Achieving Sustainability in Smart Cities Mission in India through Universities' Innovation in India

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Abstract

Background. As per the global trend, the Government of India has also designated 98 cities in India as smart cities to manage them more efficiently with technology. While the definition of Smart City is ambiguous and evolving, the UN's Sustainable Development Goal -11 talks about making cities and human settlements inclusive, safe, resilience and sustainable. The preventive methods during the pandemic COVID-19 have used technology for better implementation of the lockdown as Drone surveillance, work from home, e-teaching, e-meeting etc.

Objective. In this background, objectives of the paper are:

Research Methods and Data. A mixed method has been used. Spearman's Rank correlation has been calculated for first and second objectives on NITI Aayog, Department of Science and Technology and Government of India data. Descriptive statistics and case study method have been used for third and fourth objectives on primary data.

Findings. The paper through Spearman's Rank correlation shows that economically developed states of India may not be sustainable and even all innovation may also not be sustainable. So, there is a need for special attention for sustainable innovation for the Smart Cities. Continuous demand for such innovative technologies can be met by innovation at engineering colleges. India has experienced an exponential growth of engineering colleges during last three decades. However, from the study of engineering colleges of Delhi, it can be said that so far they are not concentrating their innovation for the development of smart cities. They need to take clue from the 'living lab' experience of Barcelona where engineering colleges and universities are playing a central role in the framework of the smart city. There is a need to sensitise these colleges and their students regarding technological needs of the smart cities. At the same time, they need to know about the special needs of marginalised groups of people and women for their safety and security etc. Like Unnat Bharat, a flagship programme of the Ministry of Education, the engineering colleges can work on the development and dissemination of social innovation under their university social responsibility (USR) initiatives. The institutions need to collaborate with other institutions and organisations to integrate their work with the CSR of the corporate sector and social sector activities of the government to achieve SDG Goal 17 of collaboration. These will ultimately help in achieving SDG 8 and 10 as will reduce inequality by creating decent work which will ultimately lead to economic development of the people in the lower segment of the smart cities.

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1. Background

Today, about 55% of the world population lives in urban areas and it is expected to grow to 68% by 2050 which will be highly concentrated in few

countries, with India leading the list with projected addition of 416 million urban populations (UN, 2018). Consequently, urban areas are going to be an engine of growth for India. Experiencing unplanned development of peri-urban areas and the daunting task of managing the urban areas, the Government of India, following the global trend, announced ninety-eight (earlier 100 but two could not materialise) cities being part of the Smart City Mission of India. (GoI, 2015). At the same time, India along with 192 other countries of the world are striving to achieve Sustainable Development Goals (SDGs) of the United Nations by 2030. There are seventeen goals and many of them have implications for urban settings, however, the Sustainable Development Goal 11 is aligned with the sustainable cities and communities. The cities need to provide opportunities for all, with access to basic services, energy, housing, transportation and more (UN, 2015) which are very similar to the core infrastructure elements of the Smart Mission of India (GoI, 2015). Consequently, the Smart Cities need to be sustainable along with being smart and efficient, for which they will require continuous technological upgradation. At the same time, India along with the whole world has recently experienced pandemic COVID-19 not only as a health crisis but has also experienced very severe economic and social consequences. Millions of people lost their jobs and had to go back to their villages as a safety net. The business ecosystem was disrupted but the new eco-system which emerged, has enhanced the process of Industrial Revolution 4.0. India's large engineering education system has huge potential for innovation. In this background, the paper discusses the role of universities for achieving sustainable Smart Cities in India. The second section of the paper discusses the status of the Smart City of India. The third section reviews available literature on Smart City Mission in India, Sustainable Development Goals, COVID19 and role of engineering colleges in developing sustainable technology. The objective and methodology of the paper has been discussed in the fourth section. The analysis has been given in the fifth section and the last section concludes the discussion and provides suggestions.

2. Smart City Mission in India

Cities have been the engines of economic growth since the First Industrial Revolution. Smart cities are now emerging equipped to face the challenges of 21st century. The definition of a "smart city" is ambiguous and evolving. It has been kept open to capture variation between and within countries. However, to use urbanisation as an opportunity to achieve efficiency, the smart city is supposed to be driven by innovation and entrepreneurship as per the growing business needs.

As India is experiencing large migration from rural-to-urban and from second tier-to-metro cities, urban planners and policymakers are under pressure to deal with issues, such as, vehicular pollution, ageing infrastructure along with generating housing, transport facility, skilling and employment for a very large population, which is vertically segmented on the basis of capacity and income. As per the global trends, the Central Government adopted the idea of 'smart cities' in 2014, a concept, which intends to manage urban area with advanced technology like information and communication technology (ICT), Artificial Intelligence, sensors, etc., to ultimately, enhance economic growth, better governance and, improved quality of life. The total number of 98 Smart Cities was based on the formula of giving equal weightage (50:50) to urban population of the State/UT and the number of statutory towns in the State/UT but at least, one SC was made in all states and union territories (GoI, 2015).

