, integrated into the study, enhance its comprehensiveness. The findings emphasise the importance of constructs such as political stability, effectiveness, corruption control, voice and accountability, and online service efficiency, aligning with research like this (Das, 2024; Kumar et al., 2020; Panahi Rizi & Hosseini Seno, 2022). In Varanasi, tax collection is robust, accounting for nearly half of the capital expenditure. Political stability is evident, but improvements are needed in online service awareness, grievance redressal efficiency, effectiveness, accountability, and corruption control. The city spent 49.02 per cent of its capital budget last year, but lacks ward committees and hence participatory planning, a key component of smart city initiatives. Using a Likert scale survey, FGDs, and interviews with policymakers, the study reveals a significant dearth of public engagement in decision-making. Our FGD findings highlighted that governance is not merely about creating infrastructure for tourism or high-profile projects, but about addressing the everyday needs of all societal segments. As one community leader remarked:

> They spend millions on grand projects, yet we still struggle with basic drainage and proper roads.

Another participant added:

> Real governance means understanding what ordinary people face, not just what looks impressive from the outside.

The governance index, which contributes 25 per cent to the liveability index, highlights regional and social class disparities in perceptions, particularly in terms of effectiveness and corruption control. Future studies should assess the impact of ward committees and refine the city's overall liveability index.

The One-Way ANOVA test reveals significant mean score differences across zones and social classes. Table 6 shows variations in responses based on these factors, indicating differing adoption patterns or service experiences. Addressing these disparities is crucial for a smooth transition to a smart city.

To understand these differences in detail, post-hoc analyses are conducted based on the condition of unequal variances assumed and the use of Games-Howell tests. The results have been discussed in Annexures 1 and 2.

The analysis reveals significant differences in perceptions of institutional factors across social strata, except for political stability, where the upper class differs notably from other groups (see Annexure 2). Zonal responses (refer to Annexure 1) also vary, particularly in Adampur and Bhelupur, regarding online services and political stability, although there is consensus on issues such as voice and accountability, effectiveness, and corruption control.

Table 6: Mean Score Variation Across Zones and Social Classes										
One-Way ANOVA – Zone Based					**One-Way ANOVA – Social Classes Based**					
	F	**df1**	**df2**	**p**			**F**	**df1**	**df2**	**p**
I-1	10.83	8	95.2	< .001		I-1	274.6	3	211	< .001
I-2	8.06	8	89.3	< .001		I-2	164.3	3	184	< .001
I-3	148.30	8	130.5	< .001		I-3	4934.4	3	202	< .001
I-4	12.30	8	113.8	< .001		I-4	49.1	3	192	< .001
I-5	35.83	8	99.9	< .001		I-5	1203.2	3	208	< .001
I-6	26.82	8	97.4	< .001		I-6	1212.9	3	206	< .001
Source: Calculated by the Authors										

For control over corruption, there is a significant difference in opinion among respondents from Kotwali and Sarnath zones, with a p-value of less than 0.05. However, the perception of others is similar, and opinions on effectiveness are generally aligned, except in Ramnagar and Rishi Mandawi zones. These variations indicate challenges in applying a uniform approach to institutional factors across different areas and social groups.

Table 7 clearly identifies the governance scores across various zones, revealing a mix of strengths and weaknesses.

Table 7: Composite Scores for Zone-Based Performance										
Zone	**I-1**	**I-2**	**I-3**	**I-4**	**I-5**	**I-6**	**I-7**	**I-8**	**I-9**	**Mean**
Adampur	2.75	2.33	2.54	3.99	2.78	3.45				2.973
Bhelupur	3.18	2.48	2.76	3.66	2.85	3.40				3.055
Dashashwamedh	2.88	2.58	2.82	3.82	3.01	3.03				3.023
Kotwali	3.34	2.50	2.66	3.40	2.94	3.52	Zone-wise data Not Available			3.060
Ramnagar	2.94	3.23	2.25	4.09	2.71	3.62				3.140
Rishi Mandawi	2.99	2.67	2.58	3.83	2.81	3.35				3.038
Sarnath	3.40	2.90	2.99	4.15	3.09	3.08				3.268
Varunapar	3.28	2.29	3.11	3.74	3.03	3.07				3.087
Mean	3.095	2.622	2.714	3.835	2.902	3.315				
Source: Compiled by the Authors										

The mean scores clearly indicate that the Sarnath zone is the best-performing zone, with a mean score of 3.268, and that I-4, or political stability, is the most effective indicator, scoring the highest mean value of 3.835.

