Review of Performance Indicators of Smart Cities in India – Ease of Living Index: a case of Lucknow Smart City

Revisión de los indicadores de rendimiento de las ciudades inteligentes en India: índice de facilidad de vida: un caso de Lucknow Smart City

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ABSTRACT

The objective of the paper is to understand the measurement approach of 'Ease of Living' concept of Smart Cities in India under the Smart City Mission with sample case of city of Lucknow of Uttar Pradesh. The city Lucknow was chosen for study, as sample case, being a city selected in the Indian Smart Cities Mission, a surprise selection under the smart city mission and good rank in 'Ease of Living' index results, both of which require merits in multidisciplinary aspects in a city and fitness of its development strategy. In this study of Lucknow city, it was observed that Ease of Living Index has few gaps in measuring the situation, as there is little clarity on 'on ground' situation from the index especially from perspective of strength and weakness of city. The study is to explore impact in ground realities as observed in the index results in weakest and strongest sector of city services.

Keywords: Smart City, Smart Cities India, Smart Cities Mission, Ease of Living Index, Liveability Index, Performance indicators of Smart Cities India

RESUMEN

El objetivo del documento es comprender el enfoque de medición del concepto de 'Facilidad de vivir' de Smart Cities en India bajo la Smart City Mission con el caso de muestra de la ciudad de Lucknow de Uttar Pradesh. La ciudad de Lucknow fue elegida para el estudio, como caso de muestra, siendo una ciudad seleccionada en la Misión India de Ciudades Inteligentes, una selección sorpresa bajo la misión de ciudad inteligente y una buena clasificación en los resultados del índice 'Facilidad de vivir', los cuales requieren méritos en multidisciplinario. aspectos de una ciudad y la adecuación de su estrategia de desarrollo. En este estudio de la ciudad de Lucknow, se observó que el Índice de Facilidad de Vida tiene pocos vacíos en la medición de la situación, ya que hay poca claridad sobre la situación "sobre el terreno" del índice, especialmente desde la perspectiva de las fortalezas y debilidades de la ciudad. El estudio es para explorar el impacto en las realidades del terreno como se observa en los resultados del índice en el sector más débil y más fuerte de los servicios de la ciudad.

INTRODUCTION

A variety of concepts come up as we discuss Smart Cities in India. There are different views as there is no one definition (Housing and Urban Development Ministry, India, 2017) under Smart Cities Mission. Some are pertaining to local challenges and aspirations, some focused at the socio-economic situation, some eye purely socio-economic aspects, a few are rooted in search for solutions; some of them link it to different sciences like climatological and cultural heritage of ancient Indian civilisation. Few experts have concluded that Smart Cities in India are dependent and thus will be driven through private partnership models in urban development, to have any specific definition. Few experts find them to be purely Information and Communications Technology (ICT) driven system establishments. Sentiments have also travelled the physical aspect of smart city between the two extreme ends of modern development between machinations of Dynamic Architecture and nature aligned Sustainable Design. But it doesn't attend to few much-needed resolutions on consequences of Smart City development. Like consequent Smart City projects will be Inclusive Development versus virtually Gated Communities as a consequence of high infrastructure and maintenance costs. The City Development Plans (CDP), one of the most criticised aspects of JNNURM, came out with statistics of gap in infrastructure and consequent demand (huge requirements) of funds and almost no vernacular resources to arrange them. Apparently Smart City Mission is consequence of combination of following:

• Need for an improved administration with control and definite deliverables in priority urban development programs

• Need for means for project funding and

• Need for creating employment in urban centers.

As all cannot be done in one time, so the mission aims at formalising development priorities through Sample Projects in Sample Cities. Three aspects were pivotal for the development of 'Ease of Living' parameters to track progress in Smart Cities under the mission: -

• Sustainable Development which is addressed through tailor-made parameters.

• Coordinated and efficient management of City Services. Electronic integration with availability of data to establish processes in place.

Planning on priority projects with clarity on fund arrangements from the proposed projects to economically sustain the projects.

MATERIAL AND METHODS

Objective: The objective of the paper is to understand the measurement approach of 'Ease of Living' concept of Smart Cities in India under the Smart City Mission with a sample case.

Relevance of Study: The smart city in India is being measured by performance of city and the Smart City Mission contributes to betterment of city performance through various means. The mission can be broadly divided into two parts:

· New development under Area Based Development or Greenfield Development and

· Overall improvement of city infrastructure via Pan City Projects.

In both the cases it is difficult to measure the progress and consequences of the projects undertaken. So, there are three aspects that concern us in the measure of 'Performance of the Smart City', namely

· Measure of performance of smart city as per mission guidelines.

· Choices of projects and future of city

· The informal systems and practices in city administration.

The third aspect is most critical as it brings up lack of certainty in above two. It is also one of the most crucial reasons because of which data is not available in most of the government offices. Following ground situations are in foundation of the apprehensions: -

Lack of public involvement in development programs, though they are pivoted on public consultation. "Smart Cities" describes the set of technologies, systems and methodologies that could enable the spread of more efficient and effective city-enabled operational applications.[1] At the heart of Smart Cities are big data (data analytics and fusion) and cloud-based sensor intelligence. Most of the analysis on Smart Cities has been geared towards town planning but if these initiatives are to be effective, they will require simple model for public participation. While there is another aspect of Smart Citizens for Smart Cities, to attend relevance on extent of use of technology, as there is lack of smart manpower which has understanding of good design with knowledge of technological advancements. As mentioned in the previous paper by the author.