There are four pillars of urban eco-system i.e. institutional, physical, social and economic and under smart city mission, these were intended to improve through layers of modern technologies. Given the fact that cities comprise a higher component of young population, capacity building among the young population of marginalised group (residing in slums) has been given emphasis under Kaushal Vikas Yojana (Skill Development Programme) so that they are able to integrate themselves with the labour market requirement of the smart city.

3. Review of Literature

Review of existing literature has been done in four sections namely, Smart City, Sustainability and Sustainable Development Goals (SDGs), COVID-19 and Emerging Issues in City Planning, and role of university in development of the Smart City.

3.1. Smart City- definition, social, economic and environment

A Smart City addresses the issue of management of rapid urbanisations through the latest technology as Information and communication technology (ICT), sensors, artificial intelligence, internet of things (IoT) etc. (Charbel, 2013; Bakici et.al., 2013; Hall, 2000). Parishwad (2014) has discussed that though there are various stages in the development of Smart City like ad-hoc, Opportunistic, Repeatable, Managed and Optimised, Smart Governance

(Participation) which emphasizes public participation in decision-making to ensure transparency in the governance is basic and crucial. Again, maintaining competency among people across gender, income, caste and class through flexibility, life-long learning, creativity, open-mindedness and opportunity, is crucial to enables them to participate in public life and enable them for optimal contribution in the economy to maintain competitiveness. Availability and accessibility of internet infrastructure as well as sustainable, innovative and safe transport systems are prerequisite for a Smart city. An attractive natural conditions, pollution free environment, environmental protection and sustainable resource management are last but definitely, not the least factors. However, without availability of cultural facilities, improved health conditions, and education facilities with social cohesion Smart City may not be sustainable (Parishwad, 2014). The smart cities agenda in India has emerged to transform urban area for development and growth. Reviewing policy documents and statements in combination with selected key stakeholder interviews, Hoelscher (2016) traces the emergence of the smart cities discourse in India, suggesting that the vision and concept of the smart city has shifted over time and has been evoked in different ways to serve different purposes. Overall, the smart cities agenda in India appears to be characterised by a failure to conceptualise and develop an integrated set of policies (Hoelscher, 2016). Gupta et. al. (2017) has given an insight into how smart cities are likely to evolve in India, by studying the priority areas considered in planning smart cities. The paper presents both the citizen and city official perspectives of smart cities. The results indicate that citizens value living, followed by mobility, environment, governance, and economy, whereas the city officials prioritise living, followed by environment, economy, mobility, and governance. The analysis also reveals how city size influences the priorities of citizens and city officials, indicating that the notion of a smart city in India may be context specific. This research further evaluates the titles of planned smart city projects to determine how many of them can be categorised as smart. It's also hoped that new smart cities will bypass the developmental "crises" (such as crime, poverty, energy shortages and slums), which grip mega-cities in the global south (Gupta at.el. 2017).

As eighty per cent of the world's gross domestic product is generated in cities, urban citizens earn on average three-times the income of their rural counterparts. Cities have a concentration of universities which are critical venues of research and innovation, political activism and cultural exchange. As per research finding, a city of eight million has 15 per cent more productivity, e.g. wages and patents produced per capita, and 15 per cent fewer infrastructure needs, e.g. gas stations, electric wires and roads, than do will two cities of four million each. (Estevez et. al. 2016). However, scratch the surface, and a very different picture emerge. The smart cities mission is promoting rapid regional urbanisation by acquiring land which belongs formally or informally to farmers and tribal people, who have used it for generations. Crucially, the monetised transformation excludes those who do not fit the vision of a smart city (Datta & Dave, 2016). Blaming globalisation for investment in India's metropolitan cities (cities with million-plus population) and their neighbourhoods during the nineties, Shaw (1999) has indicated the growth of urban cores of high investment and the virtual bypassing of the remaining metropolises. On the basis of the growth patterns of the 23 metropolises, she has discussed widening of interregional economic disparities (Shaw, 1999). Aijaz of Observer Research France has given detailed areas of concern in case of establishment of a smart city in India as informal growth of peri-urban areas, social exclusion of poor and marginalised section or slum dwellers (Aijar, 2016). On the basis of the experience of Hyderabad Smart City, Kummitha suggests that effective planning is not enough but the complete eco-system needs to be created with enough room to incorporate suggestions of all stakeholders (Kummitha, 2019).Jennifer (2017) has discussed that the political authority must plan effectively to combat issues of the structural causes of urbanisation and rural distress as poverty and improved quality of life in expanding urban areas (Jennifer, 2017).Transformation of a city to Smart does not happen instantly. Strategic Development is required which needs an understanding of the issues and challenges for the particular city. In this regard, Tiwari and Jain (2014) have discussed Lavasa as an Indian Smart City, which is efficient but exclusive and may have repercussion. Vanolo (2014), in presenting a theoretical reflection and smart city politics of Italy as a case study, believes that the smart city discourse may prove to be a powerful tool for the production of docile subjects and mechanisms of political legitimisation. It analyses how the smart city discourse proposed by the European Union has been reclassified to produce new visions of the 'good city' and the role of private actors and citizens in the management of urban development (Vanolo, 2014). Cocchia (2014) provides a detailed review of existing literature on Smart and digital city in the west. Leading smart cities such as Stockholm, Barcelona, New York, Vienna, and Toronto have incorporated efficiency into buildings, infrastructure, and social spaces using technological advancements, increasing the livability, workability, and sustainability of these places.

