Review on Identification of Success Factors for Designing of Smart Cities

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Abstract

Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches digital and information technologies, urban planning best practices, public private partnerships, and policy change to make a difference. They always put people first. The India Smart Cities Challenge is designed to inspire greater creativity from municipal officials and their partners, more involvement and inspiration from citizens, and the development of proposals that will produce concrete benefits in people’s lives. The urban initiatives in India have first time fallen in line with global development paradigms. Irrespective of Indian priorities being different, there is need to understand these development paradigms. In this context the Smart city concept needs to be looked from different perspectives. These perspectives will lead towards the final outcomes and aspirations as well as provide a tool to develop city vision. The aim of this paper is to identify and evaluate the main factors affecting the designing of Smart City projects. Literature review about Smart City was reviewed to identify the factors affecting the designing of Smart City. In addition, other local factors have been added as recommended by local experts.

Keywords: Smart City, Success Factors

I. INTRODUCTION

Urbanization is an index of transformation from traditional rural economies to modern industrial one. It is a long term process through which the ratio of population between rural and urban gets changed in favour of urban settlement. Quite often the Indian Urbanisation has been considered as over urbanisation due to its rapid growth of urban population especially in large cities. It has been observed that high rate of population growth in urban areas particularly in large cities is the result of high natural growth and poverty driven rural to urban migration in short and long run.

Urbanization is not only associated with economic development but over the time it started aspiring people due to better quality of life. Cities are seen as solutions for boosting economy, generating employment, creating skills, providing better health services and many more things. Expression of change from being habitat to providing such breadth of services was not brought in a day; cities have eventually developed into these dimensions. These developments are projected to a big number in next fifteen years. The India is trying to cope up with this dynamics and trying to cope up with complexities of city and urban development in country.

Cities are engines of growth for the economy of every nation, including India. Nearly 31% of India’s current population lives in urban areas and contributes 63% of India’s Gross Domestic Product (GDP). With increasing urbanization, urban areas are expected to house 40% of India’s population and contribute 75% of India’s GDP by 2030. This requires comprehensive development of physical, institutional, social and economic infrastructure. All are important in improving the quality of life and attracting people and investments to the City, setting in motion a virtuous cycle of growth and development. Development of Smart Cities is a step in that direction.

The urban initiatives in India have first time fallen in line with global development paradigms. Irrespective of Indian priorities being different, there is need to understand these development paradigms. In this context the Smart city concept needs to be looked from different perspectives such as Government and Institutions, City Councils, Market agencies and last but not least the Citizens. These perspectives will lead towards the final outcomes and aspirations as well as provide a tool to develop city vision.

Smart development implies a holistic development with integration of all key dimensions of urbanism i.e Economy, infrastructure, Environment, Governance, Quality of Life and People. Government of India, has embarked upon Smart Cities Missions along with other key initiatives in each of these dimensions. Policy makers, urban planning professionals, academicians
and researchers seeking knowledge in making of smart cities need to have an understanding of inter linkages of all these dimensions and the related programs.

Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches digital and information technologies, urban planning best practices, public private partnerships, and policy change – to make a difference. They always put people first. The India Smart Cities Challenge is designed to inspire greater creativity from municipal officials and their partners, more involvement and inspiration from citizens, and the development of proposals that will produce concrete benefits in people’s lives.

The paper insists the objectives:
1) To study Smart City concept and to design parameters for ranking in designing of Smart City in context with Gujarat.
2) To identify the most affecting parameters from the stakeholder’s survey which influence the designing of Smart City.

II. NEEED OF THE STUDY

The extraordinary level of urbanization and consequent growth in size and numbers of cities in India present both challenges and opportunities. The phenomenal growth in urban population challenges traditional approaches to city management. To address challenges of Urbanization and Urban Growth, Government of India has initiated Smart City program. These initiatives is directed at how the respective cities can transform themselves in different policy areas such as the use of alternative or renewable energy, use and management of natural resources, waste reduction and management, carbon emission, green areas, to desired sustainable socio-economic outcomes. The Prime Minister has a vision of developing ‘one hundred Smart Cities’, as satellite towns of larger cities and by modernizing the existing mid-sized cities.”

III. SMART CITY: WHAT IS SMART CITY?

“The first question is what is meant by a ‘Smart City’. The answer is, there is no universally accepted definition of a Smart City. It means different things to different people. The conceptualization of Smart City, therefore, varies from city to city and country to country, depending on the level of development, willingness to change and reform, resources and aspirations of the city residents. A Smart City would have a different connotation in India than, say, Europe. Even in India, there is no one way of defining a Smart City.

