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A NEW APPROACH TO INFRASTRUCTURE DEVELOPMENT IN SRI LANKA'S URBAN AREAS

Lahiru ALAHAKOON[1*], Jurgita Černeckienė[2], Leo JANSONS[3], Wanigasinghe Mudiyanselage Miran TEKSHAN[4]

[1, 3, 4] *Riga Technical University, Riga, Latvia*
[2] *Kaunas University of Technology, Kaunas, Lithuania*

**Corresponding author`s e-mail: lahirualahakoon1994@gmail.com*

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Abstract. This article discusses new approaches for addressing urban infrastructure issues in Sri Lanka, focused on transportation, utilities, green spaces, and prospective infrastructure requirements. The fast urbanization in Sri Lanka has resulted in problems, including traffic congestion, insufficient housing, ineffective utilities, and environmental damage. These obstacles impede economic development, social equality, and environmental sustainability. The research, informed by four hypotheses, investigates the impact of transport and mobility, utilities and public services, green spaces and sustainability, and future infrastructure planning on satisfaction with existing infrastructure. The study employs a mixed-methods approach, integrating quantitative data analysis, GIS technologies, case studies, and stakeholder interviews. Data gathered from 385 respondents around Sri Lanka offers insights into residents' perceptions of infrastructure quality and their goals for urban development. The results indicate that transportation and mobility substantially influence contentment. Effective public transport, sustainable mobility alternatives like electric buses, and intelligent traffic management systems are crucial for enhancing connectivity and decreasing congestion. Utilities and public services significantly contribute to satisfaction. Dependable water, electricity, and waste management services are essential, with suggestions to upgrade infrastructure, embrace renewable energy sources, and include smart technologies.

Keywords: *Affordable housing, urban infrastructure, public-private partnership, renewable energy, sustainability, transportation, water management.*

INTRODUCTION

Urbanization has emerged as a hallmark trend of the 21st century, with cities globally undergoing swift expansion due to rural-to-urban migration and natural population growth. Sri Lanka is experiencing an increasing urbanization rate, projected to reach 50 % by 2030 (Ministry of Housing and Construction of the Government of Democratic Socialist Republic of Sri Lanka, 2016). This transition has exerted significant strain on the nation's urban infrastructure, especially in sectors such as transportation, housing, water supply and management, and energy supply. These sectors are essential to a city's operation, efficiency, and quality of life; nevertheless, in numerous Sri Lankan cities, they are either underdeveloped or burdened by the pressures of increasing populations (Mawilmada et al., 2016). Sri Lanka requires a comprehensive approach to infrastructure development that integrates sustainable practices, new technology, and policies aligned with the needs and aspirations of its inhabitants to maintain its urban transformation and promote inclusive, resilient growth (Asian Development Bank, 2021).

Historically, infrastructure development in Sri Lanka has encountered obstacles stemming from constrained resources, ineffective planning, and sluggish project execution. Numerous metropolitan regions continue to contend with challenges like traffic congestion, housing deficits, water scarcity, and energy reliability problems (Hettiarachchi & Gunawardhana, 2022). Colombo, the country's economic center, exemplifies these issues, facing recurrent traffic congestion, elevated housing expenses, and intermittent flooding resulting from insufficient drainage systems (Kariyawasam et al., 2022). Resolving these issues necessitates a multifaceted strategy that incorporates economic, environmental, and social elements into the planning and implementation of urban initiatives. This approach, emphasizing sustainability and inclusivity, can assist cities in effectively managing their expansion while enhancing living circumstances for all inhabitants (Li, 2024).

An integrated strategy for water management may assist Sri Lankan cities in confronting these difficulties. The implementation of green infrastructure, including rain gardens and permeable pavements, has proven effective in cities such as Tokyo and Singapore, where it aids in stormwater management and mitigates flood risks (UN-Habitat, 2020). Furthermore, enhanced water recycling systems and rainwater harvesting projects could augment municipal water supply, hence improving water security and environmental sustainability (Japan International Cooperation Agency Report, 2010).

The demand for energy in urban areas of Sri Lanka is escalating swiftly, and the existing infrastructure frequently fails to accommodate this growth. Numerous urban families encounter recurrent power outages, especially in low-income areas where grid reliability is most deficient. Sri Lanka's energy composition, predominantly dependent on fossil fuels, exacerbates pollution and greenhouse gas emissions, underscoring the necessity for a shift to renewable energy sources (Ministry of Power and Energy Report, 2021). Despite the significant potential of solar energy in Sri Lanka, attributed to the country's abundant sunlight, its adoption is constrained mostly by substantial initial costs and insufficient government incentives (Asian Development Bank, 2021).

