# Smart City Profiles & Urban Local Body Performance: An Empirical Study of Indian Smart Cities – Round–1

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*Abstract*— The present phase of most industrialized, creative and innovated corporate functioning has made human life: especially urban life as more facilitated but complex with broaden and escalated Cities in various facets. This has made the Cities more challenging to be governed and become smarter in public administration so as to manage and control the entire community and satisfy its requirements in a smart way. The concept of Smart Cities has its root cause in the Smart community thinking since almost 1960s, which mainly includes the People, Properties, Places, Process, and Prices (5Ps of Smart Cities). Those are prevailed among population & its growth, water & drainage management, electricity & technology supply, transport & traffic management, environment & healthcare management, waste & sanitation management, etc. The Smart Cities also require to be integrated with Information and Communication Technology (ITC) as well as the Internet of Things (IoT). Further, the significant innovation in the technology, business processes and economic restructuring enforce to transform our Cities into the Smart Cities. However, it is more vital to understand about the major impulsive playing their greater role in making the city as a Smart City. This paper examines 8 profile parameters as independent variables and 7 profile parameters as control variables, of the 20 Indian Smart Cities – round-1 and proposes their impact on the performance indicators of Urban Local Body (ULB), their financial status, facilities and approved project cost. These profile parameters fall under demographic profile, economic profile and infrastructure profile. The data of these Cities have been extracted from the official website of Smart Cities Mission, Ministry of Urban, Government of India. With the help of Microsoft Excel and SPSS, Multiple and Pooled Regression Analysis as well as T-test were run to understand the relationship between the studied variables. The research result identifies the most impacting profile parameters for Smart Cities development in India. The study not only reveals how diverse parameters are but also recommends the need for constant progression of choosing them based on the benchmarks obtained from best observance.

***Key words:*** Smart City, ULB, Profiles, Performance, Governance, Green Buildings, Smart City Governance

## I. INTRODUCTION

The modern era of liberalized, privatized, and globalized economies entail the urban life to be filled with constant supply of fundamental resources and services through the advanced mechanism. The availability of such necessities in an appropriate and finest mode improves the quality of life and the efficiencies of the City administration. Further, in the present phase of most industrialized, technological creative and innovated corporate functioning, economic restructuring; human life: especially urban life has become more facilitated but complex. Most of the Cities across the globe have been broadening and escalating consistently in various facets. This has made the Cities more challenging to be governed and become smarter in public administration so as to manage and control well the entire community and satisfy its requirements in a smart way. The concept of Smart Cities has been of a flame discussion since almost 1990s, which mainly includes the People, Properties, Places, Process, and Prices (5Ps of Smart Cities). The elementary aspects of a city include population & its growth, water & drainage management, electricity & technology supply, transport & traffic management, environment & healthcare management, waste & sanitation management, etc. to be integrated with ITC and IoT.

Most of the institutions and councils be it National Institute of Urban Affairs, Smart Cities Council of India or any others working on Smart Cities emphasize on the crucial objective of providing integrated information, resources dissemination, assembling the industry data and showcasing the significant achievements for Smart Cities development. In January, 2017, the Smart Cities Mission, Ministry of Urban, Government of India has declared the list of first 20 Cities to be developed as the Indian Smart Cities – round 1. The concept of Smart Cities is relatively a new phenomenon in India. In this context, it is apparent that these Cities would be the pioneer and benchmark among all Smart Cities of India further. It is also more significant to learn and identify the main parameters enabling the Cities to become Smart Cities. (Dr K N Sheth 2014)

This paper examines the impact of various profiles, of these 20 Indian Smart Cities – round-1, on the performance indicators of their ULB, their financial status, facilities and approved project cost. The profiles of these Smart Cities include demographic profile, economic profile and infrastructure profile. These all profiles accumulate the Smart Cities' Infrastructure in context of sustainable development of the cities. The data of these Cities have been extracted from the official website of Smart Cities Mission, Ministry of Urban, Government of India duly upgraded in March, 2016. With the help of appropriate statistical tools, the relationship between these variables have been studied and tried to identify the most optimal Profile Parameters to be invested into for developing them as Smart Cities.

