Gender Centricity of Indian Smart Cities: What Matters Most?

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Abstract

The paper analyses the concept of a 'Smart City' from the gender perspective, focusing on the knowledge implications for smart cities in India. The present study is a focused survey based on the opinion of experts to explore the gender perspectives in smart cities in a holistic manner by focusing on all critical gender dimensions that should find a place in projects and plans. As India has also embarked upon a Smart Cities Mission, the study tries to explore which gender perspectives are more crucial and what are the constituent features of these broader gender perspectives.

A structured questionnaire has been adopted to collect data from 99 respondents who are involved in policy making and implementing the Smart Cities Mission from 16 states of India. The study focused on five key dimensions of smart cities: Safety, Equal Opportunity to Work, Health and Hygiene, Infrastructure and Housing and Urban Mobility.

Analysis reveals that Safe Urban Mobility, Transportation and Infrastructure Development, Capacity Development and Community Based Solutions and Work Welfare are the most significant gender-centric indicators in smart cities. The research is an attempt to provide possible explanations to key functionaries involved in the Smart Cities Mission to plan and design gender-centric smart cities.

Keywords: Gender Perspective, Smart Cities Mission, Factor Analysis, Gender Centricity- Smart City Model (GCSCM)

Introduction

An ever-growing population and the strive for sustainability have given rise to several developmental paradigms where livability conditions are being challenged every now and then. Across the world as

civilisations grew and developed, many imbalances were created in the geographical, environmental, ecological and social spheres. These imbalances have several manifestations and dimensions which can be seen today.

In present times, for instance, a modern settlement or organised community life are faced by a number of challenges. To name a few, these range from waste management, preventive health care, poor air quality, traffic congestion and obstacles to mobility, social safety and security, energy distribution, resource optimisation, time management, ease of living and many more. Several such issues gave rise to the Smart City concept which stressed on how people can better live, plan, commute, transact and interact with social, geographical and political systems. The advent of technology has further necessitated the need to rethink how cities operate.

When urban ecosystems are being discussed, it is about men and women, young and the old, abled as well as disabled. Though the practical needs will be different for all categories, a smart city should ideally ensure ease of livability for all. In the wake of poor developmental indicators on women, the rising number of women related crimes and increasing concerns on safety, health and empowerment etc, smart cities require a gender lens too. When a nation's resources are committed to the development of new age urban systems, they cannot be devoid of gender centricity, and the present study tries to explore this in various ways. But before looking into the intersectionalities between gender and a smart city, a conceptual understanding of the concept is imperative.

Smart Cities

The term 'Smart City' has been used now for several years mostly by technology-based companies. However, the broader meaning refers to revamping of urban infrastructure in terms of accessibility to services, buildings, transportation and mobility, energy and water distribution, public safety etc. (Albert et al. 2009, Chourabi et al. 2012).

Conceptual definitions of most contemporary research and theories related to smart cities (Cocchia A., 2014; Komninos, 2018; Pardo & Taewoo, 2011) emerged after the year 2000, when technological breakthroughs and innovations were being witnessed across the developed nations. Therefore, it may be inferred that the broader understanding of the concept was related to technological integration for improvement of urban systems through the application of science and technology transformation. Some of the most important definitions by academicians have in fact highlighted the role of technology in smart cities thus focusing on how to become a smart city and not much has been spoken about what actually is a smart city.

"Smart Cities are the urban centers of the future, made safe, secure, environmentally green, and efficient because all structures—whether for power, water, transportation, etc.—are designed, constructed, and maintained making use of advanced, integrated materials, sensors, electronics, and networks which are interfaced with computerised systems comprised of databases, tracking, and decision-making algorithms" (Hall et al. 2000). "Smart Cities focus on quality of life of an urban environment by understanding the city dynamics through the data provided by ubiquitous technology" (Oliver, 2011).

