
Elementary & Auxiliary Strategies Imparting “Smartness” To A City

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Abstract: The buzz word smart-city has gained momentum in the recent few months owing to the nation-wide programs launched by the Indian government. According to the sources, a smart city is defined as a city that provides all the modern facilities to ease the lifestyle of the people. Further, it must ensure safety of the environment and conserve energy and other natural resources. This paper presents a comprehensive report on the elements and strategies that need to be implemented for a city to be considered as a smart city. It contains a report on the various futuristic plans and measures that the Indian government has formulated to turn the concept of smart cities into reality. The paper also intends to describe the roles and responsibilities of the various stakeholders in the actualization of the smart cities.

Keywords: Smart city, Strategy, Building Information Modelling, Sustainability.

I. INTRODUCTION

An efficient city is the one that is designed in such a manner that during its construction and in its lifetime of operation it effectively and optimally utilizes the available natural resources while being minimally dependent on the passive energy sources. It ensures least disruptive exploitation of the naturally resources i.e. land, water and energy. The key factor here lies in the fact that a city is not merely a consumer of resources but is also a generator and exporter of energy, materials and resources. It facilitates the preservation and restoration of the life sustaining environmental system.

With growing awareness towards the sensitivity of the ecosystem and need for environment safety, the concept of eco-friendly strategies is rapidly gaining recognition. The design and implementation of the “green” projects are site specific and hence it is necessary to pre-decide on the strategies to be adopted followed by site selection [15].

Certain measurable targets include water conservation, resource and material management, energy efficiency, on-site treatment of rain and storm water, construction waste management etc [15].

The need here is to evolve such systems that are compatible with the green strategies and involve the citizens to participate in the process. “Smart” solutions promise to cater to these needs and save on time, energy and resources while ensuring a bright future.

II. DEFINITION OF A CITY IN THE INDIAN CONTEXT

The census of India, 2011 has identified two essential criteria for a space to qualify as an urban area. First is the establishment of a municipality, corporation, cantonment board or a town area committee. Another criterion forms its basis on the minimum population cover of the area with a population of 5,000 as the threshold value. Moreover, it is required that at least 75% of the male population is engaged in secondary or tertiary sources of livelihood given the fact that majority of the cultivators are based in the rural areas. Furthermore, a settlement to be recognized as a city must possess a minimum population density of 400 persons per square kilometer. Therefore, on one hand villages comprise of large spans of cultivable land and fewer people, cities on the other hand is far more densely populated in comparison. It thus validates the fact that city governance and management needs to adopt a multi-dimensional form to address the needs and issues of the cities.

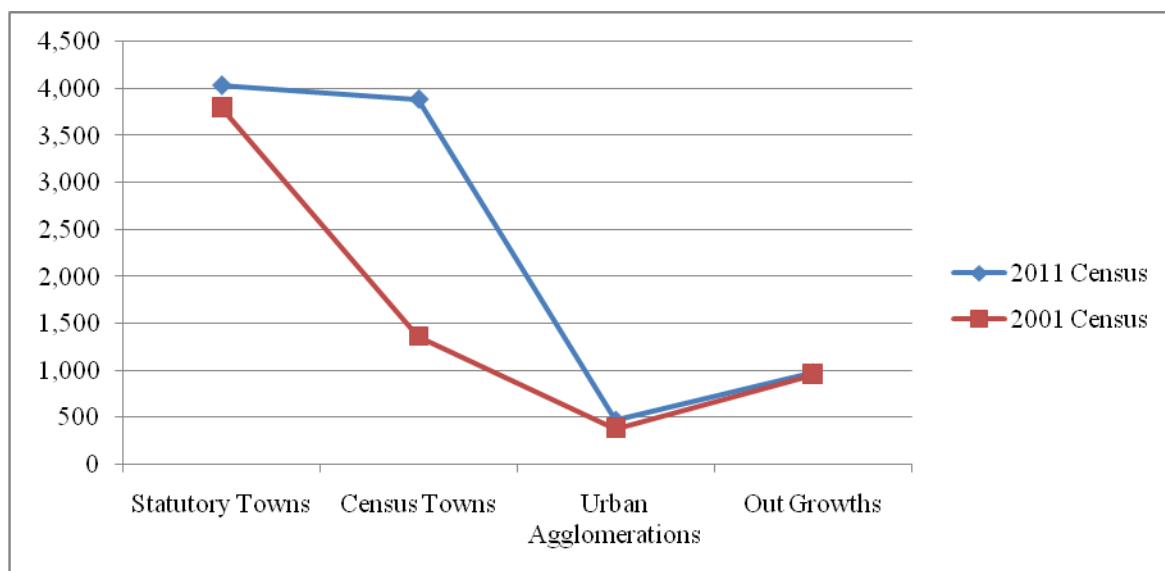


Figure 1: An inter-comparison of the population densities of the various urban areas [13]

Urban agglomeration comprises of a series of urban spreads inclusive of two or more towns or an integration of a statutory town and its adjoining growths (OGs). It must shelter a population of at least 20,000. Examples include Delhi UA and Greater Mumbai UA [13].

