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Creation of Smart Cities - Perception and Strategies towards Liveable Futures

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The concept of creating has been talked about lately, in spite of this, there is ambiguity on understanding what goes into the creation of a smart city (Angelidou 2015; Hortz 2016). Smart city creation is an innovative technique, certainly bound to reap abundant success with advancements in technology, it is relatively new, and can be seen as a successor of information (Yigitcanlar 2006). The creation of the smart city concept clubbed with technology makes a city a better place, that is liveable and offers a vision for sustainable development. The demand for such cities is multiplying with time, carrying different dimensions like better quality of life, optimum utilisation of resources, saving on time and energy, comfortable life, being environmentally friendly , thereby creating a smart city that is developed for a liveable future. Against this backdrop, an attempt has been made to assess the perceptions and strategies of creating a smart city. Primary data was collected through a developed questionnaire based on the existing literature and the data was analysed using a non – parametric test to obtain the results. The study comprehends that there is no universally accepted definition for creating a smart city. It means different things to different people. The paper contributes to the growing body of knowledge on creativity, and sustainable development for liveable futures through the concept of smart city based on the perception people carry about the smart city they live in.

Key words: *Smart city, perception, uniqueness, effective, urbanisation.*

Introduction

The era of globalisation in the 20th century has witnessed growing populations, an unprecedented extent of urbanisation and has resulted in organic development in magnitude,

with numbers of metropolises in diverse fragments throughout the globe. Urbanisation is a global phenomenon that is transforming human life the way it is moving. It has become a megatrend in the 21st century.

The perception of the smart city has evolved due to the application of advanced information technology, the positioning of developmental models anticipating socio-economic outcomes that ensures the creation of smart cities and creating sustainability in urbanisation. Making a city smart decreases the challenges that cities face, such as required health care, housing, water, lack of energy resources, and abating infrastructure (roads, schools and commutes) (Washburn, 2011).

Dynamic advancements in Information and Communication Technologies (ICT) facilitating mobile apps, free social media and cloud computing help cities with abundant opportunities to understand, communicate and forecast urban needs and functions (Dirks, 2009) (Berst, 2013). In this connection, projects on smart cities are observed as a comprehensive approach for a planned conurbation (Requena, 2014). (Cole, 2015) accents the necessity to bring the conurbations to a level where a quality life can be delivered which citizens demand as is everybody's right. Moreover, nowadays a challenge is that youth in metropolises constitute 25 percent of the current world populations, and in India approximately 28 percent of the population actively participates in civic engagements (UNPFA, 2015).

Technology, apps and the usage of technology with apps by citizens are the three important key drivers for creation of a smart city. These applications become successful if the citizens can avail themselves of these facilities to the fullest. The different dimensions that describe a smart city include, better quality of life, optimum utilisation of resources, saving on time and energy, comfortable life, and environmental friendliness .

By 2025, there will be cities that would deploy smart applications, which would cut down the transit time from one point to another by 20 % on average. This depends on aspects like the population of a city, density, transit time, technology used. Digital signage to update citizens on real-time information on delays in trains, flights and other transport facilities would make the citizen's life more convenient.

The Indian Government`s smart cities mission applies the concept of area improvement of existing Indian cities, bringing the best practices to the new urbanism movement into the purview of developmental activities. This can stimulate the local economy, harness the economic identity of a place and its pupils and improve the standard of living of its citizens (A.N.Nand Kishore, 2016). Considering the challenge of growing populations where half of humanity i.e. 3.5 billion reside in conurbations today, by 2030, it is projected that the majority of the people will be the inhabitants of a metropolis. The cities across the world

occupy just 3% of the terrestrial land, accounting for nearly 60-80% of all energy consumption. Approximately 95% of the urban expansion will be seen in the developing nations in the coming decades (UNHouse, 2016).

Objectives

- To assess the perception of youth on the creation of the smart city concept
- To understand the perspective on aspects relating to creating uniqueness of Pune city
- To assess the factors in creating smart cities for a liveable future

To comprehend the objectives, the paper is divided into three sections; firstly, the researcher has tried to bring in the conceptual background, giving the idea about the concept of sustainable cities, further the context of the Indian smart cities mission laid down by the government of India has been discussed, considering the world scenario of smart and sustainable cities. Subsequently, how a city called Pune in the state Maharashtra can be perceived as a smart city is being highlighted. Section three highlights the research methodology, explaining the research approach to achieve the objectives, followed by data analysis and interpretation with major findings and conclusion.

Cities are considered as engines of sustainable development where ideas, commerce, culture and infrastructure flourish for the wellbeing of the citizens. And India is no less compared to the world`s developing urbanisation. In the latter half of the 20th century, India was predicted to surpass China by the year 2014, as it was declared as the second most populous nation in the world (Express, 2017). This results in the fact that the proportion of the urban population is continuously increasing and according to the estimations, 66 % of the population will be urban citizens by 2050, due to the higher standard of living that can be found in those places, which raises potential problems of geographic management. In order to overcome these issues, the concept of smart cities has gained much significance. The youth today are technology driven and perceive the concept of smart cities as economic drivers that stimulates actions towards economic growth, infrastructure, gender equality, health and well-being, water and sanitation, energy, business and innovation, eliminating inequalities, production and consumption, climate action and ecosystems. Smart cities in India are heading towards becoming the most populous in the world by 2030. The smart city as a phenomena is used widely, though perceptions vary . The metropolitan cities in India that are considered as tier one cities, like Mumbai, Delhi, Kolkata and Chennai, have proved their footprints in sustainable development. The mounting population is migrating to the top tier cities of India and is building new mega cities that are estimated to generate approximately 80% of economic growth.