Most of the authors put forth their propositions as to how technological developments and digital innovations can improve the quality of life in urban ecosystems (Bell, R. et al.2008; Komninos, N., 2009; Odendaal & Nancy, 2003; Vassilaras et al. 2010).

The submission here is that the prevailing research on the subject falls short of adequately understanding the components and dimensions of smart city development and seems to be overburdened by the emphasis on technology. As a common understanding, today smart cities are perceived as a technology driven urban ecosystem.

Holistic Understanding of Smart Cities

However, some studies are noteworthy highlighting the human and people related reading of the subject. Amongst them the most popular is the research published by Giffinger et al. (2007) where he attempts to drift from the common understanding of an excessive tech-centric perspective to a more "human-related reading of the subject." He stresses on people, mobility, economy, environment, governance and living. Similarly, other social and economic dimensions were discussed by Caragliu et al. (2009), where the focus was on participatory governance, natural resource management and investment in human and social capital. It was argued that Smart City is a holistic concept and technology is only a driver but the research in this domain has been largely restricted to application of technology-based solutions with a limited interdisciplinary approach where management of social, cultural, economic and political well-being was overshadowed (Williams & Edge, 1996). Therefore, gradually the limited understanding of the subject came to be criticised heavily and it was concluded that the strategic implementation of smart city projects will fail to give desirable results of sustainability due to its techno-centric imaginations (Aibar et al.1997; Hommels, 2005).

Research Gap and Questions

Despite the emergence of literature in the origin and development of smart cities, many aspects and perspectives specially with reference to gender centricity in India remain unexplored. The research so far on the subject suggests a varied understanding of the subject. It is surprising that most of the urban development plans and projects propose heavy investments into ICT based solutions and stress little on gender related issues. However, in the context of sustainability, gender perspectives occupy an integral position. Several researchers (Bansal, 2021; Beebeejaun, 2017) have attempted to study the intersectionalities between gender and a smart city. Governments, along with all stakeholders are responsible for creating better experiences for women in urban environments. Ultimately, to achieve gender equality in all aspects, it is imperative that women are viewed as important stakeholders and not just as beneficiaries. This will lead to a participatory approach where plans and actions, policy dialogues and budgetary commitments have gender perspectives incorporated within. In the context of sustainable development goals, critical aspects related to women's economic empowerment and equality, social welfare and health care and gender related crimes and discrimination have occupied centre stage in policy as well as planning. Therefore, like other developmental programmes the Smart City also cannot fall short of gender dimensions.

As India has also embarked upon a Smart Cities Mission, the study tries to explore which gender perspectives are more crucial and what are the constituent features of these broader gender perspectives. I repeat that most of the smart city projects have been conceived keeping in mind

the technological innovations. They are silent on more holistic aspects like gender centricity and inclusivity. The present study has been undertaken with a view to understand what makes gender-centric smart cities and which areas require policy interventions in smart city projects. Going forward, these areas can serve as performance parameters for gender appraisal of urban development projects. The authors have attempted to come up with a comprehensive list of indicators that define gender centricity of smart cities. The central objective of the study was to derive those gender-centric indicators which require policy attention for development of smart cities. This article tries to answer the following research questions:

- Can a conceptual model be developed to provide the important variables that determine gender centricity or inclusivity of smart cities in the country?
- What are the different indicators required to ensure the gender centricity of smart cities in the Smart Cities Mission of India?

Theoretical Background and Model Development

Women represent around half of the world's population with a representation of 49.6 per cent of the global population (United Nations, 2019). However, there is an absence of participative efforts and collective planning from the gender perspective in the development of smart cities. Academicians believe that the future of smart cities should talk about peoples' experiences and how to make them more fulfilling. Caitlin Kraft-Buchman discussed the dual nature of cities; she referred to popular representations of cities as "places of economic opportunity, liberation, and reinvention," but conversely also of "fear, danger, and violence for women, from dark city streets to public transport."