As it can be inferred from the above figure, the number of people occupying the towns has seen a sharp rise and is continue to increase invariably in future.

RANK	CITY/ URBAN AGGLOMERATION	2011	2001	1991	1971	1951
1.	Mumbai	18.41	16.37	12.57	5.97	2.97
2.	Delhi	16.31	12.79	8.38	3.65	1.44
3.	Kolkata	14.11	13.22	10.92	7.42	4.67
4.	Chennai	8.70	6.42	5.36	3.17	1.54
5.	Bangalore	8.50	5.69	4.09	1.66	
6.	Hyderabad	7.75	5.53	4.28	1.80	1.13
7.	Ahmedabad	6.35	4.52	3.30	1.75	
8.	Pune	5.05	3.75	2.49	1.14	
9.	Surat	4.59	2.81	1.52		
10.	Jaipur	3.07	2.32	1.52		
11.	Kanpur	2.92	2.69	2.11	1.28	
12.	Lucknow	2.90	2.27	1.64		
13.	Nagpur	2.50	2.12	1.66		
14.	Ghaziabad	2.36				
15.	Indore	2.17	1.64	1.10		
16.	Coimbatore	2.15	1.45	1.14		
17.	Kochi	2.12	1.35	1.14		
18.	Patna	2.05	1.71	1.10		
19.	Kozhikode	2.03				
20.	Bhopal	1.88	1.45	1.06		

Table I: Population covered by the various significant Indian cities based on the data collected by the Government of India in the year 2011 [9]

III. EVOLUTION OF SMART CITIES IN INDIA

Countries like Singapore and England are positively and incessantly working towards turning their cities smart. India has joined the league too encouraged by the latest national policies. Following the steps towards sustainable development, the Smart Cities Mission of the Government of India is a bold and bright step. The aim here is to accelerate growth, generate more sources of livelihood and improve the quality of living of the people. Area based development is a measure to incorporate the slums and urban sprawls into the city structure and bring upon a holistic development of the whole. Moreover, greenfields will be developed around the city fabric to leave room for healthy expansion [2]. The smart cities mission will for the first phase of its functioning, cover 100 cities under the Ministry of Urban Development.

	Conversion of Existing Cities		New Cities	
Ongoing/Developed	Municipal level initiatives <ul style="list-style-type: none"> • Greater Hyderabad • Surat • Coimbatore • Bangalore • Jamshedpur • Kanpur 	Targeted efforts <ul style="list-style-type: none"> • GPS/GPRS for solid waste management, maintaining parks ,street lights • On-line water quality monitoring and building plan approval scheme • GIS to standardise property tax • IT-enabled 24/7 single-window call centre 	Private Initiatives <ul style="list-style-type: none"> • Lavasa • Smart City Kochi 	Model Cities <ul style="list-style-type: none"> • Efficient recycling and waste management • Knowledge based industry township • Special Economic Zone status
Planned	Central level initiatives <ul style="list-style-type: none"> • Phase 2 of Jawaharlal Nehru National Urban Renewal Mission • Establish 2 smart cities in each of the 28 states with population of 5 to 10 Lakhs 	Targeted efforts, Foreign Partners <ul style="list-style-type: none"> • Fully wired/broadband • Carbon Neutral • Energy Efficient 	State level initiatives, Foreign Partners, Driven by DMIC <ul style="list-style-type: none"> • Dahej Ecocity, Gujarat • Sanand Changodar, Gujarat • Shendra Ecocity, Maharashtra • Manesar Bawal Ecocity, Haryana • Jhajjar Manesar, Haryana • Neemrana Ecocity, Rajasthan 	

Figure 2: Tabular representation of the evolutionary stages of Indian smart cities [9]

