A COMPARATIVE ASSESSMENT OF CITIES IN INDIA WITH SMART CITIES OF DEVELOPED NATIONS BASED ON EXISTING SOCIO-ECONOMIC PARAMETERS.

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Abstract— Cities and communities face incredible changes in population growth, increased greenhouse gas emissions, polarized economic growth, decreased budgets, etc. This study will explore the concept of smart cities as a potential urban construct that can address the environmental, social and ecological sustainability challenges which society is facing now-a-days. In present study, different cities are considered for comparing the existing status with developed nations. For this, a model approach has been developed to assess the parameters that are required for ranking the selected cities. This study identify the current issues that are necessary to be addressed to make the cities smart and sustainable.

Keywords- comparison, smart cities, sustainable cities, model, Developed nations, ICT

I. INTRODUCTION

Smart cities are defined as cities where investments in human and social capital and traditional and modern communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance. A smart city is the same as a digital city, and sometimes its meaning is close to that of a sustainable city. The essence of being smart in modern society lies in acting locally but being networked outside one’s own geographical location. The technological systems can be managed only when they are integrated properly. Typology of smart city functions includes smart economy, people, governance, mobility, environment and living. This study is required for one to understand the concept in a better way and how we can incorporate it in the future. The smart city balances efficiency against equity and it focuses on improving the ability of its citizenry to innovate through a balance of cooperation with competition.

II. PROBLEM STATEMENT

Urbanization, demographic shifts, and the rapid advancement of new technologies are paving way for development of smart cities. India had has always considered the current problem as first to deal with. From decades or can say centuries, the focus is only on developing mega cities (Mumbai, Madras, Kolkata, Hyderabad, Delhi etc) which overburdened the civic amenities. In west a network of smart city is created while connecting them through less smart but sustainable small hubs. Hence the best approach is to segregate the industrial zone from the administrative and residential while connecting them with good and healthy public ways to make efficient smart cites even for future generations.

Objectives

• To study the basic concept of smart city, its concern, influencing factors and existing challenges for planning a city as smart,
• To study the different aspects of a smart city which includes smart economy, people, governance, mobility, environment and living in a developed nation,
• To study the smart city concept in Indian context,
• To make a comparative assessment of the existing infrastructure and various social factors in different Indian cities.

III. LITERATURE REVIEW

The research begins with the study to understand the concept of smart city. It has been defined and understood differently by diverse groups. The root of this term derived from the (Smart Growth Movement) in the late 1990s. Although a wide range of using the term of ‘smart city’, there is unclear understanding of the substantial concept among academics and practitioners. Some scholars worked to give definition of this term as smart city (Ghana): ‘A Smarter City is one that accelerates its journey towards sustainable prosperity by making use of new smart solutions and management practices’. Smart cities can be defined as those that adopt ‘Scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life’. Smart cities can be defined as per Cohen: ‘Smart Cities use information and communication technologies (ICT) to be more intelligent and efficient in the use of resources, resulting in cost and energy savings, improved service delivery and quality of life, and reduced environmental footprint all supporting innovation and the low-carbon economy’. Smart cities are those that ‘provide public services to their citizens in a more convenient way, that are more responsive and citizens-centered, that provide the right information in real-time to allow for better every day and business decision-making, and that achieve all this in an economically viable way so as to improve environmental sustainability’. After exploring through different literature studies, the smart city can define as ‘A city with developed urban area which creates optimal place to live improving their quality of lives; enhancing the key components i.e. living, environment, mobility, economy and governance. This can be done by improving human, social and traditional capitals and various infrastructural facilities’