India is heading towards building tier two cities in the category of smart cities, including Pune, amongst the city profiles of the twenty smart cities mission. The increasing population of Maharashtra over the last few decades has led to huge pressure on the existing infrastructure, emphasising the need for efficient delivery of urban services. Pune has been acclaimed in the category of business and industrial hubs for tier two cities, being the ninth most populated city in India and the second largest city in Maharashtra.

Historically Pune is considered as an essential economic hub in Maharashtra as a result of the snowballing number of industries. The Pune region is popularly known for being the most eminent automotive sector. It is also known for having a large military base and is the headquarters for the Indian Air Force (South Command). Congruently with its distinctive merits, a major chunk of the population of young professionals migrates due to rapidly rising information technology and education centres, and these are considered dominant sectors. Having these eminent potentials, the Maharashtra Industrial Development Corporation (MIDC) has initiated to develop a new IT park to accommodate the rising growth in Pune. It has witnessed large scale investments, including a Food Cluster Development project, aided by the World Bank, and an International Exhibition and Convention centre, that started in 2017 (Meghraj, 2014).

Pune possesses diverse enthralling spots of natural exquisiteness and affluent cultural heritage. There is an array of ancient cultural sites of heritage value, magnificent landscapes, heritage sites, temples, forts, forests, waterfalls, wildlife, western ghats and hill stations. Pune is well known for its cultural heritage and its roles in the fields of music, art, religion and philosophy. It is a city of bio-diversity gardens. It is considered a cultural capital of the state due to its rich heritage. Pune has been able to maintain its distinctiveness as an educational hub for management, engineering education and film making. Experts are of the opinion that availability of quality education is one of the growth drivers for becoming a smart city, apart from climatic conditions and landscape. The interesting fact about Pune is that it has also been acclaimed as a destination for international education for many foreign students. It has more than 110 MNCs, along with other established companies, production units, IT hubs, emergent start-ups, crafting it as a promising destination for sustainable development. Pune is acclaimed as the 'Oxford of the East,' having 811 colleges, producing more than 30% of a technically cultivated workforce, triggering an Information and Communication Technology (ICT) revolution in the city. The presence of renowned IT multinational companies has paved their establishment in Pune. Over the years the city has evolved as a strong manufacturing base into auto and engineering. It is eighth in the country in terms of urban agglomerations population size, contributing 11% to Maharashtra's GDP, with a 1065 billion GDP value ranking fifth in the country, ranking second in India in software exports, contributing 9% and the second best city in the country in terms of quality of life. With these remarkable features, Pune tends to be a likely smart city with sustainable growth.

Literature Review

Smart city creation is a phenomena of confusing term and several attempts have been made to perceive it in different ways (Anthopoulos, 2006) and still there is inadequate understanding of the aspects of smart metropolis among experts and academicians related to the new metropolis (Hafedh Chourabi T. N.-G., 2012). It entails achieving global integration by exemplifying the vessel of technological innovation as an approach under the phenomena of smart metropolis. It has evolved as a paradigm to address the modern and looming worldwide issues comprising communal, ecological, pecuniary and governance (Trevor Clohessy, 2014).

Smart conurbations have not been described in a holistic view comprising definite attributes, but versioned into various dimensions ranging from web based conurbations, ICT to a metropolis pertaining to education of its inhabitants (Komninos, 2002). In 1994, for the first time the concept of smart city was used (lombardi, 2012). The marvel of smart metropolis has evolved to emphasise the significance of information and technology revolution in last two decades (Hans Schaffers, 2012). According to (Sunil Choenni, 2001), city development and quality of life is extremely influenced by the level of education of inhabitants, commute and conveyance, health and hygiene, municipal administration claiming utmost priority. A metropolis can be described as smart, when "investments are made in humanoid and communal wealth and conventional commute systems as well as in automated (ICT) infrastructure fuelled with ecological economic growth and a superior class of wellbeing, with an optimal use of natural possessions, through a democratic government" (Andrea Caragliu, 2011).

Moreover, smart conurbations have been widely underlined as a term for digital cities where a common multi-tier architecture for towns was initiated assigning software and service layers (Anthopoulos, 2006). It entails that ICT factors are vital elements for the sustainability of smart cities. Web based mesh network and Virtual City was one of the pioneering smart metropolises represented by America-On-Line (AOL) cities. Similarly, the digital city of Kyoto (Wang, 2001) (Ishida, 2002), and the digital city of Amsterdam (Lieshout, 2001) can be attributed to this. A knowledge based approach was adopted by Copenhegan by developing a communal databank having crowd sourcing options delivering indigenous facts & figures, that can be accessed through internet (Bastelaer, 1998).

The Broadband metropolitan approach was introduced where fibre optic cables were installed in the conurbations to build connectivity between households and confined enterprises through ultra-high speed networks (Townsend, 2007). An ambient cities approach also was introduced in New York and Atlanta by installing wireless broadband networks in the towns (Ganapati, 2008). Cities like Barcelona, Austin (USA), Tampere (Finland) and European cities (http://smart-cities.eu, http://smart-cities.info) complement prolific perspectives of ICT

applications. ICT would contribute to states in terms of (smart regions), education (smart citizens), administration and governance, mobility (smart transport) and sustainability (smart ecosystems). The above literature identifies the existence of several alternative forms of smart cities that have evolved for more than two decades. The literature covers the holistic view of wide facades pertaining to community development, governance and environment. There are other components that are uncommon, like education, safety, mobility, environment and infrastructure. The inter-relationships among these can become the mechanisms of conurbations.