Many definitions of Smart Cities exist. A range of conceptual variants is often obtained by replacing “Smart” with alternative adjectives, for example, “Intelligent” or “Digital”. The label “Smart City” is a fuzzy concept and is used in ways that are not always consistent. There is neither a single template of framing a Smart City, nor a one-size-fits-all definition of it. In the urban planning field, the term “Smart City” is often treated as an ideological dimension according to which being smarter entails strategic directions. Governments and public agencies at all levels are embracing the notion of smart-ness to distinguish their policies and programs for targeting sustainable development, economic growth, better quality of life for their citizens, and creating happiness.”

- Bakici et al. (2012) defines “Smart City as a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce, and an increased life quality.”
- Barrionuevo et al. (2012) says “Being a Smart City means using all available technology and resources in an intelligent and coordinated manner to develop urban centers that are at once integrated, habitable, and sustainable.”
- Cisco defines Smart Cities as those who adopt “scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life”.
- IBM defines a Smart City as “one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources”.
- Hall (2000) says “A Smart City is a city that is prepared to provide conditions for a healthy and happy community under the challenging conditions that global, environmental, economic and social trends may bring.”
- Lombardi et al. (2012) defines “The application of information and communications technology (ICT) with their effects on human capital/education, social and relational capital, and environmental issues is often indicated by the notion of Smart City.”
- Nam and Pardo (2011) states “A Smart City infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains.”
- Thite (2011) says “Creative or Smart City experiments aimed at nurturing a creative economy through investment in quality of life which in turn attracts knowledge workers to live and work in smart cities. The nexus of competitive advantage has shifted to those regions that can generate, retain, and attract the best talent.”

So smart is something like as shown in figure 1.
IV. CRITICAL LITERATURE REVIEW

Urbanization is an index of transformation from traditional rural economies to modern industrial one. It is a long term process through which the ratio of population between rural and urban gets changed in favour of urban settlement. Quite often the Indian Urbanisation has been considered as over urbanisation due to its rapid growth of urban population especially in large cities. It has been observed that high rate of population growth in urban areas particularly in large cities is the result of high natural growth and poverty driven rural to urban migration in short and long run.

Urbanization is not only associated with economic development but over the time it started aspiring people due to better quality of life. Cities are seen as solutions for boosting economy, generating employment, creating skills, providing better health services and many more things. Expression of change from being habitat to providing such breadth of services was not brought in a day; cities have eventually developed into these dimensions. These developments are projected to a big number in next fifteen years. The India is trying to cope up with this dynamics and trying to cope up with complexities of city and urban development in country.

The urban initiatives in India have first time fallen in line with global development paradigms. Irrespective of Indian priorities being different, there is need to understand these development paradigms. In this context the Smart city concept needs to be looked from different perspectives such as Government and Institutions, City Councils, Market agencies and last but not least the Citizens. These perspectives will lead towards the final outcomes and aspirations as well as provide a tool to develop city vision. Hall (2000) stated that the vision of the smart city is the urban centre of the future. The systems and structure will monitor their own conditions and carry out self-repair. The smart materials and structures are also known as the intelligent or adaptive materials. The smart city concept was in a planning stage since late 1998, but it received its first funding in January 2000. The future will require rethinking of the relationships between government, city managers, business, academia and the research community. [32]

Al-Hader et al. (2009) studied the smart infrastructure development framework and the surveyed positional accuracy of locating the assets as a base of the smart city development architecture integrated with all the facilities and systems related to the smart city framework. The paper also discussed the main advantages of the proposed architecture including the quantifiable and non-quantifiable benefits. [2]

Anthopoulos et al. (2011) highlighted the interrelationship between smart city and urban planning. The dimensions of the urban planning are Environmental protection (Quality), Sustainable residential development (Viability Timeline), Resources capitalization (Capacity) and Coherent regional growth support (History and Landscape). [6]

Bhagat (2011) observed the growth rate of urban population during the 1971 to 2011. According to the 2011 Census, urbanization has increased faster than expected. For the first time since independence, the absolute increased in the urban population was higher than that in the rural population. This has huge implications for providing infrastructure and other civic amenities in urban areas. [14]

Nam et al. (2011) discussed inevitable risks from innovation, strategies to innovate while avoiding risks, and contexts underlying innovation and risks. This paper aims to fill the research gap by building a comprehensive framework to view the smart city movement as innovation comprised of technology, management and policy. [49]