IV. METHODOLOGY

In the present study, the methodology compares the cities in India with four ranked smart cities in Asia and Europe are being considered- Seoul, Singapore, Copenhagen and Amsterdam. The main features of these developed nations are well developed ICT systems, Innovative measures adapted, Well maintained infrastructural facilities, High eco-efficiency, High quality of life, Smart enhancements in built environment, mobility, economy and governance, Highly efficient resource management. Table 1 presents the basic demographic details of four ranked cities. Based on the extensive literature survey, the major features that are considered in ranking the first four smart cities in the world are E-governance, E-commerce, ICT in education, CO2 reduction, Green growth, digital enhancing public transport, sustainable transport, free public Wifi, smart meters and smart grids, green roofs, multi-story car parking. Recently smart cities mission has been introduced and different cities in India are in a pace of development. For the development, historical background has been studied first and 10 cities are being assessed for basic infrastructural facilities and social factors.

| Table 1 Basic demographic details of four ranked smart cities |
|---------------------------------------------------------------|
| **Seoul** | **Singapore** | **Copenhagen** | **Amsterdam** |
| Area | 605.2 km² | 716 km² | 88.25 km² | 219.4 km² |
| Population | 10 million | 5.4 million | 550,000 | 1.2 million |
| Project | 2011 | 2004 | 2012 | 2009 |
| Domains of the project | Infrastructure, management, | Economy, people, governance, | Climate and environment, | Living, working, mobility, public |

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4.1. Benchmarks for smart cities in India

The Smart City initiative is stipulated to cover 100 cities in the next 5 years from 2015-2020. The 100 Smart Cities will be divided among the different States and Union Territories of India. Each State will have a certain number of potential Smart Cities with at least 1 in each state. Table 2 presents the benchmarks laid out by India’s Ministry of Urban Development across several categories.

| Category                  | Benchmarks                                                                 |
|---------------------------|-----------------------------------------------------------------------------|
| Transportation            | Maximum travel time of 30 minutes in small & medium size cities & 45 minutes in metro areas. Footpaths and bicycle tracks in each direction on all streets. High quality & high frequency mass transport within 800 meters of all residences in areas with a density of 175 people per hectare. |
| Spatial Planning          | 95 percent of residences should have access to retail, parks, primary schools, and recreational areas within 400 meters walking distance. |
| Water Supply              | 24/7 supply of water and 100 percent of households with direct water supply connections. 100 percent efficiency in collection of water related charges. |
| Sanitation & Waste Management | All households to have access to toilets and to be connected to waste water network. All schools to have separate toilets for girls. All households to be covered by daily door-step collection system. |
| Telecom & Electricity     | 24/7 supply of electricity for every household. Telephone and mobile connection for every household. 100 percent Wi-Fi coverage throughout the city. |

4.2. Assessment parameters

Assessment is the key phase and the most critical for the successful execution of any smart city transformation strategy. Thorough assessment will lay a strong foundation to design the strategy for smart cities and help the city administrators analyze current state and performance through various lenses, while also taking into consideration the readiness of the city for the transformation. Here three factors are being considered as listed in Table 3.

**Current status:** Defines the current level of city performance and service delivery across each of the benchmark and is assessed.

**Technology intervention:** Defines the use and state of technology solutions for city operations and the delivery of various city services.

**Contribution to smart city:** Defines the contribution made by individual benchmarks in city operations.

| Data Vector Rating | Rating 3                  | Rating 2                  | Rating 1                  |
|--------------------|---------------------------|---------------------------|---------------------------|
| Current status     | High service delivery     | Medium service delivery   | Low service delivery      |
| Technological Intervention | High technology involvement (for city monitoring and control points) | Medium technology involvement (limited to city monitoring only) | Low technology involvement |
Based on the ranking of each parameter and its importance in making the city smart, the following equation is derived to calculate the cumulative score on 10 points scale.

