

Review Paper

Smart Cities and its Economic Aspects: *An Indian Perspective*

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ABSTRACT

In India, cities populations are expanding due to the growing interest of the populations and to avail advance facilities. Most of the cities are overcrowded and for that reason cities need to be developed. To provide advance facilities and for betterment of the life, cities in India are modernized and re developed as a smart or intelligent city. Smart City is highly enriched and progressive city in context of technology emergence. Therefore, the smart city far ahead than normal city regarding area development, technology based smart applications and planning of the city. Many cities are approved and also wait for the approval for development as a smart city in India. Numerous projects of smart city are designed according different perspective of city. ICT has huge impact on smart city-based project to build intelligent or automated solutions. Cities economy depends on the population growth. Economic condition of the cities much better than village or town. Growth of the urbanization accelerate very fast according to the increasing demand and potentialities. Economic impacts on the society and urbanization analyzed in this paper. Fund allocated for the various projects of smart cities. Various projects in different fields and estimated funds approved for development of projects analysis in this paper.

HIGHLIGHTS

- ① Smart city is the advanced city in terms of technological intelligent solutions.
- ① Smart city is the knowledge economy city.
- ① Smart city is the environment friendly city.
- ① Advance technologies are used in smart city project development.
- ① Smart city helps to make the country economically strong.

Keywords: Smart City, Digital India, Digital Economy, Knowledge Economy, Development

Urban populations increase daily in rapid rate. By 2050 it reached in high peak and approximately reached at 80% populations in several cities of India (Georgiadis *et al.* 2021; Ortega-Fernández *et al.* 2020). Economy of the country depends on cities progress. Growth of GDP reached 70% by 2030 in most of the cities of India. For sustainability, cities need to transform as a smart or intelligent city with the support of ICT (Ramaswamy & Madakam, 2013; Šurdonja *et al.* 2020). Smart City is far progressive than the general city in aspects of the technological solutions (Dameri, 2013; Das, 2021; Moik *et al.* 2021). Economic growth of the countries increases as per

the expansion of the smart cities (Yahoo Finance (n.d.)). Scope of the smart city is expanding in world according to the technological expansion and demand of the city (Winkowska *et al.* 2019). India is also progressing in smart city development and 100 cities are considered from different states by government of India collaborated with state government for development as a smart city in different phases (Kidwai & Saraph, 2018; Praharaj

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et al. 2018; Praharaj *et al.* 2017). Many projects under the mission of smart city completed and other are still progressing. Smart City projects are based on the area development, sanitation, waste management, transportation, energy, economic improvement, education and healthcare (Hayat, 2016; Moik *et al.* 2021). 48,000 crore funds assigned to develop projects in 100 smart cities [Ministry of Housing and Urban Affairs Smart City (n.d.); Lee *et al.* 2016; Praharaj *et al.* 2018). 100 crores are spending for each smart city development in India according the assigned funds (Hoque & Prakash, 2023). Smart cities projects developments extent on supply electricity, sufficient water supply, solid waste management, sanitation, smart mobility and urban transportation, housing, Digitalization and IT connectivity, e-governance, environment sustainability, provide safety and security for the inhabitants of the cities, healthcare and education (Moik *et al.* 2021). According to the nature of cities and areas, construction of smart cities is categorized as re-development, retrofitting, PAN city (Gupta & Hall, 2017). So, smart cities are transformed according to the new areas, existing areas.

Financial aid plays vital role to make the smart cities. Challenges faced to generate funds for the smart cities in India. Funds are generated from the various sources. The financial aids and sources are analyzed and compared in this paper.

Objectives of the work

Followings are the objectives of this paper entitled "Smart Cities and Its Economic Aspects: *An Indian Perspective*"

1. To survey about different projects and economy of smart city
2. To analysis and study smart cities economy in India.
3. To analysis funds allocated for the projects in different smart city aspects.
4. To know about progress of smart cities in economical perspectives.
5. To study smart cities in international context.
6. To study the association of technologies in smart city.

Methodology Adopted

Many research papers, articles, books, journals survey in this paper. Secondary data collected from journals, reports, and websites contents. Data organized and represented in table. Data analysis and exploration done after organize and preparing the data. Data based on the perspectives of Indian smart city economy and data collected from smart city government websites.

