

Technological Influences over Factors for Sustainability of Smart Cities

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ABSTRACT

Purpose: Emerging technologies have completely revolutionized the world and helped people getting connected to each other than ever before. Due to rise in population and urbanization, transformation of cities into Smart Cities is a necessity which can be fulfilled through Internet of Things and other emerging technologies.

Although the paper describes the kind of support given by emerging technologies to the development and measurements of smart cities worldwide, it gives emphasis to the infrastructural development and service deliveries of smart urban development in India based on its own standards.

Design Methodology/Approach: This research work was based on secondary data. The secondary data was collected from various journals, newspapers and annual reports such as World Population Review and World Economic Forum etc.

The methodology for this research work was [4] –

Parameters for measurement of smart cities development were set. For establishment of these parameters, 37 different journals, newspaper articles and annual reports were studied. These parameters are shown in Figure 4.

Establishment of elaborated sections for parameterizing Indian smart cities development was done and 12 essential parameters were established which are shown in Table 1 and Table 2.

Analysis of major contribution and influence of emerging technologies for development of smart cities was done. It is shown in table 3.

Critical analysis of measurement of Delhi as a smart city based on secondary data was done.

Finally, a conclusion for smart urban planning, based on the above steps, was constructed.

Findings: At the end critical analysis of Delhi as a smart city was done based on the same parameters of measurements. Rapid urbanisation in India has impacted the development of the capital city very negatively. The improvement needs public decision-makers, policy officials, technology developers and citizens of India to not only look for increasing infrastructure of the cities but also make policies for improvement of environmental sustainability and quality of life.

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Introduction

After jogging in the early morning when you reach home, the main door of your house senses your presence and gets unlocked itself for you, the air conditioner of your room senses your body temperature and sets the thermostat at a temperature which suits you. Microwave and coffee maker starts working five minutes before you starts taking your breakfast. Once you get ready to leave your room, lights, fans and air conditioner get switched off on their own. Doors of your car garage opens itself as soon as they gets signal that you have keyed in your car. The home security system gets on alert when you leave the home. That's how the technology of IOT serves humans. Such a home is known as smart home where all the devices are connected together through an internet connected network and work without any human intervention which makes life of humans easier. [28], [29]

If we talk about smart city, it is almost same but on a larger scale. Smart city will include automation of education system, transportation system, power distribution, health care and agriculture etc.

But, this is only a technical aspect of a smart city. There are few other essential features too other than inclusion of technology which are mandatory for making life of the citizens comfortable, making mother earth a place to live and creating an ecosystem for sustainable development of the whole city as well as society. [19], [20]

Literature Review

In 2016, Caragliu [1] suggested that the city becomes smart, "when investments in human and social capital and traditional and modern Information and Communication Technology (ICT) fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance."

In 2017, Mohanty [17] explained Smart City as "a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants. Smart cities are greener, safer, faster and friendlier."

The Brundtland Report in 1987 [32] mentioned that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Webster in 2018 suggested, "A "City" is a place where people live that is larger or more important than a town. It is an area where many people live and work" [34].

According to Dhingra and Chattopadhyay [6], a smart and sustainable city gives improved quality of life, economic growth with better employment opportunities, easy and improved access to social and community services, efficient basic services and infrastructure such as better transportation system, water management, waste management and other utilities.

Harrison in 2010 told that a smart city is "connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city" [12].

In 2007, Giffinger [9] gave definition of a city -"well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive, independent and aware citizens".

Hall defined city in 2007 that it "monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens"[11].

A city "striving to make itself "smarter" (more efficient, sustainable, equitable, and livable)" [24].

In 2010, Toppeta suggested, "combining ICT and Web 2.0 technology with other organizational, design and planning efforts to dematerialize and speed up bureaucratic processes and help to identify new, innovative solutions to city management complexity, in order to improve sustainability and livability." [32]

"The use of Smart Computing technologies to make the critical infrastructure components and services of a city which include city administration, education, healthcare, public safety, real estate, transportation, and utilities more intelligent, interconnected, and efficient" [34].

A comprehensive definition of smart sustainable city can be stated as, "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects" [2].