In the past decade, the amount of publications addressing this subject has grown conspicuously with the advent of smart city projects endorsed by the European Union. Being a developing economy, the smart city phenomenon is new in the Indian scenario, and there exists no worldwide accepted description of a smart city. Several definitions form different meanings. A few of them are described below.

1. The UK Department of Business envisages conurbations as a progression, in which we find amplified citizen engagement, innovative infrastructure, intellectual wealth and hi-tech know-hows that create sustainable smart cities , gaining resilient abilities to respond to contingencies.
2. According to the British Standards Institute, smart cities connotes, “An active assimilation of systems (human, physical and digital) that helps in building a viable atmosphere to provide ecological, affluent and encompassing prospects for its inhabitants.”
3. A phenomena fetching optimum intersected information and limited resources obtainable at its disposal to comprehend and monitor its operations as illustrated by IBM.
4. CISCO terms smart conurbations as those adopting ascendable resolutions that optimise a digital revolution resulting in increased productivities, declining costs and improving standards of living.

Thus from the above it can be understood that there are many definitions of cities that are quoted in the world. The representative elements of smart cities consist of a combination of a smart economy, flexible commutes, infrastructure, ecology, effective living by vigilant people and effective regulatory surveillance. It can be termed as a unified metropolis system. A smart city vision involves the vision of infrastructure, renewable energy resources, building new systems of mobility and the community having the habit of innovation and adaption (Sejal S Bhagat, 2014).

According to (Aoun, 2013), a smart city is key for enabling urban areas to become more sustainable. Technology has played a significant role in urban planning by producing novel practices of manufacturing, arcades, communities, organisations, diligences, and business

collaborations . It helped the planners to make smart cities by using smart devices and smart concepts (Rocco Papa, 2013). Technology, infrastructure, environment and policies are critical factors that are to be addressed for integrated frameworks that can be used to envisage how the policy makers and governments outline the implications (Hafedh Chourabi, 2012). In the application of smart city solutions, there are many challenges that are encountered by the government and the various stakeholders. However, it is meant for public welfare with limited available resources (Tryfonas, 2012). These initiatives increase the value of the city. Researchers call the concept of smart city digital city also. A few application systems that are used in the process of making the smart cities are smart medical treatments using digital space, building wireless cities, adequate shelters, effective municipal facilities and social management, attractive tourism and green cities (Kehua Su, 2011).

For urban development, the role of social setup, humanoid wealth and edification is vital (Florida, 2002). Advocated creative community that drives economic growth through 3sT (tolerance, technology, and talent), that are connected to pupils with their affiliates. Vigilant community is an essential constituent of a smart city (Giffinger, 2007) (Gudrun, 2010). The phenomena of smart public refers to the aspects of continuous education, communal and cultural diversity, inventiveness, tolerance, and involvement in inclusive growth. Social architects are of the opinion that issues affiliated with conurbations be resolved through creative human minds and bright scientific ideas by identifying smart solutions (Caragliu, 2009). Smart conurbations are the centres of higher education and smart work forces (WintersJ.V., 2010). Education is a critical magnet that makes urban sprawl prominent. Corporations, business houses, the public at large of all backgrounds descend to vibrant learning environs (Boise, 2002). On the basis of the above deliberations, smart conurbations need to be educational hubs where combined intellects and social learning make a city niftier (Coe A, 2001).

The cultural heritage of a city is represented by ancient memorials, historic structures, cultural traditions, local narratives and community lifestyles (Mehta, 2018). The citizens of the metropolis are prospective members in its governance, assessing and preserving the culture heritage of the city (Ann Borda, 2017). The smart cultural heritage phenomena emphasises collaborative and partaking methods making cultural data openly accessible to public, increasing the chances for interpretations, digital curations and innovation (Angelaccio, 2012). These aspects offer immense and exceptional access to the traditional memorials interested in the cultural consumer (Angelidou, 2015). A city`s cultural heritage describes the identity of communities. Showcasing a community`s historic commemorations in smart city initiatives has the impending prospects to endorse social interconnections and intensify innovation and boost tourism (Europeana, 2015). The cultural heritage has been addressed by smart city strategies across countries and stands mostly on the untapped phenomena, offering several assimilating prospects (Angelidou, 2017). Urban mobility is a

critical economic issue enabling the geniuses of smart and sustainable development and hence a sustainable transport ecosystem is essential (Dastan Bamwesigye, 2019). For any city, progressive infrastructure is the pioneering step towards creating an overall smart city framework and architecture (Rodzi, 2009). According to the McKinsey report (Eric Hannon, 2019) a metropolis should provide operational solutions by encouraging innovation, smoothing a cooperative environment, and achieve sustainable aims. In its report, Deloitte has explored the possible ways in which conurbations across the world have approached integrated mobility. It explained how urban with the help of shared independent mobility, smart linked technologies and infrastructure has created an ecosystem that is affordable, quicker and safe smart infrastructure refers to intelligent transportation (mass transit and individual mobility) systems, buildings, bridges and tunnels, road networks, traffic management, smart parking, charging and energy stations, multimodal options, passenger's information panels, navigations facilities (Peeples, 2018) (UN, 2016). According to the World Bank, by 2031, approximately 600 million people are going to live in Indian cities. Currently in India, only 20 cities over five lakh populations have organised systems of community transport; that too has declined from 70% to 40%, extending alarming signals of fatal accidents that are the highest in world. Urban transportation is an essential pillar for quality of life of citizens in metros (Vishvesh Prabhakar, 2015). (Matthew N.O. Sadiku, 2017) has presented the analogy of the use of ICT as a solution for smart transportation. The smart city mission of GOI includes environmental sustainability as one of the core elements. Environmental dynamics involve scenic countryside and topography, weather, pollution, flowing reservoirs and galaxies of vegetation as a key constituent. Sustainable environmental dimensions focuses on preservation and fortification of natural environs (Aman Randhawa, 2017).