The main purpose of this paper to make analyses for the economic aspects of smart city in India. Analysis done in three phases. First phase describes the projects status of smart city in India. Second phases of analysis done according to the revenue sources and allocation for smart city projects in India. Third phase of analysis based on the top smart cities economic status in India. Figure 1 shows analysis phases done in this paper for economic aspects of smart cities in India.

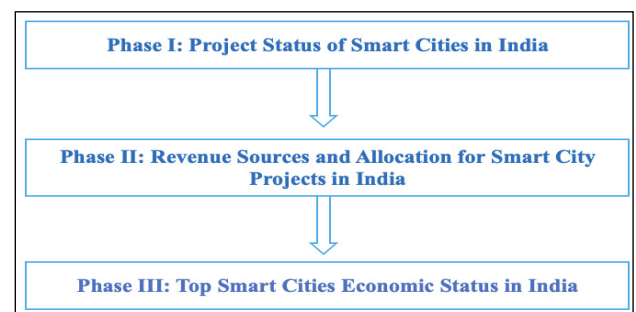


Fig. 1: Phases of Analysis for Economic Aspects of Smart Cities in India

Smart City: A Brief

Technology involvement in society and urban development makes the cities as smart and intelligent (Dameri, 2013). Cities improving in every area by developing the projects where main perspective is to make technology based, automated, intelligent and environment friendly projects (Rajasekar *et al.* 2018). There are revolutionary changes in the life standard as per the fastest growth in the technology era. Today life more advance and people depends on the smartest technologies (Kumar *et al.* 2020).

Smartcity development is the characteristic digital society (Paul & Aithal, 2018). Digitalization is the main objective of digital society (Paul *et al.* 2022). Improvement of society and life standard are main aspects of the urbanization. Environment, Industry, Transportation, Education, Healthcare, Governance,

and Economy are the smartest units associated with smart city (Das, 2023; Madakam & Ramaswamy, 2015; Purnomo & Prabowo, 2016).

Followings are smart cities units:

- ♦ Smart Education
 1. Smart Class Room
 2. Online Education
 3. Digitalization in education system
 4. Smart Assessment System
 5. Online Examination System
- ♦ Smart Industry
 1. Digitalization in Industry
 2. Automation of Production unit.
 3. Automation in product delivery
 4. Smart monitoring of manufacturing
 5. Smart Security
- ♦ Smart Healthcare
 1. Smart Hospital
 2. Digitalization in Healthcare
 3. Automation in Healthcare
 4. Smart Laboratory
- ♦ Smart Transportation
 1. Digitalization of Transportation System
 2. Automation in Transportation and Mobility
 3. Environment friendly transportation
- ♦ Smart Governance
 1. Online governance services with involvement of people
 2. Digitalization of governance
 3. Automation in governance services
- ♦ Smart Environment
 1. Smart Monitoring of Environment
 2. Smart Disaster Management
 3. Digitalization in Environment
- ♦ Smart Economy
 1. Smart Business
 2. Online Transaction in business
 3. Digitalization in economy

Smart Cities in Developing Countries: International Perspectives

Smart Cities are emerging in almost all the countries across the world. Technology and society more advance in modern edge. Economically strong and developed countries are progress in every area. Urbanization is the part of the development of the countries because growth of the inhabitant in the urban areas increasing very fast. Continent wise different countries financial grow this varied in the world. European and American countries are financially robust (Caragliu *et al.* 2011; Kidwai & Saraph, 2018; Lytras & Şerban, 2020; Sancino & Hudson, 2020; Lee *et al.* 2016). Potentialities of the smart cities in the financially rich countries are expanded. As compared to the other continent countries, African countries financial state are not in good status. As per the present status 40% peoples are living in the cities of African countries (Slavova & Okwechime, 2016). Impact of the various factors impedes the financial growth of the African countries (Slavova & Okwechime, 2016). Food and social security main factors those effects on the economy. Countries in Asia also progressing in smart cities development (Joo & Tan, 2020). Singapore is one of the famous and best smart cities in Asia (Mahizhnan, 1999). Highest economic countries are emphasis on the infrastructure enhancement of the cities to constitute the smart cities (Goel, 2023). Some smart cities in highest positions are from different countries and continents as per the Smart City index as follows.