Enhancing access to cost-effective, renewable energy sources might markedly enhance energy reliability while furthering Sri Lanka's environmental objectives. Germany and Denmark have exemplified the feasibility of decentralized renewable energy systems, enabling families and businesses to produce their own electricity and diminish dependence on the national grid. In Sri Lanka, a combination of policies promoting solar, wind, and small-scale hydropower might improve the accessibility of renewable energy for the urban population and strengthen the resilience of the national energy infrastructure (Musafer, 2023).

1. RESEARCH METHODOLOGY

A mixed-methods approach was used to thoroughly evaluate the infrastructure development requirements in metropolitan regions of Sri Lanka. A comprehensive literature analysis was undertaken to examine existing infrastructure frameworks, urban issues, and sustainable practices derived from worldwide case studies. Quantitative data, encompassing metrics on infrastructure investments, population density, and environmental impacts, was collected from governmental and international databases to establish a solid statistical foundation. Qualitative insights were gathered via interviews and surveys with key stakeholders, including urban planners, government officials, and residents, to comprehend the specific infrastructure difficulties encountered in these areas. A case study investigation juxtaposes Sri Lankan urban infrastructure with those of chosen global cities, pinpointing successful ideas that can be tailored to the local environment. Furthermore, Geographic Information System (GIS) mapping and spatial analysis were employed to pinpoint regions with significant infrastructure deficiencies, facilitating a visual comprehension of the spatial distribution and accessibility of infrastructure resources. The statistical analysis of quantitative and qualitative data facilitates the identification of actionable insights aimed at formulating data-driven recommendations for sustainable infrastructure development specific to Sri Lanka's distinctive urban context.

The study employs a systematic approach and technique to tackle urban infrastructure issues in Sri Lanka, emphasizing sustainable, inclusive, and pragmatic solutions for sustainable urbanization in Sri Lanka. There are several social, cultural, and economic issues pertaining to urban infrastructure development. It draws out a strategic action plan that seeks to bring the issue of inclusiveness, environmental transition, and preparedness in development. As proposed in the hybrid model, the application of new technologies, PPPs, and community involvement can positively address issues like low public awareness, resource scarcity, and culture that now hinder the implementation of knowledge management.

2. RESULTS AND DISCUSSION

The data for this study was collected through a guided interview method with the view to capturing information from stakeholders in the Sri Lankan urban infrastructure market. The target participants, therefore, included government and private company workers, university students, urban residents and others who have a stake in the identified public hospitals and health care institutions. The interviews adapted here, however, encompassed several aspects of availability, costs, and the requirements for public infrastructures within cities.

Of the total contacted, 385 agreed to participate, and out of the target group, we got a response rate of 95 %. This response rate is quite acceptable in qualitative research since the requirement of high numbers of participants that would facilitate quantitative research is not demanded. The data collection process was carried out in adherence to the tenets of ethical practice; anonymity and voluntary participation of participants was observed.

1.1. Reliability of the Measures

Table 1. Reliability of the Variables (Developed by Authors)

Variable	Items	Cronbach's alpha value	Status
Transportation and mobility	04	0.791	Good
Utilities and public services	04	0.779	Good
Green spaces and sustainability	04	0.770	Good
Future infrastructure needs	04	0.836	Good
Satisfaction with current infrastructure	04	0.842	Good

This study assessed the reliability of variables by Cronbach's alpha (CA), an indicator of internal consistency. CA values exceeding 0.7 signify that items within a variable are interconnected and consistently assess the same construction. All variables in this study exhibited strong internal consistency, with Cronbach's alpha values ranging from 0.770 to 0.842. The analyzed factors included transportation and mobility (0.791), utilities and public services (0.779), green spaces and sustainability (0.770), future infrastructure needs (0.836), and satisfaction with current infrastructure (0.842). The elevated CA values indicate that respondents possess a comprehensive understanding of each variable, acknowledging the interrelation of several components within urban infrastructure. The transportation and mobility variable evaluated the accessibility, reliability, and capacity of public transport, whereas utilities and public services addressed water, sanitation, power, and waste management. Green spaces and sustainability explored the function of green infrastructure in urban settings, future infrastructure needs assessed anticipations for forthcoming urban development, and satisfaction with current infrastructure evaluated respondents' satisfaction with existing urban infrastructure. This consistency signifies that participants recognize the significance of these aspects in urban development and possess explicit expectations for future infrastructure requirements.