IV. “SMART” STRATEGIES

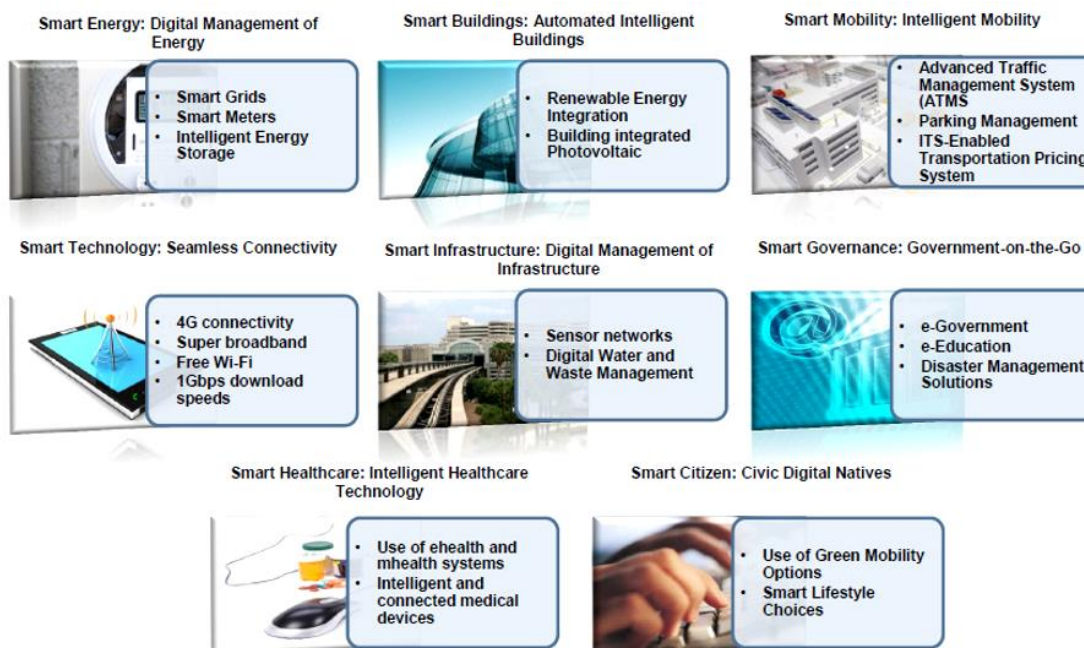


Figure 3: Smart City Parameters [5]

A. Smart Buildings

“The ideal building would be inexpensive to build, last forever with modest maintenance, but return completely to the earth when abandoned.” -David Bainbridge

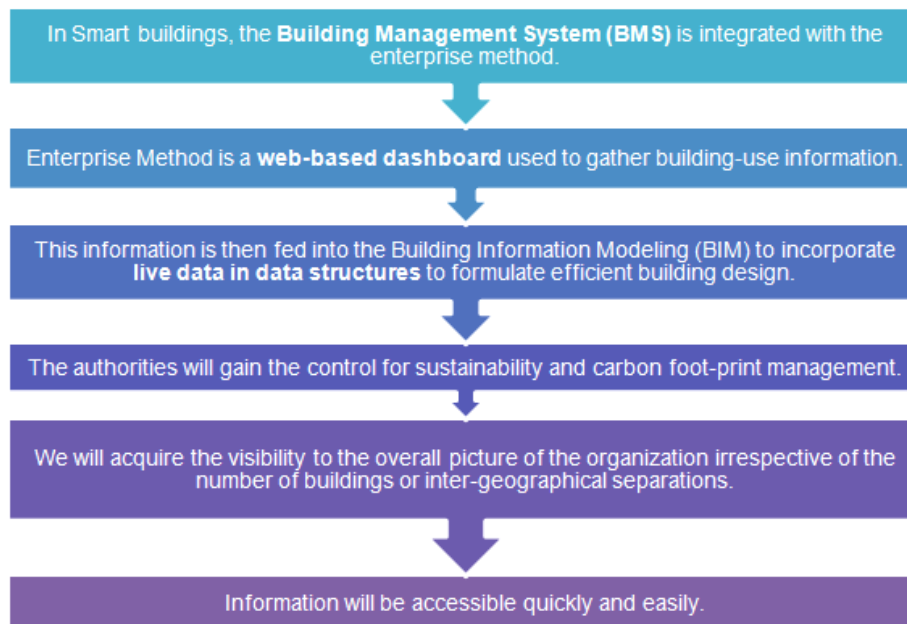


Figure 4: Work-flow of Smart Buildings

The building industry faces numerous challenges including economy, societal demands, commercial targets, depleting conventional resources, rising population, space crisis, pollution, natural calamities, global warming and so forth. To combat these challenges, researchers have developed several measures, building materials, techniques and technologies. For example, the vernacular architectural techniques evolved in countries like China, Korea and Japan where naturally found materials like mud, bamboo, paper and straw have found extensive usage. Furthermore, mud houses built in Africa and other parts of the world offer greatly attractive and comfortable abodes to the users. Bamboo with its seismic resistance ability is yet another such material that comprises of multifarious properties of great utility to the building industry. These naturally occurring construction materials are playing crucial roles in mitigating the adverse impacts on environment and reduction in carbon-footprint [7].

