Intelligent Town Planning for Indian Smart Cities: Principles and Practices

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Abstract: **Smart cities are well thought-out as engines of growth and contribute near 80% of the universal economic output. A smart city calls for intelligent and successful town planning and that is a paramount need of 21st century. The objective of this paper is to highlight the principles of intelligent town planning, which can be coupled with sustainable architecture to create a smart living city. This paper presents a set of the widespread multidimensional components critical for smart city concept and the core factors for a booming town planning scheme. The paper spotlights on different strategies of town planning that can be put in practice with real time monitoring. A case study of Dholera (The First Indian Smart City) is also revealed. The study is expected to integrate diverse communal values and improves confined imagination, perceptive and obligation, to crucial solutions for planning cities.**

Keywords: **Intelligent Town Planning, Infrastructure, Smart Cities, Sustainable Architecture, Urban Growth.**

I. INTRODUCTION

21st century is marked with a sturdy global movement to rising awareness of the population in reasonably few big cities. Large crowded cities can be extremely industrious, productive, inventive and hence enviable for our future. However the rapid incursion of new populace presents irresistible challenges to their managements [1].

Along with the optimistic benefits that mount up from crowded, assorted cities, there are some negative aspects too such as unofficial development, traffic blockage, waste management, dearth of resources and crime. According to the United Nations Population Fund (UNPF 2007), out of total world population, more than 50% i.e. 3.3 billion lived in urban areas. By 2050, due to the evolution of smart cities, this figure is anticipated to increase to 80 % that is 5-6 billion [1,2].

With the speedy increase of the urban population worldwide, cities face a diversity of risks, hazards and problems; for example, physical risks such as worsening conditions in atmosphere and transport, and monetary risks such as unemployment. This rapid evolution to a highly developed population will generate many challenges for the town planning, scheduling, development and functioning of cities that are invigorating new thoughts in the responsible and concerned professions such as engineers, architects, town planners, financial analysts etc. [1,2].

The unparalleled rate of urban growth creates urgency and necessity to discover smarter ways to control the associated challenges. A smart city is the solution that is being promoted across the world as a key to confrontations of urbanization and sustainable development. Smart cities are recognized to effectively operate in a smarter way to solve problems. Recent practices to make cities superior for living have become successful cases for new city progress strategies.

1.1 Defining Intelligent Town Planning

Intelligent town planning is a professional, technical and political process associated with the development and use of land, preservation and use of environment, social well-being and the design of the urban form, including air, water, and the infrastructure passing via urban areas. Town planning is also cited as urban, regional, city or rural planning or a combination of these worldwide. Town planning takes many forms and it can share contexts and processes with urban design and smart city [3]. Intelligent Town planning has many benefits as shown in fig 1 below:

Fig. 1: Benefits of Intelligent Town Planning

Technical aspects of town planning involves executing scientific, technological processes, deliberations and features that are involved in planning for property use, urban design, natural resources, infrastructure and transportation. Town planning includes practices such as: forecasting population growth, zoning, contouring, geographic mapping, surveying and investigating open space, identifying transportation patterns, perceiving water and food demands, assigning healthcare and social services. Multiple aspects of town planning are shown in fig 2 below:

Intelligent Town Planning					
Physical Aspects	**Social Aspects**	**Cultural Aspects**	**Economic Aspects**	**Political Aspects**	**Ecological Aspects**
E.g Built Environment	E.g Human Relationships	E.g Spiritual Environment	E.g Financial Environment	E.g Ideological Environment	E.g Natural Environment

Fig. 2: Multiple aspects of Intelligent Town Planning

1.2 Defining Smart Cities

Although there is no universal and fix definition of a smart city, it has been defined by numerous agencies and societies worldwide. Every country has its own description of a "smart city" depending on its economy and current urban growth. The conceptualization of smart city, thus, differs from city to city and country to country, depending on the scale of development, readiness to revolutionize and restructuring resources and desires of the city dwellers. Even in India, there is no single approach of defining a smart city.

Rocco Papa et al. defined smart city as an urban development perception to incorporate manifold information & communication technology solutions in a impregnable pattern to administer a city's assets [4,5]; the city's assets include, multiple things like local information systems, community centers, public library, transport systems, hospitals, parks, water supply plants, power plants, law imposition and other social services. The goal of creating a smart city is to augment the class of life, by using technology to upgrade the performance of services and meet population's needs [6].