Academicians have suggested that gender inclusive smart cities can be achieved in various ways. Technology can be used in three ways to ensure a gender inclusive smart infrastructure design: Firstly, it can provide platforms for city planners to engage and interact with women in cities to understand their needs. Secondly, it can help in better analysing the problems confronted by women in cities using real-time data. Smart city applications can be designed to continuously collect and monitor gender disaggregated data and adequately respond to the needs of women. For example, existing evidence suggests that the mobility pattern of women, including mode of transportation, time and frequency of journey, are quite different from that of men (Leydesdorff et al. 2011; Macke et al. 2018; Sauer, 2012; Voytenko et al. 2015).

It is encouraging that in recent years most smart city projects have realised the importance of incorporating gender needs into their plans. For instance, in India, NITI Aayog in their paper "Reconceptualising Smart Cities: A Reference Framework for India" (Bhattacharya et al. 2015) have proposed a few gender related needs in terms of transport and safety, but a strategic road map or plan of action at policy level is yet to be rolled out.

In the context of smart cities, United Nations Women (UN Women) has time and again cautioned that most of the critical gender aspects are missing in urban planning approaches. "Programmes generally lack critical inclusion aspects. More opportunities for livelihood do not automatically translate into inclusion, especially gender concerns" (UN Women, 2012).

Therefore, although discussions around gender concerns and perspectives in urban planning have been increasing at a fast pace, it has also been realised that gender-centric planning is a missing but important ingredient of urban planning or the more recent smart city development initiatives. Urban safety is an important gender dimension and one of the most talked about in the context of increasing number of crimes and violence cases amongst women. According to UN Women, "A safe city for women is a city where women can enjoy public spaces and public life without fear of being assaulted, and where violence is not exercised against women in either the home or the street." The importance of women's safety in urban spaces should occupy a central position in activities related to urban planning (Mahadevia et al. 2019; Leao et al. 2019; Ceccato, 2012; Sur, 2014; UN Women, 2019). The growing gender gaps in urban infrastructure have to be addressed to foster safety and security of women in cities (KPMG, Global 2019).

The incorporation of the gender perspective in urban planning and design is however not only limited to safety but several other dimensions as well, such as "use of public services and spaces," "mobility", "health and hygiene", "climate resilience", "equal opportunity for work", "right to housing and asset ownership" and other such aspects (World Bank, 2020; Chant, 2013). Urban infrastructure, especially housing for women has also been stressed upon as an important indicator of gender-centric cities over the past two decades (Larsson, 2001; Moira, 1989; Skaburskis, 1997; Varley, 1993; Walker et al. 2013). Despite this, most smart city projects are silent on housing and infrastructure aspects related to women.

Similarly, issues related to sanitation, health and hygiene are pressing gender issues that need to be looked into to achieve holistic urban planning. In the wake of rapid urbanisation, urban health and clean environment occupy a prominent position in planning (Butsch et al. 2012; Chaplin, 2017). Sanitation is particularly a major concern. According to United Nations General Assembly, "Sanitation was established as a separate human right by the United Nations General Assembly in January 2016." The inequalities in access to urban sanitisation continue to affect the health of women and girls. Studies have shown that there is tremendous social, physical and emotional pressure and stress on women due to improper access to water and sanitation (Phadke et al. 2011; Tilley et al. 2013; Truelove, 2011). There is absolutely no dearth of literature to show that gender mainstreaming and sanitation programmes have not been properly implemented, adding much to the woes of women particularly in slum areas with little access to basic sanitation facilities such as community toilets. An extensive bibliometric study by Susan Chaplin in 2017 brings out such nuanced observations on several issues related to gender and sanitation in general, and particularly to the Indian urban context.