Apart from infrastructural scarcity, Indian urban areas are also tackling environmental dilapidation, air pollution, and growing occurrence of climate-induced hazards (Rajneesh Dwevedi, 2018). (Anjos L., 2019) has displayed the association between smart city practices concerning citizens' participation in the process of urbanisation with respect to landscape transformation. (Laura A. Wendling, 2018), posits that nature based solutions would offer a means to effectively steer the water-energy sources, improving conurbation resilience by using natural resources. (Bulkeley, 2003) in their book presented an investigation on how cities would combat the effect of climatic variations and its prospects for urban sustainability. (Govindarajulu, 2014) highlighted global best practices in using urban green spaces as cost effective methods in conserving bio-diversity, climatic change adoption, disaster risk management and strengthening ecological balances in Indian cities. Indian tier two and three cities are inclined to several climatic risks and challenges and to combat these climate resilient policies are the need of the hour for sustainable development.

The phenomena of smart cities introduces new practices and services which support the outcome of policy making and urban planning through resource capitalisation, coherent regional growth and environmental protection (Leonidas, 2011). The deliberations pertaining to smart cities revolve around the dimensions like people, technology, policy making and institutions. Smart means inventive and transformative alterations driven by technology, considering the societal factors too (Pardo, 2011). On the whole, it has been seen that the understanding of smart cities is perceived in different ways. For a few, it is the application of technology in making life smart, others perceive it as innovation driven by technology, a city rich in heritage and culture, a city unique in climatic and weather conditions, efficient in transport and utility services etc. The research is based on the premise that different people perceive the concept of the smart city differently as per their closeness. The above literature review has produced different dimensions to the concept of the smart city. But very few have focused on how people perceive the smart city from the angle of climatic and natural environment, heritage, educational nucleus, entertainment and lifestyle and effective transport.

Research Methodology

For the study, primary data was used through a structured questionnaire. Secondary data was also included by way of a review of the literature through inclusion of research papers around the topic.

The structured questionnaire, comprising close ended questions, was devised and circulated across 500 respondents using a simple random sampling method. From this group, 469 respondents were chosen from different states in India. The respondents had background and knowledge about the concept of the smart city, since they had explored various cities across India. To increase the rate and quality of the responses, the five point Likert scale has been used. For the reliability of the questionnaire, measuring the parameters, Cronbach's alpha was used. The reliability coefficient alpha score of the factor was 0.934, indicating a greater extent of reliability and consistency amongst the questions in the questionnaire. The respondents' profiles consisted of the youth belonging to the ages of 20-30 and 30 -35. The aim of collecting the primary data was to identify how youth perceives the concept of the smart city and their aspiration towards Pune as smart city. The various parameters that have been considered to explain the uniqueness about Pune, are heritage and culture, climate, education hubs, transport and traffic, entertainment travel & lifestyle and landscape . Secondary data has been collected from government websites, books, magazines, journals, portals and newspapers. To conduct analysis and test the hypothesis, statistical tools like the non- parametric test that included the Wilcoxon signed-rank test and factor loading have been adopted to obtain results in the study.

Data Analysis & Interpretation

Wilcoxon signed-rank has been used for the analysis. It is applicable in situations where two sets of quantitative or ordinal values are not independent, and non-parametric analysis is used. The aim is to investigate the opinion of the respondents related to the uniqueness of creating a smart city. The unique features of Pune city, stated in terms of its heritage and culture, as an educational hub, transport and traffic, landscape and landmarks, and climatic/weather conditions have been considered for the study. Statistical association of the variables has been analysed for the following factors: effectiveness, efficiency and sustainability of the uniqueness of the features of Pune as smart city. Hypotheses have been formulated to assess the perception that youngsters have about Pune`s uniqueness to be considered as a smart city.

Data Analysis

a) Unique features of creating a smart city:

Table 1: Summary Statistics

Variables	Min	1st Quartiles	Median	3rd Quartiles	Max
Heritage and Cultural roots	2	4	5	5	5
Educational hub	2	4	5	5	5
Entertainment Travel & Lifestyle	2	4	4	5	5
Transport & Traffic	1	2	3	4	5
Landscape & Landmark	1	3	4	4	5
Climate	2	4	5	5	5

Inference: Table 1 presents summary statistics of opinions related to 'Unique features of Pune city.'

Table 2: Wilcoxon Test

Variables	P-value	
Heritage and Cultural roots	7.00E-09	< 0.05
Educational hub	1.00E-14	< 0.05
Entertainment Travel & Lifestyle	1.00E-12	< 0.05
Transport & Traffic	6.00E-02	> 0.05
Landscape & Landmark	8.00E-07	< 0.05
Climate	2.00E-16	< 0.05

Inference: Table 2 represents Wilcoxon test with all the variables to be significant (p-value < 0.05) except for Transportation and Traffic to be insignificant (p-value > 0.05).