Table 1: Best Smart Cities in The World

Smart Cities	Country	Continent
Zurich	Switzerland	Europe (Hello Lamp Post (n.d.))
Geneva		
Lausanne		
Oslo	Norway	
Copenhagen	Denmark	
Stockholm	Sweden	
Helsinki	Finland	
Amsterdam	United Kingdom	
London		Ocean (Hello Lamp Post (n.d.))
Auckland	New Zealand	
Canberra	Australia	
Taipei	Taiwan	
Singapore	Singapore	Asia (Hello Lamp Post (n.d.))
New York	America	
		North America (Hello Lamp Post (n.d.))

Table 1 shows the smart cities in highest position in the world. As per the survey Europe has large number top smart cities. Also, Asia and America have maximum number of best smart cities. The economy of the European and American countries higher than the other continents. Therefore, the smart cities quantities increase in the economically developed countries in the world.

Technological Involvement of Smart City

Technology association in smart cities makes the innovative and smartest solutions. Application of ICT makes changes in cities IT infrastructure. Innovative projects are implemented using advance Information Technologies. IoT and AI technology associated with enhancement of smart city IT Infrastructure (Ghazal *et al.* 2021).

IoT and AI are the key technologies to build smart city Information Technology based projects solutions. IoT and AI applied in various platforms in smart city. Smart Traffic Monitoring, smart parking system allotment, smart weather, smart waste management, smart home, smart mobility are the examples of the IoT and AI based applications (Rajab & Cinkelr, 2018). Sensors in IoT receive the signals to operate the devices automatically (Vijai & Sivakumar, 2016). Sensors also convert the received signals into the information that analyze to generate the output by the AI technology (Ghazal *et al.* 2021). Network configuration is required for the connectivity of the objects with Internet in IoT (Hello Lamp Post (n.d.)).

Cloud computing play the role to make virtual storage repository and provide virtual data processing units in clustered data centers (Agarwal & Agarwal, 2017). Virtualization is a function of Cloud computing to manage the processing of large set of data in multiple processors. Cloud computing is also involved with association of IoT and AI to make smart city projects (Madakam & Ramaswamy, 2015; Paul, 2022). Cloud Computing is essential for education, healthcare, e-governance, transportations and other sectors (Khan & Kiani, 2012).

Block Chain, AR and VR technologies involvement required in smart city-based projects according to the experiments. Block Chain AR and VR are the new IT technologies. Block Chain, AR, and VR have prospects to applied in the projects near

future (Jamei *et al.* 2017). AR and VR are mostly used and experimented in education, healthcare sectors. Research is still going on to apply Block Chain technology in smart city projects (Wei, 2022). Block Chain technology is utilized in commercial sectors and in information security (Singh *et al.* 2022; Treiblmaier *et al.* 2020). Fig. 2 shows associated technology in smart city.

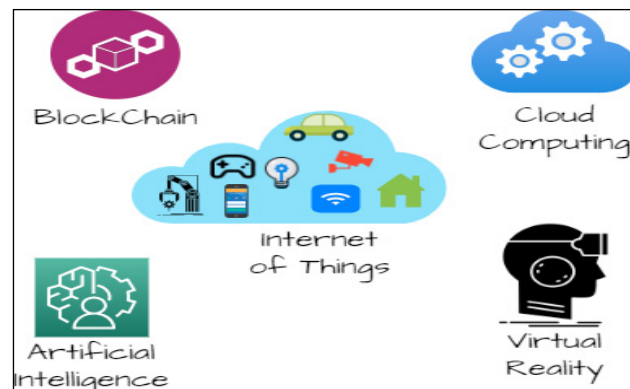


Fig. 2: Technology Association in Smart City

Economical Aspects of Smart City in India

₹ 1,81,322 crores invested for the 7,804 smart cities projects by January 2023 (Kidwai & Saraph, 2018). 67.22% projects equal to the cost ₹ 98,796 crores done. 32.77% equal to the ₹ 82,526 may finished in this year (Vats, 2023). Therefore, maximum number of projects finished and rest of the projects may end soon. Smartcity projects growth accelerated to complete remaining projects by 2030.