The notion of smart cities is greatly related to the function of human capital, communal and relational capital using information and communication technology [5].

II. PRINCIPLES OF INTELLIGENT TOWN PLANNING

Intelligent town planning is an aspect of urban planning that contains a set of principles projected to direct the formation of city plans and municipal designs. These are anticipated to reunite and amalgamate varied urban planning and executive concerns.

The principles are shown in table 1 below:

Table 1: Principles of Intelligent Town Planning

Principles of Intelligent Town Planning	
1	Equity with Nature
2	Equity with Customs
3	Convenient Technology
4	Cordiality
5	Project Efficiency
6	Human Form
7	Town Planning as an Opportunity Source
8	Regional Alliance
9	Balanced and Mix Use Development
10	Institutional Probity

Although there can be many principles of intelligent town planning but this paper will reflect only 5 main principles as described:

1) **Equity with Nature**
   - According to promoters of intelligent town planning, equity with nature highlights the difference between employing resources and utilizing them.
   - It focuses on the aspects ahead of which deforestation, GWT reduction, soil removal, forest fires and flooding support one another in urban development, saving or annihilating life sustain systems.
   - This principle upholds environmental evaluations to spot delicate zones, endangered ecosystems and habitations that can be improved through preservation, mass control, land use plan and open spaces design in a smart city.
   - This principle supports energy utilization and savings throughout life duration and pollutant discharge analysis.
   - This belief states that there is a level of human habitat concentration in which the resources that are consumed will be restored through the restocking natural cycles of the seasons, creating ecological balance [11].
   - The principle prevents deforestation of hillside trees, excavation on slopes, discarding manure and industrial waste into the natural drainage structure, excessive paving and construction on sharp slopes.
   - This urban speculation proposes that the urban environmental balance can be sustained when delicate areas are reserved, protection of eco-systems is followed and low intensity habitat areas are considerately recognized [10].
   - Thus, the principle functions within the balance of nature, with an objective of shielding and conserving those rudiments of the ecology that cherish the environment. Therefore, the first principle of intelligent town planning is that urbanization should be in equilibrium with nature.

2) **Equity with Customs**
   - Equity with customs or traditions is proposed to incorporate plan intrusions with accessible cultural assets, with regard to customary practices and models of style.
   - This town planning principle stipulates respect for the cultural inheritance of a place. It seeks out customary knowledge in the outline of human settlement, in the order of construction plans, in the patterns of style, in the symbols and signs that convey meanings through adornment and designs.
   - This principle compliments the order produced into building systems through years of adjustment to ambiance, to communal circumstances, to accessible materials and to technology. It endorses architectural styles and designs intended to communicate artistic values.
   - This principle calls for familiarizing awareness toward remarkable monuments and heritage

structures. Natural sights and scenes require respect; giving surety that buildings do not obstruct major vista lines toward visual possessions. Rooted in the principle is the concern for sole cultural and public picture of regions, their signs and symbols. Their amalgamation into the spatial order of urban locations is encouraged. Supporters promote the direction and construction of urban plans using local knowledge and sense systems, articulated through art, skill, urban space and architecture.

- Planning decisions must function within the equilibrium of tradition, insistently protecting, supporting and preserving general components and constituents of the urban pattern in order to make a city smart and efficient.

3) **Convenient Technology**
- Apposite technology accentuates the employment of construction materials, building techniques, infrastructural systems and asset management which are reliable with local frameworks or circumstances.
- People's abilities, climatic conditions, local resources and appropriate capital investments, obstruct technology, where as the copious craftspeople, labor-concentrated methods, additional savings and capital demanding methods are suitable for technology.
- For every dilemma there is a series of latent technologies, which can be useful, but a proper fit between technology and other resources must be recognized [7].
- Promoters argue that liability and simplicity are improved by superimposing the physical spread of urban services and practices upon dominating electorates, such that people's ambassadors are interlinked with the urban industrial systems needed for a public society.
- This principle is in coordination with ICT (Information & Communication Technology) concept of smart city.