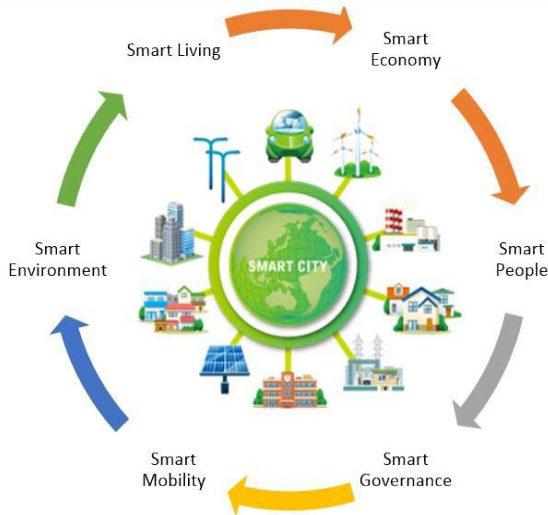


Figure – 1 Characteristics of a smart city

Source – Smart Biz Tech Solutions
<http://www.smartcityaligarh.com/>

Urbanisation in India

There are 40 cities in India which have more than one million population, 396 cities have population between 100,000 and 1 million and 2500 cities have population between 10,000 and 100,000. Mumbai and Delhi have more than 10 million residents [37].

Holger Dalkmann and Ashwin Prabhu, 2013 Due to migration of villagers to cities, India’s urban population is expected to increase from 377 million in 2011 to 590 million by 2030. [13]

Figure 2 gives a comparative analysis of growth of population in urban areas and decline of population in rural areas of India. It also shows that the urban population is increasing year by year whereas rural population is decreasing which displays fast urbanization process in India. Projections to 2050 show a large urbanization phenomenon reaching almost 50% of urbanization of the villagers of today, with a total population that grows. This insight of urbanization is alarming for the government of India for making timely arrangements for accommodating huge number of people who migrate to cities from their villages. For sustainable development of cities, it is must to create a system to predict the requirements of such migrators.[35]

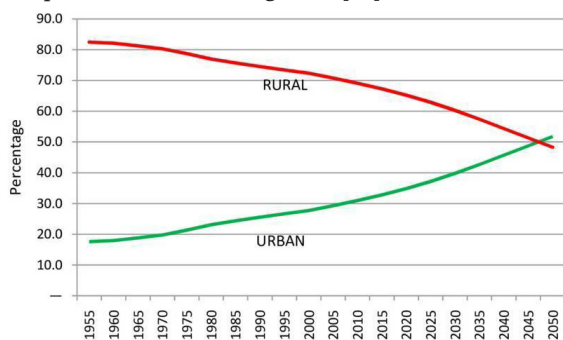


Figure 2 - Changing share of Urban and Rural populations in India (%):1950 to 2050 in India

Source: Population Trends of Urban India (UN Report)

According to Census 2011, approximately 31% of Indian population migrate to urban areas and cities contribute 63% of GDP. It is expected that by 2030, urban areas in India will accommodate 40% of villagers and contribute 75% of India’s GDP. Such massive group of people certainly tend to become disorganized and disordered [15]. Statistical estimations indicate that the percentage of people living in the cities will account for around 70% by 2050 [2]. The figure 2 shows the explosion of population in Delhi. The population has increased 26 times by now as compared to population in 1950. [26]

Considering this trend of urbanization and the mission of sustainable development of cities, the concept of smart cities came into existence for future urban development

Development of smart cities is one of the steps for improving the quality of life of the citizens and to make the cities more sustainable [31].

According to 2019 statistics, 10 most populated cities in India are shown in the figure 3 out of which Delhi is supposed to be on top. But in the year 2020, Mumbai is on the top in terms of population increase in major cities in India.(Fig 3, [37]).

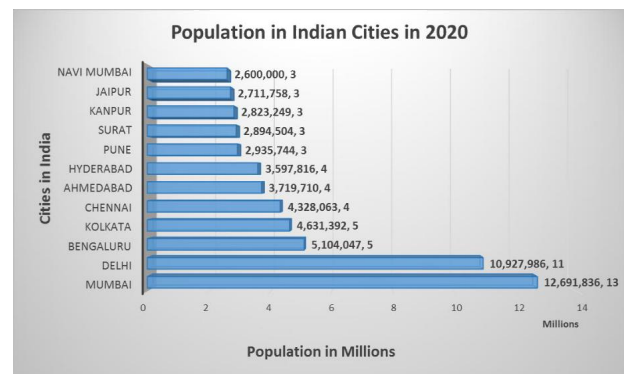


Figure 3 – 10 most populated cities in India in 2020 (Source - World Population Review)

Smart City Framework

In India, increased growth rate of urbanisation, effects of population growth and the environmental impacts due to human activities are the major hurdles of development of cities. The holistic approach of sustainable development of a smart city is based on five main pillars [30],[31],[36] shown in figure 4.