1.2. The Validity of the Measures

The Kaiser–Meyer–Olkin (KMO) statistics were employed to evaluate sampling adequacy for factor analysis, with values approaching one signifying enhanced appropriateness. The analysis revealed KMO values between 0.712 and 0.862 for the variables, indicating satisfactory to exceptionally satisfactory sampling adequacy. Transportation and mobility (0.765) and future infrastructure needs (0.862) had notably strong internal correlations. The Bartlett's test of sphericity, yielding a p-value of 0.000, demonstrated significant correlations among variables, validating the use of factor analysis. Each variable was condensed into four factors, corroborating the premise that these extracted factors represent the fundamental components of each variable and accurately depict the underlying structure of the dataset. Although utilities and public services (0.712) and green spaces and sustainability (0.789) had marginally lower KMO values, they remained adequate for factor analysis, albeit perhaps less internally consistent than the other variables.

1.3. Environmental Sustainability and Building Performance

Table 2. Validity Measures (Developed by Authors)

Variable	KMO Values	Bartlett's test of sphericity values	Factors	Status
Transportation and mobility (TM)	0.765	0.000	04	Good
Utilities and public services (UPS)	0.712	0.000	04	Acceptable
Green spaces and sustainability (GSS)	0.789	0.000	04	Acceptable
Future infrastructure needs (FIN)	0.862	0.000	04	Good
Satisfaction with current infrastructure (SCI)	0.760	0.000	04	Good

Adaptive reuse offers significant environmental benefits, aligning with the principles of sustainability and circular economy. Bullen (2011) notes that reusing existing buildings minimizes the need for new construction materials, thus reducing the carbon footprint and resource consumption. This is particularly relevant in the Latvian context, where many Soviet-era buildings require substantial upgrades to meet modern energy efficiency standards.

Integrating sustainable practices in adaptive reuse projects not only reduces environmental impact but also enhances the long-term viability and affordability of housing projects (Bratuskins & Treija, 2019). Retrofitting existing buildings with energy-efficient technologies can significantly reduce energy consumption and operational costs, providing long-term economic benefits through reduced utility bills.

1.4. Demographics

This research examined demographic data from 385 participants, concentrating on age, occupation, residential location, length of urban residency, and housing condition. The sample had a balanced age distribution, with the predominant cohorts being 36–50 and 51+ years old (33.2 % each), succeeded by 26–35 (16.9 %) and 18–25 (16.6 %). This distribution indicates a strong representation of middle-aged and older people, perhaps offering an extensive perspective on urban infrastructure issues.

The sample was uniformly distributed among six occupational categories: students, employed individuals, self-employed persons, retirees, government officials, and others, each comprising approximately 16–17 % of the total. Participants were predominantly from three principal Sri Lankan cities: Colombo, Galle, and Kandy (28.6 % each), while 14.3 % were from other regions. This distribution guarantees extensive coverage of urban experiences nationwide. The sample was nearly evenly divided between individuals residing in urban regions for 1–3 years (50.1 %) and those for 4–6 years (49.9 %). This equilibrium facilitates comparisons between relatively young and more established urban inhabitants. Housing status statistics indicated that 50.1 % of participants were renters, 34.8 % were homeowners, and 15.1 % were classified as "Other." A significant percentage of renters may suggest cost challenges or a propensity for mobility in urban environments.

The demographic profile of the study guarantees a wide and representative sample, encompassing a range of age groups, professions, and living experiences. Diversity enhances the study's capacity to deliver thorough insights on urban infrastructure views and requirements across various demographic groupings. The equitable distribution among categories and the lack of missing data enhances the reliability and validity of the results.