4) **Human Form**
- Intelligent town planning persuades land level, walker leaning urban patterns, based on suitable dimensions. Walkable, mixed use urban communities are promoted over single-purpose blocks, connected by motor ways and bordered by parking lots.
- An enduring human form of town planning, town design and city planning has been the encouragement of people affable places, pedestrian pathways and public spheres where people can assemble freely [9]. These can be playgrounds, backyards, gallerias, malls, patios, coffee bars etc.
- Smart town planning promotes the level of the walkers moving on the trails, as opposed to the level of the vehicles on the arterial highway. It promotes the land plan of conceivable area, as opposed to the images of frontage [8]. It also promotes the individual visibility of persons living in a city.
- Intelligent planning eliminates false barrier and endorses in person contact. Promoters argue that the vehicle, single use zoning and the creation of public

structures in remote compounds worsen the human form and the human balance of the city.
- The focus of intelligent town planning here is the communication along movement conduits, passage nodes, and interactive centers within vivacious urban cores.
- Intelligent planning envisages urbanity as a method of aiding human conduct towards more liberal, passive, compliant and more susceptible modalities of communication and quarrel resolution [9].

5) **Opportunity Formation**
The intelligent town planning visualizes smart city as a driving force for personal, social and economic development through access to a variety of societies, services, amenities and information providing a range of opportunities for better service, economic commitment, education, and amusement.
This principle aims to augment access to asylum, health care and human capital development. It aims to increase security and sanitary conditions. The opportunity medium must also react to youthful professionals, to expert, well-paid laborers, to the upper middle class and to rich capitalists.
If an array of needs and of levels of growth of housing is addressed, then opportunities are being shaped and created.
Intelligent town planning upholds smart opportunities through access to:
- Fundamental primary education, expertise development and awareness about the urban world
- Basic fitness, clean water, solid waste clearance and sanitation
- Urban facilities like rainstorm drainage, energy, infrastructure and transportation [9,10]
- Public involvement and deliberations
- Finance and venture policies/schemes
- Land/ urbanized space where commodities and services can be produced [8]
- Intelligent town planning provides a broad range of sectors, districts and regions where activities and tasks can occur without disparaging from one another

III. **ROLE OF TOWN PLANNER IN INTELLIGENT TOWN PLANNING**

A town planner is a person who decides what a town and its people need to flourish. He visualizes and build ups strategies that he thinks will help the most people in the most gainful ways. Some town planners work in concurrence with other neighboring or regional planners to develop plans that may cross-benefit civilians in adjacent zones and districts.
Town planning encompasses many diverse restraints and brings them under one roof. The role of town planner is basically to systematize all elements of a town or other built up environment in order to construct a smart city [8].
The following are the duties of a town planner along with planning process (as shown in fig 3):
- To create and endorse healthy conditions and atmosphere for all the people
- To make correct use of the land for the correct purpose by zoning [8]
- To make sure systematic development
- To avoid intrusion of one zone over the other

- To preserve the individualism of town
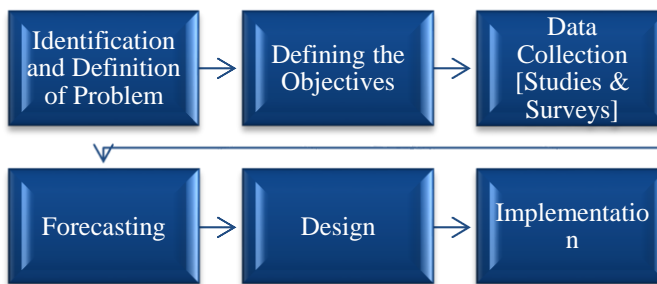
Planning Process

Fig. 3: Planning process in town planning

Planning process of a town can be very hectic and it needs some expert supervision to effectively manage things. Planning process starts with identifying and defining a problem of an existing town or to be developed town, and then goals of town planning are formulated by expert committee. Town is always designed by conducting various surveys of well developed towns across the world. After complete data analysis, final blueprint of the town is prepared by concerning the government and local municipal authorities. Implementation of the design is the vital and core task of planning process, normally high experienced and skilled contractors are hired for the execution purpose along with well renowned project management consultants. The final stage of planning process that is followed after execution is the review of built up area or region so as to identify the problems that may call for redesigning or restructuring.