Table 3: Factor Loadings

Variables	Factor Score
Heritage and Cultural roots	0.3
Educational hub	0.7
Entertainment Travel & Lifestyle	0.6
Transport & Traffic	0.2
Landscape & Landmark	0.2
Climate	0.5

Inference: Table 3 educational hub (factor score 0.7) and entertainment travel and life style (factor score 0.6) and climate (factor score 0.5) are the variables contributing to the unique features of Pune city whereas transport & traffic and landscape & landmark being the least contributors with factor score 0.2.

b) Sectorial Prioritisation of Pune City

Table 4: Summary Statistics

Variables	Min	1st Quartiles	Median	3rd Quartiles	Max
Citizen Participation	2	3	4	4	5
Identity and Culture	2	3	4	4	5
Economy and employment	2	4	4	5	5
Education	2	4	5	5	5
Health	1	4	4	4	5
Biodiversity	2	4	4	4	5
Housing and inclusiveness	1	4	4	4	5
Transportation and mobility	1	2	3	4	5
Intelligent Government services	1	3	4	4	5
Energy supply and source	2	3	4	4	5
Water supply	2	3	4	4	5
Water Waste Management	1	3	4	4	5
Underground electric wiring	1	3	3	4	5
Internet connectivity	1	3	4	4	5
Sanitation	1	2	3	4	5
Safety	1	2	3	4	5
Climate change	1	3	4	4	5

Inference: Table 4 represents summary statistics of opinions related to 'Sectorial Prioritisation of Pune city. '

Table 5: Wilcoxon Test

Variables	P-value	
Citizen Participation	1.00E-02	< 0.05
Identity and Culture	1.00E-03	< 0.05
Economy and Employment	7.00E-10	< 0.05
Education	2.00E-16	< 0.05
Health	2.00E-16	< 0.05
Biodiversity	6.00E-16	< 0.05
Housing and inclusiveness	4.00E-15	< 0.05
Transportation and mobility	6.00E-01	> 0.05
Intelligent Government services	1.00E-08	< 0.05
Energy supply and source	3.00E-15	< 0.05
Water Supply	4.00E-14	< 0.05
Water Waste Management	2.00E-07	< 0.05
Underground electric wiring	9.00E-02	> 0.05
Internet connectivity	2.00E-09	< 0.05
Sanitation	7.00E-02	> 0.05
Safety	6.00E-02	> 0.05
Climate change	7.00E-12	< 0.05

Inference: Table 5 shows the Wilcoxon test with all the variables to be significant (p-value < 0.05) except for transportation and traffic, underground electric wiring, sanitation and safety to be insignificant (p-value > 0.05).

Table 6: Factor Loadings

Variables	Factor Score
Citizen Participation	0.5
Identity and Culture	0.2
Economy and creating Employment	0.5
Education	0.7
Health	0.6
Biodiversity	0.3
Housing and inclusiveness	0.6
Creating Transportation and mobility	0.2
Intelligent Government services	0.7
Energy supply and source	0.7
Water Supply	0.7
Water Waste Management	0.8
Underground electric wiring	0.5
Internet connectivity	0.7
Creating Sanitation facilities	0.3
Safety	0.4
Climate change	0.4

Inference: Table 6 Variables contributing to sectorial prioritisation of Pune city are education (factor score 0.7), health (factor score 0.6,), housing and inclusiveness (factor score 0.6), intelligent government services (factor score 0.7), energy supply and source (factor score 0.7), water supply (factor score 0.7), water waste management (factor score 0.8) and internet connectivity (factor score 0.7).

c) Key smart solution to be created in the city, which can benefit most people with minimum intervention

Table 7: Summary Statistics

Variables	Min	1st Quartiles	Median	3rd Quartiles	Max
Smart Parking	2	4	4	4	5
Ambulance tracking	2	4	4	4	5
Renewal Energy Management System	3	4	5	4	5
Traffic Management	3	4	5	5	5
Sanitation & Solid Waste management	2	4	5	4	5
Hassle free civic services	3	4	4	4	5
Public Transport	2	4	5	5	5
Rain Water harvesting	2	4	5	5	5

Inference: Table 7 presents summary statistics of opinions related to 'Key smart solution to be created in the city, which can benefit most people with minimum intervention.'

Table 8: Wilcoxon Test

Variables	P-value	
Smart Parking	3.00E-06	< 0.05
Ambulance tracking	1.00E-03	< 0.05
Renewal energy Management System	2.00E-08	< 0.05
Traffic Management	5.00E-14	< 0.05
Sanitation & Solid Waste management	8.00E-10	< 0.05
Hassle free civic services	5.00E-08	< 0.05
Public Transport	2.00E-16	< 0.05
Rain Water harvesting	1.00E-10	< 0.05

Inference: Table 8 shows the Wilcoxon test with all the variables to be significant (p-value < 0.05).

Table 9: Factor Loadings

Variables	Factor Score
Smart Parking	0.6
Ambulance tracking	0.5
Renewal energy Management System	0.7
Traffic Management	0.6
Sanitation & Solid Waste management	0.7
Hassle free civic services	0.8
Public Transport	0.7
Rain Water harvesting	0.5

Inference: Table 9 displays variables contributing to 'key smart solutions to be created in the city, which can benefit most people with minimum intervention,' which are smart parking, renewal energy management system (factor score 0.7), traffic management (factor score 0.6), sanitation and solid waste management (factor score 0.7), hassle free civic services (factor score 0.8), public transport (factor score 0.7).

d) Pune is a city rich in biodiversity – showing important aspects

Table 10: Summary Statistics

Variables	Min	1st Quartiles	Median	3rd Quartiles	Max
City surrounded by hills rivers, fertile soils	1	2	3	4	5
Economic growth	3	4	4	4	5
Community	2	3	4	4	5
Environmental pollution and control	1	4	4	4	5
Natural Recourses: conservation and management	1	4	4	4	5
Social issues in relation to development and environment	1	2	3	4	5
Environmental awareness and education	2	4	4	4	5
Parks and gardens	2	4	4	4	5
Water resources	2	4	4	4	5
Commercial places	1	3	4	4	5
Solid waste & Environment management	1	2	3	4	5
Eco-housing concepts	1	3	4	4	5

Inference: Table 10 presents summary statistics of opinions related to 'Pune is a city rich in biodiversity – important aspects.'