## II. LITERATURE REVIEW

Many research scholars have extracted the Smart Cities' meanings and indulgent in the deep augmentation of the Smart communities in several Cities of the globe. Since 1950s and 1960s, the urbanization has been taken place at very high pace. Especially in the developed economies, the notion of Smart Cities has been emerged well in advanced in the 1970s. The United Nations has defined the urbanization as the movement of people from rural to urban (2004). The United Nations (world urbanization prospects, 2014) estimate that by 2030, over 60% of the global population will be living in "megacities" with 10+ million, large cities with 5-10 million, medium cities with 1-5 million, and smaller cities and peri-urban communities, progressively more rigorous in Asia, Africa, and Latin America. The UN also opines that this fraction could rise to two thirds by 2050. A consultation workshop with state governments and stakeholders on Smart Cities was organized in 2015 in India. The workshop covered the agendas like: pre-requirements for Cities to participate in the self-nomination process (competition), kind of support and hand-holding that Indian Cities need to prepare for the Smart City challenge, proposed policy having development at three spatial levels - retrofitting, redevelopment and greenfield, integrate the Smart City mission with the national urban development mission for 500 Cities and other urban development programs of the centre and the state Governments, governance mechanism through citizen participation in decision-making, innovative financial tools to be conceived in order to make ULB's self-reliant, kick-start issue of muni-bonds, and pooled finance development scheme (PFDS).

As far as the relationship being established between various profile parameters in the form of services of the Smart Cities rendered to its citizens as well as the performance indicators is concerned, numerous studies performed worldwide, including those in India, have shown positive relationship. However, there is hardly any research work found highlighting specifically about the service parameters covered in this study. Therefore, under this study, we have observed a definite link between profile parameters and performance indicators of the Indian Smart Cities. This study originates the review of many such literatures by broadly highlighting the findings of the studies carried out in various countries and mainly in India. Categorically initiated review of literature are elaborated in the under mention Para.

Albino V. et al, (2015) evolved the definition of smart city along three main directions, representing perspectives through which the concept has been studied: technology, people, and community. International Electro-technical Commission, Geneva, Switzerland (2016) has considered the energy, transportation, water, sustainable building, and other city services as the basic parameters of the smart cities.

The major parameters that determine the pilot smart city initiatives should have a positive impact to ensure stakeholder confidence. These parameters are: Economic growth potential - location with respect to growth corridors, committed investments, etc.; Infrastructure preparedness - Physical infrastructure and facilities such as roads, water supply, sewerage, drainage, sanitation, etc., and social infrastructure such as education institutions, and health care facilities; Educated citizens - education level, presence of knowledge institutions, participation in governance, use of internet-based services; Proactive city government - timely preparation of required plans and their revision, responsiveness to reforms, efficiency of citizen services and grievance redressal; and ICT intervention preparedness - database, GIS-based map, etc. (Bhattacharya, S., and Rathi, S.: CSTEP Report-2015). Each city has its established functional cycle of people-economy-enterprises-culture. Using technology to improve quality of life within this functional cycle will be challenging, but will be the most desirable form of a smart city in India. (Rathi & Bhattacharya, 2015).

An analysis of the objectives and Europe 2020 targets of Smart City initiatives finds that despite their early stage of development, Smart City objectives should be more explicit, well defined and clearly aligned to City development, innovation plans and Europe 2020 in order to be successful (Catriona Manville et al, 2014). Wherein, the Smart City characteristics include Smart governance, Smart economy, Smart mobility, Smart environment, Smart people and Smart living. In this study most initiatives aim to contribute towards Smart, sustainable and inclusive growth. Environmental issues and green solutions appear to be the principal concern; nearly 50% of sampled initiatives address environmental problems Policy Department A: Economic and Scientific Policy through improved energy efficiency in buildings or smarter City transportation options. Further, inclusion of characteristics recognized as Smart City hallmarks (e.g. environment and innovative use of ICTs) may be motivated by a desire to attract businesses to the City or to participate in European-funded Smart City projects.

Through the discussion of various theory and parameters governed the development of Smart Cities across the globe, Dr. Debjani Ghos et al, National Institute of Urban Affairs (2015) established the clarity about how the City comprises various systems, networks and environments that lend themselves to transformation for achieving the objectives of the Smart Cities mission of Government of India. The study also focused on various layers of Smart Cities development. As per the Smart Cities development models, the choice of technological patterns is linked to each projects requirements: a Greenfield City requires larger ICT investments for the development of new builds for scratch, while Brownfield Cities require an evaluation/transformation of existing ICT capabilities.