IV. TOWN PLANNING COUPLED WITH SUSTAINABLE ARCHITECTURE

Town planning involving sustainable architecture aims at creating structures that are tailored to local social-economic, civilizing and ecological frameworks, having in mind the outcomes to upcoming generations [10].

Within this framework, the main concern must be to reduce energy consumption in structures both in terms of upholding and personified energy, through the use of passive design tactics, i.e. reducing the use of energy consuming equipment like HVAC or non-natural lighting, through an intelligent adjustment of the building to the local climatic situation [10]. The practice of sustainable architecture within town planning is an indispensable factor for a sustainable development [11]. The formation process must incorporate not only climatic stratagems, but also problems regarding the social-economic impact of the structure throughout the diverse phases of its subsistence.

Formulating an approach for sustainable town planning agenda in the Indian context is tremendously complex due to the variations in the urban and metropolitan regions of the country. Sustainable town planning tries to simplify the planning process and sets a large structure of urban planning in the country [11]. It focuses on planning realism of elemental dimensions of sustainability and clarifies a work framework of the vibrant sustainable planning. Sustainable town planning entangles an all resources management i.e. human resource, financial resource and physical resource.

Key Features of Town Planning Integrating Sustainable Architecture

- Present a scaffold of sustainable planning in a region or a town
- Assimilates the models of livability and affordability
- Contrasts disparity and sustainability in the town planning milieu
- Elucidates the impact of capacity design and supervision on the outlook of sustainable planning
- Connects information and action
- Improves the civilized and natural situations
- Embraces out for functional interconnections
- Respect seasons, natural patterns, life patterns, beliefs and history of a town
- Designs craftily and redesigns considerately
- Balances socio-economic-environmental effects
- Holds in a participatory approach of decision-making
- Works for multiplicity and diversity of outcome
- 'Works about' rather than 'approaching through'
- To promote smart cities across the country
- To make sure that all societies' needs are met
- To make sure that all progress and maintenance is sustainable ultimately in a communal, fiscal and green sense

V. CASE STUDY OF DHOLERA: FIRST INDIAN SMART CITY

In the 20th century, the master plans of numerous new cities (both built and unbuilt) planned across Asian, African and American countries imply that regular town planning was a contrivance of the post majestic state to make a break from its regal past and enforce a more collective concept of modernity for its people [5]. Smart cities are now debatably the new urban trend of the 21st century. Combining urban and cybernetic planning, smart cities are being promoted across the world. In India, particularly there has been a progress towards creating 100 new smart cities in the future in order to incite monetary growth and urbanization.

In India, the smart city description has been identical with the green or sustainable cities, which now conceivably form the new urban debate of the 21st century.

Smart Cities Mission: Making a Smart India

Smart Cities Mission is an urban restoration program launched by the Government of India with a job to build up 100 smart cities all over the nation and making them public friendly and sustainable. The Ministry of Urban Development (MoUD) is accountable for executing the mission in cooperation with the state governments of the individual cities. Smart cities are expected to be operational with crucial infrastructure that will present a high-quality life through smart solutions [4]. Efficient town planning ensures better water and electricity supply, hygiene, solid waste management, competent urban motility and public transport, strong IT connectivity, E-governance and civilian participation along with security of its citizens and that are some of the possible traits of the smart cities.

A total of 15 billion US Dollars has been permitted by the Indian breakfront for development of 100 smart cities and renovation of 500 others. First consignment of 20 cities chosen in the second stage of competition will be granted a central support of 30 million US Dollars each during this fiscal year followed by US$15 million per year throughout the next three years. The residual money will come from the states, municipal bodies and the corporate tie ups. Also, 10% of budget allowance will be given to state provinces as incentive based on accomplishment of improvements during the preceding year (Source: MoUD Data).

Case Study
Dholera SIR (Special Investment Region) has been visualized as the first smart city of India, a city situated in the vibrant state of Gujarat, just 100 kilometers away from Gujarat's capital Ahmadabad. It is all ready to define how contemporary India shall appear in a period to come. This venture is a very grand and ambitious project of both central government and government of Gujarat state [6].