The informal operations and arrangements in government bureaucracy, though there are definite guidelines. Administration works on sensitive issues and routine issues differently. Sir Mark Tully Delivered the third 'Buch Memorial' Lecture on "Challenges of Governance in India" organised by National Centre for Human Settlements & Environment (NCHSE) in Bhopal on 5th October 2017, 'Corruption is just a symptom of bad governance' 'Digital working will decrease corruption'. 'Technology is never going to be perfect'. 'For the bureaucracy, the approach sticks to what is written in the book rather than the reality in experience at ground level.' [2]

Methodology: In this study we have first understood the smart city model and analysed it. Then we have analysed the rating system and how it is being done. The government had studied ease of living index in a city which has been completed by us by studying each indicator. We have recorded all the issues and our observation about the indicators. Then we have analysed the weakest and strongest sector to understand the current situation. Then we have observed the impact of ease of living indicator rating on the ongoing projects. The paper is primarily limited to 'Governance' aspect in Smart City Mission in India. A multi-level enquiry with systematic survey, interviews, public and expert consultations, study of Indian Smart City Mission and practical application in a city, study of international Smart City programs, study of different models of smart city suggested by experts and practitioners. The data from website of mission program was used for quantitative

methods. The official documents and proceedings were documented through interactions in various offices for getting the official data for measure of Ease of Living Index.

1. Determinants of Ease of Living Index:

Measure of Smart City: The index exercise was launched in January 2018 by Ministry of Housing and Urban Affairs (MoHUA) which is described in detail in previous paper by the author.[3] it is assumed in this paper that smart city concept has following key aspects (Tomer et al. 2014)

· Smart Cities begin with an economically-driven, technologically-focused vision

· A successful city specific vision which must address three key economic drivers, productivity, inclusivity, and resiliency

· Cities must reform government to successfully implement their economic vision

· Cities must balance the relationship between project scale and risk tolerance

· Cities require stronger networks and improved communication tool. [4]

1.1 Relevance of determinants of Ease of Living Index

Liveability can be measured by measure of 'Standard of Living' or 'Quality of life'. MoHUA's Liveability Index combines elements of both approaches. Standard of Living can be measured by Level of material goods and necessities available to a certain socio-economic class in a certain geography measured through Income, Wealth, Consumption and flourishing economy. Ease of Living Index is calculated with critical indicators and is aimed to:

· Ease planning decisions.

· It measures status of various government schemes, missions and programmes, PMAY, AMRUT, Digital India, HRIDAY, Swachh Bharat Mission,

· Establishes a system for collection of data.

· It gives peer status, locally and internationally.

· It gives status of various goals in a city

· Good Health – 10 indicators

· Quality Education – 6 indicators

· Clean Water and Sanitation – 12 indicators

· Good Jobs and Economic Growth – 8 indicators

· SDG goals - Sustainable Cities and Communities – 30 indicators

· Peace and Justice – 7 indicators

· Partnership for Goals – 2 indicators

There are various measures as indicators for ranking the programs based on objectivity and purpose. The setting of indicators is as follows:

1.1.1 Input Indicators

These indicators refer to the resources needed for the implementation of an activity or intervention, measuring the quantity, quality and timeliness of resources. CITY keys indicators list following as input

indicators: (development of) smart city policy, smart city expenditures, cross departmental integration of smart city policies, establishment within the administration, monitoring and evaluation of smart city projects. So, policies, human resources, materials, financial resources are input indicators which in case of major Indian cities are compiled in the CDP. India has 40 cities with more than a million people, 397 cities with between 100,000 and 1 million people, and over 2500 cities with between 10,000 and 100,000 people. [5] CDP is a concept evolved out of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) for listing city vision, financing and project implementation work but with no statutory backing.

1.1.2 Process Indicators

Process indicators focus on proceedings of agenda and assurance of its success. Improvisation of operation systems and mechanism of government machinery shall fall in Process Indicators. CITYkeys indicators: interoperability; cyber security; privacy, improved digital literacy; There is lack of infrastructure and manpower and hence there is little stress on process indicators.

1.1.3 Output Indicators

Output indicators are measure of quality and quantity of output of the activity. CITYkeys marks following as output indicators: online services, number of open datasets; quality of open datasets; number of innovation hubs in the city. Service Level Benchmarking (SLB) is a type of Output Indicator with documentation on tangible attributes of the program which has been developed to

・ To identify a minimum set of standard performance parameters for the water and sanitation sector that are commonly understood and used by all stakeholders across the country; [6]

・ To define a common minimum framework for monitoring and reporting on these indicators.

・ To set out guidelines on how to operationalise this framework in a phased manner. [7]

・ The scheme for the disbursal of Performance Grant was revised by MoUD keeping in mind the transformational urban reforms. The ULBs are at the forefront of this shift, based on the decentralisation agenda articulated under the 74th Constitutional Amendment.

Table 1: Indicators in Service Level Benchmarking

INDICATORS			
Water Supply	Storm Water Drainage	Sewage Management	Solid Waste Management
Coverage of water supply Connections	Coverage of storm water drainage network	Coverage of toilets	Household level coverage of solid waste management services
Per capita supply of water	Incidence of water logging/ flooding	Coverage of sewage network services	Efficiency of collection of municipal solid waste
Extent of metering of water connections		Collection efficiency of the sewage network	Extent of segregation of municipal solid waste

Extent of non-revenue water	Adequacy of sewage treatment capacity	Extent of municipal solid waste recovered
Continuity of water supply	Quality of sewage treatment	Extent of scientific disposal of municipal solid waste
Quality of water supplied	Extent of reuse and recycling of treated sewage	Efficiency in redressal of customer complaints
Efficiency in redressal of customer complaints	Efficiency in redressal of customer complaints	Extent of cost recovery in SWM services
Cost recovery in water supply services	Extent of cost recovery in sewage management	Efficiency in collection of SWM charges
Efficiency in collection of water supply-related charges	Efficiency in collection of sewage charges	

1.1.4 Outcome Indicators

Outcome indicators scale, quality, and quantity, of spread of the program. CITY keys mentions following as outcome indicators: access to high-speed internet; people reached by the project. Following are some outcome indicators from various organisations,

Table 2 Methodology by various organisations for computing Smart City Rankings.