1. Physical Development –
 - a. Traffic management - Multi-modal Public Transportation
 - b. Uninterrupted power supply
 - c. waste management and sanitation - Zero emission solid and liquid waste
 - d. Assured and Metered Water Supply
 - e. Pollution free environment



- f. Neighbourhood markets infrastructure
 - g. City wide connectivity
2. Technical Development –
- a. High-Speed Broadband Connectivity
 - b. Deployment of emerging technologies in various fields
 - c. Use of Internet of everything
 - d. Robust ICT infrastructure
 - e. City wide Connectivity
 - f. Open data/ sharing of data
3. Social Development –
- a. Inclusive Development: Affordable Housing, Night Shelters, etc.
 - b. Quality Education in all Neighborhoods
 - c. Health Care in all Neighborhoods – Tele- medicine
 - d. Entertainment and Recreational Facilities
 - e. Cultural, Sports and Fitness Centers
4. Economic development-
- a. Finance Centers and Services
 - b. Increased employment opportunities
 - c. Means of Personal Growth
 - d. Means of Market growth
 - e. Small and Medium Manufacturing Enterprise Clusters
 - f. Trade Facilitation and Logistics Centers
 - g. Incubation Centers
5. Institutional Development
- a. Skill Development Centers
 - b. E-governance – 24x7 Online Public Service Delivery
 - c. Safety, Security and Enforcement
 - d. Disaster Management and Resiliency systems
 - e. Minimum Government, Maximum Governance
 - f. Citizen Engagement

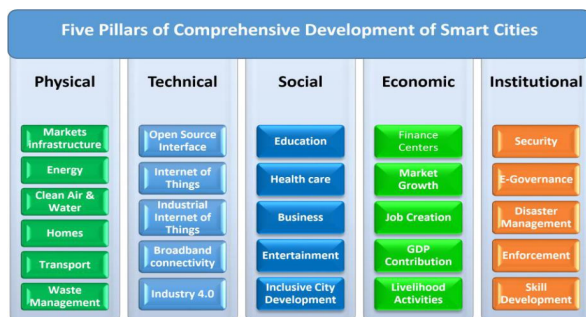


Figure 4 - Five Pillars: Comprehensive Development of cities in India

Source - smartcities.gov.in

4.1 Parameters for Measuring the Smart Cities

The term smart city is used for the holistic development of the city for increasing the quality of life of its citizens. Giffinger, in 2007 [9], proposed a model for ranking few smart cities in Europe. In order to do SWOT analysis of those cities they proposed few dimensions to be measured. Those dimensions are [25],[27] -

- Smart economy,
- Smart people,
- Smart governance,
- Smart mobility
- Smart environment
- Smart living.

Emerging Technologies due to 4th industry revolution can play a vital role in monitoring and harnessing citizens' ability to access facilities provided by state or central government with security and safety [18]. Therefore, for fast growing development of smart cities, emerging technologies or Industry 4.0 may also be considered as one more dimension for measuring the ranking of smart cities in an economically, socially and environmentally sustainable way [20],[21],[28],[29].

Drawbacks of Previous Research that are Resolved by the Proposed Work

According to the previous studies, the pillars of comprehensive development of smart cities were as below-

1. Physical
2. Social
3. Economical
4. Institutional

Due to the influence of emerging technologies over the universe, one more component was added as a pillar of comprehensive development of the smart cities. And that component is Technical. Emerging technologies have played a significant role in holistic development of cities.

Objectives of the Study

The overall objective of this research work is -

- To analyse the effect of various emerging technologies of Industry 4.0 over parameters of development of smart cities.
- To analyse the development of smart cities so that rating can be done accordingly.
- To measure Delhi as a smart city based on various components as Delhi was taken as a case for analysis of development as a smart city.