The Adampur zone exhibits relatively low performance, particularly in grievance redressal, despite moderate political stability, which may be attributed to infrastructural limitations. Bhelupur zone's moderate governance performance, marked by better digital infrastructure, is hindered by challenges in transparency and resource allocation. The Dashashwamedh zone, which serves as Varanasi's central business district and houses major landmarks such as the Vishwanath Temple, the Ganga Corridor, and the bustling local market, often experiences high tourist footfall that overshadows local civic priorities. While political stability and effectiveness remain steady, the heavy emphasis on tourism-centric development has limited avenues for local citizen participation in governance and weakened the responsiveness of grievance redressal mechanisms for residents.

Kotwali zone high scores in online services and corruption control suggest better administrative practices, but lower scores in grievance redressal indicate bureaucratic inefficiencies. The Ramnagar zone excels in terms of political stability and corruption control, but falls short in voice and accountability, reflecting a top-down governance approach. Rishi Mandawi's zone consistently yields moderate scores, suggesting

stable governance, while Sarnath's strong political stability and citizen participation are offset by challenges in administrative efficiency. Varunapar zone's good performance in voice, accountability, and online services contrasts with its struggles in grievance redressal and corruption control, highlighting gaps in enforcement and service delivery.

The mean scores from Table 8 clearly indicate that the Upper stratum is the best-performing group, with a mean value of 3.628, and that I-4, or political stability, is the most effective indicator among all, with a value of 3.842.

Table 8: Composite Scores for Social Strata-Based Performance										
Strata	**I-1**	**I-2**	**I-3**	**I-4**	**I-5**	**I-6**	**I-7**	**I-8**	**I-9**	**Mean**
Lower	3.44	2.51	2.68	3.68	2.77	3.36				3.073
Middle	2.83	2.74	1.94	3.81	2.55	4.03	Zone-wise data Not Available			2.983
Slum	2.19	1.90	2.07	3.78	2.40	3.72				2.677
Upper	3.90	3.17	4.70	4.10	4.20	1.70				3.628
Mean	3.090	2.580	2.848	3.842	2.980	3.202				
Source: Compiled by the Authors										

Lower scores in grievance redressal and control of corruption within the lower strata may indicate limited access to resources and services, leading to less effective governance. The middle strata exhibit a more balanced performance, though lower scores in voice and accountability suggest potential challenges with civic engagement or representation. The slum areas show the lowest scores, particularly in online citizen services and effectiveness, likely due to socio-economic disadvantages, limited infrastructure, and reduced governmental focus. In contrast, the upper strata achieve the highest scores, especially in online citizen services and political stability, reflecting better access to services and a more favourable governance environment. However, the low score in control of corruption in these areas could point to issues with regulatory enforcement, even in more affluent communities.

The variations in governance scores across different zones and strata in Varanasi city are influenced by a combination of infrastructural, socio-economic, and administrative factors, with each zone facing its own unique set of challenges and advantages. Strengthening weaker factors through stakeholder engagement is crucial. This approach can be applied to other emerging smart cities in India, enabling comparative studies of institutional factors across regions for a deeper understanding.

The study provides a clear assessment of Varanasi's governance in its smart city planning, highlighting areas needing improvement. However, the study's limited timeframe allowed for the evaluation of only one liveability index element, limiting a comprehensive understanding of the city's overall liveability.

In summary, Varanasi's governance challenges are deeply intertwined with its complex urban morphology. High-density zones, historic market areas such as Vishwanath Gali, and the ghats often experience infrastructural bottlenecks, congestion, and inadequate service delivery. These areas perform poorly on governance indicators due to inefficient spatial planning, limited public participation, and weak regulatory enforcement. While smart city initiatives in Varanasi prioritise heritage conservation and tourism infrastructure, essential governance issues such as waste management, traffic control, and informal economic regulation remain inadequately addressed (Das et al., 2024).

Effective governance extends beyond administrative efficiency, relying on public perception and behavioural responses. In Bangkok, the *Open Bangkok* initiative

demonstrated that policy success is strongly influenced by community engagement and localised decision-making. (Das et al., 2022). Similarly, Kuala Lumpur's *People-Centric Smart City Framework* integrates community inputs to ensure equitable governance. However, in Varanasi, governance struggles to engage lower-income groups due to socio-economic disparities, institutional distrust, and policies that prioritise high-tech solutions over immediate local needs. Furthermore, behavioural resistance to digital platforms for governance can hinder policy implementation (Das & Zhang, 2021).

Conclusion

This study aimed to explore the governance status of Varanasi as a smart city. In doing so, the study has highlighted key insights into governance efficiency as well as challenges in Varanasi, providing a comprehensive perspective for policymakers to enhance urban liveability. To address the challenges, governance frameworks must integrate participatory planning, community-driven development, and adaptive policymaking. Drawing from global models, Varanasi could benefit from localised governance councils, digital inclusivity programmes, and heritage-sensitive urban management to bridge governance gaps and enhance liveability. The governance index plays a crucial role in smart city development, influencing infrastructure growth, resource optimisation, and quality of life improvements. Effective governance can serve as a catalyst, fostering collaboration across socio-economic strata to drive Varanasi's smart city transformation forward, ensuring sustainable and inclusive urban development. Future research should explore the remaining three pillars —social, economic, and physical — of liveability in Varanasi to determine the overall levels.