A lot of progress has to occur in Dholera to make it as a smart city, like construction of an international airport, metro rails, expressways, core power projects etc. The construction and technology boom in Ahmadabad city is one of the key reasons why this city in Gujarat has materialized as a vital real estate market in the country.

One of the chief drivers of this development is the Delhi-Mumbai Industrial Corridor (DMIC), which is a USD 100 billion state subsidized project for trade development. Dholera SIR is a major project under the DMIC Project, a goal to make it an international manufacturing hub hold up by superlative infrastructure. It is going to be a much planned city in every style and also marketed as the peak of technology-obsessed urbanism. The comparison between the present and future of Dholera city is shown in the fig 4 and 5 respectively.

Dholera smart city twirls its back on the challenges of accessible Indian cities fighting with greenhouse gasses, traffic jamming and slums. Dholera assures to be the city without infuriation of urban life [6].

According to DNA India, out of the 100 smart cities to be developed, Dholera SIR Gujarat is foremost in the vision that the central government has laced with USD 500 Million in its fund and land chosen by the state government. Although Dholera SIR will be extending over 920 sq km, the starting Phase-I will cover 153 sq km and real work will start from a minor area of 22.5 sq km depicted as Activation Area. Dholera has already commenced the massive infrastructure project on an opening area of 22.5 square kilometers. This Activation area is sub-alienated into business zones, knowledge parks, IT zone, solar energy zones, housing zone, farming zone, special corridors, logistics, city hubs, villages, and tourism resorts.

The project is expected to get finished by 2019 and shall encompass of roads, water and sewage conduct plants, general seepage treatment and many other facilities [6]. The city would be built as a top-notch city, with a 10 lane superhighway running between the cities from Ahmadabad to various seaports. It would be the planet's biggest urban town development venture worth $12 billion. (Source: DNA India).

Prominent Features of Dholera Smart City:
- Net area 920 km^2
- Developable are 567.39 km^2
- World-class infrastructure & transportation: inside & outside
- Central backbone expressway & metro rail to link Dholera SIR with colossal cities
- Airport, sea port, docks and harbors in the environs
- Convenience to mega cities: Ahmadabad, Bhavnagar, Vadodara etc.
- Advantage of sea coastline, natural world park, golf course
- Full potential for private sector participation and public-private partnership (PPP)
- Full potential to boost employment by 2 times and industrial output by 3 times
- Proximity to Gujarat International Finance Tec-City
- Proximity to petro-chemicals and petroleum investment regions

Challenges in Smart City Mission:
Every new improvement comes up with plenty of challenges. This mission has many challenges, let's identify 5 of these:
- The first challenge on face of the government is the retrofitting of the present infrastructure of the cities. It is important to decide the city's fault than directly working on it.
- The preponderance of project will be sponsored by the private sector as there is a requisite of USD 50 Billion per annum for next 20 years in line to construct 100 smart cities. Arranging this finance will be difficult task for everyone.
- Regrettably 70% Indian cities doesn't have city development plan, which is a principal barrier for smart city. However, government is trying to trounce this issue.
- Accomplishment of this plan largely depends on the three rank government of India i.e. central government, state government and local government to argue the matter of financing and applying other paramount practices.
- Another concern is software infrastructure in diverse cities is assisted by numerous hawkers; hence it is pretty complicated to hold this composite structure [4].

Fig. 4: Dholera city at present (Source: bing.com)

Fig. 5: Proposed sketch of Dholera city (Source: bing.com)

VI. CONCLUDING NOTES

By the end of the 21st century, it is expected that the worldwide population will be spiky and steady and the immense mass of those people will be residing in cities and that will ceased the current dynamic construction and growth of urban ability. Following are the conclusions of this study:

- The fundamental notion of intelligent town planning schemes is grouping together all the property under diverse possessions and reallocating it in a suitably recomposed form after subtracting the land mandatory for open spaces, public infrastructures, IT services, road networks and shelter for the economically weaker section.
- An exclusive opening is there in the future decades to figure the outlook of universal society through modernism in urban systems and town planning.
- The author expects that the complicated conceptualization of town planning and smart city in this paper will contribute to future potential studies.
- As the paper studied numerous conceptual dimensions of intelligent town planning, the idea is a natural connection among technical, individual and industrial modules.
- Town planning is the key that every organization should acquire to attain consistent, dexterous and cost efficient operations within a city. It has been measured as an imperative way to reform various businesses in town for attaining breakthrough perfection in performance.
- The concept of intelligent town planning has been publicized as the new great-scale vision to direct the planning schema for the twenty-first century.
- This paper was initially designed to offer a logical grounds and elucidation of good practice in the design of cities. It is not projected to be a master plan but somewhat a demonstration of the qualities of successful town planning.