Again, in the urban context, although employment opportunities are more as compared to the rural areas, equal access to such opportunities is still questionable. This is mainly due to economic inequality in the labour market and a disproportionately higher burden of care work and unpaid labour (Fraser, 2014; Sayer, 2005). Yet another reason could be hostile transport systems and mobility related issues. A meticulous review of literature reveals that mainstreaming gender in urban development and planning involves several dimensions. Each dimension can be thought of as a broader construct of 'gender well-being', comprising various indicators or parameters that drive the overall dimension.

In her paper titled "Addressing Gender Concerns in India's Urban Renewal Mission" for the UNDP, Dr. Renu Khosla (2009) discusses the multiple facets of gender in urban infrastructure development and suggests ways for mainstreaming gender and achieving good urban governance where women are not viewed only as beneficiaries but active partners and stakeholders of planning and implementation. The study puts forth many differential impacts of urban development on men and women. These are in the form of Access to Municipal Services like water and sanitation, Women's Rights to Urban Spaces – Land, Housing and Finances, Access to Livelihoods and Employment, Right to Social Services like health care and education, Safety and Security, and Urban Transport. The study further elaborates on each of these dimensions by enlisting micro-level parameters that need to be addressed through proper implementation.

Measures

Amidst the rising concerns of gender centricity in smart cities, the present study is an attempt to explore the gender perspectives and related indicators or workable areas so as to achieve this objective. The study carefully examines the available literature on the subject and based on that identifies five major pressing gender related issues which are of prime importance in gender inclusivity of smart cities for the future. The study variables are as under:

a. Independent variables:
    Safety, Equal Opportunity to Work, Health and Hygiene, Infrastructure and Housing and Urban Mobility. The questions and scales to measure these variables are presented in Appendix II.
b. Dependent variable:
    Gender Centricity of the model (Figure 1).

Figure 1: Hypothesised Conceptual Model: Gender Centricity in Smart City Model (GCSCM)
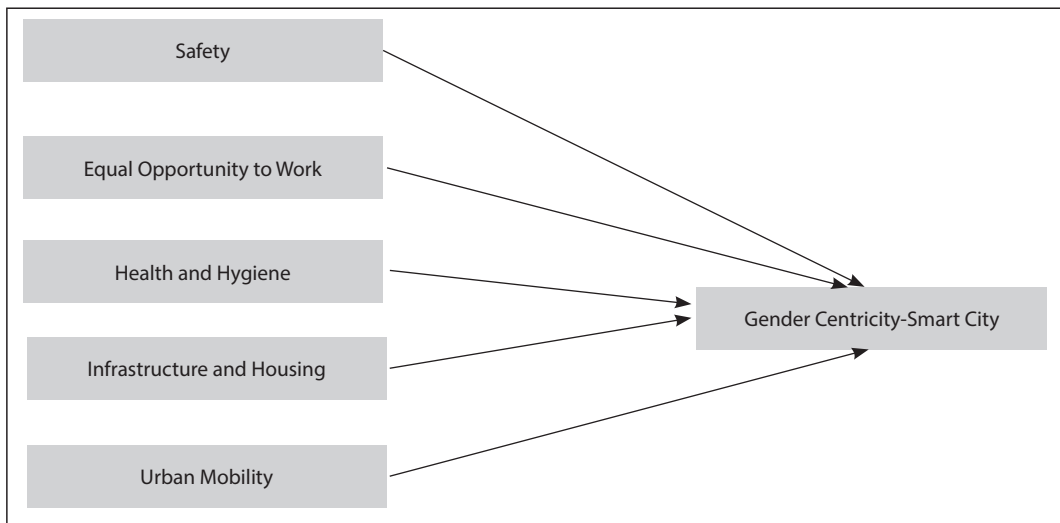
Methodology

The present quantitative research is conducted through a survey designed to collect responses. However, in the present study, researchers opted for empirical quantitative research methods.