"Smart cities Ranking of European medium-sized cities", Giffinger R. et al, (2007), defines a Smart City as a well performing in a forward-looking way in the six characteristics: Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment, and Smart Living; built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens. With the help of these parameters, his study has ranked 70 European Cities and concludes that truly smart cities use this city ranking as a tool to benchmark with other cities, and draw lessons from better performing cities, perhaps resulting in policy transfer.

"Urban Green Growth Strategies for Indian Cities", Vol. 1, ICLEI-South Asia (2015), defines a Smart City as characterized by an ideal combination of sustainability and competiveness, thus attracting capital investments. This paper

opines that by providing quality infrastructure and adequate availability of electricity, water, etc. and offering simple and transparent online processes to facilitate the establishment and efficient management of enterprises will serve this definition. The labour force will be trained according to the skills required by the local industries.

Underpinning much of the discourse about 'smart cities' is the tremendous growth and innovation in the electronics, IT, IT enabled services and allied sectors over the last two to three decades. And two of the prominent terms associated with the co-evolution of these sectors are Machine-to-Machine Communication (M2M) and Internet of Things (IoT). Together these two terms encompass the hardware, software and telecommunication options that can make public services or human activities more efficient, thereby making them central to the discourse on the aspirations from Smart Cities, (Kapur D. and Sequeira R.C., 2016).

Critical levels are emerging (or presumably emerging) in City Governments to address economic and social issues. Their success in this endeavor depends largely on meeting financial requirements for various tasks and stakeholders and this paper explores the different but inter-linked aspects of their financial health, revenue sources, budgeting capacity and expenditure planning, as these dictate how far they can address the emerging roles due to decentralization and globalization (Manu Mahajan, 2006).

Jawaid M. F. & Khan S. A., (2015) through their research titled as "evaluating the need for Smart Cities in India, emphasized on the Greenfield and Brownfield developments of the Smart Cities. He underlines that the cost of infrastructure and urban service delivery is also increased to be uneconomical at one point of time and the urban services require decentralization. His study highlights further on the challenges to cope up with the crisis within the constrained budget which could only be met with the meticulous, coordinated and planned development of new urban centers and Cities or development of the satellite towns which are also technologically advanced, self sustaining and ecological. The Smart City concept is one such upcoming concept which is deemed to be the solution for the present day problems as well as the sustainable future. He opines that in the absence of any definite guidelines and case specific solutions to develop the Smart Cities in India, there is need for further research to work out the parameters, definitions and guidelines for the development of new Cities.

Pune has complied very exceptionally with more than 70% in its governance and this can be explained by understanding the JNNURM promoted by the Government of India (National Institute of Urban Affairs, 2006). The JNNURM stated that all those Cities proposing their development plans in India, for instance the cases of Chandigarh and Pune, should modify their government structure to demonstrate the compromise and responsibility to achieve the goals stated in their plans towards sustainable urbanization.

As far as analyzing and rating the Smart Cities in India is concerned, Parishwad O. and Singh T., (2014) enlisted generalized parameters for Smart Cities development. His examination says that the Smart City development is more concerned with making progress as concerns the Smart indicators rather than rating a City, which inevitably is a snapshot in time. Non-weighted factors and parameters express that the Urban Development is a complex process in different dimensions and evaluation that ultimately relies on the performers, their preferences and individual objectives.

Shen L. Y. et al (2011) examined 9 different practicing Cities of the world and proposed a comparative basis, namely, International Urban Sustainability Indicators List (IUSIL), for allowing the better understanding of drivers and goals of each practice and identifying under what circumstances various practices selected their indicators. Their comparative analysis is categorized in four different dimensions: environmental, economic, social and governance and resulted the ways comparative basis can lead to knowledge sharing between different practicing Cities, which can also be used to guide the selection of indicators of sustainable urbanization plans and improve the effective communication of the status of practices. Their study also suggests the need for consistent processes of choosing indicators based on the benchmarks obtained from best practices. The economical dimension of Hong Kong City has been on the top and more balanced with the IUSIL. Barcelona, Chandigarh and Pune have also been at good level of economical dimension compliance. Their study also found that Malaysian Government has clearly addressed a great deal on social issues in their plan for Iskandar to ensure the conditions and the environment needed to meet the expectations of the foreign investors. Further, in the plan, it is stated that one of the main drivers to develop an urban development plan that is in line with the principles of sustainable development was the increasing population growth in Melbourne.