Final Score = (Current status × 0.3) + (technology intervention × 0.3) + (contribution to smart city × 0.4)

### Table 4 Socio-Economic data of the selected cities

| Basic Details | Delhi | Bangaluru | Pune | Hyderabad |
|---------------|-------|-----------|------|-----------|
| **Total City Area** | 1484 Km² | 741 Km² | 710 Km² | 650 Km² |
| **Sex Ratio (Women/1000 Men or % of males and females)** | Males 57% Females 43% | Males 54% Females 46% | 948/1000 | Males 52% Females 48% |
| **Population** | 1.1 Cr | 84.81 Lakh | 31.24 Lakh | 68.09 Lakh |
| **City Demographics** | | | |
| **Per capita Income** | 86.34% 60.46% | 86.62% 49.41% | 86.15% 47% | |
| **Literacy Rate** | 2.1 lpa | 2.12 lpa | 1.27 lpa | 1.16 lpa |
| **Crime Index** | 86% | 88.62% | 86.15% | 82.96% |
| **Economy** | | | |
| **Gross Domestic Product** | INR 1578 Bn | $ 83 Billion | INR 3024 Bn | INR 700 Bn |
| **Pollution Index** | 86.97 | 69.08 | 81.16 | 81.94 |
| **Social Infrastructure** | | | |
| **No of Hospitals** | 131 | 2666 | 18000 | |
| **No. of Schools** | 22 | 27 | 161 | 50 |
| **No of Parks** | | 181 | |

### Table 5 Cumulative average score for various parameters

| Cities | Delhi | Bangaluru | Pune | Hyderabad |
|--------|-------|-----------|------|-----------|
| **Main Aspects** | Cumulative Avg. Score | Cumulative Avg. Score | Cumulative Avg. Score | Cumulative Avg. Score |
| **Power** | 2.54 | 2.45 | 2.54 | 2.48 |
| **Water supply** | 2.20 | 1.95 | 1.85 | 1.90 |
| **Public safety** | 1.95 | 2.10 | 2.03 | 2.18 |
| **Disaster management** | 2.10 | 2.16 | 2.16 | 1.98 |
| **Transport** | 1.74 | 1.81 | 1.51 | 1.61 |
| **Sewerage and sanitation** | 2.10 | 2.00 | 1.80 | 1.40 |
| **Solid waste management** | 1.62 | 1.50 | 1.80 | 1.62 |
| **Storm water drainage** | 1.47 | 1.57 | 1.27 | 1.27 |
| **Health** | 2.20 | 2.10 | 2.20 | 2.10 |
| **Education** | 1.73 | 1.80 | 2.25 | 1.80 |
| **Municipal corporation** | 2.24 | 2.24 | 1.86 | 2.00 |
| **Sustainability** | 1.58 | 1.73 | 1.50 | 1.75 |
Table 6 the consolidated average score of various parameters.

| Cities          | Delhi | Bangaluru | Pune | Hyderabad |
|-----------------|-------|-----------|------|-----------|
| **Main Aspects**|       |           |      |           |
| Power           | 8.47  | 8.17      | 8.47 | 8.27      |
| Water supply    | 7.33  | 6.50      | 6.17 | 6.33      |
| Public safety   | 6.50  | 7.00      | 6.77 | 7.27      |
| Disaster management | 7.00 | 7.20      | 7.20 | 6.60 |
| Transport       | 5.80  | 6.03      | 5.03 | 5.37      |
| Sewerage and sanitation | 7.00 | 6.67      | 6.00 | 4.67 |
| Solid waste management | 5.40 | 5.00      | 6.00 | 5.40 |
| Storm water drainage | 4.90 | 5.23      | 4.23 | 4.23 |
| Health          | 7.33  | 7.00      | 7.33 | 7.00      |
| Education       | 5.77  | 6.00      | 7.50 | 6.00      |
| Municipal corporation | 7.47 | 7.47      | 6.20 | 6.67 |
| Sustainability  | 5.00  | 5.7       | 4.7  | 5.7       |

V. RESULTS AND DISCUSSIONS

5.1. Overall assessment of cities

Table 4, 5 and 6 shows the socio economic data, cumulative and consolidated average scores calculate for each parameter for four selected cities. The calculated scores assess the existing conditions of the city and the sectors to be improved to make the system smart.