Item Development

There is no dedicated and suitable questionnaire available that could be used to collect responses. Therefore, the researchers developed the present study's items after a robust literature review. From these, a total of 29 items were created and measured via a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree). Validation of items was done with the help of expert judgement. The expert panel comprised two academicians and two field practitioners. The list of all possible items based on the literature review was placed before the panel for deliberation and discussion. Finally, a grouping of items was done after two rounds of discussion with the experts. The final questionnaire was developed based on the feedback given by the experts by including five core factors: Safety (eight items), Equal Opportunity to Work (seven items), Health and Hygiene (five items), Infrastructure and Housing (four items) and Urban Mobility (five items). The complete list of all the items is presented in Appendix I.

Participants and Procedures

The present study has been conducted from the perspective of planners and policy makers who are involved in urban development and related activities. The selected participants were also the participants of Gender Budgeting and a Smart Cities National Level Workshop which was sponsored by Ministry of Women and Child Development, Government of India, New Delhi. The participants were civil servants, district planners and CEOs of *zilla parishads*. They had been nominated by their respective government departments at state as well as national level. The demographic analysis of the respondents is presented in Table 1.

Table 1: Demographic Details of Participants in Survey

Item	Type	Frequency	Per Cent
Gender	Male	61	61.62
	Female	38	38.38
Age Group	25–35 years	12	12.12
	36–45 years	36	36.36
	46–55 years	29	29.29
	56 years and above	22	22.22

Source: Author's Compilation from Data

A purposive sampling approach has been applied to collect data in the electronic form. The participants were selected on the basis of their profile and role in smart city development. The study sample consisted of officers involved in the planning and implementation of smart cities and other related projects of urban development. The data was collected from November 2019 to February 2020 from 16 states across India. A total of 121 questionnaires were collected. However, some of them were found to be incomplete or ambiguous and therefore were discarded for further analysis. Finally, 99 questionnaires which were complete in all respects were found suitable for inclusion in the study.

The results of this study must be viewed in light of some limitations. Although the study started with a rigorous literature review on the chosen topic, still researchers don't claim its findings as holistic as much more research is possible in this area. Despite the fact that the participants for the study are from across India and accomplishing statistical support, the factors relevant to gender inclusivity in smart cities in India need further testing and this conceptual model (GCSCM) can be considered as a base framework. Further research in this field would do well to widen the required dimensions to ensure that the developed instrument is operational and effective for the long term with different sub-groups. It can be undertaken to develop indicators on other criteria such as, for the 'short term' or for the 'long term', 'economic' or 'social' influencers. Another limitation of this work is that it is confined to understanding gender inclusivity in smart cities from a few stakeholder perspectives but this could also be studied from the point of view of common citizens.

Data Analysis

The study is exploratory in nature as the literature reveals that there are a host of factors that determine gender centricity of cities. Planners and researchers across countries have attributed varied importance to these dimensions. In the Indian context, it is important to explore the important variables that determine gender centricity or inclusivity in smart cities in the country. Hence, Factor Analysis was used. "Factor analysis is a technique for identifying groups or clusters of variables towards any object" (Field, 2005). These clusters are grouped as a factor and further interpretations are made by segregating items with high loading and finally extracting a smaller number of relevant factors (Bryman & Cramer, 1999).

The statistical method for factor analysis used in the study was Principal Component Analysis. The use of PCA technique has become increasingly popular in the social science domain and it can be used on ordinal as well as presence–absence data (Syms, 2008).

This was found suitable as a large number of factors were to be reduced to the most important set of components requiring immediate policy attention. In terms of gender, the observed variables are highly correlated to each other and had similar response patterns. This is a prerequisite for applying factor analysis as a statistical method and further, the principal component analysis was applied (Bryant et al. 1995; Wood et al. 1996). For instance, urban mobility is intricately linked to safety, infrastructure, and opportunity to work. In order to study observed highly correlated factors, the method was employed as the most suitable technique to identify fewer gender dimensions of integral importance.