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Ethical Approval

This research did not require ethical approval as it did not involve any procedures requiring approval by an ethics committee, according to the guidelines of the journal.

Conflict of Interest

The authors have no affiliation with any organisation with a direct or indirect financial interest in the subject matter discussed in the manuscript.

Author Contribution Statement

MJ (First Author): conception, design, analysis and interpretation of the data; collection of primary and secondary data; and drafting the article.

SS (Second Author): conception, design, analysis and interpretation of the data; critical review of the manuscript for important intellectual content; and approval of the final version.

Informed Consent

All the data required for assessing citizens' perception have been collected with the participants' consent.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Annexure 1

Correlation among the zones of Varanasi

Games-Howell Post-Hoc Test – Online citizen services

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	-0.423	-0.124	-0.591	-0.188	-0.232	-0.650	-0.529
	p-value	—	0.012	0.995	<.001	0.905	0.716	<.001	0.027
Bhelupur	Mean difference		—	0.299	-0.169	0.235	0.191	-0.228	-0.106
	p-value		—	0.469	0.670	0.635	0.774	0.394	0.996
Dashashwamedh	Mean difference			—	-0.467	-0.064	-0.108	-0.526	-0.405
	p-value			—	0.043	1.000	0.998	0.019	0.344
Kotwali	Mean difference				—	0.403	0.359	-0.059	0.0623
	p-value				—	0.078	0.080	0.999	1.000
Ramnagar	Mean difference					—	-0.044	-0.462	-0.341
	p-value					—	1.000	0.038	0.483
Rishi Mandawi	Mean difference						—	-0.418	-0.297
	p-value						—	0.035	0.603
Sarnath	Mean difference							—	0.121
	p-value							—	0.992
Varunapar	Mean difference								—
	p-value								—

Games-Howell Post-Hoc Test – Grievance Redressal

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	-0.149	-0.251	-0.176	-0.898	-0.569	-0.569	0.040
	p-value	—	0.952	0.615	0.877	0.005	0.001	0.001	1.000
Bhelupur	Mean difference		—	-0.102	-0.026	-0.748	-0.420	-0.420	0.189
	p-value		—	0.993	1.000	0.023	0.022	0.022	0.579
Dashashwamedh	Mean difference			—	0.075	-0.647	-0.318	-0.318	0.291
	p-value			—	0.999	0.073	0.230	0.230	0.139
Kotwali	Mean difference				—	-0.722	-0.393	-0.393	0.216
	p-value				—	0.029	0.031	0.031	0.344
Ramnagar	Mean difference					—	0.329	0.329	0.938
	p-value					—	0.741	0.741	0.002
Rishi Mandawi	Mean difference						—	-0.230	0.379
	p-value						—	0.713	0.040
Sarnath	Mean difference							—	0.609
	p-value							—	<.001
Varunapar	Mean difference								—
	p-value								—

Games-Howell Post-Hoc Test – Voice and Accountability

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	-0.219	-0.2812	-0.116	0.296	-0.0381	-0.446	-0.566
	p-value	—	0.929	0.895	0.998	0.958	1.000	0.168	0.176
Bhelupur	Mean difference		—	-0.0625	0.102	0.515	0.1806	-0.227	-0.348
	p-value		—	1.000	0.999	0.575	0.983	0.868	0.738
Dashashwamedh	Mean difference			—	0.165	0.578	0.2431	-0.165	-0.285
	p-value			—	0.993	0.534	0.961	0.992	0.939
Kotwali	Mean difference				—	0.413	0.0781	-0.330	-0.450
	p-value				—	0.794	1.000	0.480	0.418
Ramnagar	Mean difference					—	-0.3344	-0.742	-0.863
	p-value					—	0.935	0.151	0.111
Rishi Mandawi	Mean difference						—	-0.408	-0.528
	p-value						—	0.362	0.309
Sarnath	Mean difference							—	-0.121
	p-value							—	0.999
Varunapar	Mean difference								—
	p-value								—