Table 11: Wilcoxon Test

Variables	**P-value**	
City surrounded by hills rivers, fertile soils	6.00E-01	> 0.05
Economic growth	9.00E-03	< 0.05
Community	6.00E-15	< 0.05
Environmental pollution and control	6.00E-15	< 0.05
Natural Recourses: conservation and management	5.00E-15	< 0.05
Social issues in relation to development and environment	8.00E-02	> 0.05
Environmental awareness and education	3.00E-03	< 0.05
Parks and gardens	3.00E-02	< 0.05
Water resources	1.00E-03	< 0.05
Commercial places	3.00E-13	< 0.05
Solid waste & Environment management	6.00E-01	> 0.05
Eco-housing concepts	2.00E-13	< 0.05

Inference: Table 11 shows the Wilcoxon test with all the variables to be significant (p-value < 0.05) except for city surrounded by hills rivers, fertile soils, social issues in relation to development and environment and solid waste and environment management (p-value > 0.05).

Table 12: Factor Loadings

Variables	**Factor Score**
City surrounded by hills rivers, fertile soils	0.2
Economic growth	0.4
Community	0.4
Environmental pollution and control	0.7
Natural Recourses: conservation and management	0.7
Social issues in relation to development and environment	0.4
Environmental awareness and education	0.7
Parks and gardens	0.6
Water resources	0.8
Commercial places	0.8
Solid waste & Environment management	0.5
Eco-housing concept	0.6

Inference: Table 12 variables contributing to 'Pune is a city rich in biodiversity – important aspects,' are environmental pollution and control (factor score 0.7), natural recourses: conservation and management (factor score 0.7), environmental awareness and education (factor score 0.7), parks and gardens (factor score 0.6), water resources (factor score 0.8), commercial places factor score 0.8), eco-housing concepts (factor score 0.6).

e) Economic activity important to Pune city

Table 13: Summary Statistics

Economic Activity	Min	1st Quartiles	Median	3rd Quartiles	Max
Service sector	3	4	5	5	5
Education	3	4	5	5	5
Entertainment industry	1	3	4	4	5
Manufacturing	2	4	4	4	5
Tourism including Heritage and culture based tourism	1	4	4	4	5

Inference: Table 13 presents summary statistics of opinions related to 'Pune is a city rich in biodiversity – important aspects.'

Table 14: Showing Wilcoxon Test

Variables	P-value	
Service sector	2.00E-12	< 0.05
Education	1.00E-14	< 0.05
Entertainment industry	3.00E-02	< 0.05
Manufacturing	4.00E-02	< 0.05
Tourism including Heritage and culture based tourism	7.00E-15	< 0.05

Inference: Table 14 shows the Wilcoxon test with all the variables to be significant (p-value < 0.05).

Table 15: Showing Factor Loadings

Variables	Factor Score
Service sector	0.6
Education	0.8
Entertainment industry	0.3
Manufacturing	0.7
Tourism including Heritage and culture based tourism	0.5

Inference: Table 15 shows variables contributing to 'economic activity important to Pune city,' which are: service sector (factor score 0.6), education (factor score 0.8) and manufacturing (factor score 0.7).

Table 16: Aspects of Pune which make Respondents Sad

Variables	Percentage
Traffic	35.19
Lack of transportation	44.44
Others	20.37

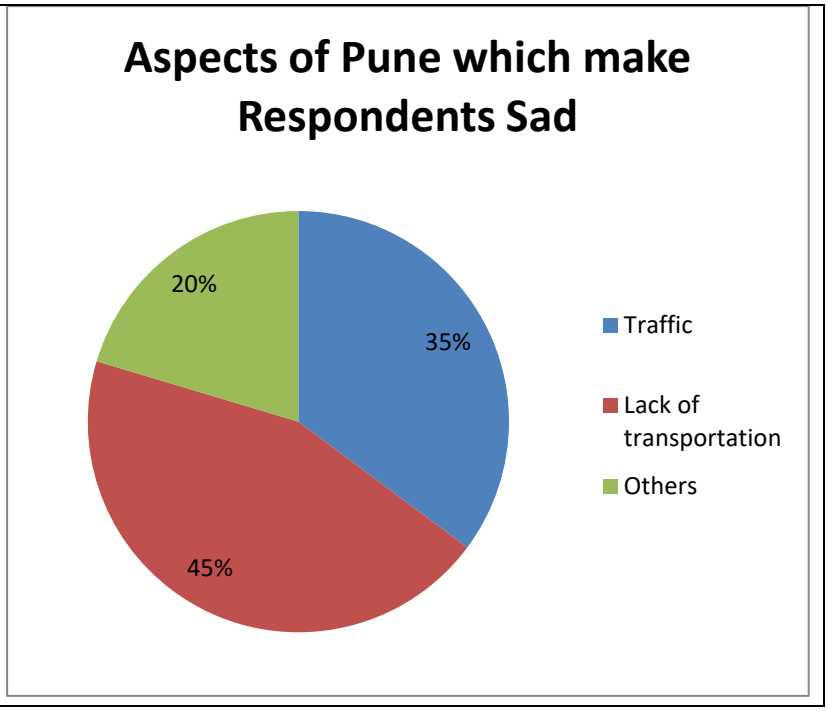

Table 16 reveals the aspects of Pune which makes respondents sad. Respondents had bitter experiences with regard to congestion on roads and lack of transportation. The other variables which affect the respondents are pollution, rains, cleanliness, and corruption.