Organisation	Smart City Ranking Methodology
Fast Co Exist	City rankings in Innovation, Quality of Life, Sustainability, Digital Community and Digital Governance
Institution of Mechanical Engineers (IMechE)	Smart City Initiative, Innovation, Indigenous Development Strategies, Sustainability
ACCIONA (Sustainability for All)	Governance, Urban planning, public management, Technology, environment, International projection, Social cohesion, Mobility and transportation, Human capital and economy
Institute of Information Sciences, Shanghai Academy of Social Sciences	Internet space, Physical space, Economic space, Digital creativity, Content originality, Smart service, Smart management
Global Smart City – 2015 (Juniper Research)	Use of smart grids, smart traffic management and smart street lighting, alongside aspects such as technological capability and social cohesion, among others.

Source: CSTEP Analysis, Center for Study of Science, Technology and Policy, Bengaluru, Karnataka, INDIA www.cstep.in [8]

1.1.5 Impact Indicators

Impact indicators identify long term influence of the policy of the program. The indicators with broader base of study and long period evaluation would be accounted as impact indicators.

1.2 Various measures of Liveability Index

Liveability Index is a study of key factors that determine the degree of liveability of cities throughout the world. The mission of the Index is to measure the compatibility of a city through given different parameters. Despite various subjective interpretations of the concept, numerous measurement tools have been developed to rank cities according to the amenities and opportunities offered to their residents in the liveability context. The most notable include the Economist Intelligence Unit's liveability index, the Mercer Quality of Living Index and OECD Better Life Index (BLI). These indexes and their indicators are briefly discussed in previous paper "Review of Performance Indicators of Smart Cities in India – Ease of Living Index: a case of Jabalpur Smart City." By the author.

2. Evolution of 'Ease of Living' as index in Smart City Mission in India

Launched in 2015, the Smart City Mission aspires to develop cities that will "provide core infrastructure, a decent quality of life to its citizens, clean and sustainable environment and application of Smart Solutions". [9] The driving forces of city planning are pivoted upon competitiveness and sustainable development in the urban areas. On the lines of evaluation of Smart Cities India, the first official document is the 'Exploratory Research on Smart Cities' by PEARL, framed in 2014.

The reports submitted by competition cities were made up of high-tech buildings and streets financed through investment options. It was found that most of the cities, unlike the intent of the mission, had least focus on city specific 'issue resolution development models. Since then Bureau of Indian Standards BIS had attempted means to establish the structure for the Smart Cities Framework. The document had consistent focus on conditions of Indian situations, Indian needs and needed action. The BIS team gave a set of 46 core and 47 supportive indicators to establish national standards for smart cities. Which are given in previous paper by the author. So, to not to complicate the mission, in the year 2016, government of India devised 'Liveability Index' as measure of goodness of Smart City. The key aspect 'Sustainable Development' was maintained in 'Liveability Index' but ICT was completely diluted.

2.1 Objective of Ease of Living Index

- The index has two major expected outcomes

- Index must catalyse actions to improve the quality of life in Indian cities.

- Assess outcomes achieved from various urban policies and schemes, addressing data gaps.

- Enhance city-level decision making

- Shaping local electoral discourse

- Serve as a basis for dialogue with citizens and urban decision-makers

· Improve access to resources transparently linking resourcing to facilitate learning and capacity building

'Ease of Living Index', was calculated on the basis of data provided by Smart City Cells referencing the national standards. The cities were measured on a hundred-point scale across 78 indicators on the following factors with weightage they carry, in points:

· Institutions and governance   25 points

· Social infrastructure carrying   25 points

· Economic factors   5 points

· Physical infrastructure   45 points

The pillars are further broken down into categories, which are fifteen in all. The index follows the Dimensional Index Methodology and is thus, promoting urban planning and management on a competitive scale. Governance takes the major share in the index. (See Figure 1.) Governance Pillar with major share of 25%, there is a 3.125% weightage to each one of following indicators: -

· Percentage of citizen services available online

· Percentage of services integrated through Command Centre

· Percentage of citizens using online services

· Average delay in grievance redressal

· Tax collected as percentage of tax billed

· Extent of cost recovery (O&M) in water supply services

· Capital spending as percentage of total expenditure

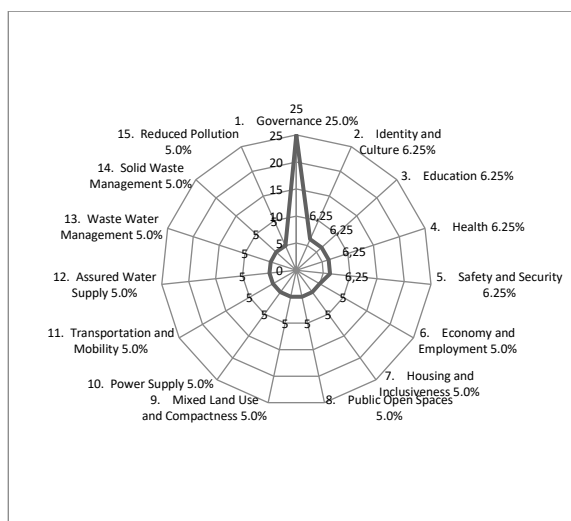· Percentage of population covered under Ward Committees/ Area Sabhas [10][11]

Figure 1 Categories with Percentage share in Ease of Living Index Score

Table 3 List of 16 indicators within Governance Category in Ease of Living Index [10]