Games-Howell Post-Hoc Test – Political Stability

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	0.328	0.162	0.591	-0.107	0.157	-0.159	0.249
	p-value	—	0.010	0.566	< .001	0.999	0.792	0.734	0.162
Bhelupur	Mean difference		—	-0.166	0.263	-0.435	-0.171	-0.487	-0.079
	p-value		—	0.644	0.233	0.317	0.772	< .001	0.994
Dashashwamedh	Mean difference			—	0.429	-0.270	-0.005	-0.320	0.087
	p-value			—	0.002	0.815	1.000	0.039	0.987
Kotwali	Mean difference				—	-0.698	-0.433	-0.750	-0.341
	p-value				—	0.024	0.009	< .001	0.055
Ramnagar	Mean difference					—	0.264	-0.051	0.357
	p-value					—	0.859	1.000	0.567
Rishi Mandawi	Mean difference						—	-0.316	0.092
	p-value						—	0.123	0.992
Sarnath	Mean difference							—	0.408
	p-value							—	0.007
Varunapar	Mean difference								—
	p-value								—

Games-Howell Post-Hoc Test – Effectiveness

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	-0.0683	-0.231	-0.156	0.074	-0.027	-0.310	-0.247
	p-value	—	0.999	0.714	0.910	1.000	1.000	0.181	0.594
Bhelupur	Mean difference		—	-0.162	-0.088	0.142	0.041	-0.243	-0.179
	p-value		—	0.940	0.997	0.993	1.000	0.489	0.885
Dashashwamedh	Mean difference			—	0.074	0.304	0.203	-0.080	-0.017
	p-value			—	0.999	0.752	0.842	0.999	1.000
Kotwali	Mean difference				—	0.230	0.129	-0.154	-0.091
	p-value				—	0.900	0.972	0.894	0.997
Ramnagar	Mean difference					—	-0.101	-0.385	-0.322
	p-value					—	**0.019**	0.412	0.682
Rishi Mandawi	Mean difference						—	-0.283	-0.220
	p-value						—	0.321	0.750
Sarnath	Mean difference							—	0.063
	p-value							—	1.000
Varunapar	Mean difference								—
	p-value								—

Games-Howell Post-Hoc Test – Control of Corruption

		Adampur	Bhelupur	Dashashwamedh	Kotwali	Ramnagar	Rishi Mandawi	Sarnath	Varunapar
Adampur	Mean difference	—	0.0501	0.415	-0.072	-0.177	0.098	0.363	0.376
	p-value	—	1.000	0.229	1.000	0.995	0.999	0.286	0.311
Bhelupur	Mean difference		—	0.365	-0.122	-0.227	0.048	0.312	0.326
	p-value		—	0.400	0.997	0.979	1.000	0.493	0.512
Dashashwamedh	Mean difference			—	-0.488	-0.592	-0.317	-0.052	-0.039
	p-value			—	0.146	0.275	0.603	1.000	1.000
Kotwali	Mean difference				—	-0.104	0.171	0.435	0.449
	p-value				—	1.000	0.980	**0.015**	0.202
Ramnagar	Mean difference					—	0.275	0.540	0.553
	p-value					—	0.943	0.340	0.339
Rishi Mandawi	Mean difference						—	0.264	0.278
	p-value						—	0.715	0.720
Sarnath	Mean difference							—	0.013
	p-value							—	1.000
Varunapar	Mean difference								—
	p-value								—

Annexure 2

Correlation among the Social Strata of Varanasi

Games-Howell Post-Hoc Test – Online citizen services		Lower	Middle	Slum	Upper
Lower	Mean difference	—	0.609	1.243	-0.464
	p-value	—	< .001	< .001	< .001
Middle	Mean difference		—	0.634	-1.073
	p-value		—	< .001	< .001
Slum	Mean difference			—	-1.707
	p-value			—	< .001
Upper	Mean difference				—
	p-value				—

Games-Howell Post-Hoc Test – Grievance Redressal		Lower	Middle	Slum	Upper
Lower	Mean difference	—	-0.231	0.606	-0.660
	p-value	—	0.043	< .001	< .001
Middle	Mean difference		—	0.837	-0.429
	p-value		—	< .001	< .001
Slum	Mean difference			—	-1.266
	p-value			—	< .001
Upper	Mean difference				—
	p-value				—

Games-Howell Post-Hoc Test – Voice and Accountability		Lower	Middle	Slum	Upper
Lower	Mean difference	—	0.741	0.617	-2.02
	p-value	—	< .001	< .001	< .001
Middle	Mean difference		—	-0.124	-2.76
	p-value		—	0.012	< .001
Slum	Mean difference			—	-2.63
	p-value			—	< .001
Upper	Mean difference				—
	p-value				—

Games-Howell Post-Hoc Test – Political Stability		Lower	Middle	Slum	Upper
Lower	Mean difference	—	-0.131	-0.099	-0.419
	p-value	—	**0.513**	**0.494**	< .001
Middle	Mean difference		—	0.0322	-0.288
	p-value		—	**0.975**	< .001
Slum	Mean difference			—	-0.321
	p-value			—	< .001
Upper	Mean difference				—
	p-value				—