Nam et al. (2011) discussed how we can consider a particular city as a smart one, drawing on recent practices to make cities smart. The paper offers strategic principles aligning to the three main dimensions (technology, people, and institutions) of smart city: integration of infrastructures and technology-mediated services, social learning for strengthening human infrastructure, and governance for institutional improvement and citizen engagement. [48]

Thite (2011) highlighted the need for and broad nature of human resource development initiatives at the intermediate level. This paper looked at smart city experiments around the world that are aimed at nurturing a creative economy through investment in quality of life which in turn attracts knowledge workers to live and work in smart cities. Using the literature on economic geography, it provides a useful theoretical framework to cross organizational boundaries and look for factors that influence the decision of knowledge workers in choosing a location to live and work. [60]

Bakici et al. (2012) presented the existing literature on Smart City initiative with case study of Barcelona. Analysis is presented with the Barcelona Smart City model. After described this model, they further explore the main components of the Smart City strategy of Barcelona in terms of Smart districts, living labs, initiatives, e-Services, infrastructures and Open Data.
The results of the case study analysis indicate that Barcelona has been effectively implementing the Smart City strategy with an aim to be a Smart City model for the world. [9]

Baron (2012) pinpointed the question about need of smart cities for resilience and presented the methodological approach. He deeply scrutinized concept of smart city and resiliency city in the paper. The main idea behind this paper was to bring these concepts together and make it a starting point for future research and reflection concerning development strategies of cities that pursue smartness and / or resiliency. [11]

Caragliu et al. (2012) examined the impact of smart characteristics on urban performance. With a sample of 94 cities from the 14 European Union countries between 1999 and 2006 they assess the city-specific impacts on urban performance of a complex "urban smartness" indicator by applying a Spatial Autoregressive Local Estimate to an urban production function. They also identified different clusters with respect to the impacts of smartness on urban performance and wealth, highlighting the need for geographically differentiated policy actions. [16]

Chourabi et al. (2012) identified eight critical factors of smart city initiatives: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment. These factors form the basis of an integrative framework that can be used to examine how local governments are envisioning smart city initiatives. The framework suggests directions and agendas for smart city research and outlines practical implications for government professionals. [19]

Cosgrave et al. (2012) found the core themes within the field of smart cities & future city policies. The implementations of smart technologies increase the value of the city. The government professionals and the stakeholders are facing various problems in achieving ambitious targets with limited resources. The grounded model of smart city is used in this paper. The model has two core influencing features “challenges & opportunities” and “public value”. [22]

Lombardi et al. (2012) illustrated an on-going study in the field of smart cities evaluation. This paper aims to offer a profound analysis of the interrelations between smart city components connecting the cornerstones of the triple helix. This analysis of the triple helix augmented using the Analytic Network Process to model, cluster and measured the performance of smart cities. [42]

Azim et al. (2014) stated that smart city designing can help improve the quality of urban life in various areas so that using the minimum amount of investment in make cities smart, we have the maximum efficiency by participation of the public in different levels of community to improve the urban life. Therefore, today urban design should be in line with smart city and its goals. In urban design, smart design should be applied. Making urban design smart doesn’t mean make all urban processes electronics but means use of all available contexts in order to enhance the quality of urban life. Information technology can be used as one of the factors that accelerate the city goals and its smart design. [8]

Bhagat et al. (2014) set out the enormous challenges facing cities, the size of the opportunity afforded by the focus being given, worldwide, to addressing those challenges by transforming city infrastructures and city systems, and the key actions needed to seize those opportunities. [15]

Cavada et al. (2014) identified the plethora of the smart city definitions and categories evidenced from the literature and shows that 'Smart cities' lacks a robust coherent definition, with many contradicting facts within what constitutes a smart vision. They demonstrated the necessity for a single 'Smart Cities' definition that deals with both the physical and digital using shared parameter value that can be adopted and scaled amongst different localities and within a range of urban contexts adjusting according to existing city conditions and visions setting the paradigm for further innovative research in this area. [17]
Centre for Cities (2014) stated the reasons behind slow progress and the challenges that needs to be overcome in the Smart Cities. They recognised that many stakeholders are involved in the smart agenda (including community organisations, local businesses, and citizens) and mainly focused on city authorities due to their role in setting out the long term economic plans for their areas. [50]

Gill et al. (2014) provided framework for establishment of smart cities and strategy for housing the urban poor in composite living through cross subsidy by unlocking of land value. Circular city predominantly based on public transport model, propelled by clean energy provides fast movement with multi-model central business districts, restricts travel from longer distances to short trips and pollution free living. Normative norms and standards of services, approval process and application of technology is prime moving factor. [30]