Cities worldwide are realising the power and importance of their role in global SDG achievement. Smart Cities are the result of the growing importance of orienting people's life towards sustainability. With this in mind, Easy Park ranked 100 cities around the world based on 19 different factors, from business ecosystem, car sharing services, citizen participation in elections, clean energy, digitalisation of government, level of education, environment protection, internet speed, living standard, public transport, smart building, smart parking, smartphone penetration, traffic congestion, urban planning, 4G LTE, wifi hotspots, and even waste disposal (Dhiraj, 2017; Easy Park, 2017, Smart Cities Library, 2017). To create the final score, they have ranked the raw data from highest to lowest value and then they have awarded a standard score based on their ranking in the following manner:

$$\text{Score}_i = 1 + 9 \left(\dfrac{x_i - x_{\min}}{x_{\max} - x_{\min}} \right)$$

Final Score$_i$= 25% Transport and Mobility$_i$ + 12.5% Sustaiability$_i$ + 17.5 % Governance$_i$ + 2.5% Innov. Economy$_i$+ 17.5% Digitisation$_i$+ 10% Living Standard$_i$+ 15% Expert Perception$_i$

Forbes has also ranked Smart cities. Elgazzar and El- Gazzar, 2017 have mapped five smart cities on the basis of variables as specific goal, measurable, achievable, relevant and time-bound and then they have tried to see that whether there is any correlation between the smart city and sustainable city (Elgazzar and El- Gazzar, 2017). Coming to Indian states, Panda et. al. have discussed a composite index for Urban Social Sustainability on the basis a three-tiered hierarchical model of Odisha. The model can be applied to all Indian cities with contextual changes. The dimensional index score and thematic index score obtained from the model helps in benchmarking the cities and identifying gaps so that it can inform national policy and planning. The social sustainability index has been developed with variables as demography, education, health, equity, housing, poverty, safety and access to basic services, which may help in making a well-informed judgement in the allocation of resources (Panda et. al. 2016).

3.2. Sustainability and Sustainable Development Goals (SDGs)

The term 'sustainability' can be traced to The Ecologist's A Blueprint for Survival, published in 1972, which may be considered as the take home of the UN's Stockholm Conference in 1972 and international treaties environmental which followed the conference. One such treaty which must be mentioned is the Brundtland Commission of 1987. It defined sustainable development as 'development which meets the needs of the present, without compromising the ability of future generations to meet their own needs'. The Bergen Declaration on Sustainable Development of the European Union (EU) in 1990 emphasise on the precaution for scientific endeavour and it must be taken care that serious or irreversible damage does not take place in any of such human activity. The Earth Summit in 1992 established 'sustainable development' as the most important policy of the 21st century. 'Sustainability' is at the heart of the Rio Declaration on Environment and Development and Agenda 21, accords signed at the Earth Summit that herald a new paradigm of society, economics and the environment. The EU's Fifth Environmental Action Programme (1993) pursues 'sustainability' in industry, energy, transport, agriculture and tourism. 'Sustainability' has also been endorsed by the Clinton Administration (1994). Following these events, 'sustainability' has now become one of the prime objectives of study in almost all disciplines of study as urban planning, development studies, economics, sociology, engineering, ethics etc. Far from being a mere aspect to study development science, today 'sustainability' has become tantamount to a new philosophy and a universal methodology for evaluating human options for decision making (Basiago Andrew D., 1995). Manfaredzadeh and Krueger (2015) have discussed sustainability as an established goal for urban development to address issues associated with negative environmental externalities (Monfaredzadeh and Krueger, 2015). Estevez et. al. (2016) have discussed that people living in larger cities tend to have a smaller energy footprint, require less road and communication infrastructure, consume fewer resources, and have higher productivity levels. Smart Cities have emerged as one response to the challenges and opportunities created by rapid urbanisation. The IDRC funded study conducted by UNU-EGOV on "Smart Sustainable Cities – Reconnaissance Study" has examined whether Smart Cities advocates sustainable development on the basis of 876 scientific publications, recommendations from 51 think-tank organisations and 119 concrete Smart City initiatives. Researchers also conducted several interviews with city managers, planners and researchers responsible for successful Smart City initiatives (Estevez, 2016). They judgement is for Sustainable Smart Cities. In India too, sustainability is being given important consideration to evaluate any project. The NITI Aayog of India has ranked all states of India by developing index for all SDGs and has also made a combined index (NITI Aayog, 2018).