Research Methodology

This research work was based on secondary data. The secondary data was collected from various journals, newspapers and annual reports such as World Population Review and World Economic Forum etc.

The methodology for this research work was [4] –

1. Parameters for measurement of smart cities development were set. For establishment of these parameters, 37 different journals, newspaper articles and annual reports were studied. These parameters are shown in Figure 4.
2. Establishment of elaborated sections for parameterizing Indian smart cities development was done and 12 essential parameters were established which are shown in Table 1 and Table 2.
3. Analysis of major contribution and influence of emerging technologies for development of smart cities was done. It is shown in table 3.

4. Critical analysis of measurement of Delhi as a smart city based on secondary data was done.
5. Finally, a conclusion for smart urban planning, based on the above steps, was constructed.

Parameters for Measurement of Smart City Development

In India, most of the citizens migrate from villages to cities which leads to the necessity of developing 100 smart cities in the country [17]. Development of smart cities may decrease the pressure of migrant population in existing urban areas and provide a comfortable life to the citizens. The service deliveries can be classified into 12 different sectors in India [25]. Following are the ideal smart services successfully implemented in various cities in India [2], [21], [22] –

Table 1 – Parameters for measurements of Indian Smart Cities
Scoring components for being a smart city in India.....

Power	Water	Public Safety	Disaster Management	Transport	Sewerage and sanitation
24x7 electricity supply	24x7 water supply	City surveillance	Disaster prediction system: Flood, earthquake, etc.: Early warning system	Transport surveillance: Traffic violation detection, speed violation detection, red light violation detection	Households connected to the waste water, sewerage network
Quality	Metering of water connections	Online FIR, complaints registration	Disaster alarms and response system	Challan Management	Treatment of waste water
Distribution losses	Billing efficiency	Verification, validation or clearance	Efficient firefighting systems	Traffic management system	Use of treated water
Energy consumption details		Complaint response time	Fire stations basis population density	City parking management	
Online payment facility	Online payment facility		Availability of fire stations with special devices and materials for firefighting	Access to para-transit	
Grievance redressal or CRM for citizens	Water losses			Availability and frequency of public transport	
Metering	Revenue realisation			Availability of bicycle tracks	
Energy efficiency initiatives: Streets, renewable, subsidy and green buildings				Continuous unobstructed footpath of minimum 2-m wide on either side of all street	
Billing efficiency				Adherence to building and parking standards	
Revenue realisation					

Rest of the scoring components of ranking smart city are as below –
Table 2 – Parameters for measurements of Indian Smart Cities

..... Scoring components for being a smart city in India

Solid Waste Management	Storm water management	Health	Education	Municipal Corporation	Sustainability
City population with regular solid waste collection (residential)	Availability of requisite drainage systems at identified hotspots in the city	Number of hospitals based on population density requirement	No. of schools	Property tax payments	Noise pollution
Collection of municipal solid waste	Rainwater harvesting	Healthcare facilities	School for specially abled	Online license issues	Air pollution
Recycling of solid waste	Evacuation of water	Emergency response facilities: Ambulance, emergency ward, etc.	College based on population density requirement	Complaint registrations	Adherence to the green building norms
City solid waste that is disposed of in a sanitary landfill, open dump, burnt			Professional colleges based on population density requirement	Licenses issuance TAT	Water pollution
Hazardous waste recycling				RTI TAT	
				Registration of birth and death	
				Online building plan sanctions	

Influence of Technology in Development of Smart Cities

Smart city is a concept of development of urban areas which includes multidimensional growth of the city and its citizens. Now that growth is easier to happen due to multifaceted emerging technologies deployed in cities. E learning, e healthcare, e building, e agriculture, e mobility, e logistics, e energy, e governance, e business and e work and e manufacturing are few service deliveries of smart cities which exist today only due to 4th Industrial revolution in the world. Processes and businesses in the world are transforming from automated to autonomous due to emerging technologies of IIOT, AI, Virtual reality, augmented reality, simulation, cloud computing, block chain, big data analytics, robotics etc.[14],[16],[23],[28],[30]. The table 1 shows the influence of industry 4.0 technologies over fast development of service deliveries in smart cities all over the world.