Indicators in Governance Pillar	Measure
1.1 Percentage of citizen services	Number of citizen services available online

available online	Total number of citizen services provided by the ULB
1.2 Percentage of services integrated through Command Centre	Number of services integrated through singular operations Centre
	Total number of services provided by the ULB
1.3 Percentage of citizens using online services	Average for all citizen services
	Number of registered users using online services in a month
	Total number of households
1.4 Average delay in grievance redressal	Average redressal period for a service
	Committed redressal period for the service
1.5 Tax collected as percentage of tax billed	Total tax collected in a year
	Total demand raised for the year
1.6 Extent of cost recovery (O&M) in water supply services	Total collection of user charges in water supply in a year
	Total O&M cost for providing water supply services during the year
1.7 Capital spending as percentage of total expenditure	Total capital expenditure during a year
	Total expenditure (revenue and capital accounts) in the same year
1.8 Percentage of population covered under Ward Committees/ Area Sabhas	Population covered under ward committees/ area sabhas
	Total population of the city

2.2 Calculation of Ease of Living Index - The Framework

Step 1 – Converting stages of progress to scores: For a given city, the stages of progress identified across the various Liveability Standards will be scored as per the scoring table 4 given below:

Table 4 Stages of progress under Liveability Standards

Stage 1	Stage 2	Stage 3	Stage 4
<50% of benchmark	≥50 < 75% of benchmark	≥75 < 100% of benchmark	Benchmark achieved
Score: 0	Score: 0.5	Score: 0.75	Score: 1

Step 2 – Calculating Category Indexes: The scores for all Core and Supporting Liveability Standards in each category will be averaged to calculate the Category Indexes. Core standards will have 70% weight and supporting standards will have 30% weight. Thus, Category Index= (Average for core standards * 0.7) + (Average for supporting standards * 0.3).

Step 3 – Weight adjustment of Category Indexes: Four pillars of comprehensive urban development have been identified under the Smart Cities Mission Guidelines, namely Institutional, Social, Economic and Physical. The 15 Category Indexes can be organised under these pillars as indicated in the diagram. Relative weights have been assigned to each of these pillars as per table 5 given below:

Table 5 Pillar weightage under Liveability Standards

Institutional	Social	Economic	Physical
30%	20%	5%	45%

Table 6 Computation of indicators with weight adjustments in Ease of Living Index

CITY	Institutional (30% weightage)	Social (20%)				Economic (5%)	Physical (45%)								
	Governance	Identity and	Health	Education	Safety	Economic	Compact	Water	Energy	Waste	Solid Waste	Housing	Open Space	Mobility	Pollution
City Name	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q
Average	A	R=B+C+D+E 4				F	S=G+H+J+K+L+M+N+P+Q 9								
Weightage	T = A * 0.3	U = R * 0.2				V = F * 0.05	W = S * 0.45								
						CITY INDEX= T + U + V + W									

The weights have been assigned depending upon the extent to which, City Governments can actively make improvements in the parameters/standards. For instance, broader outcome areas such as economic development cannot be influenced by the actions of City Governments alone and have therefore been assigned the lowest weight.

Step 4 – Calculating City Index: Index= (Average for Institutional Category Indexes * 0.3) + (Average for Social Category Indexes * 0.2) + (Average for Economic Category Indexes * 0.05) + (Average for Physical Category Indexes * 0.45).

Step 5 – Ranking of Cities: Inter-City ranking sheet will be prepared for the various Category Indexes (step 2) and the overall City Liveability Index (step 4)

3. Review of Ease of Living Index of a Smart City, India

The methodology is simple and evaluation reviews are based on study and analysis of city and the index. The review is centered at the core concern, governance, which happens to be the priority pillar of the index.

· Evaluation of Index

· Evaluation of method

· Evaluation of impact.

3.1 Introduction of Lucknow Smart City

Lucknow has been selected as one of the Smart Cities under Urban Ministry 100 Smart City Mission. The 100 Smart City Mission was launched by Hon'ble Prime Minister Shri. Narendra Modi ji on June 21, 2015. The Municipal Corporation has prepared the Smart City Proposal that will provide smart solutions to the urban infrastructure issues. The approach towards making Lucknow a Smart City involves improving resource management by adding connectivity and intelligence within existing infrastructure. All of our citywide solutions are envisioned to develop clean, green & efficient Lucknow as a citizen centric city with modern economy & outlook anchored in its traditional heritage & culture with a great quality of life.

The strategic focus and blueprint for Lucknow Smart City will comprise interventions in four focal points namely:

• Jeevant Lucknow (Liveable): The stress on physical and social infrastructure emerged as one of the threats & it gets strengthened even more. Now it has become necessary to provide the city with basic infrastructure to meet the demand and supply gap in a proactive approach.

• Sugam Lucknow (Mobility): Traffic and transportation has emerged as the major concern, hence resulting as our main theme for city wide intervention. Smart solutions will be implemented in the city in sync to Area Based Development & Pan City Development Programs.

• Swachh Lucknow (Clean): Sanitation emerged as another prime concern. Open Defecation, Solid Waste Management, Poor Sanitation, Pollution, Unorganized and inaccessible open spaces emerged as major concern in making Lucknow Smart City.

• Samruddh Lucknow (Prosperous): Harnessing on its strengths of Heritage, Culture, Handicraft, Cuisine and connectivity to encourage tourism by strengthening the support system that eventually facilitate employment (direct and indirect).