B. Smart Technology

Also, advancements are ceaselessly taking place in other areas of science and technology, the fruits of which tickle down to the construction industry as well. Information technology has rapidly grown in magnitude and has presented seamless communication channels before us. Useful data is available to us at the tip of our fingers, thanks to the latest smart phones, tablets and palmtops. Cloud computing technology enables transference and storage of data in cloud-based platforms which is accessible from anywhere anytime. Data extraction and manipulation is readily available to the users. Building Information Modeling (BIM) is a technique which facilitates the simulation of the building and its elements at every stage of design and construction. It gives information regarding the energy performance of the building apart from the aesthetic and spatial predictions. This information provides opportunity to develop on the existing system and rectify errors, if any. The greatest advantage of smart building is that it takes into consideration, the feedback that is received from the users. This information is then continuously fed into the loop and becomes a parameter in design process. Smart buildings are based on the inclusiveness concept. People's opinions and feedback form a necessary aspect of this system.

Considering the fact that information availability will form the basis of smart cities, adequate measures would be taken to ensure connectivity at the fastest possible speed and at the lowest possible rates. Efforts are being made to provide free wi fi to the people in order to establish right to information for all citizens irrespective of their economic backgrounds. Furthermore, even remote areas that may have once been inaccessible are increasingly being brought to the coverage area. Information can now be accessed by all and at any location.

C. Smart Energy

Smart buildings provide the power to the users to control the energy expenditure of their environment with the help of smart meters. These smart meters will expose the usage data to the users in order to help them plan the degree of usage depending upon the circumstances. These smart meters will be backed by smart power grids that have the facility to provide the demanded amount of power custom-made of every user. Therefore, smart cities will be able to save on power by enabling dynamic input-output provision. The most notable factor here is the fact that smart grids will be able to support not only the conventional sources of energy generation but all other energy generation systems as well including solar, solar-thermal, wind and geothermal energy systems. It thus necessitates the incorporation of smart power grids, smart meters and the smart buildings in the framing of the city structures, thus giving birth to the smart cities. We thus arrive at a stage where smart cities become the ideal choice for the creation of novel city fabric. The actualization of such a structure calls the need for intensive training and dissemination of information regarding their usage and maintenance to the masses.

D. Smart Mobility

Transportation system constitutes another significant element of the city. At present, traffic jams presents itself as a grave problem for the people. It spoils the atmosphere of the city and is also a cause for rise in noise and air pollution. Needless to say, it renders the road transport to be an unreliable mode of transport owing to the harassment and wastage of time that one faces due to traffic jams. Traffic jams are a result of unprecedented and uncontrolled vehicular and pedestrian movement on road. Besides this, the uncontrolled vehicular movement causes chaotic traffic flow and unfortunate road accidents. Advanced Traffic Management System (ATMS) is responsible for looking into these concerns. With the help of digitalized monitoring systems, controlled traffic movement will be ensured which will further mitigate the presence of sudden traffic jams on road. This will simultaneously enhance safety and security on road where every unit on the road is taken under vigilance. The tracking system will be boosted as a result. Not only will the smart cities possess advanced systems for monitoring of vehicular movement on road but will also manage the parking systems. Digitalized recording of parking systems will facilitate the accurate spacing to be allotted for the activity. Any space left can be recycled and used for other activity as per the requirement.

Lifting of vehicles parked at non-parking zones by the governmental agencies is a common practice these days. However, there is no legitimate fixation of penalties. With digitalized parking management systems, people will have access to the standard rates of fines allotted and will also help carry out a comparison between the cities. This will enhance transparency and establish the faith of the people in the governance. Transparency will also be established in terms of travel costs since the ITS-Enabled transportation pricing system will determine only the standard fares are used. People will have the access to all the information via internet. Smart phones and sharp connectivity will

ensure the availability of this data at all occasions. Therefore, the smart policies will also help us fight corruption and establish transparency even in the day to day life happenings.