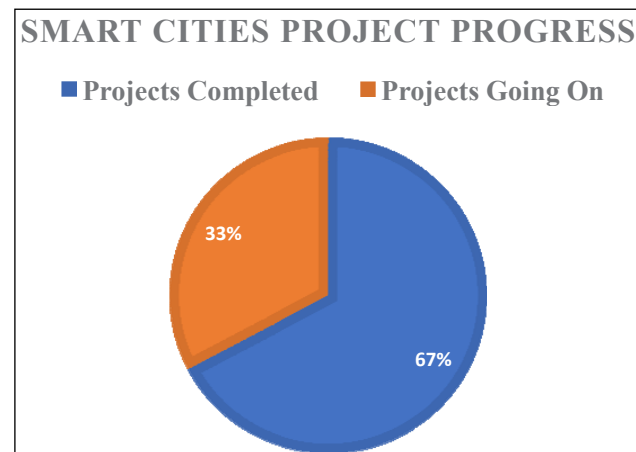


Fig. 3: Smart City Project Status

Fig. 3 shows the status of the smart city projects in India till now. Smart cities are selected from different state of the country (Hoque & Prakash, 2023). According to the approval and potentialities,

different cities are going to be converted as smart city. Number of smart city projects are allocated for the cities as per the economic growth and progress of the cities. In India, Karnataka is the state where maximum number of smart cities projects done and around 768 projects finished. Other state are follows according to the order such as Madhya Pradesh, next Uttar Pradesh and Tamil Nadu. Large quantity of smart city projects are finished for states Karnataka, Madhya Pradesh and Uttar Pradesh such as Tumakuru, Indore, and Varanasi.

Economical aids required to build the smart cities. Funds raised from the different sources in smart cities in India. 48,000 crores funds assigned to construct smart cities within the five years. Gathering funds from different sources accelerate the development of projects under smart cities. Funds allocated for different projects in different sectors of smart cities (Purnomo & Prabowo, 2016). Funds given to the cities according to the potentialities and importance of the cities from various states. Total funds divided into different category like 93% funds for projects, 5% for administrative cost and office expenses, and 2% for others. Various sources of funds produced from different private and public schemes.

Sources of Capital for Smart Cities

Table 2: Sources of grant for Smart City in India

Sl. No.	Sources of Capital	Origins
1	Government of India Funds	500 crores invested for smart city
2	State Government/ULB	500 crores invested for smart city
3	User Charges	Revenue from different user charges including: ♦ Telecom, ♦ Gas ♦ Electricity ♦ Parking fees ♦ Water
4	Private Public Partnership (PPP)	Business between public and private party
5	FFC Recommendation	On the basis of land related tax including: ♦ Vacant tax ♦ Conversion Charges ♦ Betterment tax ♦ Advertisement tax ♦ Entertainment tax ♦ Professional tax

6	Municipal Bonds	Municipal bonds related to debt or others.
7	Borrowing from Bilateral and Multi-laterals	Borrowing funds from bilateral and multilateral financial institutions.
8	National Investment and Infrastructure Fund (NIIF)	Revenue generated from infrastructure development.
9	Convergence with other Government scheme	Government programs with the convergence such as: ♦ AMRUT ♦ SBM ♦ HRIDAY ♦ Digital India ♦ Skill Development ♦ Housing for all

Table 2 represents the sources of capital for the construction of smart cities. There are government and private organization fund (Gupta & Hall, 2017; Moik *et al.* 2021). Funds sources from different sectors such as Central and State government, Programs of central/ state government and ULBs, PPP, Loans/Debts, Own Sources, and Other Sources. The budgets assigned in each sector. Funds used in different aspects of smart city development. Following are the funds sources and amount of funds utilize for different purposes of smart city (Ministry of Housing and Urban Affairs Smart City (n.d.); Vadgama *et al.* 2015). Table 3 presents the investment from different sources for smart city projects.