Table 7 Position of Lucknow city in Smart City Mission selection results

Rank	Name of State/UT	Name of City	Score (%)
1	Odisha	Bhubaneswar	78.83
2	Maharashtra	Pune	77.42
7	Madhya Pradesh	Jabalpur	63.03
11	Madhya Pradesh	Indore	59.89
12	Delhi	NDMC	59.63
18	Tamil Nadu	Chennai	56.16
29	Uttar Pradesh	Lucknow	53.24

3.2 City Status in Ease of Living Index Results

Pune (Maharashtra) ranked first among 116 cities (with population of 1 million plus) in Ease of Living Index released by Ministry of Housing and Urban on 13thAugust 2018. Lucknow stands all India 73rd rank with Ease of Living Index as 31.76.
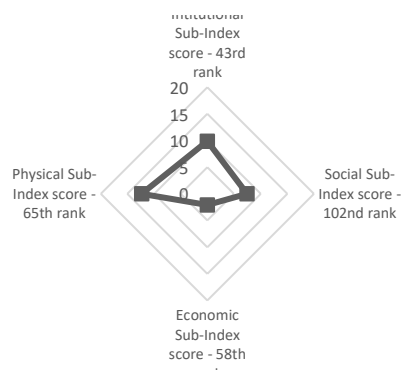
Figure 2 Sub-Index scores of Lucknow City for four pillars with respective all-India rank

Stage I - Evaluation of Index was done to check the city status and index results in context of Governance Pillar. A comprehensive study of ground situation was done, from office to office and methods and means of meeting goals and deliverables were observed. The system of electronic working is quite evident in Municipal Corporation but it is nowhere near the excellence mark in e-governance.

Lucknow City Development Plan documents following on governance in Lucknow:

• The interdepartmental coordination in LMC is low. The interdepartmental knowledge transfer is not in practice.

• There is lack of implementation of Master Plan and Traffic rules. There is lack of facilities. A dynamic physical assessment and maintenance plan for the municipal asset should be prepared. The land potential should be harnessed for improving the revenues.

• Public involvement both in consultation and development should be encouraged.

From the fact that 'Ease of Living' indicator wants to facilitate a dialogue between public and administration, it needs to be known and understood by the citizens.

3.3 Measure of smart City – Governance

GOVERNANCE INDEX= (Average for core standards * 0.7) + (Average for supporting standards * 0.3)

PERCENTAGE OF CITIZEN SERVICES AVAILABLE ONLINE= (Sum of B)/ (Sum of A) *100 = 100%

Sources of information: e-suvidha, (2019), services.india.gov.in (2019), LMC website (2019), [12]

4. Evaluation of method - Computation of indicators –

For calculation of the index there are over systematic 500 different data required from over 50 sources for computing 79 indicators. Accessibility is an issue due to lack of proper Data collection and Management policy/guideline for internet-based platform of government/or public bodies it is hard to ensure data availability in a form that it can be interpreted. There were following major issues in data required:

As city infrastructure is being assessed, there are cases of duplication of the datasets in the Ease of Living assessment due to various reasons. Integrated Command and Control Centres (ICCC) are gradually coming up with convergence of services and complaint redressal through use of IT, integrating ULB, Police, Health (Hospital), Fire etc., but still not having the information expected. Green building rating is done after the construction and by different agencies and Municipal Corporation is not bound to keep the records. Percentage of total energy derived from renewable sources cannot be appropriately tracked. The required data of some department are not available at the city level and available at state level.

- System of maintaining the record of data is not the same as that required for computation of index.

- Percentage of interchanges with bicycle parking facilities is a vague gauge in a city like Lucknow.

- Record of the drains is not available in terms of primary, secondary and tertiary classification.

- Data sources mentioned in the methodology is not same throughout the country in different states.

- Total number of intersections with pedestrian crossing facilities on major roads is sought but major road is not defined.

- What all are the uses included in reuse and recycling is not specified under extent of reuse and recycling of waste water.

- Use of water is not specified to know the prescribed standards in indicator.

There are incidences of lack of data, and data not collected by the concerned authority, or the expected source is not elaborate or exhaustive.

- Like, Rashan Cards are being issued to each household. There is no real time monitoring of this data.

- No proper management of record of proceedings of meetings of ward committees' members,

- Non availability of Records of unprotected historic buildings, lack of track of current use/condition of historic buildings, no specific rule for reuse / restoration/ demolition of unprotected historic monuments.

- No record is maintained for number of cultural/sports events hosted by city.

- Age group wise population of students enrolled in schools is not available.

- There is no proper record of Health infrastructure and practitioners in the city.

- There is no record of vendors registered and formal spaces provided to them.

- No record of privately-owned recreational places.

- No updated record of existing land-use.

- No updated data on mode share of non-motorised transport.

- No record of implementation of rainwater harvesting

- Coverage of toilets is assessed on the basis of some surveys.

- The concern for universal accessibility in public rights-of way is alarming with lack of awareness, and there is no evident implementation of universal design principals in the city.

- All services are not displayed in Citizen Charter.

- Tax collected data is not appropriate.

- There is no collection of occupancy and nature of occupancy data from the hotels.

The indicators track the available data rather than the system correctness.

- Like due to ignorance of public and lack of efficient closure report of CM helpline application, proper and reliable data is not available.

- Extent of cost recovery (O&M) in water supply services is a measure of Tax collection, which is on monthly basis and not efficient.

- ULB does not allocate funds from municipal budget, and funding is done through sponsorship.

- Percentage of school-aged population enrolled in schools includes students from rural area enrolled in the city school.

- Installation data on is available for surveillance, in terms of number of streets, public places, junctions covered through surveillance systems but not on the status of fitness of cameras etc.

- Under 'Number of recorded crimes per lakh population', incorporation of efficiency of crime reporting is lacking in the methodology.

- Net Density data might not reflect the city status as it includes undeveloped and under developed areas.

- Only provisional quantity can be available for waste water.