The study focuses on five key dimensions of smart cities: that is Safety, Equal Opportunity to Work, Health and Hygiene, Infrastructure and Housing and Urban Mobility. Each of the five dimensions was explored through a structured instrument to capture those indicators which are

integral to gender centricity. The sub-items under each of these were presented in a set of Likert scale statements. The indicators and items were derived through extensive literature review and expert judgement.

As discussed earlier, the five thematic areas so identified have been split into constituent indicators which have been represented in the form of affirmative statements on a Likert Scale Continuum ranging from 1 (strongly disagree) to 5 (strongly agree). The responses captured have been subject to Statistical Analysis in Advanced Microsoft Excel. According to the requirement of the study, statistical tools like factor analysis have been used to arrive at inferences. The principal component analysis method was used in factor analysis.

Results and Discussion

The results of the principal component analysis have been discussed below. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test (Lee, 2007) is applied for testing the suitability of the data for application of factor analysis and association between variables under study. Simply stated, "KMO measure of sampling adequacy is a test to assess the appropriateness of using factor analysis on the data set" (Mikkelsen, 2019). The results are presented in Table 1. The results show a KMO value of 0.755 (Table 2) which is greater than the acceptable value of 0.6 (Lee, 2007).

The principal component analysis method was executed (Wood et al. 1996) and the results (Tables 3A, 3B, 3C) reveal that the 29 indicators spread across five variables are constituent of four major gender dimensions. These four dimensions or components which are latent constructs of gender centricity have been called C1, C2, C3 and C4. Only significant correlations above 0.5 have been considered for mapping of factors to components (C1, C2, C3, C4). The four components are discussed subsequently (refer to the Annexures for factor descriptions).

C1 is categorised as Safe Urban Mobility; C2 as Transportation and Infrastructure Development; C3 as Capacity Development and Community Based Solutions and C4 as Work Welfare. These four major dimensions are latent variables which describe the level of gender centricity of a smart city. The four have been indirectly derived from the measurement of 29 indicators after running the factor analysis through the PCA method. Since most of the correlations are quite significant, their contribution to factor loadings in explaining the overall variance in the study is justified.

The indicators related to safety, security and protection of women exhibit a high degree of correlation with C1 that is Safe Urban Mobility. This implies that safety is of utmost importance to development of smart cities. The indicators (sub–items) mapped to the component are basically a manifestation of the identified latent component, that is, Safe Urban Mobility. It strengthens the argument that issues relating to safety of women and their freedom to move around from place to place significantly impacts their ability to work.

The second important aspect is gender-centric infrastructure development. Transportation, housing, hostels and health care is also of prime importance when gender- centric infrastructure is to be developed. Good transportation systems, hostel facilities for working women, good health care services and affordable housing can significantly increase the participation of women in the workforce by taking care of their basic needs. All the indicators mapped under this component bear a high degree of correlation with identified latent component C2, that is, Transportation and Infrastructure Development.

The third important aspect which was identified as latent component C3 is Capacity Development and Community Based Solutions. Issues related to skill development and confidence building should be addressed in order to develop sensitive and responsible community-based organisations. To build gender-centric cities, there is a need to strengthen social institutions through capacity development, education and sensitisation. A gender-neutral approach of all stakeholders is very important while crafting important policy decisions. Going forward, the presence of strong social institutions like schools, NGOs, community-based models should be the hallmark of a city that is capable of solving its problems through a participatory approach.

The last latent component, C4, has been categorised as Work Welfare. Sub-items related to this component talk about political, economic and social benefits to women to increase their workforce participation. State benefits like maternity leave, day care etc. act as high motivators for a number of women to join the workforce as they majorly contribute to care work in families which includes care of children, sick and the elderly people. In view of this, policy makers should concentrate not only on provision of basic hygiene factors like clean washrooms and safe drinking water but also take care of the long-term welfare of working women. This involves legal provisions related to labour laws, entrepreneurship development and promotion of women-centric organisations. Thus, the constituent component, Work Welfare has also been identified as an important gender dimension of smart cities.