Table 3: Financial aids from different sources

Sources	Grant	Percentage
Central and State Government	93,552 crores	45%
Programs of Central/State government and ULB	42,028 crores	21%
PPP	41,022 crores	21%
Loans/Debts	9,843 crores	4%
Own Sources	2644 crores	1%
Other Sources	15,930 crores	8%

Fig. 4 shows the estimate of grant from various sources using bar chart. Fig. 5 shows the percentage of grant from sources for the smart cities projects using pie chart.

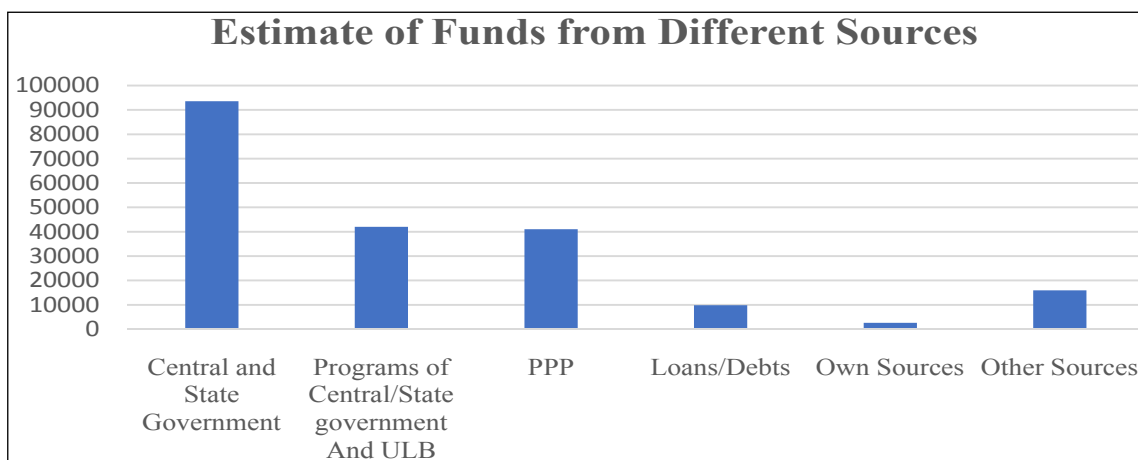


Fig. 4: Grant from different sources

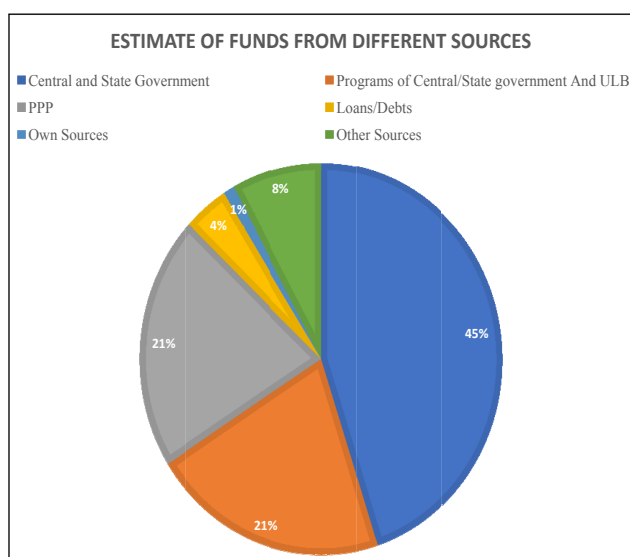


Fig. 5: Estimate of grant from Different Sources

Principal amount distributed to the different smart cities of India according to the different sources of fund. After analysis, it is observed that maximum financial aids come from Central and State government, PPP, and programs of Central/State Government and ULBs. less amount of capital generated from loan debts, other sources and own sources (<https://smartcities.gov.in/financing>). Some state takes proper step to generate capital from different sources efficiently. Sufficient capital provided to each city by the assessment of the performance and score. Fund are allocated to the qualified smart cities in each year. Cities utilize that capital in different sectors for development of the smart cities projects in every year.