- Measure of extent of signal synchronisation varies with use of different technology.

- Coverage of sewerage network suffers from lack of availability of appropriate property records.

- Air pollution sample locations are often taken from near industrial areas.

5. Evaluation of impact - City Service Sector Status

Lucknow is the capital city of Uttar Pradesh state and one of the most prominent cities in India in terms of commerce, education, historical, architecture, culture, Urdu literature etc. The city is the 11th largest metropolitan city in the country and after Delhi, it is the 2nd largest city in Northern part of India. [13]
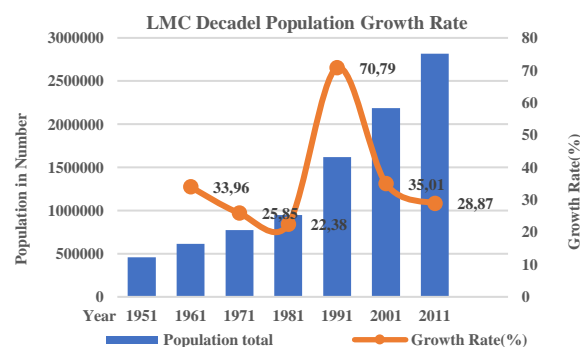

Figure 3 Decadal population growth of Lucknow (as per Census 2011)

For the review of city services, we have to analyse the status of infrastructure and services. The agencies providing these are: -

- Lucknow Municipal Corporation is the Municipal Corporation responsible for the civic infrastructure and administration of the city of Lucknow, Uttar Pradesh. The organization is known, in short, as LMC. This civic administrative body administers the city's cleanliness and other public services like public health and parks. The head of the LMC is the mayor. LMC consists of 110 wards for which elections are held every five years to select the corporators.[13]

- Lucknow Development Authority (LDA) is Established in 1974 under the Uttar Pradesh Urban Planning & Development Act 1973, LDA has progressed from small beginnings to embrace an overreaching authority in the development scenario of Lucknow. In consonance with the aspirations of modern India, LDA aims at coordinated and planned development of a historical city: to enable Lucknow to achieve pride of place as the worthy capital of the largest State of the country which has played a very important role in the Freedom

Struggle, to extend urban infrastructure to absorb the pressures of a rapidly changing society, and to provide an environment which would enable the utmost satisfaction level of all sections of its inhabitants. [13]

· Lucknow has been selected as one of the Smart Cities under Urban Ministry 100 Smart City Mission. The approach towards making Lucknow a Smart City involves: [13]

· Improving resource management by adding connectivity and intelligence within existing infrastructure.

· All of our citywide solutions are envisioned to develop clean, green & efficient Lucknow as a citizen centric city with modern economy & outlook anchored in its traditional heritage & culture with a great quality of life.

While the city administration is responsible for a planned development, development direction is hooked upon the fund sources and priorities of funding schemes. In a comparison of the expenditures planned under various Smart Cities of the Uttar Pradesh state, Bhubaneshwar as a benchmark gives following insight.

Table 8 Comparison of Population, Total SC Cost, Municipal Area, Population Ratio with Cost, Cost Ratio with Area of three Cities (Indore, Bhubaneswar, Lucknow)

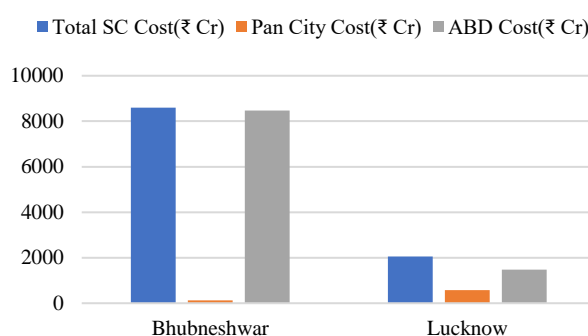| City	Population	Total SC Cost (₹ Cr)	Municipal Area(sq.km)	Population Ratio with Cost	Cost Ratio with Area
Indore	1,994,397	5099.6	276	391.09	18.48
Bhubaneshwar	885,363	8594.68	135	103.01	63.66
Lucknow	2,817,105	2053.33	349	1371.97	5.88

Figure 4 Total Smart City Cost of Lucknow City is too low in comparison of Bhubaneshwar city.

In the year 2015, revised City Development Plan for Lucknow proposed an overall investment estimated at Rs. 44,77,646 Lakhs, Under the revised CDP for Lucknow, the investment plans need to be prepared in line with the national, state and ULB level mission and vision. The investment estimation has been done in line with the strategies proposed for the town in short term, medium term and long term. The costs of the projects presented herewith are based on the unit cost and preliminary feasibility studies carried out in various sectors.

The total estimated capital investment required for providing efficient services to the present population and future population of the city by the year 2041 is 44,77,646 Lakhs.

5.1 Observation of Lucknow city:

In the study of the city Lucknow in terms of its 'Liveability' there are many Issues identified through analysis on each index some of the major issues following-

Governance Index

- Lack of fast and efficient service delivery as there is no control and command center

- About only 35% of total users are registered to govt. portals, due to lack of awareness and lack of more user friendly and integrated online user applications.

Economic Index

- Secondary activities in the city could be supported by creating infrastructure and amenities.

- Lack of employment opportunities in the city and the female workforce participation in the city is very low.

- There is a need to diversify the economy by promoting tourism apart from trade and commerce.

Health Index

- Even though the facilities are sufficient there is need of more affordable healthcare units for lower income groups.

- The prevalence of water borne disease is higher than the vector borne disease indicating the poor quality of water.

- Numerous schemes are being implemented and beneficiaries are registered. But when we see the real picture the beneficiaries are not benefited as per the guidelines of the scheme. They are either benefited after a long period are not benefited at all.