1.5. Descriptive Statistics

Table 3. Descriptive Statistics (Developed by Authors)

	N	Minimum	Maximum	Mean	Std. deviation
TM MENA	385	1.00	5.00	4.1175	0.69502
UPS MENA	385	2.00	5.00	4.2935	0.58231
GSS MEAN	385	1.75	5.00	4.2039	0.64976
FIN MEAN	385	1.00	5.00	4.1260	0.56513
SCI MEAN	385	1.00	5.00	4.3130	0.72175
Valid *N* (listwise)	385				

From the data obtained, it is evident that all five variables, from the TM MENA to SCI MEAN, have relatively high averages with a scale ranging from 4.11 to 4.31. This indicates that respondents are likely to respond positively to these aspects. Nevertheless, the changes in response support the statement that not all the participants have the same level of satisfaction; some even express more dissatisfaction or have dissimilar opinions about TM MENA and SCI MEAN. Such descriptive statistics are convenient to illustrate the respondents' perceptions by infrastructure-related dimensions. Although there are quite high overall job satisfaction ratings, there are great fluctuations in response when it comes to satisfaction with infrastructures provided or mobility rates, which would suggest that such aspects need some improvement or there are mixed opinions on such issues.

1.6. Best Practices and Future Directions

Inferential data in five domains – transportation and mobility, utilities and public services, green spaces and sustainability, future infrastructure needs, and satisfaction with current infrastructure – indicate overwhelmingly favorable perceptions from the respondents. The transportation and mobility (TM MENA) initiative received a mean score of 4.1175, accompanied by a t-value of 116.243 and a p-value of 0.000, signifying robust approval, with a confidence interval between 4.0479 and 4.1872. Utilities and public services (UPS MENA) achieved a score of 4.2935, accompanied by a t-value of 144.673 and a p-value of 0.000, indicating considerable positive sentiment, with a confidence range from 4.2352 to 4.3519.

Green spaces and sustainability (GSS MEAN) had a mean of 4.2039, a t-value of 126.949, and a p-value of 0.000, indicating strong endorsement for environmental activities, with a confidence interval ranging from 4.1388 to 4.2690. The future infrastructure needs (FIN MEAN) yielded a mean of 4.1260, a t-value of 143.254, and a p-value of 0.000, indicating a robust demand for further infrastructure development, corroborated by a confidence interval of 4.0693 to 4.1826. Satisfaction with current infrastructure (SCI MEAN) achieved a score of 4.3130, accompanied with a t-value of 117.252 and a p-value of 0.000, signifying a high level of satisfaction, with a confidence interval ranging from 4.2407 to 4.3853. The results indicate that respondents predominantly possess favorable opinions in all domains, with a distinct focus on future infrastructure requirements and contentment with current services.

1.7. Correlation Analysis

The correlation analysis presented examines the relationships between five key dimensions of urban infrastructure satisfaction: transportation and mobility (TM MENA), utilities and public services (UPS MENA), green spaces and sustainability (GSS MEAN), future infrastructure needs (FIN MEAN), and satisfaction with current infrastructure (SCI MEAN). These are cross tabulation and scatter diagrams for nominal and interval levels of measurement, while Pearson correlation coefficients are used to measure the strength and direction of these relationships. The correlation coefficients reveal that all variables are from a moderate to a high degree positively related. For example, TM MENA and UPS MENA are positively related as measured by *Gamma* = 0.586, which decreases when one increases satisfaction in the other. This trend is observed in most of the variables, pointing at interrelated impressions of urban infrastructure.

Table 4. Correlations (Developed by Authors)

		TM MENA	UPS MENA	GSS MEAN	FIN MEAN	SCI MEAN
TM MENA	Pearson correlation	1	0.586**	0.592**	0.544**	0.629**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000
	N	385	385	385	385	385
UPS MENA	Pearson correlation	0.586**	1	0.670**	0.595**	0.685**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000
	N	385	385	385	385	385
GSS MEAN	Pearson correlation	0.592**	0.670**	1	0.706**	0.715**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
	N	385	385	385	385	385
FIN MEAN	Pearson Correlation	0.544**	0.595**	0.706**	1	0.762**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
	N	385	385	385	385	385
SCI MEAN	Pearson correlation	0.629**	0.685**	0.715**	0.762**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	385	385	385	385	385

** Correlation is significant at the 0.01 level (2-tailed).

1.8. *R* Square (R^2)

Table 5. Model Summary (Developed by Authors)

Model	*R*	*R* square	Adjusted *R* square	Std. error of the estimate
1	0.836[a]	0.699	0.696	0.39815

[a] Predictors: (Constant), FIN MEAN, TM MENA, UPS MENA, GSS MEAN.