Economies of different smart cities such as Delhi, Chennai, Ahmedabad, Pune, Jaipur, Indore, Surat,

and Hyderabad are compared to know the economic condition of the smart cities (Yahoo Finance (n.d.); Bhatia, 2022). As per the GDP of these smart cities Delhi has highest economic growth in the country. Hyderabad is the Second highest smart city in economic growth. These smart cities are the top smart cities in economic growth. Therefore, Investment is also high for these smart cities. Investment is same for all the top smart cities (Ministry of Housing and Urban Affairs Smart City (n.d.)). All these smart cities improving in every sector like transportation, education, healthcare, industry development, economy, living, and environment. Table 4 presents top smart cities GDP and project investment according to the economy. Fig. 6 shows top 8 smart cities economy using bar chart.

Smart Cities Fund and Economic Status

Table 4: Economy and Funds Redemption of the Smart Cities

City	GDP (billion)	Funds (in Cr.) Redemption
Delhi	167	196
Chennai	66	196
Ahmedabad	64	196
Pune	48	196
Jaipur	24	196
Indore	14	196
Surat	40	196
Hyderabad	74	196

Core Findings

India is one of the largest countries as per the population in the world. India improving in every field and established as a top developing country in the world. India stands in the highest position according to the economic progress. GDP of India increasing as per the growth of development (Randhawa & Kumar, 2017). Economy of India continuously progressing and was 7% per year from 2017 to 2018 (Ministry of Housing and Urban Affairs (n.d.)). India progressing in the urbanization to enhance the economic growth of the country to sustain in the technology era. As per WUP 2018 report, the urban population will reach at 60 crores in the year 2030 and by the report of WUP 2018, 50% populations will live in the cities in the year 2050. Therefore, the population continuously increasing in the cities in India as per the report of WUP 2018 [Ministry of Housing and Urban Affairs (n.d.); Garg & Agarwal, 2014; Rana *et al.* 2019). The main reason behind the urbanization is the economic growth, modernization of the society and the advance era. Most of the countries in the world construct the cities as smart cities to improve the economic conditions and sustain in the world economy. India also progressing to convert existing cities as smart and intelligent cities with assigned projects.

88% investment released till now for the construction of smart cities in India. Investment is generated from different sources. Budget to build the smart cities proposed by the government and is hiked to 16,000 crores as per budget 2023-2024 (Vats, 2023).

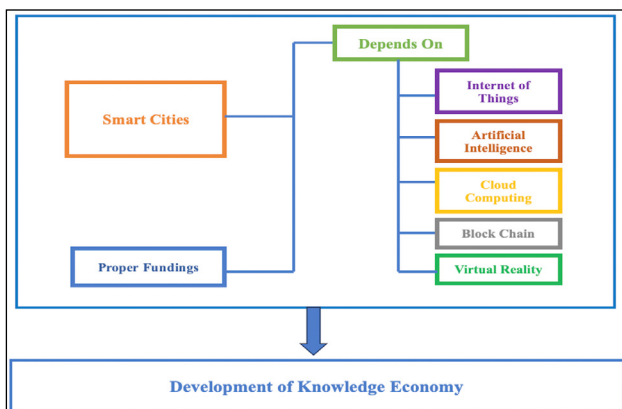


Fig. 7: Development of Knowledge Economy

Fig. 7 shows the development of knowledge economy according to the development of smart cities.

CONCLUDING REMARKS

Smart city projects are ICT and non-ICT based. Different projects assigned in different aspects for each smart city. The projects of the cities approved according to the fund and economic development of the cities. Development of clean and eco-friendly environment for the smart cities is the main target of the mission. Environment friendly smart solutions build in different areas of the smart city. Sources of investment for the smart city projects analyzed to study about the financial supports to build the projects. According to the economic status of the smart cities, the top smart cities are improving in every part. Urban development growth increasing slowly as per the investment and initiative. Various aspects of smart cities economy including origins, budgets, investment of capital top cities are compared in this paper. Smart city development is the priority to enhance the economic growth for the country. As per the analytical views of the population status of urban areas, large populations of the country will shift in the cities in future. Thus, Cities areas need to extent and provide smartest infrastructure for the citizens for betterment of the life.

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