Education Index

- Less student-teacher ratio in the primary schools and there is no provision of child care facilities.

- Because of poor sanitation condition hygiene of the school is hampered.

Housing & Slums Index

- Poor housing condition and Inadequate access to sanitation is observed at many major areas of the city.

- Most of the slum area is along railway tracks and river Gomti and No provision of water supply through pipe line in slum area.

Green Space Index

- The percentage of organized open and green apace in the city is lower than the standard percentage mentioned in URDPFI guidelines.

Mobility Index

- Limited public transport options and Non-availability of information regarding routes, frequency and stops etc.

- Absence of traffic signals and pedestrian crossing at some junctions.

- Cycle and pedestrian tracks are disturbed by the Encroachment of roadside activities on roads and sidewalks.

Water Index

- Inadequate service delivery and management of water supply.

- Because there is no metering, it is impossible to accurately assess consumption, leakage and revenue potential.

Energy Index

- Slum areas are not covered through proper electric connections.

Pollution Index

- The RSPM (PM10) level at all the areas were higher than the NAAQS.

- The noise level at all the locations during day and night time showed higher level than the respective permissible limits

- Rapid growth of number of vehicles, their technological development and release of invisible tailpipe pollutants emission are serious debatable issues even for the policy maker.

So, the best and the worst sectors in city services are Education and Reduced Pollution respectively. Samples of pollution level are taken from the different parts of the Lucknow city.

5.2 The status of Education Sector:

Education is one of the most important aspects of human development. This indicator denotes educational opportunity, and determines the coverage of formal education among school aged population in the city. Currently, The Right of Children to Free and Compulsory education Act (RTE Act) of 2009 provides for children below the age of 14 to be provided free and compulsory education. To calculate Education Index, we have considered 5 factors as per Ease of Living Index (MoHUA). We have calculated education index for three wards, ward-107, ward-54 and ward-32.

Table 9 Indicator in Education Sector in Ease of Living Index

Percentage of school-aged population enrolled in schools	
Primary education student-teacher ratio	
Percentage of students completing primary education	Core
Percentage of female school-aged population enrolled in schools	
Percentage of schools with access to digital education	Supporting

Table 10 Values(ward-107+ward-54+ward-32) of Indicators in Education

INDICATOR	VALUE	UNIT	PARTICULAR	VALUE
3.1 Percentage of school-aged population enrolled in schools	100	%	Total enrolment in primary schools	12302
			Total population in the age group of 6-14 years	12302
3.2 Primary education student-teacher ratio	96.2	Ratio	Total number of students in primary grades	12302

			Total number of teachers available for primary grades	124
3.3 Percentage of students completing primary education	100	%	Number of students from a school cohort completing primary education	7951
			Total number of students belonging to the school cohort	7951
3.4 Percentage of female school-aged population enrolled in schools	100	%	Total female enrolment in primary schools	5961
			Total female population in the age group of 6-14 years	5961
4.5 Percentage of schools with access to digital education	100	%	Number of schools with facilities for using digital educational	39
			Total number of schools	39

5.3 The status of Reduced Pollution:

Air pollution, noise pollution, and water pollution all adversely affect the quality of urban life. High pollution level can negatively impact the health of its citizens as well as the natural and cultural ecosystem of the city. It can damage ecological sites and cultural heritage in the city which determines the ease of living of the city. The samples are taken from the different areas of the city (Aliganj, Vikas Nagar, Indira Nagar, Gomti Nagar, Charbagh, Aminabad, Alambagh, Chowk, Amausi, Hazratganj, Lalbagh, Talkatora, Mahanagar.) As per study these are the following issues regarding the pollution in Lucknow city: -

• The RSPM (PM10) level at all the areas were higher than the NAAQS.

• Rapid growth of number of vehicles, their technological development and release of invisible tailpipe pollutants emission are serious debatable issues even for the policy maker.

Table 11 Reduced Pollution Indicators in Ease of Living Index [10]

Concentration of SO2 - air pollution Concentration of NO2 - air pollution Concentration of PM10 - air pollution Level of noise pollution (Day) Level of noise pollution (Night)	Core

Table 12 Values of Reduced Pollution Indicators

INDICATOR	VALUE	BENCHMARK
Concentration of SO2 - air pollution	20.4 µg/m³	50 µg/m³
Concentration of NO2 - air pollution	54.9 µg/m³	40 µg/m³
Concentration of PM10 - air pollution	204 µg/m³	60 µg/m³
Level of noise pollution (Day)	68 dB	55 dB
Level of noise pollution (Night)	61 dB	45 dB

Sources: NAAQS, UPPCB, Assessment of Air Pollution in Lucknow by Geetika Saluja [14]

5.4 Actual Work Done in Weakest Sector

A lot of on ground work is being done to reduce the pollution in the city like Improvement in the traffic management, Encroachment is removed at many places for smooth flow of traffic, Foot paths are restored for

pedestrian, and cycle track is provided along most of roads in the city. The pollution control equipment is installed in air polluting industries and the ban on use of polythene is also a good step to reduce pollution but on ground these rules are being violated continuously.

5.4.1 Proposed ABD Projects

The chosen retrofitting area, Qaiserbagh of 813 acres is an inter phase between the old city and the relatively newer part of the city. The key components for the Retrofitting of Qaiserbagh area are listed below [4 key components and 48 Sub projects].

5.4.1.1 Liveable - Jeevant Lucknow

- Utility Improvement: Utility Ducts, Drainage, Water Supply, Electricity and PNG network.

- Smart Grid: Rooftop Solar Panel PV, Rain Water Harvesting, Waste Water Treatment & Reuse.

- Slums and Urban Poor: Infrastructure works & Facilities and night shelters.