Table 17: Aspects of Pune which make Respondents Glad

Variables	Percentage
Climate & weather	44.44
Culture and heritage	13.89
Education	7.41
Job Opportunities	6.48
safety	3.70
Transportation	1.85
Others	17.59

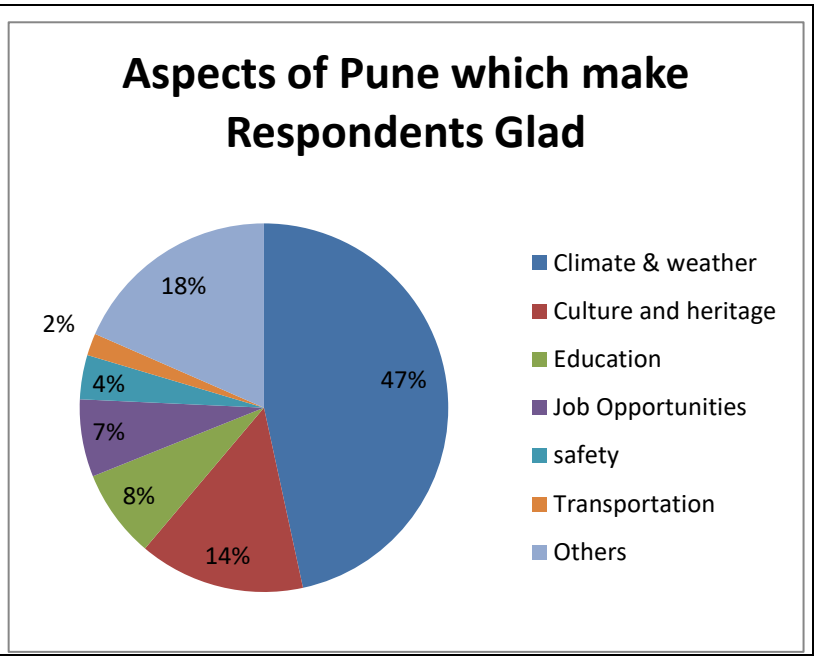

Table 17 indicates the aspects of Pune which make the respondents glad. The majority, 47% of the respondents, are glad about the climate and weather, 14% about culture and heritage, 18% about cab services, food joints, diverse crowd, and others.

Table 18: Aspects to get Pune from Sad to Glad

Variables	Percentage
Enforce traffic rules	20.37
Improve Transportation facilities	39.81
Work on smart city initiatives	25.00
Others	14.81

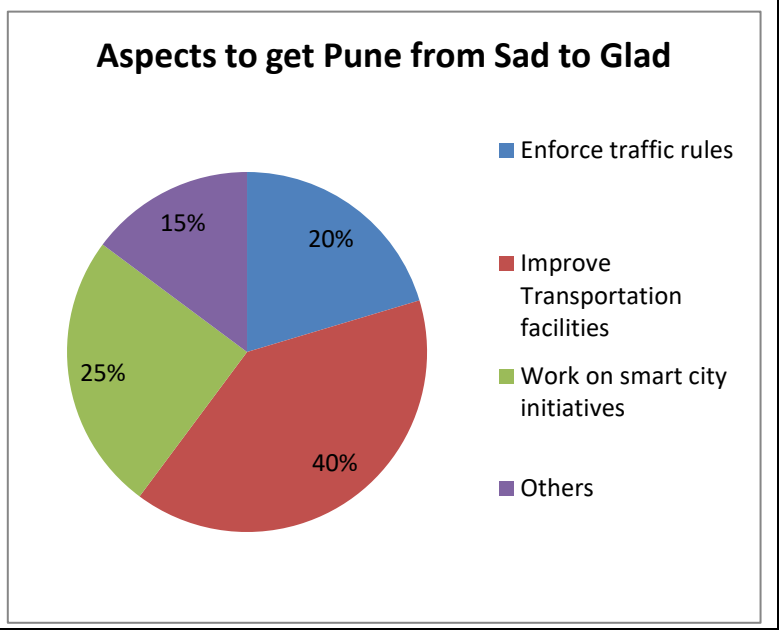

Table 18 highlights the aspects of Pune which the respondents want to make them transform from sad to glad. The respondent's major issue is related to traffic and lack of transportation.

Hence 40% of respondents want to improve transportation facilities, 25% work on smart city initiatives, 20% control of traffic, 15% of respondents want better civic sense, better governance, plantation, cleanliness, and others.

From Tables 15, 16 and 17, it is very clear that respondents are concerned with traffic and transportation. There is tremendous scope to undertake traffic and transportation issues under smart city initiatives.