3.3. COVID-19 and Emerging Issues in City Planning

During COVID-19, countries have taken unprecedented and drastic measures to contain the spread of the virus by closing towns, cities, and national borders, disrupting the business ecosystem around the world (SMEFF, 2020). Over a period of fewer than two weeks, since it was officially declared a pandemic by WHO, COVID-19 disrupted lives and economies around the globe. According to a briefing issued by the United Nations Department of Economic and Social Affairs, the COVID-19 pandemic will likely shrink the global GDP by almost one per cent in 2020 (Dung, Thi Bich and Tho Trần Bá, 2020). However, precaution during COVID- 19 has shown a way of life which is very much aligned with the concept of Smart City. Findings of a joint research project on manufacturing trends, ABI and Nokia reveals that post-Covid-19 traffic levels will be only 80 to 90 percent of the pre-COVID-19 as people are finding digital lifestyles more convenient usually through initiatives such as e-Home, e-Office, e-Government, e-Health, e-Education and e-

Traffic etc. These initiatives may be used to create a common framework to enhance city's performance. Management of COVID-19 is a "laboratory type learning experience" for taking advantage of the inherent flexibility of technologies to handle emergency situations. The demands of social distancing and implementation of complete lockdown as preventive measure for COVID-19 has shown to the corporate sector that Industrial Revolution (IR) 4.0 has to be implemented more aggressively. Enterprise Digital Transformation through IR 4.0 finds that three-fourth of respondents are looking to upgrade their communications and control networks by the end of 2022 while 90 per cent are investigating probability to use either 4G and/or 5G in their operations (Smart City World News, 2020).

3.4. University and their Role in Maintaining Smart City

Discussing Barcelona's smart city model, Bikici et. al. (2013) have discussed proactive engagement and collaboration of public and private organisations along with universities in developing a smart city. Cities should base their Smart City models on three main pillars—infrastructure, human capital and information. The most remarkable experiment is of 'Living Labs' which have been used as tools and processes for the creation of user innovation cooperatively in real-life environments. It is employed for learning, conducting tests and research for the implementation of new technologies and services of organisations in large-scale real-life environments. As a promising method, living labs not only provide benefits like product improvements but also foster innovation and give insights for future markets while lowering risks (Bikici et.al., 2013). From Italy, India, the U.S., Russia, Japan, Pakistan, Tanzania, South Africa, and Canada, Stansbury (2015) has discussed nine cases of higher educational institutions alignment to the needs of "smart cities of the future". The authors explain the concept of a smart city as any city utilising technology as a critical enabler to solve rising urbanisation issues and improve the cities' environments according to a set of priorities. Smart cities are currently thriving which include those in Barcelona, Chicago, Amsterdam, Stockholm, and Yokohama, as well as in India. However, the only chance for a smart city's success, note the authors, is to ensure that its citizens are motivated, and enabled, to be a driver for these innovations. This motivation hinges on businesses' and academia's willingness and readiness "to modernize their approach to the citizen's inclusion and immersion in education and services in the fast changing conditions of the global market;" specifically, in developing collaborative and tech-based skills. In Italy, the universities facilitate career path developments, tailoring training programs and designing competency management for smart city institutions and organisations. Institutions are working for developing citizens' competencies through informal learning by applying effective semantic-based tools for information, discovery and knowledge sharing. In India, preference is given on multiple choice questions in educational assessment and active learning toward enhancing the conceptual understanding of students which could lead in the development of next-generation graduates and a skilled workforce. The U.S. advocates a learning model in which university students work as co-creators of a community infrastructure asset information through an integrated network of community stakeholders. These students help in solving issues of disasters like hurricanes and storms using geospatial information systems and a learning design model where students are co-creators of value to cities. A network of internationalised universities in Russia helps in revitalisation measure for a city which is facing instability in improving the urban performance and reduces political and social risks. The Digital Signage Project of the Kanazawa Institute of Technology (KIT), Japan combines project based learning and on-the-job-training initiatives to teach digital skills, specifically within digital signage, and produce digital multimedia presentations to engage the city's audience. Social media may be used in Pakistan, as a tool for e-learning. As social media has become a driver for growing educational needs, it is being used to provide quality informal education to all citizens regarding smart city concept. Higher educational institutions in Pakistan harness Facebook to improve students' academic performance through facilitating communication between students and faculty and so, support the development of social capital and user-generated content. In Tanzania, mobile-based systems have been discussed for cost-effective e-learning content delivery in resources, which reduce the dependence on internet connection and a fully operational technology infrastructure. In the University of Cape Town, South Africa, researchers focus on sustainable development in a research and learning agenda, exploring the link between smart buildings and an intelligent community, employing the University as a case study and serving as a best practice example for urban development in Cape Town. In Canada, researchers demonstrate the complexity of smart city ecosystems and urban development, and offers a debate on health-care management practices and proper involvement of people in the decision, management, and design procedures With these papers, Klett and Wang hope to facilitate towards the adaptive implementation of the smart city concept with support of higher education, in order to "advance the educational landscape and the employment conditions of tomorrow's smart workforce by improving human, learning, work, and live performance in a smart city setting". So far, smart city has been ranked as defining "Smart City" in a "technological" rather than "intelligence" sense. Realising the importance of universities in innovating technology for the smart city, Singh (2019) has examined the preparedness of engineering institutions of Delhi, India regarding Smart City and found that the Smart City mission is seen as a project of the government and it is not being seen as an innovation challenge for engineering institutions.