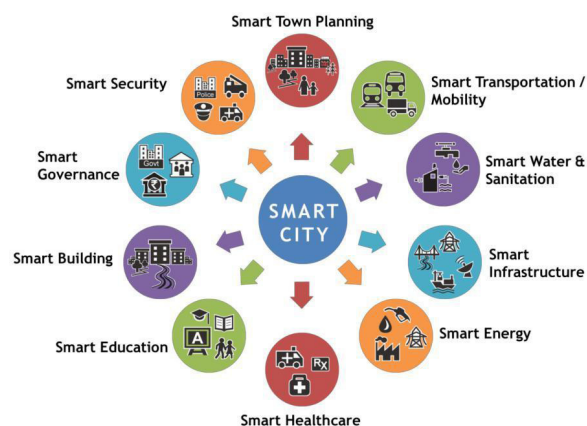


Figure 5 – Smart Solutions for smart cities.

Source – **Rolta India Ltd.**
(<http://www.rolta.com/solutions/smart-city-solutions/>)

Influence of Emerging Technologies for Development of Smart Cities Worldwide

The smart solutions for smart cities are displayed in the figure 5. The measurement of dimensions of smart cities, based on Industry 4.0 technologies [26] and their benefits can be presented in tabular form as below in the Table3-

Table 3 – Influence of emerging technologies for development of smart cities

		Emerging Technology used	Services Delivery	Benefits	Dimensions for smart city measurement
E- Learning	Use of Smart Devices & Broadband > 50 Mbit/s	Gamification, virtualisation, access to computing	Experience and engagement	engagement of students in mastering contents and developing new skills	Smart Environment - 1. Fuel saved from transportation 2. Due to use of electronic books tons of paper will be saved which in turn will save lakhs of trees Smart Economy - cost saving due to the decrease in expenditure per student Smart Living - e-learning participants
		Advanced Data Analytics	Personalised learning	data driven identification of learning gaps approves for fully personalised learning and teaching methods and experiences	
		Smart Portfolio Systems	Life-long learning	learning is no longer restricted to school or a course, but will be a continuously monitored lifelong process	
		Online Community Platforms	Fluid and collaborative	fluidity across content and institutions and enables everyone to be both a student and a teacher	
E- Health	Use of smart device and partnership with medical practitioners	1. Remote Diagnostics 2.Video conferencing 3. Cloud Computing (for health data storage of individuals) 4. Augmented Reality	1. Access to real-time health records 2. outcome oriented reimbursement	Remote access to electronic patient's health records on smart devices and use of wearables and biosensors	Smart Environment - fuel saved from transportation Smart Governance - space for medical facilities released for urban use Smart Economy - cost saving Smart Living - e-health beneficiaries
			Remote patient-doctor interaction	Data generation and big data analytics enable automatic processing and interpretation of data for self-directed health recommendations	
		Personalised medicine	DNA sequencing due to plummeting costs will become affordable for everyone enabling e.g.- gene therapy		
		Training and surgery	Medical training and surgery through augmented reality		



E- Building	Use of smart devices and Wi-Fi with very high bandwidth and Internet of Things, Industrial Internet of Things, Internet of everything, Sensors and actuators	Monitoring, detection and diagnosis technologies 1. Real time and continuous monitoring 2. Data analytics and cloud computing 3. Sensor Technologies 4. convergence of OT and IT	Energy resource efficiency	automation and generation of actionable information reduces energy use and resource wastage due to smart sensors and data analytics	Smart Environment - 1. Energy saved 2. Better housing quality 3. Water saved from being wasted 4. Waste water reduced Smart Economy - cost saving Smart Living - 1. Improved quality of life 2. Enhanced living and working conditions ensuring occupants' comfort that leads to enhanced productivity of individuals 3. smart metering Smart Governance - central energy management system
		Alarm management and automation 1. Data analytics tools 2. Predictive maintenance 3. Machine automation and pattern recognition	Improved process efficiency	1. Fully automated maintenance 2. Building and energy management solutions integrated into wider utility or city infrastructure 3. Predictive maintenance and automation	
		Energy management technologies 1. Smart metering and sensors 2. Demand response technologies	Enhanced living	1. Building environment optimised for security, safety, productivity, reliability, health and comfort 2. Real time information accessible remotely from dashboard or user interface	
		Information and Communication platforms 1. Dashboards & customer interfaces 2. Mobile & Social	Enhanced information and connectivity		