- Gomti River Front Development.

- Beautification of Parks/Greens & Establishing Open Gyms & Wifi Hotspots.

- Smart City Knowledge Management Centre- "One Lucknow Centre"

5.4.1.2 Mobility - Sugam Lucknow

- Mobility: Mobility nodes-"One Lucknow Node" (6-nos.), Pedestrian infra & street furniture, Pelican Crossing for Interconnecting Parks (Begum Hazrat Mahal Park & surroundings), Cycle Track, Variable Message Signs, New Multi-Level Car Parking [Globe Park, Vegetable Market, Qaiserbagh Crossing and Fish Market, Qaiserbagh Crossing], Smart Parking Solutions for Off Street Parking [Qaiserbagh Bus Stand, Dayanidhan Park and Sarojini Naidu Park] and Smart Parking Solutions for On Street Parking at 9 Locations, Smart Ticketing [Temporary Encroachment Regulation & penalty system] and Road & Junction Improvements.

- Safety and Security: CCTV Camera, Emergency Call Points and Modern Police Kiosks, Energy Efficient Street Lighting.

5.4.1.3 Clean - Swachh Lucknow

- Sewerage, Solid waste management: Door to Door Collection, Smart Road Bins and Smart Community Bins, Road Cleaning Equipments, Sanitation [Public and Community Toilets].

5.4.1.4 Prosperous - Samruddh Lucknow

- Heritage, Culture and Recreational Space: Awadh Walk on ThandiSadak, Centralized Recreational Space at Begum Hazrat Mahal Park, International Culture & Heritage Centre at Chhattar Manzil, Tourist Information Centre at Sibtainabad Imambara, Façade Lighting & Restoration of Lal Baradari, Archaeological Research and Heritage Centre at Roshan-ud-Daula Kothi, Public Library at Kothi Darshan Vilas, Heritage Conservation Institute- Kothi Gulistan-e-eram, Cultural Club at Rifa-e-Aam Club and Restoration of Morris Market near Qaiserbagh Crossing.

- City Branding: Cuisine & Handicraft Festivals, Cultural Theme Events, Awareness. [13]

5.4.2 Proposed Pan City Projects:

The pan city proposal of Lucknow comprises of a number of proposals under the focal points of Sugam Lucknow and Smruddh Lucknow.

5.4.2.1 Mobility- Sugam Lucknow

• Integrated Traffic Management System: Junction Improvement, Intelligent traffic signals, Traffic sensors, Variable message signs, Pelican crossing, Augmentation on and strengthening of existing command center.

• Smart City Surveillance System: Installation of additional CCTV Cameras, Networking, Augmentation and strengthening of existing command center.

• Smart Solutions for Existing Parking: Electronic ticketing system.

• ICT for City Bus Services: GPS bus tracking system (automatic vehicle tracking system), CCTV Cameras on board, On board display panels, Automatic fare collection system, Bus Operation command center.

• Smart Bus Shelters: Passenger information system, Ticket vending machine, Water ATMs.

• Unified Smart Mobility Card [Integration Infrastructure]- "ONE LUCKNOW": One card for all, one payment card for Buses, metro, parking and bicycle hiring (Urban Mobility Nodes) in the initial stage which can be further extended to various other modes like city taxi service, auto etc.

• Urban Mobility Nodes- "ONE LUCKNOW NODE": IPT mode terminal, Solar based charging for E-rickshaws, E-suvidha Kendra/ "ONE LUCKNOW KENDRA", Free WiFi, Public toilets, bicycle hiring, commercial area(kiosks), parking area.

• Energy efficient street lighting (LED)

5.4.2.2 Liveable -Jeevant Lucknow

• One Lucknow Smart City Management System/Portal: A centralized backend command centre to be set up for enabling and empowering all sectors of governance for better delivery of services to the citizens.

• Capacity Building programs: to ensure participation of the administration and its wings in an effective manner with smart city management system. This step will help achieve the intent of the portal. [13]

5.5 Review of ground realities: Status and resolution of issues in proposed projects

Gomti River front development is totally different on ground from papers. It is totally failure project due to poor implementation and corruption. The cost recovery or the economy that was expected to be generated from the project is almost nothing. (See Figure No. 5) Cycle and pedestrian track are also in very poor condition due to lack of timely maintenance. The primary objective of the Cycle and pedestrian track project was to increase 'Non-Motorized Transit' (NMT) in the city but the result is different. (See Figure No. 6)

Figure 5 Current condition of Gomti Riverfront Development.

Figure 6 Current Situation of Cycle and Pedestrian Track.

As conclusion, this paper intended to conclude on governance aspect of the Smart City Mission and its assessment from Ease of Living index. Index makes basics of municipal governance clear for the city administration at all levels and hence gives opportunity to be willingly formally organized work force on priorities with clarity on severity of various challenges of urban management listed as indicators. While the other aspect of extent of use of technology is yet to be realised, there is obvious understanding on lack of smart manpower. There is need for capacity development and with 'Ease of Living Index' Smart City Cell. Ease of Living index comparison will create competitive evolution of Municipal Corporation without context of individual resources and challenges. It is observed in the study that more than planning proposals, smart city management is about resolution of issues, with a development vision. And in case of Lucknow there is a conscious development of projects towards making of a better city. From first step of better pillar of governance we need to establish the development of cities as a constant process from one stage to another through stakeholder ownership in urban management as 'Smart' Development.

As found in this study of Lucknow city, it was observed that Ease of Living Index has many gaps in measuring the situation, as there is little clarity on 'on ground' situation from the index calculators especially from perspective of strength and weakness of city. While it was a known fact that Lucknow was an under developed area, it was realised through various interviews that it has huge potential for growth if organised development took momentum in the city.

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