The regression model predicts that SCI MEAN (satisfaction with current infrastructure) from FIN MEAN, TM MENA, UPS MENA, and GSS MEAN have a strong fit. A robust positive relationship (*R* = 0.836) of the predictors with the dependent variable is shown using the correlation coefficient. This model explains 69.9 % of the variance in SCI MEAN, and the adjusted *R* square (0.696) that accounts for the number of predictors also indicates this explanatory power. A relatively small average deviation of observed values from predicted values is indicated by the standard error of the estimate (0.39815), which indicates good prediction accuracy. Taken together, the model successfully describes the relationship between the explanatory variables and satisfaction with the current infrastructure.

1.9. ANOVA Table

Table 6. Analysis of Variance (Developed by Authors)

Model		Sum of squares	*df*	Mean square	*F*	Sig.
1	Regression	139.795	4	34.949	220.460	0.000[b]
	Residual	60.240	380	0.159		
	Total	200.035	384			

[b] Predictors: (Constant), FIN MEAN, TM MENA, UPS MENA, GSS MEAN.

ANOVA results show that the regression model with the predictor FIN MEAN, TM MENA, UPS MENA and predicting the SCI MEAN (satisfaction with current infrastructure) has a significant statistical value. The given fact that the F-value is 220.460, which indicates that the dependent variable's explained variance is greater than the unexplained variance by far, implies that the model is basically working well. The p-value of 0.000 implies that the likelihood of this result happening by chance is incredibly small, making clear the collective effects of all the predictors on the dependent variable. The regression sum of squares (139.795) tells us how much variance is explained by the predictors, and the residual sum of squares (60.240) is unexplained variability. The regression model is shown to be valid by the ANOVA analysis, which strongly supports the significant role of the predictors for explaining satisfaction with the current infrastructure.

1.10. Analysis of Coefficient

Table 7. Coefficients (Developed by Author)

Model		Unstandardized coefficients		Standardized coefficients	*t*	Sig.
		B	Std. error	*Beta*		
1	(Constant)	0.592	0.169		3.501	0.001
	TM MENA	0.178	0.039	0.171	4.583	0.000
	UPS MENA	0.277	0.050	0.223	5.505	0.000
	GSS MEAN	0.189	0.050	0.170	3.761	0.000
	FIN MEAN	0.531	0.053	0.416	10.039	0.000

[a] Dependent variable: SCI MEAN.

The coefficients table shows how much a particular variable contributes to the regression model used to predict SCI MEAN (satisfaction with current infrastructure). This baseline level of satisfaction, where all predictors are zero, is a constant value (B = 0.592, p = 0.001). Also, among the predictors, the most significant driver of satisfaction is FIN MEAN (future infrastructure needs), with a standardized coefficient (*Beta* = 0.416, p = 0.000). Likewise, there is a strong impact (*Beta* = 0.223, p = 0.000) on UPS MENA (utilities and public services); next on TM MENA (transportation and mobility, *Beta* = 0.171, p = 0.000) and GSS MEAN (green spaces and sustainability, *Beta* = 0.170, p = 0.000). This confirms that improvements in all variables have a positive effect on satisfaction with the current infrastructure, and all variables have positive coefficients. P-values of all the predictors are less than 0.001, validating their relevance in the model.

1.11. Hypotheses Testing

Hypothesis 1: Transportation and mobility (TM MENA) positively impact satisfaction with current infrastructure.

The transportation infrastructure is positively related to satisfaction with current infrastructure: B = 0.178, unstandardized coefficient for TM MENA. This relationship has proved to be statistically significant by the significance of value (p = 0.000). With this, we reject the null hypothesis and support the alternative hypothesis that improvements in transportation and mobility greatly increase satisfaction with infrastructure.

Hypothesis 2: Utilities and public services (UPS MENA) positively impact satisfaction with current infrastructure.

The B coefficient has a value of 0.277 and a significant level of p = 0.000 for UPS MENA. This result underscores the powerful and positive effect of utilities and public services on satisfaction. This variable has a huge influence, according to the standardized coefficient (*Beta* = 0.223). Since that, we reject the null hypothesis and support the alternative, and utilities and public services play a significant role in satisfaction.

Hypothesis 3: Green spaces and sustainability (GSS MEAN) positively impact satisfaction with current infrastructure.

Green spaces have a significant positive relationship with satisfaction (p = 0.000, B = 0.189), thus confirming the coefficient for GSS MEAN. It has a moderate impact on the standardized coefficient (*Beta* = 0.170). This means that the null hypothesis is rejected, and as a result, the alternative hypothesis is accepted, which proves that green spaces and sustainability play an important role.