E- Agriculture	Use of Smart Devices & Broadband > 50 Mbit/s and Internet of Things	<p>Precision agriculture</p> <ol style="list-style-type: none"> 1. Connectivity between machines and equipment 2. Sensors and satellites 3. Advanced data analytics 4. ICT enabled processing of genomic sequencing of livestock, seeds and plants 	Resource efficiency	<ol style="list-style-type: none"> 1. Monitoring, tracking real time data 2. Right time information to the right people through mobile Apps, messaging 3. Enhanced resource efficiency (water, fertiliser, nutrition, equipment etc.) 	<p>Smart Environment -</p> <ol style="list-style-type: none"> 1. Optimum water utilisation for farming 2. Reduce food waste at all stages <p>Smart Economy -</p> <ol style="list-style-type: none"> 1. Cost saving due to reduced wastage of water 2. Less chances of wastage of crops and money of farmers 3. Increased growth of quality crops 4. Increased income levels of farmers
		<p>Information and Communication platforms</p> <p>Online platforms and Apps for collection of data and transform it into meaningful information, communication and decision making support</p>	prevention of wastage of food	tracking, data-centric decision making processes based on real time data and the right information throughout the food chain reducing food waste at production, distribution and consumption	
		<p>Farm management technologies</p> <p>Automation and optimisation of general farm management practices and back office IT</p>	enhanced productivity	higher crop yield and income potential by enhanced farm management technologies - monitoring soil and livestock, forecasting, early detection of problems	<p>Smart Living -</p> <ol style="list-style-type: none"> 1. Time saving of farmers 2. Improved quality of life <p>Smart Governance -</p> <ol style="list-style-type: none"> 1. Real time information is communicated to farmers through Apps (e.g. - weather information, plants and seeds information) 2. Better irrigation and fertiliser facilities 3. remote and real-time tracking of food
		<p>Traceability and tracking system</p> <p>Smart logistics (RFID, GPS) for better tracking of food as it is stored and transported</p> <p>Tracking of equipment throughout lifecycle or food chain</p>	Shock resilience	Advanced analytics and forecasting allow for preventive cautions to environmental shocks and build resilience	



E- Mobility and Logistics	use of smart devices with high speed internet Internet of Things Cloud computing	ICT Platforms 1. Real time information gathering and data analytics 2. Traffic management platform 3. Driving support technologies 4. Information Technologies 5. “Car to Car /device/ home appliance” communication	Traffic control and optimisation	1. Automated driving 2. Autonomous vehicles 3. Driverless cars	Smart Environment - 1. Less CO ₂ emission due to traffic management 2. Fuel saved Smart Economy - 1. Cost saving due to fuel saving 2. Increased productivity and work efficiency Smart Living - time saved due to efficient traffic management
		Monitoring and Analytics 1. Social media technology & apps management technology 2. GPS/GEO Location based services 3. Board Computer system 4. RFID/NFC technologies 5. Remote diagnosis 6. Connected private and public vehicles	Connected Private Transportation	1. Car/route sharing 2. Inter modal transport 3. convenience services	
		Tracking and Tracing Technology 1. Connected commercial vehicles, load units, products and machines 2. Augmented Reality and wearable technologies 3. Commercial unmanned Aerial Vehicles (UAV)	Smart Logistics	1. Fleet management and optimised roots 2. Digital warehouses 3. operational agility	

E- Energy	use of smart devices, Internet of things, cloud computing and artificial intelligence	<p>Convergence of IT/OT</p> <p>1. Integration of Operation Technology</p> <p>2. enterprise technology used to monitor and control physical devices, assets and processes and Information technology</p>			<p>Smart Environment -</p> <p>1. Energy Saving</p> <p>2. Saved Grid</p> <p>3. Reduced emissions</p> <p>Smart Economy -</p> <p>1. Addition revenues</p> <p>2. Money saving</p> <p>Smart Governance -</p> <p>Universal access to energy</p> <p>Smart Living -</p> <p>1. Better Quality of Life</p> <p>2. Lower costs, improved customer service, decreased outage time and increased reliability</p>
		<p>Distribution management system</p> <p>1. 2 way flow of information</p> <p>2. Component management</p> <p>3. sensor technologies</p>	Improved load management	<p>1. Real time demand response technologies flatten the demand curve</p> <p>2. decreases system load by better supply and demand matching</p>	
		<p>Demand Response Technologies (B2B, B2C)</p> <p>1. Technologies using real time information to better match supply and demand (load management)</p> <p>2. incentives to shift demand</p>	enablement of renewables	Improved load management allows better integration of variable and distributed energy (in micro grids)	
		<p>Advanced Data Analytics</p> <p>1. Modelling support</p> <p>2. Real time system analytics</p> <p>3. forecasting, prediction and contingency analysis</p>	Grid efficiency	Improved load management and remote optimisation of assets/ operations through grid monitoring result in lower efficiency losses during transmission, storage and / or distribution	
		<p>Energy Storage Technology</p> <p>Help to manage power supply</p>	Resilient energy infrastructure	Improved management of power supply and peak loads through energy storage creates a more resilient grid.	