Delhi, the capital city of India, spans an area of 1484 km² and has a population of 1.1 crore. Delhi has an overall score of 8.47 in power, which is an important contributor to smart cities. The city has effective systems in place for ensuring 24X7 power supply, online payment facilities and visibility of energy consumption details.

Water, another significant contributor to the smart city framework, has a consolidated score of 7.33 in Delhi. The capital needs to improve on its water billing efficiency, metering of water connections, mitigation of water losses and round-the-clock water supply. In public safety, Delhi has a consolidated score of 6.50 in safety. Factors such as surveillance, utilisation of technology, online FIR registration facilities, and complaint response time require substantial improvements. In disaster management, Delhi has a consolidated score of seven out of 10. Technology intervention in disaster management is a core concern. Moreover, factors such as the availability of adequate fire stations basis the population density, specialized equipment, efficient disaster alert and response systems, as well as prediction and warning systems require significant improvements. With consolidated scores of 5.40 and 4.90 in solid waste management and storm water drainage respectively, Delhi needs to upgrade its waste management and drainage infrastructure. Presently, technology intervention is substantially low in areas such as waste collection and recycling, as well as rainwater harvesting and drainage systems. In terms of municipal corporation services, Delhi has a consolidated score of 7.47.

The city has fairly efficient mechanisms in place for online license issuance, property tax payment, online building plan and birth registration certificates. However, there is scope for more technology interventions in these domains. In terms of sustainability, Delhi has a consolidated score of 5.27. The figure 3 shows Delhi’s performance in all parameters. Delhi is leading in water supply facilities & sewerage and sanitation facilities Bengaluru, the city of electronics, has a consolidated score of 8.17 in power. In transport, the city has a consolidated score of 6.03, while in water the city has a score of
6.50. In the areas of safety, disaster management as well as sewerage and sanitation, the city has scores of 7.00, 7.20 and 6.67. Bengaluru is required to considerably improve its technology intervention in solid waste management and storm water drainage. In overall sustainability, the city has a score of 5.77. The overall performance of the city is shown in figure 1. Pune, with a population of 31.244 lakh, spans an area of approximately 710 km². The city has a consolidated score of 8.47 in power. In the areas of water, safety and disaster management, Pune has consolidated scores of 6.17, 6.77 and 7.20, respectively. The city is required to improve its technology intervention in these areas in order to further improve its service delivery to citizens. Pune has consolidated scores of six each in areas of solid waste management as well as sewerage and sanitation. With a score of five in sustainability, the city requires to considerably improve in the sustainability domains of air and noise pollution. The overall performance of the city is shown in figure 2. Pune has the highest score of 7.50 in education and 6.00 in solid waste management.

Hyderabad, the city of pearls, covers an area of 650 km² and has a population of 68.09 lakh. In the power domain, the city has a consolidated score of 8.27. With technology intervention, Hyderabad has fairly efficient systems in place for electricity grid operations and management, online bill payment facility, mitigation of distribution losses, metering and grievance redressal. Though the city is considerably using technology in the power domain, day-and-night power supply continues to remain an area of concern in certain parts of Hyderabad. In the water, municipal corporation, education and disaster management domains, Hyderabad has consolidated scores of 6.33, 6.67, 6.00 and 6.60 respectively. Sewerage and sanitation, a critical to-have component for embarking on the smart city journey, has a consolidated score of 4.67 in Hyderabad. The city requires considerable technology intervention in areas of waste water treatment, usage of treated water, and connectivity of households to the waste and sewerage network. The city also requires considerable improvements in areas of overall sustainability and storm water drainage. The overall performance of the city is shown in figure 4.
5.2. Comparative assessment of smart cities in India and developed nations

From the matrices and case studies of Indian cities and four ranked smart cities, it is clearly evident that smartness of developed countries cities are high and they are providing high facilities like smart grid, smart meters, etc. The Indian cities are still lacking basic infrastructural facilities like 24x7 electricity and water supply, affordable housing, etc and trying to achieve those parameters which count for making a city smart. Developed nation’s cities achieved basic infrastructural amenities long back. Those cities are now focusing on development of their advanced technological interventions like mass transit systems, ICT systems, etc in a more beneficial and efficient way unlike the Indian cities. From above situations we can find that smartness in Indian cities means achievement of basic amenities and their proper management. MoUD has mentioned basic facilities as the benchmarking for smart cities in India. Developed countries are far ahead of India. Their smartness is high because of utilization of ICT, advanced technologies, etc. In the recent scenario Indian cities are in the pace of achieving low smartness (basic facilities) which needs to be improved a lot.