3.4. Research Gap

In nutshell, a smart city will use latest technology to manage the city smartly. As engineering colleges are hotbed of innovation and Europe have shown the way by the concept of 'living lab' that keeping university at the centre of the smart city eco-system will ultimately, fetch the efficiency. Thus, any city can be transformed to a smart city. However, not much study has been done on engineering colleges- smart city collaboration for innovation.

4. Objective of Study and Methodology

In this background, the paper tries

1. To investigate whether the economically developed states of India are sustainable also?
2. To examine whether the innovative states are sustainable?
3. Are engineering colleges innovating for smart city mission of India? and
4. How to include slum areas in the smart city?

A mixed method has been used. The NITI Aayog of India has development index for all 17 Sustainable Development Goals and a composite goal on which all states and union territories of India have been ranked (NITI Aayog, 2018). It has been used as a base and has been modified as per requirement. The State Innovation Index developed **by the Institute for Competitiveness** has also been used. The SDG No.11 is about making cities and human settlements inclusive, safe, resilient and sustainable. To discuss SDG 11, the index of NITI Aayog uses four indicators given in the Table 1.

Table 1. Indicators for the SDGs- 11- Sustainable Cities and Communities

SN	Indicators
1.	Household completed under PMAY as a percentage of net demand and assessment of houses
2.	Percentage of urban households living in slums
3.	Percentage of wards with 100% door-to-door waste collection
4.	Percentage of waste processed

Source: NITI Aayog, 2018, p. 137

Spearman's Rank correlation has been calculated for first and second objectives on NITI Aayog, Department of Science and Technology and Government of India data. For first objective, Spearman's Rank Correlation Coefficient has been calculated with states ranking on the basis of index of SDGs and Per Capita State Domestic Product (SDP) (in Rupees - 2013-14). Data for year 2013-14 has been used as the state-wise information was available for maximum states. The logic for the first objective is see the correlation between index and economic development as economic sustainability comes first whenever sustainability is discussed.

Though experts are of divergent view on the definition of smart city, however, all are unanimous that it will have applications of latest technology for enhancing efficiency. In the previous section on review of literature, experience of 'living lab' of Barcelona has been discussed. The SDG No 9 is about building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation. The index developed by the NITI Aayog uses four variables given in the Table-2.

Table 2. Indicators for the SDGs- 09: Industry, Innovation & Infrastructure

SN	Indicators
1.	Percentage of Targeted habitations connected by all-weather roads under Pradhan Mantri Sadak Yojana (PMSY)
2.	Number of mobile connections per 100 persons in rural and urban areas (Mobile Tele Density)
3.	Number of Internet Subscribers per 100 population
4.	Percentage of Gram Panchayats covered under Bharat Net

Though, none of the variable of the index considers innovation but, emphasises more on the infrastructure. However, the infrastructure has very high correlation with SDG achievements. Correlation between ICT and 4th, 3rd, 9th, 5th, 11th & 7th Sustainable Goals are 73%, 71%, 65%, 51%, 41% and 16%, respectively (Huawei, 2018). For discussing the second objective, the spearman correlation has been calculated for the Index of SDG09 and State Innovation Index developed by the Institute for Competitiveness.

To investigate the third objective of the paper, research of Singh (2019) on Universities involvement with smart city has been used for giving university perspective. She has scanned the internet platform to find out opportunities for innovation at the engineering institutions or among engineering students. Finding of the study done by her (2019) with second year B.Tech. students of Delhi Technological University has also been used (Singh 2019) has been used to evaluate the fourth objective.

5. Analysis

The economic aspect is very important and it is perceived that sustainable urban setting will have higher income and economic prosperity. The NITI Aayog has ranked all the states as has been discussed below, according to the index for SDG11 which is about sustainable cities and communities.

5.1.

On the basis of index of SDG-11 developed by the NITI Aayog, only Goa has come in the category of front runner with 71 points, Sikkim (56), Chhattisgarh (54), Gujarat (52) and Jharkhand (52) are the sates which are considered as performersalong with Andaman and Nikobar Island (64) as union territory in the same category. All other states and union territory have scored less than 50 and have come under the category of Aspirantswith Jammu & Kashmir (23) securing the lowest score among states and Dadar & Nagar Haveli (06) among Union Territory. However, when they are compared through Spearman's rank correlation with the ranked states based onPer Capita State Domestic Product (SDP) (In Rupees) - 2013-14 (Table- 3), the correlation has been found very low (0.144499).