E- Business and Work	use of smart devices, Internet of things, cloud computing and artificial intelligence	Integrated multichannel infrastructure 1. Apps for retail mobile shopping 2. Videoconferencing/ Augmented Reality 3. Location based services 4. Advanced Data Analytics 5. Retail 3D Printing	E-Commerce	1. Integrated multichannel infrastructures/mobile shopping 2. 3 D Printing 3. Delivery of Demand	Smart Environment - Fuel saved from transportation Smart Economy - Money saved including fuel and paper costs Smart Living 1. Time Saved due to e commerce transactions 2. Dynamic Workplace
		Financial Services 1. Online Banking Apps 2. Digital currencies (bit coin) 3. Financial market insight and investment platform (BuX) 4. Videoconferencing, digital assistants,	E Banking	1. Faster and 24 by 7 access 2. Transparency of Banking	
		Work Opportunities 1. Voice over IP 2. Telecommuting/ collaboration tools 3. Videoconferencing 4. Augmented Reality	E- Work	1. Telework (mobile workspace) 2. Virtual Business Meeting	
E-manufacturing	Smart devices and Industry 4.0	Cyber Physical System (CPS)	Virtual manufacturing	1. Remote monitoring of physical processes 2. Real time communication and cooperation 3. Performance management and continuous refinement of processes	Smart Economy Increased productivity Optimised production processes Increased profits circular supply chain Smart Living Increased flexibility Customer centric production smart services Smart Environment Increased Resource Efficiency Autonomous factories
		IIOT and M2M			
		Embedded system production technology			
		Global Network	Customer centric production	1. Integrating customer preferences in development and production process 2. decentralised production networks/ distributed manufacturing	
		Data Analytics and cloud computing			
		3D printing	Circular supply chain	Remanufacturing of products, components and waste, circular packaging	
Drones and Robotics					
Augmented Reality devices	smart services	creation of a cross sector eco system of services with up- and downstream integration			

Measurement of Delhi as a Smart City

Being the capital of the country, there is mass migration of people in Delhi which is increasing year by year. And due to this increased urbanisation in Delhi, more energy, more homes, clean environment, educational institutions, health care arrangements, more occupational activities, more chances of personal and professional growth, recreational activities and security arrangements are necessary to arrange by the Delhi government or central government.

Based on the parameters given in Table 1 and 2 an assessment of 20 big cities in India was done by PwC in 2016 and Delhi was one of those cities.[25]

The figure 6 shows that Delhi as a city improved in terms of energy, health care, and e- governance and education. But it lagged behind in terms of sustainability and storm water management to reach to the level of a smart city.

On completion of the benchmark assessment, the administrators and policymakers of Delhi need to examine their city's readiness to take the next phase of transformation and accordingly modify the policies and regulations.

For making Delhi a smart city, the government needs to deploy customized solutions without copying directly from Barcelona or San Francisco or Singapore or any other smart city in the world because it's not necessarily true that two different cities may face the same kind of problems in the process of becoming a smart city.

SMART CITY COMPONENT SCORING OF NEW DELHI

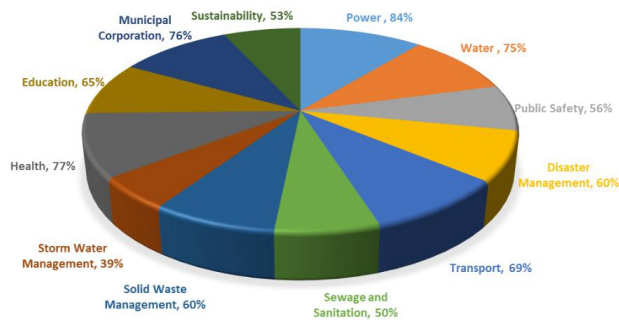


Figure 6 – Measurement Scoring of Delhi as a Smart City

Conclusion and Future Areas of Research

Due to environmental challenges and population expansion in the cities, sustainable smartness of cities has become a necessity [2]. Smart cities are opportunities to transform the world. The 4th industry revolution may act as a catalyst in such a transformation.