Table 19: Interpretation of "Smart" in a Smart City

Variables	Percentage
Efficient	4.63
Effective	13.89
Sustainable	52.78
Equitable	21.30
All of the above	7.41

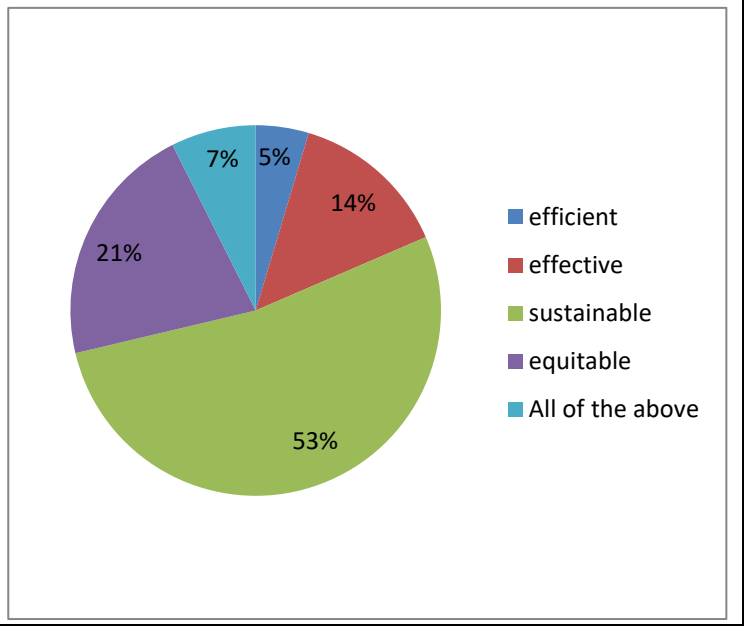

Table 19 highlights respondents' opinions related to SMART in a smart city. The majority, 52.78%, believe that smart means 'sustainable,' indicating "meets the needs of the present without compromising the ability of future generations to meet their own needs," 21.30% feel that smart means 'equitable,' relating it to "fair and impartial," 13.89% think smart means 'effective,' relating it to "successful in producing a desired or intended result," 4.63% link it to 'efficient,' meaning "working in a well-organised and competent way and achieving maximum productivity with minimum wasted effort or expense" and 7.41% relate smart to all variables.

Discussion

It has been observed from the hypothesis testing and data analysis that the concept of smart city is extremely context specific. It highlights that the citizens who are the respondents to the study undertaken understand and perceive the smart city in different connotations. On the basis of parameters that were selected to find out how Pune as a smart city is perceived leads

to the assumption that the majority of the people supported it on account of the educational hub aspect with the P Value P = 1.00E-14 and a factor score of 0.07 @ significance level **α** of 0.05. This shows that the legacy that Pune city is carrying as an educational hub usually referred to as the Oxford of the east is well accepted by the people. Pune is being branded on its uniqueness as an educational hub when compared to other options. Efficiency is one of the key aspects for the economic priority area of the smart city. When considering the efficiency on account of transport, the respondents' reaction was negative, proving that transport and utility services are not the key component on the basis of which Pune city can be rated as a smart city and cannot adopt the increase of the large growing urban population. With the level of significance **α** of 0.05 being the P value 6.00E-02 and at a factor loading of 0.2. it is clear that transport and utility services are grossly overstretched amongst the urban population. This requires the attention of the government and policy regulator to respond to the needs and challenges of transport and urban infrastructure systems. It is the most urgently required service as a matter of citizen concern. Already Pune citizens have witnessed the concept of the Bus Rapid Transport route (BRT). To enhance these services, invite private participants can be invited too through efficient utilisation of existing stock and integrated interventions. Further, Pune's status as a sustainable smart city is because of its unique climate and weather conditions. It has been proved by the hypothesis at the level of significance **α** of 0.05 being the P value 7.00E-12 with a factor score of 0.4 under the sectoral prioritisation of Pune city and the factor score is 0.5, as a unique feature of Pune. Respondents strongly agree on the fact that its climatic conditions are favourable, as they all experience the monsoons that increase the quality of a healthy life.

On account of the sustainability of Pune city in relation to its heritage and culture, respondents approve on the fact with the hypothesis being tested at the level of significance **α** of 0.05 its P value 7.00E-09 as a unique feature 1.00E-03 for sectoral prioritisation with a factor score of 0.2. Respondents strongly agree and support the fact the Pune is rich in its heritage and culture. Those cities that are sustainable are so only because they are able to retain their sustainable development of historic and built heritage in urban areas and acquire an incomparable status in modern culture and in modern life. Being a historical place, Pune has acquired high acclaim for heritage-based sustainable development. The environment and landscape attract people to migrate from rural to urban areas. In case of Pune, it also has the natural flair of environment and its landscaping surroundings. With a given level of significance **α** of 0.05 with P value of 8.00E-07 the respondents strongly agree on the fact that Pune is a smart city due to its natural environment and beautiful landscape. The major findings support that Pune`s effectiveness in being a smart city is on account of its educational hub, sustainability due to its heritage and culture, and its climate and weather conditions and environment being viable and apt for awarding it as a smart city. The perception that Pune is a smart city has been proved with the help of the proven hypothesis

of this research. The study can be deliberated further analysing the cross tabulations on various parameters identified.

Conclusion

It can be concluded that the smart city doesn't have any one common definition, in theory or practice. The perception about the same differs from individual to individual. Pune city is an economically vibrant and sustainable city from the dimensions of commercial viability, heritage and culture, climate and weather conditions and improving infrastructure for utility services. It is a stride towards unifying several facets associated with smart cities that has led to the foundation for creating a smart city. These varied dimensions are differently perceived by different people, whereas their motives behind their perceptions are only how to make the city a smart city for better living and improving the quality of life. Eventually, under the Government of India mission of smart cities, Pune will take strides in reaching the expectations of all the stakeholders through leveraging technology, good governance and sustainable development.

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