Singh K. & Sharma N., (2016), highlights that to develop the Chandigarh as one of the Indian smart cities need to overcome the challenges in the sectors like Healthcare, Education, Solid Waste Management, Regulating Traffic, and Transportation Services. This paper concludes that in India, administration in the cities is often confronted with a multitude of key problems, surrounded to these challenges.

The Secretariat of United Nations Commission on Science and Technology for Development (UNCSTD), Budapest, Hungary has divided the Smart City Infrastructure parameters into two categories: (1) physical and (2) digital. This chapter provides brief descriptions of the following smart physical infrastructures: (1) Smart Buildings, (2) Smart Mobility and Transport, (3) Smart Energy, (4) Smart Water Management, (5) Smart Waste Management and (6) Smart Healthcare, with case studies and examples. In context to the digital infrastructure is concerned, a brief discussion on ICT and Data infrastructure in the forms of Urban layer, Sensor layer, Connectivity layer, Data Analytics layer, Automation layer, Broadband connectivity, Internet of Things, and Big data is done. The Un concludes by highlighting the need for an integrated approach in dealing with these diverse smart city infrastructure components.

Verbruggen & Kuik, (1991) opined that urban sustainability indicators are crucial for helping on target setting, performance reviews and facilitating communication among the policy makers, experts and public. Further, Choguill, (1993) emphasized that the significance of sustainable urbanization has been increasingly appreciated, efforts to promote the practice

have led to the development of instruments in form of policies and incentives to effectively integrate the concerns on environmental protection, economy equity and social wellbeing into urban development plans.

## III. RESEARCH PROBLEM & OBJECTIVES

### *A. Problem Identification:*

The category, size, area, culture, governance, etc. of various Cities vary in different aspects. While declaring any City as proposed Smart City, the authority needs to consider many factors and indicators affecting the quality of life and the service efficiency of the City administrative officials. The primary aim of transforming a City into the Smart City is to improve the life quality of the people and increase the efficiency of the services through enhanced and optimized employment of the resources available in the form of other 4Ps i.e. Properties, Place, Process and Prices. However, it is tricky to comprehend the most appropriate characteristics which lead a City towards the Smart urban growth. Through this study, it is tried to understand and identify such impacted characters and factors that determine the City as Smart City.

Majority of Indian Cities have been performing well in improvising the citizens' life and efficiency of officials' services since last few financial years. Hence their contribution towards urbanization of the Indian Economy has been very significant. Has it been a positive indicator of well performed Cities and contributing very significant share to the urbanization of Indian Economy since years, it implies that the City Profile Parameters would have been proved as well governed parameters. If this is the truth, it is more imperative to study that how about them being influenced on Performance Indicators of the Cities belonging to the other part of the nation those are yet to be identified and proposed to be the next Smart Cities. Therefore, it is a matter of aflame to think on getting more Indian Cities into the listing of the Smart Cities as well as making them the best governed Cities of the Indian Economy. Simultaneously, it is also significant to understand that how differently these Cities are being governed from each other as far as its profiles are concerned.

### *B. Research Objectives:*

After a widespread review of literature, the key objectives of this study have been rolled out as under.

1) To explore that whether City Profile Parameters influence the Cities' Performance Indicators.
2) To discover differentiations of the impact of Profile Parameters on City Performance Indicators.
3) To identify the most optimal Profile Parameters to be invested into for developing the Smart Cities.
4) To understand the differences between mean proportions of the Infrastructure Profiles and ULBs' Performance of the Cities.

## IV. RESEARCH DESIGN

This segment depicts the sampling process adopted for the selection of the data to be analyzed and resulting sample. This also furnishes details on the statistical tools along with the empirical tests to be applied for analyzing the identified and defined key variables, and their relationships for the study.