The Indian government is also very keen for this transformation and has taken very major steps to make smart cities a reality with the launch of 'India's 100 Smart Cities Challenge' in 2015 in which a rigorous competition took place among 100 aspirant cities to come up with their holistic plans for becoming number one smart city of the country. [25]

In smart cities of India, efforts are also being made to generate energy and create compost from waste, reduce the amount of waste generated by the construction, restoration and destruction of buildings, and manage water resources more effectively through smart solutions by using technology. [7], [8]

The overall purpose of plan of the government of India to develop major cities of the country into smart cities is to increase Livability, Workability and Sustainability in those areas. [17]

All the above mentioned three factors make a city, a smart city, a better place to survive. In India, one of the main reasons of lack of development or very slow progress of future smart cities, may be the continuous urbanisation.

This becomes the future scope of this study which can be analysed through another research work. This may be entirely different area for future research for assessment of growth of smart cities. Equal distribution of resources of various occupations and means of livelihood among cities and villages may stop speedy growth of urbanisation in India and it is possible only with smart cities, development of smart villages in the country.

Since city development is a slow process, patience and cooperation of citizens is highly valued. Speed of development of a city depends on the quality of citizens too which can be assessed through their education, life style, their sensitivity towards environment and surroundings, comfort level and their expertise of using smart gadgets and technologies etc. Although basic infrastructure is provided by the government, but more educated citizens create more sustainable environment in the cities by maintaining that infrastructure, sanitation and cleanliness and healthy way of living. The role of technology comes after that.

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Annexure 1

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Reviewers Memorandum



Internal Assessor Statement: The study is basically based on the secondary data and only covers Delhi as a sample. Whereas, there are many other metro cities in India, and analysis of those can bring some different results and can also help in providing a comparative analysis of them. The study thus lays the roadmap by providing further scope to other researchers to conduct a similar study by employing primary data on a larger sample size.

External Critic (National): The study has done a critical analysis of Delhi as the measurement of a smart city based on various identified parameters. Along with that the study also throws lights on the emerging technologies influence on the development of smart cities worldwide which provide a comparative analysis of smart cities technologies across globe.

Outer Reviewer's (Global) observation: Though the study is based on a very appropriate theme, yet a more robust research methodology could be employed to get the more precise results. A good number of references are used which is appreciable on the part of authors. But the study lacks a more accurate and precise conclusion due to the lack of primary data.



Vinita Sharma and Tanu Manocha
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**Editorial Excerpt**

The article has 14% of plagiarism which is the accepted percentage as per the norms and standards of the journal for the publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the authors (Vinita and Tanu) and accordingly all the corrections had been incorporated as and when directed and required to do so. The comments related to this manuscript are noticeably related to the theme "**Technological Influences over Factors for Sustainability of Smart Cities**" both subject-wise and research-wise. The study aims to analyse the impact of industry 4.0 technologies via various identified parameters for the development of smart cities. The finding of the study is based on the secondary data collected from various reliable sources such as journals, newspapers and various annual reports etc. The paper highlights various parameters for the development of smart cities. The study concludes that rapid urbanisation has very negatively impacted the development of Delhi as a smart city. For making Delhi a smart city, there is a need that the government deploy customized solutions without copying directly from other nations. Overall, the paper promises to provide a strong base for the further studies in the area. After comprehensive reviews and editorial board's remarks the manuscript has been categorised and decided to publish under "**Theme Based Paper**" category.

Acknowledgement

The acknowledgement section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work and effort taken while writing a paper. The data presented and analyzed in this paper by (Vinita and Tanu) were collected first handily and wherever it has been taken the proper acknowledgment and endorsement depicts. The author is highly indebted to others who had facilitated in accomplishing the research. Last but not least endorse all reviewers and editors of GJEIS in publishing in a present issue.

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