E. Smart Infrastructure

Finally, one of the most influential aspects of a city is its waste management. Every year tons of waste gets added to already massive dump of garbage. According to a daily newspaper, our country generates 47 million tons of solid waste every year and 1.3 million tons of waste every day [1]. Majority of this waste is biodegradable and non-radioactive in nature is recyclable in nature. Under the Prime Minister’s Swachh Bharat Abhiyan, several conceptual ideas of waste management have been brought into practice and many are being researched. The biodegradable waste is being recycled to form manures utilized in agricultural lands. Best out of waste ideas are supported by the national bodies [1]. Apart from these, newer emerging technologies like nano-composts can be seen as promising measures for tackling the enormous garbage [6].

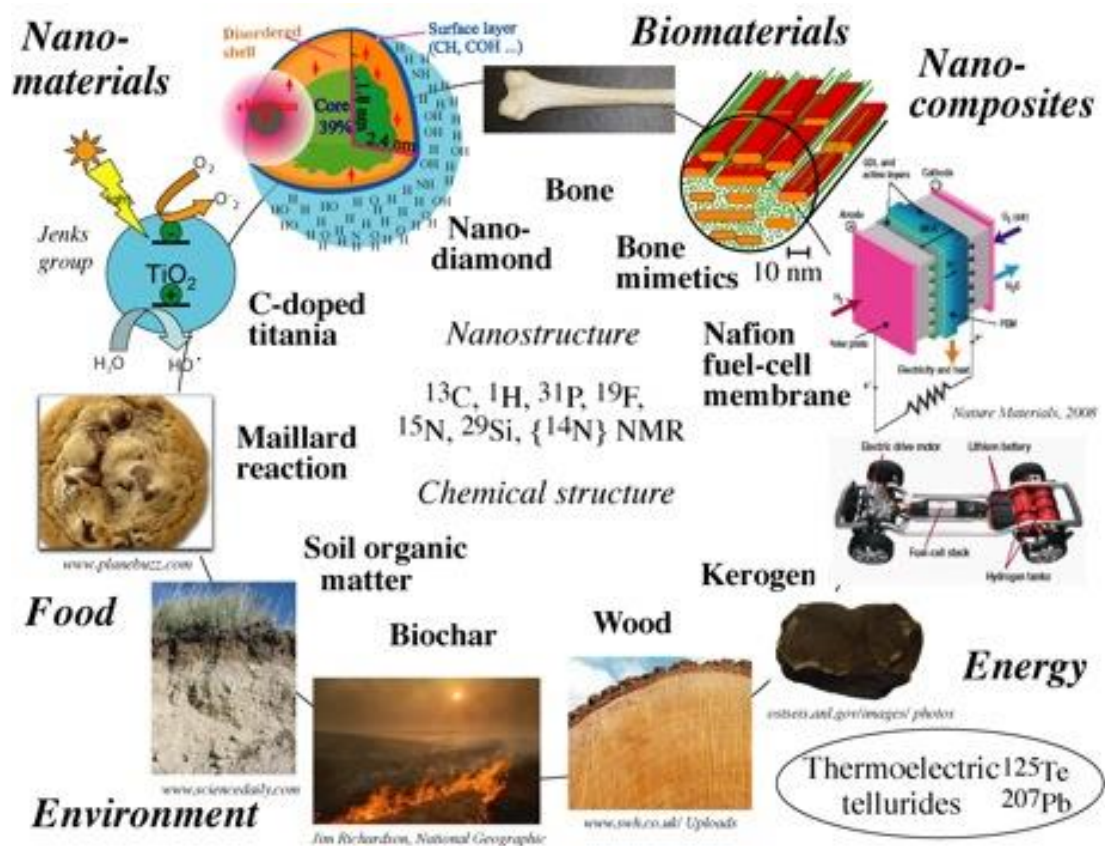


Figure 5: The vicious circle that the system of Nano-composite waste disposal follows [6]

Another technique of decomposing the waste is by using the thermal power generated using alternate sources of energy [3]. Owing to the disparate nature of the wastes, it is imperative to adopt custom-made strategies for each kind. This has greatly helped both in waste management as well as safety of the masses from radioactive wastes [14].