VI. CONCLUSIONS AND RECOMMENDATIONS

India is witnessing heightened aspirations and expectations from citizens as well as the leading developed economies across the globe. The new government at the center has embarked on an ambitious trail to transform the landscape of India with the announcement of several smart cities. With the promise of benefits for citizens, the government and businesses alike, smart cities seem to be the next promising leap for national and state administrations. With a strong wave of digitization and technological evolution across the globe, it is only imperative that cities leverage ICT and technology for simplifying city activities and functioning such as transport, utilities, waste management and education. Some of the concluding points are as follows:
• From the matrices and case studies of Indian cities and four ranked smart cities, it is clearly evident that smartness of developed countries cities are high and they are providing high facilities like smart grid, smart meters, etc.
• The Indian cities are still lacking basic infrastructural facilities like 24x7 electricity and water supply, affordable housing, etc and trying to achieve those parameters which count for making a city smart.
• Developed cities are now focusing on development of their advanced technological interventions like mass transit systems, ICT systems, etc in a more beneficial way.
• In the recent scenario Indian cities are in the pace of achieving low smartness (basic facilities) which needs to be improved a lot.

Depending on the analysis of case studies and literature review, it is recommended to shift all “non-smart” cities toward smart city. Although the transition to a smart city is not trip and cannot be achieved overnight, but the first step is a determination to achieve this goal, then the stakeholders would take part in developing our cities to smart with collaboration of governments and companies, researchers, architects, designers and urban citizens.

REFERENCES

[1] Cocchia, Annalisa, “Smart and Digital City: A Systematic Literature Review”, Switzerland: Springer International Publishing, 2014.
[2] Abid, Mohammed Talib,”Assessment of Smart City Approach: Its Tools and Components”, 2014.
[3] Joyce Mwangama, Asma Elmangoush, Joseph Orimolade, Neco Ventura, Ronald Steinke Prototyping Machine-to-Machine Applications for Emerging Smart Cities in Developing Countries. South Africa: s.n., 2014.
[4] Gordon Falconer, Shane Mitchell, Smart City Framework. s.l.: Cisco Internet Business Solutions Group (IBSG), 2012.
[5] Cohen, B. The top 10 Smart Cities on the planet”, Fast Company. www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet. [Online] [Cited: Monday October 2015.] www.fastcoexist.com/1679127/the-top-10-smart-cities-on-the-planet.
[6] Kogan, Natalia. Exploratory research on success factors and challenges of smart city projects. Seoul: s.n., 2014.
[7] Rudolf Giffinger, Christian Fertner, Hans Kramar, Robert Kalasek, Nataša Pichler, Evert Meijers. Smart cities - Ranking of European medium-sized cities. s.l.: Centre of Regional Science, 2007.
[8] India, Ministry of Urban Development Government of. [Online] June 2015.
[9] Neel ratan, anoop verma, et. al. How smart are our cities. s.l.: the indian express group, 2015.
[10] India, census of. Census of india. [online] 2011.
[11] Brandt, julia & svensson, linnéa. Approaching urban sustainability- a minor field study in india. Delhi: s.n., 2013.
[12] Luis m. Correia, klaus wünstel. Smart cities applications and requirements. 2011.
[13] Charles roxburgh, susan lund, john piotrowski. Mapping global capital markets 2011. S.l.: mckinsey & company, 2011.
[14] H. Schaffers, n. Komninos, M. Pallot. Cities –smarter, greener, better. Scientific american magazine, 2011.