Jucevicius et al. (2014) developed a conceptual model of smart city as consisting of three layers: qualities of the smart city, smart infrastructure and objects or dimensions of smartness of the city. The main emphasis is on knowledge, intelligence and smartness of the city. Development of smart city requires the identification and agreement on the right level of smartness for a particular city. The key idea of smart city is achieving a well-balanced level of satisfaction of all stakeholders in the city, taking into account their inherently different expectations and economic, environmental and social viewpoints. It is also about optimizing the costs and benefits in achieving such satisfaction. [45]

Madakam et al. (2014) emphasized the vital role of smart cities in the world and then smart city six axes or dimensions. They concluded that cities are frequently confronted with a large number of key problems, like unexpected development, informal real estate markets, construction of slums, inevitable population growth, high urban densities, lack of infrastructure, inadequate transport facilities, traffic jamming, poor power supply, in competent health services, deficient in of basic services, poor natural hazards management in overpopulated areas, crime, water, soil and air pollution leading to environmental degradation and climate change are leading the urban citizen life in unhappy. [43]

March et al. (2014) critically explored the implementation of the Smart City, tracing how the ‘environment’ and environmental concerns have become an organising principle in Barcelona’s Smart City strategy. Through an urban political ecology prism they aim to critically reflect upon the contradictions of the actually existing Smart City in Barcelona and how Smart discourses and practices might be intentionally or unintentionally mobilised in ways that serve to depoliticise urban redevelopment and environmental management. They stressed the need to repoliticise the debates on the Smart City and put citizens back at the centre of the urban debate. [45]

Mosannenzadeh et al. (2014) provided a framework to define Smart City and its sub-system. They had done keyword analysis on literature and it was against the main research questions (why, what, who, when, where, how) and it was based on three main domains involved in the policy decision of making process and Smart City plan development: Academic, Industrial and Governmental. Urban authorities can apply this framework in Smart City initiatives in order to recognize their main goals, main components, and key stakeholders. [46]

Raparthi et al. (2014) identified that four barriers—conventional urban planning mindset, lack of incentive-based practices and resources, ad-hoc planning, and lack of integrated land use transportation and environmental planning—impede smart-growth strategies in India. The study reveals that cities in India are not completely embracing smart-growth strategies in their development plans, and the use of smart-growth strategies differs among highly populated metropolitan cities versus less-populated cities. Furthermore, the results reveal a theory of planning action, which urban planners may tend to incorporate in their early stages of planning steps to address sprawl before they move toward more complex political policies. [55]

Ryser (2014) explored the notion of smart city by contrasting a narrow with a wide understanding of smart cities and by putting the notion of smart city into the context of some city typologies generated over the last few decades. The paper drew on debates, research, government policies and industry declarations about smart cities, and other adjectified cities, to single out the specificities of smart cities, and explore what they may contribute over and above to current urban policies and planning strategies. [56]

Sofronijević et al. (2014) analyzed the various elements of a Smart City and related to different options for economic growth and business innovation improvement. This paper presented and identified managerial aspects of the Internet of Things as not only a basis for the Smart City outlook, but also as a major prospect to develop certain business opportunities leading to competitive advantages for companies operating out of smart cities. [59]

Tiwari et al. (2014) described the smart city projects in India namely Lavasa: smart hill city & Gift: Gujarat International Finance Tec-City. The main dimensions of three pillar basic smart city model are Economy, Environment & Society. GIS solutions can help the policy makers & planners for decision making purposes. Ultimately this paper helps to understand the use of GIS & its integration with various approaches to formulate, stimulate, interpret and validate the sustainable development of urban areas, steering a smart and sustainable future for smart cities. [61]

Albino et al. (2015) clarified the meaning of the word “smart” in the context of cities through an approach based on an in-depth literature review of relevant studies as well as official documents of international institutions. They also identified the main dimensions and elements characterizing a smart city. Descriptions of smart cities included qualities of people and communities as well as ICTs. [1]

Angelidou (2015) identified the underlying and often forgotten principles that are shaping forces of the smart city conceptions. He explore the recent history of smart cities, identified the principal drivers of the current smart cities and yields conclusions about strategic planning for the development of smart cities today. [3]
Anthopoulos et al. (2015) systematically explored and compared existing smart city modelling and benchmarking methods. There are six common dimensions among the approaches, namely people, government, economy, mobility, environment and living. They utilized existing smart city analysis models in order to review three representative smart city cases and useful outcomes are extrapolated from this comparison. [5]