### *A. Data Collection Methods:*

In March, 2016, under the Smart City Mission, Ministry of Urban, Government of India has identified 20 Indian Cities as Smart Cities in round – 1 with the fundamental definition, some typical features of comprehensive development, strategic components and challenges for funding and area based development. All these Cities falling in round - 1have been taken for the study. The City Profile Parameters and Performance Indicators of these Cities have been studied. These data may be proved as the fundamental base for strategy formulation and selection procedure of other Smart Cities under the mission of 100 Smart Cities development by Government of India.

### *B. Defining Variables:*

The variables under different categories for the study have been identified and listed as under:

*1) Cities' Performance Indicators (Dependent Variables):*
- PTCov = ULB's Property Tax Coverage (in %).
- PTCol = ULB's Property Tax Colection (in %).
- TI = ULB's Total Income (in '000 INR).
- TE = ULB's Total Expenditure (in '000 INR).
- BF = Households with Banking Facilities (in %).
- TAPC = Total Approved Project Cost under JNNURM (in '000 INR).

*2) City Profile Parameters – Demographic & Economic (Independent Variables):*
- TPop = Total Population (in '000).
- UPop = ULB Population (in %).
- PGR = Population Growth Rate (in %).
- AoC = Area of City (in Sq. Kms.).
- WAG = Working Age Group – 15 to 59 Years (in %).
- WP = Work Participation (in %).
- SE = Self Employment (in %).

- SSEZ = Number of Sanctioned SEZs.

*3) Infrastructure Profile Parameters (Control Variables):*

- WA = Households with Water Access (in %).
- EA = Households with Electricity Access (in %).
- TF = Households with Toilet Facilities (in %)
- DF = Households with Drainage Facilities (in %)
- HO = Households with Ownership (in %)
- CLA = Households with Computer/Laptop Access (in %)
- MPA = Households with Mobile Phone Access (in %)

## V. HYPOTHESES DEVELOPMENT

There is hardly any empirical research work found which have experienced and discovered any effects of City Profile mechanisms on its' performance indicators in either of the form. However, on the basis of various relevant research studies and regulatory organizations focus on progressing the citizens' life and certain relatively assumptions and interpretations, this study reveals the impact of various Cities Profile Parameters on their Performance Indicators and the other inferences with the following hypothesis.

- H1: The size of the Population is positively related to the City performance.
- H2: The Population Growth is positively related to the City performance.
- H3: Area of City is positively related to the City performance.
- H4: Working Age or Participation is positively related to the City performance.
- H5: Self Employment Ratio is positively related to the City performance.
- H6: Number of Sanctioned SEZs is positively related to the City performance.
- H7: There is no significant difference between the mean proportions of the Cities' Infrastructure Parameters.

## VI. DATA ANALYSIS

This study used the Pearson's Correlations among the variables first and then the Multivariate as well as Pooled Regression Models have been developed and applied to test the relationship of the selected Cities' Profile Parameters and Performance Indicator variables. The regression models believe that there is a relationship between a single dependent variable that is metric one and numerous Independent Variables which may be metric or non-metric too. Beyond these all, the T-test has been run to understand the difference between the Performance Parameters of the selected Cities under the study.

### *A. Regression Model:*

The classic 'Y' is denoted as the dependent variable and the independent variables have been denoted with 'X1, X2, X3,……, Xn'. The critical model has been developed as under:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots\ldots + \beta nXn + \varepsilon$$

This regression model has been applied to the analysis and corresponding interpretation of the data. This model has run for the Correlation first and followed with the multiple regression as well as the pooled regression by inserting the control variables in the regression model.

Below is the table shows the descriptive statistics of all three sets of variables entered into the analysis of the study. The descriptive statistics have been interpreted thereon.