Table 3. States were ranked on the basis of Index for SDG11 and Per Capita State Domestic Product (SDP) (In Rupees) - 2013-14

SN	States	Index of SDG-11	Ranking on the basis of SDG11	Per Capita State Domestic Product (SDP) (In Rupees) - 2013-14	Ranking on the basis of per capita SDP
I	II	III	IV	V	VI
1	Andhra Pradesh & Telangana	35	12	98930.8	16
2	Arunachal Pradesh	44	22	91086.79	14
3	Assam	32	8	51570.6	4
4	Bihar	43	21	36456.05	1
5	Chhattisgarh	54	26	66400.54	6
6	Delhi	39	16	229911.9	28
7	Goa	71	28	207269.2	26
8	Gujarat	52	25	127276.2	21
9	Haryana	30	5	148205.9	24
10	Himachal Pradesh	41	20	117279.7	19
11	Jammu & Kashmir	23	1	72188.65	8
12	Karnatka	26	3	97385.89	15
13	Kerala	46	24	114012.7	18
14	Madhya Pradesh	39	17	59997.58	5
15	Manipur	31	6	45862.18	3
16	Meghalaya	39	18	77066.88	11
17	Maharashtra	34	10	136013.5	23
18	Nagaland	32	7	77981.11	13
19	Odisha	34	11	66522.26	7
20	Pudducherry	27	4	161934.1	25
21	Punjab	36	13	105156.5	17
22	Rajasthan	45	23	72802.63	9
23	Sikkim	56	27	210810.5	27
24	Tamil Nadu	33	9	124132.8	20
25	Tripura	38	15	73813.16	10
26	Uttarakhand	41	19	129021.3	22
27	Uttar Pradesh	37	14	42249.83	2
28	West Bengal	25	2	77280.69	12

Source: Statistics Times' 2015 for the Per Capita State Domestic Product (SDP) (In Rupees)-2013-14 NITI Aayog, 2018, p. 138 for index of SDG11.

It may be inferred that the states which are higher ranked on SDG 11 are not economically higher ranked also. However, efforts need to be made for urban area to be economically sustainable too and eventually, innovation comes to focus. There is need to emphasise sustainable innovation demarked it from just innovation.

5.2 To further emphasise, the states which have been ranked on the basis of SDG 09 has been correlated with the ranking of the states on the basis of innovation index (Table 4). Only Puducherry (100) and Delhi (100) have been categorized as Achiever. The states and union territory whose SDG index

Table 4. States Ranked on the basis of Index for SDG09 and State wise Innovation Index

States/ Union Territory	INNOVATION INDEX	Rank	SDG09	Rank
I	II	III	IV	V
Andhra Pradesh	26.73	16	31	10
Arunachal Pradesh	26.69	15	16	5
Assam	21.72	6	35	13
Bihar	14.12	2	38	15
Chhattisgarh	19.1	3	30	9
Delhi	42.88	30	100	30
Goa	36.45	26	0	3
Gujarat	30.47	22	65	27
Haryana	26.86	17	50	23
Himachal Pradesh	30.1	21	43	18
Jammu & Kashmir	25.03	13	35	14
Jharkhand	12.97	1	47	21
Karnataka	35.07	24	57	25
Kerala	36.36	25	68	28
Madhya Pradesh	22.28	8	27	7
Maharashtra	37.84	27	53	24
Manipur	23.41	11	72	29
Meghalaya	19.44	4	42	17
Mizoram	30.87	23	0	2
Nagaland	21.9	7	0	1
Odisha	19.79	5	32	11
Punjab	27.18	18	48	22
Rajasthan	23.71	12	62	26
Sikkim	28.15	19	1	4
Tamil Nadu	42.56	29	46	20
Telangana	26.22	14	16	6
Tripura	22.86	10	38	16
Uttarakhand	22.35	9	33	12
Uttar Pradesh	38.5	28	29	8
West Bengal	28.75	20	45	19

Source: NITI Aayog, 2018, p. 114 for index of SDG 09 and State Innovation Index 17, institute of Competitivenessfor Index of Innovation

are between 65 to 99 as Manipur (72), Kerala (68) and Gujarat (65) as states and Chandigarh (76) as union territory have been kept in the category of Front Runner. Rajasthan (62), Karnatka(57), Maharashtra (53) and Haryana (50) are Performer (64-50). Rest are having score below 50 and they have been considered as Aspirant with Goa, Mizoram, Nagaland, Daman & Diu and Lakshadweep who are having zero score. Here also, the Spearman Rank Correlation between the SDG09 index with state Innovation index and the correlation has been found low (0.233815). Therefore, the innovation will not be automatically sustainable but need to be planned to be so.

5.3. Role of Engineering Colleges in Innovating for Smart Cities in India

As per the Global Innovation Index (GII) 2018, India has gained the 6th spot globally in number of graduation in Science and Engineering and 57th in terms of innovation which is up three places from 2017 (GII, 2018). National and International programmes which has been initiated in India have been discussed below:

5.3.1 National programme of Smart City

The University Grants Commission (UGC) has issued a statement to all universities and colleges affiliated to it to start programmes on urban planning as a subject (UGC, 2016). Following the line, Graduate School of Smart Cities Development at Gujarat Technological University, Ahemdabad has started eight e-coursesinone semester course on Smart City. These courses are dealing with different aspect of sustainable smart cities (Gujarat Technological University, 2019). The Ministry of Human Resource Development has initiated Smart India Hackathon 2019. It will provide students across the country a platform to solve some of pressing problems faced by citizen's in their daily lives, and thus, inculcate a culture of product innovation and a mindset of problem solving. The last edition of the hackathon saw over 5 million+ students from various engineering colleges compete for the top prize at 35+ locations. Winners were awarded also Rs 1 lakh, Rs 75,000 and Rs 50,000 (MHRD, 2019). Federation of Indian Chamber of Commerce and Industries (FICCI) organised Smart Cities Summit on February 22' 2019 (FICCI website, 2019)

For technical manpower at the lower segment, the Ministry of Skill Development and Entrepreneurship has several programmes of skill up gradation and innovation such as Pradahan Mantri Kaushal Vikas Yojana (PMKVY), Sankalp, Udan, Star, Polytechnic scheme and vocationalisation of education (MSDE, 2019).