Komninos et al. (2015) addressed the problem of low impact of smart city applications observed in the fields of energy and transport, which constitute high-priority domains for the development of smart cities. They argued that the impact of applications depends primarily on their ontology, and secondarily on smart technology and programming features. They underline the relationships between innovation and ontology, and discussed how we can improve the effectiveness of smart city applications, combining expert and user-driven ontology design with the integration and orchestration of applications over platforms and larger city entities such as neighborhoods, districts, clusters, and sectors of city activities. [38]

Papa et al. (2015) identified the main characteristics of a smart and resilient urban system and framed into a conceptual model. They signified a preliminary step for the development of an operational tool capable to guide planners and decision-makers in carrying out multi-objective strategies addressed to enhance the response capacities of complex urban systems in the face of climate change. [52]

Shelton et al. (2015) suggested a greater attention be paid to the ‘actually existing smart city’, rather than the exceptional or paradigmatic smart cities. This paper grounds the critique of the ‘smart city’ in its historical and geographical context. They demonstrated the utility of understanding the material effects of policies in actual cities around the world, with a particular focus on how and from where these policies have arisen, and how they have unevenly impacted the places that have adopted them. [57]

Soumaya Ben Letaifa (2015) clarified how to design and implement strategies for building smart cities. Despite extensive research on cities successful transformation into smart cities, a gap exists on how these cities services shift toward smart services and on the methodology that the cities follow in transforming these services. This qualitative study builds on an integrative literature review and case studies to propose a methodological framework for the implementation of smart cities. [40]

Zubizarreta et al. (2015) introduced the necessity of a holistic, integrated, and multidisciplinary approach to the concept of smart cities. They analyzed the relationship between the different European smart classification standards and 61 applications from 33 smart cities distributed in North America, South America, Europe and Asia. After showing actual smart cities, they provided a multidisciplinary analysis of applications from cities throughout world and suggested the concepts and steps for building future smart cities. [65]
V. MAJOR FINDINGS OF THIS LITERATURE REVIEW

66 factors have been identified and classified into 9 different groups as follows:

1) For Environmental, eight factors were identified from the previous work as: Availability of Natural resources, Greenhouse gas emission, Consumption of energy from renewable sources, Quality of resources, Environmental protection, Sustainable resource management, Biodiversity, Recycling of used resources.

2) For Economic, nine factors were identified from the previous work as: GDP growth per capita, Global partnership, Cost of the project, Entrepreneurship, Stakeholder participation, Profitability, Domestic investment, Foreign direct investment (FDI), Land acquisition.

3) For Physical, ten factors were identified from the previous work as: Water supply, Sanitation, Storm water management, Urban development, Solid waste management, Power Supply, Educational facilities, Heritage maintenance, Infrastructural facilities, Affordable housing.

4) For Social, eleven factors were identified from the previous work as: Poverty, Healthcare facilities, Demographic changes, Recreational and cultural facilities, Smart People, Safety and Security, Employment Rate, Qualification Level, Tourist attractivity, Social Cohesion, Immigration friendly environment.

5) For Mobility, six factors were identified from the previous work as: Intelligent transport system, Modification in public transport system, Quality of public transport system, Public transport vehicle management and passenger info, Parking facilities, Pedestrian walkways & Cycle paths.

6) For Innovation and learning, four factors were identified from the previous work as: Research and development, Innovative spirit, Open mindedness, Ability to develop content and application.

7) For Political, six factors were identified from the previous work as: Transparent governance, Public and social service, Political interference of inhabitants, Political strategies and perspective, E-governance, Change in housing bylaws, codes etc.

8) For Operational and Managerial, eight factors were identified from the previous work as: Speed of work, Service Condition and Quality, Flexibility in labour market, Availability of workforce, Productivity, Disaster management, Advance construction management, Building Information Modeling.

9) For Information communication and Technology, four factors were identified from the previous work as: City wide IT infrastructure, Internet Accessibility, Location based Service and Spatial planning, Sensor System and Detectivity.
VI. CONCLUSION

Smart development implies a holistic development with integration of all key dimensions of urbanism i.e Economy, infrastructure, Environment, Governance, Quality of Life and People. Government of India has embarked upon Smart Cities Missions along with other key initiatives in each of these dimensions. An integrated framework for assessing the factors affecting designing of smart city was developed, which contained main 9 groups containing different 66 factors which provides an extensive background to enhance understanding of the smart cities so as put the entire research in an appropriate theoretical context.

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