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.755
Bartlett's Test of Sphericity	Approx. Chi-Square	3441.184
	Df	406
	Sig.	.000

Table 3A: Principal Component Analysis

	Communalities	
	Initial	**Extraction**
S1	1.000	.743
S2	1.000	.674
S3	1.000	.768
S4	1.000	.845
S5	1.000	.699
S6	1.000	.774
S7	1.000	.584
S8	1.000	.802
EO1	1.000	.897
EO2	1.000	.818
EO3	1.000	.922
EO4	1.000	.648
EO5	1.000	.732
EO6	1.000	.691
EO7	1.000	.691
HH1	1.000	.849
HH2	1.000	.833
HH3	1.000	.737
HH4	1.000	.898
HH5	1.000	.904
IH 1	1.000	.683
IH 2	1.000	.802
IH 3	1.000	.757
IH 4	1.000	.641
UM 1	1.000	.791
UM 2	1.000	.821
UM 3	1.000	.800
UM 4	1.000	.893
UM 5	1.000	.691

Note: Extraction Method – Principal Component Analysis

Source: Statistical Output of Primary Data from Advanced Microsoft Excel

Table 3B: Total Variance

Com-ponent	Initial Eigen Values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Vari-ance	Cumula-tive %	Total	% of Vari-ance	Cumula-tive %	Total	% of Variance	Cumu-lative %
1	12.862	44.353	44.35	12.8	44.353	44.353	5.76	19.865	19.86
2	3.258	11.234	55.58	3.25	11.234	55.587	5.12	17.678	37.54
3	2.963	10.217	65.80	2.96	10.217	65.804	4.84	16.712	54.25
4	2.235	7.705	73.50	2.23	7.705	73.509	4.50	15.535	69.79
5	1.068	3.682	77.19	1.06	3.682	77.192	2.14	7.402	77.19
6	.886	3.054	80.24						
7	.817	2.816	83.06						
8	.707	2.437	85.50						
9	.553	1.905	87.40						
10	.519	1.789	89.19						
11	.447	1.542	90.73						
12	.412	1.422	92.15						
13	.379	1.307	93.46						
14	.313	1.081	94.54						
15	.290	1.000	95.54						
16	.241	.830	96.37						
17	.198	.682	97.05						
18	.154	.531	97.59						
19	.135	.465	98.05						
20	.120	.414	98.46						
21	.096	.331	98.80						
22	.083	.288	99.08						
23	.068	.236	99.32						
24	.061	.209	99.53						
25	.044	.151	99.68						
26	.037	.127	99.81						
27	.023	.081	99.89						
28	.022	.077	99.96						
29	.009	.031	100.0						

Note: Extraction Method: Principal Component Analysis

Source: Statistical Output of Primary Data

Table 3C: Rotated Component Matrix

Variables	Component			
	Rotated Component Matrix			
	1	**2**	**3**	**4**
S6	0.816			
S4	0.809			
S8	0.797			
IH 4	0.677			
S2	0.672			
S5	0.648			
S7	0.56			
S3	0.515			
EO1		0.899		
UM 1		0.849		
HH1		0.806		
IH 3		0.655		
EO6		0.647		
IH 2		0.581		
UM 5		0.546		
S1		0.546		
UM 4			0.8	
HH3			0.783	
IH 1			0.688	
EO7			0.676	
UM 3			0.627	
EO5			0.599	
EO3				0.918
EO4				0.769
UM 2				0.767
HH4				0.691
HH2				0.554

Note: Extraction Method: Principal Component Analysis
   Rotation Method: Varimax with Kaiser Normalisation, a rotation converged in 16 iterations