Hypothesis 4: Future infrastructure needs (FIN MEAN) positively impact satisfaction with current infrastructure.

The most impactful predictor is FIN MEAN with B = 0.531. Strong support for the hypothesis is found in the significance value (p = 0.000). Its dominant role in shaping satisfaction is revealed through the standardized coefficient (*Beta* = 0.416). Despite this, the alternative hypothesis is reiterated that addressing future infrastructure needs has a significant impact on satisfaction.

CONCLUSIONS

This study examines the intricacies of urban infrastructure development in Sri Lanka, focusing on essential sectors such as transportation, housing, waste management, water systems, and electricity. It seeks to identify shortcomings, suggest feasible alternatives, and create a sustainable urban development framework. The results highlight the rigor of the research, the efficacy of the methodologies utilized, and the significance of the suggested remedies.

Transportation and mobility are critical elements of urban infrastructure, which significantly impact citizens' satisfaction levels. The research indicated that advancements in transportation systems, including improved accessibility, reliability, and capacity, favorably influence opinions of urban infrastructure, as demonstrated by a substantial *Beta* value of 0.171 (p = 0.000). Efficient transport networks enhance connectedness and convenience, essential for daily life in urban environments. These findings underscore the necessity of tackling issues such as traffic congestion, public transit inefficiencies, and accessibility discrepancies to guarantee a seamless commuting experience. Investments in contemporary transportation technologies, like intelligent traffic management and sustainable transit systems, may increase mobility and diminish environmental impact. Prioritizing transport infrastructure in urban design enhances quality of life and equity in cities, as gains in mobility are directly linked to citizens' quality of life and contentment with their urban surroundings.

Utilities and public services, including water supply, energy, sanitation, and waste management, are essential in determining satisfaction with urban infrastructure. The research demonstrated a significant positive correlation between utilities and public services and satisfaction levels, with a *Beta* coefficient of 0.223 (p = 0.000). Dependable and accessible public services are essential for the operation of metropolitan areas, directly influencing people's health, safety, and comfort. Insufficient or erratic utility services can result in discontent, interrupt daily activities, and present considerable public health hazards. This highlights the necessity for ongoing investments in the enhancement and upkeep of public service infrastructure to accommodate the increasing demands of urban populations. Furthermore, implementing sustainable practices, such as renewable energy integration and effective water management, can bolster the resilience and environmental sustainability of these services. Ensuring high-quality utilities and public services is essential for promoting urban satisfaction and facilitating sustainable city development.

Green spaces and sustainability are essential for enhancing urban life quality and fostering environmental health. The research revealed a substantial positive effect of green areas on satisfaction with infrastructure, indicated by a *Beta* value of 0.170 (p = 0.000). Urban parks, gardens, and sustainable planning projects offer leisure options while addressing environmental issues such as heat islands, air pollution, and biodiversity decline. Green infrastructure cultivates communal cohesion, improves visual attractiveness, and promotes the emotional and physical well-being of citizens. The results highlight the necessity of incorporating green spaces into urban design to establish balanced and resilient settings. Emphasizing sustainability in infrastructure development, including the integration of renewable energy and environmentally friendly materials, can enhance these advantages. By prioritizing green spaces and sustainability, cities may tackle ecological issues while improving citizens' satisfaction and quality of life, so rendering urban areas more habitable and sustainable.

Addressing future infrastructure requirements is essential for guaranteeing the enduring sustainability and operability of metropolitan areas. The research identified future infrastructure development as the primary determinant of satisfaction, with a *Beta* coefficient of 0.416 ($p = 0.000$). Urban inhabitants are progressively emphasizing proactive investments in housing, transportation, and public infrastructure to address population expansion and changing requirements. Proactive planning enables communities to anticipate and address difficulties such as overcrowding, deteriorating infrastructure, and resource constraints. The results underscore the significance of creative strategies, including smart city technologies and sustainable urban designs, in addressing future requirements. By cultivating adaptation and resilience in infrastructure, communities may more effectively serve their inhabitants while advancing economic growth and environmental conservation. Ultimately, addressing future infrastructure requirements is crucial for improving satisfaction, guaranteeing equitable access to services, and facilitating the comprehensive growth of metropolitan regions.

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