- The perception of sustainable architecture and planning surmounts the individual boundaries of the development and urban design approaches.
- Sustainable town planning can be used as a critical framework to radically shift the practice of limited participation from governing authorities towards a more integrated and extensive view.
- This paper has presented an exhaustive critical analysis on Dholera smart city to propose how the progression of building new cities in India is furcated by contradictory demands of economic growth and communal integrity.
- Dholera shows how a broadminded state efforts to magnetize global capital, boost economic growth through the construction of new sectors, townships, protectorate cities and eco-cities.
- Dholera is yet to be built, but the twirls and twists in its uniqueness and politicization as a smart city presents us an imminent into the future of 100 new Indian smart cities planned by the recently elected central government.

Future Work on Indian Smart Cities:

- India is likely to come out as the world's 3rd biggest construction market by the year 2020 by adding up near 12 million homes every year.
- 'Honeywell Survey' affirms that around 2,000 buildings in India need to endow more in smart building technologies. Airfields and hotels attain the highest, schools and suburban buildings the lowest.
- Automation technologies to play a major role in the competent processes of buildings. The Indian commerce guesstimates the Indian construction automation and control systems market to raise three fold in profits terms by 2019.
- Smart screening, cross-device rapport, voice controls, wireless connectedness, illumination facilitated by motion sensors are only some features that need to be developed.
- More than 3,000 green building projects, with a built-up area of more than 2.8 billion sq. ft. listed with the Indian Green Building Council (IGBC), out of which 617 green building projects are proficient and practical. Indian Government should pay concentration on these areas to fulfill the dream of smart cities mission.

References

[1]. Colin Harrison and Ian Abbott Donnelly, "A theory of smart cities," Proc. 55th Annual Meeting of the ISSS, 2011, pp. 1-15.

[2]. Taewoo Nam and Theresa A. Pardo, "Conceptualizing smart city with dimensions of technology, people and institutions," Proc.12th Annual International Conference on Digital Government Research, 2011, pp. 282-291.

[3]. Philip R. Berke, "Does sustainable development offer a new direction for planning? Challenges for the twenty-first century," Journal of Planning Literature, Vol. 17, pp. 21-36, August 2002.

[4]. Robert Goodspeed, "Smart cities: moving beyond urban cybernetics to tackle wicked problems," Cambridge Journal of Regions, Economy and Society Advance Access, vol. 8, pp. 1-14, August 2014.

[5]. Rocco Papa, Carmela Gargiulo and Adriana Galderisi, "Towards an urban planner perspective on smart city,"

Journal of Land Use, Mobility and Environment, vol. 1, pp. 5-17, March 2013.

[6]. A. Datta, "New urban utopias of postcolonial India: Entrepreneurial urbanization in Dholera smart city, Gujarat," Dialogues in Human Geography, vol. 5, pp. 3-22, March 2015.

[7]. Mihyar Hesson, Hayder Al-Ameed and Muhammad Samaka, "Business process reengineering in UAE public sector: a town planning case study," Business Process Management Journal, Vol. 13, pp. 348-378, March 2007.

[8]. Shirley Ballaney and Bimal Patel, "Using the 'development plan - town planning scheme' mechanism to appropriate land and build urban infrastructure," India Infrastructure Report, pp. 190-204, 2009.

[9]. John Montgomery, "Making a city: Urbanity, vitality and urban design," Journal of Urban Design, vol. 3, pp. 93-116, February 1998.

[10]. M. Correia Guedes, M. Pinheiro and L. Manuel Alves, "Sustainable architecture and urban design in Portugal: An overview," Renewable Energy, vol. 34, pp. 1999-2006, March 2009.

[11]. Petter Naess, "Urban planning and sustainable development," European Planning Studies, Vol. 9, pp. 503-523, June 2001.