Source: Statistical Output of Primary Data

Concluding Remarks and Future Research

In this study, we made an attempt to explore the gender perspectives in smart cities and related indicators or workable areas so as to achieve gender centricity. In the light of the study's results, the authors suggest that any urban planning project should develop a performance yardstick based on these four dimensions. While a smart city should take care of day-to-day safe movement of women, it should also focus on developing more inclusive infrastructure and transportation systems. In order to increase participation of women in the workforce and enhance their employability, policy makers should promote work welfare and undertake capacity development of all stakeholders and encourage a participatory approach towards development. More economic opportunities should be created for women in smart cities by focusing on short-term and long-term needs. Important aspects are safety, availability and accessibility of work benefits, good transportation systems, people centric planning, capacity building, sensitisation of stakeholders. These should be prioritised in smart city planning. It is important to conduct gender-centric appraisals of smart cities by using these indicators.

Thus, without having a proper gender-based framework of development, a city cannot transform into a safe and smart city. A major consideration in the development agenda of a smart city is that we have to concentrate on a gender inclusive, fast and secure development strategy. Without considering gender security and development, cities cannot develop. The smart city with gender security will be the best answer to the problems that urban areas are facing today More studies are required to confirm the conceptual framework developed in this study. This may be done by analysing the gender centricity of current smart cities in India. The study has included five critical dimensions, and efforts can be made to make the framework more exhaustive by including more critical factors based on experiences and perceptions of citizens in general and women in particular.

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Annexure I: Survey Instrument

Construct	Questions	Code Assigned
Safety	The waiting time for buses, metros, trains and other public transports should be reduced	S1
	Proper lighting and electrification of community places and markets are very important to ensure safety	S2
	Technology based ICT solutions should be promoted to ensure safety during emergency situations	S3
	Capacity development and training in areas like self-defence should be mandatory in schools and colleges	S4
	Lack of visible police or civil guards during the late hours can cause security issues for women	S5
	Proper signage and display of important phone numbers can promote safety of women	S6
	Extra security force is required at clubs and pubs which are more prone to gender crimes	S7
	Capacity building of social institutions like schools, colleges, hospitals, community centers, health centres etc. should be undertaken regularly	S8
Equal Opportunity at Work	The number of working women's hostels should be increased in smart cities	EO1
	Entitlement to maternity benefits should be mandatory as per extant government rules	EO2
	Compulsory crèche and day care facilities should be provided as per extant government rules	EO3
	More women-oriented organisations should be promoted by state governments to encourage more women entering the workforce	EO4
	Capacity building of small and medium sized women entrepreneurs should be done regularly through Skill Training Centers	EO5
	Need based grants and scholarships should be made available for upgradation of qualification and skills	EO6
	More women should be employed as drivers, conductors, at petrol stations, as security guards etc. to promote active citizen engagement and gender confidence	EO7
Health and Hygiene	The number of working women's hostels should be increased in smart cities	HH1
	Entitlement to maternity benefits should be mandatory as per extant government rules	HH2
	Compulsory crèche and day care facilities should be provided as per extant government rules	HH3
	More women-oriented organisations should be promoted by state governments to encourage more women into the workforce	HH4
	Capacity building of small and medium sized women entrepreneurs should be done regularly through Skill Training Centers	HH5

Construct	Questions	Code Assigned
Infrastructure and Housing	Smart Cities Mission has a largely gender-neutral approach in the context of infrastructure development	IH 1
	Affordable housing should be the top priority of the Smart Cities Mission	IH 2
	Building smart cities starts with people, not technology	IH3
	Smart infrastructure in smart city development should be gender inclusive	IH4
Urban Mobility	Increasing the frequency of public transport can lead to gender well-being in terms of urban mobility	UM1
	Exclusive transport for women in metros, trains, buses should be available in smart cities	UM2
	Good eating facilities at reasonable rates should be should be available in smart cities	UM3
	Multipurpose community centers and clubs should be developed by urban local bodies to foster socialisation and freedom of expression	UM4
	There is a need to engendering set-ups like Ola and Uber car pools, transport associations etc. through campaigns	UM5

Source: Authors Representation of the Survey Instrument