5.3.2. International Programmes of Smart City

To explore the issues, innovations and integrated approaches towards **environmental** sustainability, Conference Series was initiated annually in the fields of Recycling, Green Energy, Pollution Control, Climate Change, Coastal Zone Management, Oceanography, Global Warming etc. Environmental Science Conferences provides a unique platform of eminent Professionals, Scientists, Researchers, Academicians, and Entrepreneurs across the globe to participate and share their research advancements and new technologies. Conference Series organizes 1000+ Conferences every year across USA, Europe & Asia with support from 1000 more scientific societies and Publishes 700+ Open Access Journals which has reputed scientists as Editorial Board Members (Conferenceseries.com, 2019). European innovation partnership on smart cities and communities (EIP-SCC) is a programme of the European Commission that brings together cities, industry, small business (SMEs), banks, research and others. It aims to improve urban life through more sustainable integrated solutions and addresses city-specific challenges from different policy areas such as energy, mobility and transport, and ICT (European Commission, 2019). The Department of Science and Technology (DST) and IC-IMPACTS, Canada have invited a collaborative research project proposal on Cyber-Physical Systems to support Green Building in Smart Cities (IC-IMPACTS & DSR, 2019).

5.3.3. University level Programmes on Smart City

Indian engineering education has experienced exponential growth in recent time. During 2018-19, there were 3,779 engineering colleges in India at Diploma level with an intake capacity of 11,24,974 and 3,242 institutions which include M.Tech and B.Tech level with intake capacity of 15,87,048 (AICTE, 2019). However, at the college level not much work is being done. Even though, the National Assessment and Accreditation Council (NAAC) gives due importance on research and out of seven criteria on which institute is evaluated, one criteria is research, consultancy and extension (25%) (NAAC, 2019). However, on the basis of study of engineering colleges in Delhi, Singh (2019) has discussed that engineering colleges are not very much involved with smart city mission of India except the Indian Institute of Technology (IIT). The IIT Delhi is ready to play a significant role in Indian Smart Cities as the current IIT Delhi campus may become a model project and by integrating their various emerging research, technology and expertise available in-house (DigiAnalysis, 2018)

Table 5. Programmes of Smart City organised by Engineering Colleges of Delhi, INDIA

Sl. No.	Name of the College	Name of the programme	Date
3.	Bharati Vidyapeeth's College of Engineering	1. International Conference on Renewable Energy Potential for Sustainable Initiatives	February 8 – 9' 2018
		2. National Seminar on Renewable Energy Potential and Status in INDIA	November 9' 2016
6	Delhi Technological University	1.. Smart India Hackathon 2019	February 14' 2019
		2. Resilient Power Grid Operation Using Synchrophosor Technology: A Smart Grid Operation Perspective	December 17-21' 2018
		3. Workshop On Power Electronics in Smart Grid and Optimal Power Trading Mechanism	November 3' 2018
		4. International Workshop On Networking of Technology and Education for Sustainable Development	October 12' 2018
		5. Workshop on Adobe spark under 'Digital Disha Programme'	October 3-4, 2018
		6. Three day's Workshop on Electronic Waste Management	August 28- 30' 2018
		7. 34th National Convention of Environmental Engineers & National Seminar on Environmental Pollution and Climate Change	August 10-11, 2018
		8. TEQIP-III Sponsored Faculty Development Programme on Emerging trends on Internet of Things (IOT) and Cyber Security applications in Smart Grid (EICS-2018)	March 12 – 16, 2018
		9. SMART Power Flow Controller for Smart Grid Applications	18-23 December 2017
		10. A GIAN Course on SMART Power Flow Controller for Smart Grid Applications	December 18-23', 2017
9.	HRM Institute of Technology and Managemen	1. International Conference on Computing for Sustainable Global Development	March 16 – 18' 2016
		2 2nd International Conference on Recent Innovation in Science, Engineering and Management (ICRISEM-15)	November 22' 2015
		3 5th National Conference on "Emerging Trends in Science, Engineering, Technology and Management: Research and Development"(CICON-2015)	September 12' 2015
10	Indian Institute of Technology Delhi	1. CERCA Organisation workshop on "Blue Sky Initiatives" for Delhi in collaboration with Embassy of Japan	April 15' 2019
		2. 2nd International Conference on SUSTAINABLE TECHNOLOGIES FOR ENVIRONMENTAL MANAGEMENT	MARCH 25-26, 2019
		3.. IIT Delhi organizes conference " Towards clean Air in Delh"	December 20' 2018
		4. Smart Grids R&D Conclave	August 27' 2018
		5. ASCE INDIA CONFERENCE 2017 ON "Urbanization Challenges in Emerging Economies: Moving Towards Resilient Sustainable Cities and Infrastructure"	12th - 14th December 2017
11.	I.G Delhi Technical University for Women	1. Workshop on "Digital Forensics and Cyber Crime Investigation"	March 17 – 18' 2018
		2. Seminar on "Cyber Crime and Cyber Law"	March 19 – 20' 2018
		3. International Conference on "Demystifying Global Transformation in Management & Technology"	April 29 & 30' 2016
		4. ICT based program on Introduction to Embedded Systems in association with NITTR, Chandigarh	February 08 & 12' 2016
14	Jamia Millia Islamia (A Central University)	International Conference on SMART CITIES: Opportunities & Challenges organized by Department of Civil Engineering	March 14- 16' 2019