### *B. Analysis & Interpretation:*

*1) Descriptive Statistics:*

| Sr. No. | Variables | N | Minimum | Maximum | Sum | Mean | Std. Deviation |
|---|---|---|---|---|---|---|---|
| 1 | ULB'S_PRPRTY_TX_CVRG_% | 20 | 17.00 | 100.00 | 1653.10 | 82.6550 | 18.86438 |
| 2 | ULB'S_PRPRTY_TX_CLCTN_% | 20 | 58.00 | 95.00 | 1640.00 | 82.0000 | 10.89181 |
| 3 | INCM_OF_ULB_IN_LACS | 20 | 38.39 | 2033164.00 | 3315681.11 | 165784.0555 | 444930.34838 |
| 4 | EXPNDTR_OF_ULB_IN_LACS | 20 | 36.72 | 219085.00 | 1362898.34 | 68144.9170 | 68372.36091 |
| 5 | HOUSHLDS_WITH_BNKNG_FCLT_% | 20 | 9.52 | 88.63 | 1347.43 | 67.3715 | 17.24742 |
| 6 | APRVD_COST_ULB_IN_LACS | 20 | 3464.00 | 390666.70 | 2048912.71 | 102445.6355 | 120670.70674 |
| 7 | PPLTN_IN_000 | 20 | 312.54 | 11034.56 | 46151.80 | 2307.5900 | 2570.14314 |
| 8 | ULB'S_PPLTN_% | 20 | 23.79 | 100.00 | 1416.62 | 70.8310 | 22.65966 |
| 9 | PPLTN_GRWTH_RATE_% | 20 | -1.59 | 6.07 | 40.21 | 2.0105 | 1.80413 |
| 10 | AREA_OF_CITY_SQ_KM | 20 | 56.92 | 1484.00 | 5544.93 | 277.2465 | 316.77113 |
| 11 | WRKNG_AGE_GRP_15-59_% | 20 | 64.47 | 73.53 | 1347.45 | 67.3725 | 2.16028 |
| 12 | WRK_PRTCPTN_% | 20 | 28.90 | 42.20 | 732.69 | 36.6345 | 3.62306 |
| 13 | SELF_EMPLYMNT_% | 20 | 19.37 | 55.85 | 775.32 | 38.7660 | 9.72950 |
| 14 | NO_OF_SEZ_IN_CITY | 20 | .00 | 20.00 | 98.00 | 4.9000 | 5.60920 |
| 15 | HOUSHLDS_WITH_WTR_ACCSS_% | 20 | 32.64 | 99.20 | 1628.16 | 81.4080 | 15.37091 |
| 16 | HOUSHLDS_WITH_ELCTRCT_ACCESS_% | 20 | 86.53 | 99.08 | 1939.85 | 96.9925 | 2.98809 |
| 17 | HOUSHLDS_WITH_TLT_FCLTY_% | 20 | 58.67 | 94.62 | 1703.85 | 85.1925 | 8.87510 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18 | HOUSHLDS_WITH_DRNG_CNCTVT_% | 20 | 68.95 | 98.04 | 1809.59 | 90.4795 | 7.14977 |
| 19 | HOUSHLDS_WITH_ONRSHP_% | 20 | 12.08 | 77.87 | 1197.86 | 59.8930 | 15.87815 |
| 20 | HOUSHLDS_WITH_COMPUTER | 20 | 13.19 | 44.22 | 505.53 | 25.2765 | 8.34346 |
| 21 | HOUSHLDS_WITH_MOBILE | 20 | 54.12 | 78.88 | 1276.49 | 63.8245 | 5.35572 |
| 22 | VALID N (LISTWISE) | 20 | | | | | |

Table 6.1: Descriptive Statistics of the Variables entered into Regression Analysis

The above table no. 6.1 shows the summary statistics of all variables subset under three categories vise, Dependent, Independent and Control for the selected 20 India Smart Cities. Initial 6 variables in the table represent as Dependent Variables (DV), next 8 variables represent as Independent Variables (IV), and remaining 7 variables represent as Control Variables (CV) in the study. As the most significant DV, the mean ULB's Property Tax Coverage and Collection are 82.65 %, and 82.00 respectively. Following this, the mean value of Income and Expenditure of ULB are 165784.05 and 68144.91 lacs Indian Rupees. Whereas, the mean value of Households with the Banking Facility is recorded as 67.37, the JNNURM has approved average of Indian Rupees 102445.64 for these cities. The tables show 70.83 % as the ULB Population for these cities. The average population growth of them is recorded as 2 % only. This result shows the recorded data for all other IVs and CVs too.