F. Smart Healthcare

Health is amongst the most sensitive assets of the city dwellers. The modern lifestyle has resulted in a decline in the availability of time. However, emergency situations can arise anytime without any prior warning. This need of constantly staying in touch with the near ones can now be obtained with the help of smart technology gadgets. Not only this, but the e-space is also professional in nature. Several professionals including those qualified in medical sciences can now remain connected to their patients constantly. This is especially beneficial for patients suffering from diseases such as diabetes, asthma etc. to refer to their doctors for medical assistance. This system of tele-medicine is also beneficial for patients suffering from diseases that are difficult to diagnose. These patients can refer to a variety of doctors world over and seek advice for their ailments. It is amongst the biggest benefits offered by the smart cities.

G. Smart Education

These smart cities will be enabled with the techniques for distance learning with the help of the internet. Irrespective of the geographical locations and distances, quality education through the means of advanced videos, text and graphics will be made available at the doorstep of the student. Students will have the facility to interact to the faculties in real time and ask queries or make suggestions. Even their actions will be recordable to the teacher located at the other corner of the globe. A healthy and colourful encounter with the people belonging to disparate backgrounds and bearing different abilities will enhance the learning process. Indeed this system of education is smart in nature as well as working.

V. CHALLENGES IN THE MAKING OF A SMART CITY

With the growth of smart cities or e-cities, vigilance against cyber crime must be strengthened. Thus e-governance will take up significant roles of policing the city structure. Newer rules will be framed that must be communicated to the citizens. Since, the city administration will form its base on the cloud-based information; the sensitivity of governance towards cyber security will increase. Cyber crime will be seen at a much stricter light and those who breach the cyber law will have to face more severe punishments.

The greatest side-effect of the e-era will be the generation of gigantic amount of e-data known popularly known as big data. The effective management of this data without any loss, theft or undesirable manipulation is a challenge that the management system needs to deal with. Moreover, the disposal of this e-data needs special concern [12].

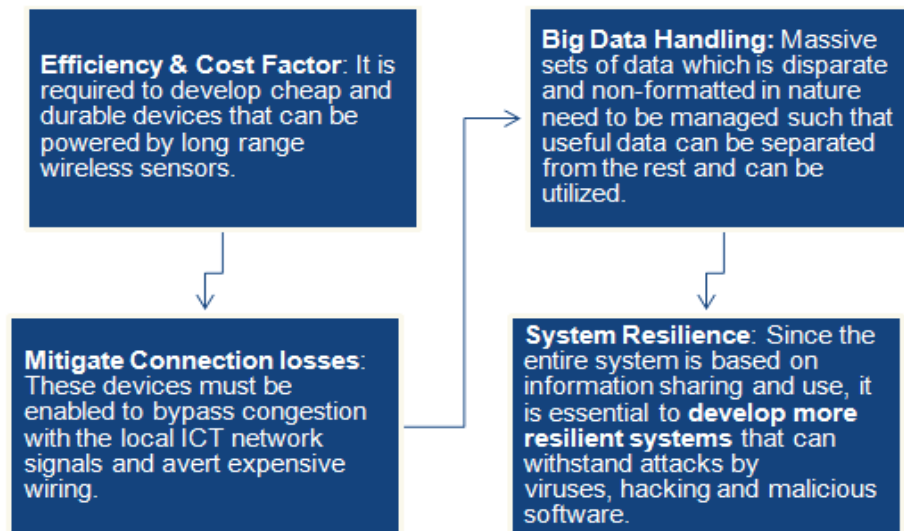


Figure 6: Areas of Concern in the actualization of Smart Cities

VI. CONCLUSION

Sustainability offers solution to the problem by introducing new and innovate technologies, techniques and patterns of thinking. To achieve sustainability over a long-term period of 100 years, Boyle suggested an approach that is based upon a framework defined by the factors such as local geology, topography, hydrology, climate, soil and other physical aspects of local landscape that can give rise to developmental limitations and risks for the human society. The long term target of smart cities is to establish sustainability. Efforts are being made to develop every possible dimension of the city life with the help of the latest advancements. Smart cities will provide the onus to the citizens of the place to take charge and actively involve themselves in the task of carrying out the development of their city. The participatory approach will ensure that people are not taken as mere consumers of the facilities but will have a role of responsibility to play in the entire process. Their feedback constitutes a necessary element in the designing of these evolved cities. Furthermore, technology as a facilitator can help us to mitigate loses and costs and ultimately assist in establishing the balance of the eco-system. The key importance is to be given to the benefit of mankind and the conservation of nature. Only when every single individual irrespective of his/her social, cultural, economical and political backgrounds works for the up gradation of the whole society can we hope for a city that is “smart” in a true sense.

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