Source: Singh 2019

As per the **Table 5**, only a few engineering colleges have organised seminar/ conferences on Smart City. Almost three-fifths of the engineering colleges in Delhi have not taken any initiatives related to 'Smart City'. However, all of them try to make their campus as smart by upgrading technological infrastructure. The topic related to, 'smart grid' is the priority area of research at Delhi Technological University. However, generally, the civil engineering department is taking related initiated. In this regard, only colleges should not be blamed. So far, Smart Citi Mission in India is a government programme and any related technological programme is pass on to the Indian Institute of Technology (IIT) Delhi.

5.3.4. Training from Engineering Colleges for Lower Segment of the Society

At DTU, students go to slum as part of their course HU: 201/202 Engineering Economics and after that prepare assignment on, 'how knowledge of their branch of engineering can be used to improve life at slum' (Singh, 2016). During the even semester of the academic year 2016-17 after demonetisation, they taught slum dwellers to handle e-money. The same process can be used to teach or train for activities related to the slum. They are also making assignment on SDG and engineering colleges since even semester of the academic year 2016-17. In 2014, the Ministry of Human Resource Development, Government of India has launched Unnat Bharat Programme in which universities collaborate with the local administration to alleviate problems of rural area (GoI, 2014). The programme should be strengthened for the Smart City Mission too.

5.3.5. Students Perspective on Smart City

During the even semester of the academic year, 2018-19, students of B.Tech. second year were asked to submit assignment on the Smart City. They were allowed to make the assignment in groups with maximum of five students. On the whole, 68 assignments were submitted by 214 students. Each one of these assignment covered what aspect has been discussed in the Table 6.

Table 6. Students perception about Smart City

No. of Assign-ments	What do you mean by Smart City	Evolution of Smart City	Advantage	Indian Smart City Mission	Technology	Finance	Technology for Inclusion			
							Female	Envi	Eco	Soci
3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7	✓	✓	✓	✓	✓	✓	X	✓	✓	✓
12	✓	✓	✓	✓	✓	✓	X	✓	✓	X
17	✓	X	✓	✓	✓	X	X	✓	✓	✓
13	✓	X	✓	✓	✓	✓	X	✓	X	✓
9	✓	X	X	✓	✓	X	X	X	X	X
7	✓	X	X	X	✓	X	X	X	X	X
68	68	22	52	61	68	35	15	52	39	40

Source: Singh, 2019

All student discussed about the concept and nature of technology but concern about inclusion of female friendly technology or for economically marginalised or socially marginalised were discussed less (Singh, 2019).

6. Conclusion and Recommendation

The Smart City Mission of India, which was initiated in 2014, is to use latest technology to manage the city smartly. To use urbanisation as an opportunity to achieve efficiency, the smart city is supposed to be driven by innovation and entrepreneurship as per the growing business needs. After break of the COVID-19 outbreak, social distancing is being maintained as a preventive method without loss of connectivity through technology as e-meeting, e-classes, e-governance etc. However, smart cities need to be sustainable as the Government of India is one of the signatories of the SDGs of UN which has to be achieved by 2030. However, the study has been able to show through the Spearman's Rank correlation, that economically developed states may not be sustainable and even all innovation also may not be sustainable. So there is need to develop sustainable Smart City. As 'living lab' of Barcelona has shown the way, engineering colleges and universities may play a very central role in the framework. However, the study of

engineering colleges in Delhi and its student reveals that except Indian Institute of Delhi (IIT), not other engineering colleges are involved in Smart City Mission. However, there is need to involve and sensitised these colleges and their students regarding technological needs of the sustainable smart cities and differential need of various segment of the dwellers. Like Unnat Bharat programme of the Ministry of HRD, the engineering colleges can work on development and dissemination of social innovation under their university social responsibility (USR) initiative. However, there is need to follow SDGs 17 of partnership with other stake holders to achieve Goal 11 of Sustainable Cities and Communities. These will help in achieving SDG 8 and 10 as will reduce inequality by creating decent work which will ultimately lead to economic development of the people in the lower segment of the smart cities. Limitation of the paper is to study the issue from the top. Further research in the field to look at the smart city from the perspective of the female, poor and marginalised group of the smart city.

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