*2) Correlation between Smart City Profiles and ULB Performance:*

Table 6.2: Correlations of the Variables entered into Regression Analysis for Indian Smart Cities – Round-1

| Variables | ULB's_Prprty_Tx_Cvrg_% | ULB's_Prprty_Tx_Clctn_% | Incm_of_ULB_In_Lacs | Expndtr_of_ULB_in_Lacs | Houshlds_with_Bnkng_Fclt_% | Aprvd_Cost_ULB_in_Lacs | Pplt n_in_000 | ULB's_Pplt n_% | Pltn_Grwth_Rate_% | Area_of_City_Sq_Km | Wrkng_Age_Grp_15-59_% | Wrk_Prtcpt n_% | Self_Employment_% | No_of_SEZ_in_City | Houshlds_with_Wtr_Access_% | Houshlds_with_Elctrct_Access_% | Houshlds_with_Tlt_Fclty_% | Houshlds_with_Drng_Cnctvt_% | Houshlds_with_Onrshp_% | Houshlds_with_Cmptr | Houshlds_with_Mobile |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| ULB's_Prprty_Tx_Cvrg_% | 1 | | | | | | | | | | | | | | | | | | | | |
| ULB's_Prprty_Tx_Clctn_% | .804** | 1 | | | | | | | | | | | | | | | | | | | |
| Incm_of_ULB_In_Lacs | .171 | -.019 | 1 | | | | | | | | | | | | | | | | | | |
| Expndtr_of_ULB_in_Lacs | .289 | .297 | .642** | 1 | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Houshlds_with_Bnkng_Fclt_% | -.149 | -.238 | .260 | .165 | 1 | | | | | | | | | | | | | | | | |
| Aprvd_Cost_ULB_in_Lacs | .281 | .239 | .647** | .700** | .123 | 1 | | | | | | | | | | | | | | | |
| Ppltn_in_000 | .054 | .113 | .181 | .603** | .286 | .572** | 1 | | | | | | | | | | | | | | |
| ULB's_Ppltn_% | -.186 | -.208 | -.083 | .388 | .222 | .255 | .309 | 1 | | | | | | | | | | | | | |
| Ppltn_Grwth_Rate_% | .056 | .143 | .088 | .452* | -.166 | .077 | -.092 | .466* | 1 | | | | | | | | | | | | |
| Area_of_City_Sq_Km | -.058 | -.004 | .076 | .460* | .325 | .238 | .892** | .210 | -.128 | 1 | | | | | | | | | | | |
| Wrkng_Age_Grp_15-59_% | .259 | .053 | .014 | .131 | .125 | .220 | .544* | .023 | -.259 | .557* | 1 | | | | | | | | | | |
| Wrk_Prtcptn_% | .138 | .283 | -.086 | -.052 | -.248 | .239 | .159 | -.206 | -.055 | .030 | .093 | 1 | | | | | | | | | |
| Self_Emplymnt_% | -.055 | -.042 | -.288 | -.320 | -.076 | -.445* | -.482* | .002 | .219 | -.502* | -.448* | -.471* | 1 | | | | | | | | |
| No_of_SEZ_in_City | .040 | .113 | .654** | .433 | .234 | .575** | .095 | -.148 | .098 | -.007 | -.136 | .086 | -.373 | 1 | | | | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Houshlds_with_Wtr_Accss_% | -.073 | .137 | .271 | .126 | -.189 | .270 | .262 | -.488* | -.293 | .190 | -.229 | .503* | -.344 | .291 | 1 | | | | |
| Houshlds_with_Elctrct_Accesss_% | .102 | .431 | .166 | .392 | -.080 | .310 | .318 | -.129 | -.037 | .178 | -.178 | .242 | -.214 | .268 | .527* | 1 | | | |
| Houshlds_with_Tlt_Fclty_% | -.029 | .258 | -.169 | .169 | .126 | .160 | .197 | .114 | .154 | .035 | .044 | .085 | -.016 | .126 | -.047 | .635** | 1 | | |
| Houshlds_with_Drng_Cnctvt_% | .079 | .266 | .316 | .503* | .012 | .423 | .421 | .128 | .034 | .281 | -.195 | .201 | -.272 | .225 | .577** | .811** | .279 | 1 | |
| Houshlds_with_Onrshp_% | -.216 | -.142 | .071 | -.120 | .129 | -.144 | -.518* | .064 | .289 | -.570** | -.849** | -.116 | .495* | .186 | -.037 | .106 | .105 | .055 | 1 |
| Houshlds_with_Cmptr | -.030 | -.192 | .372 | .189 | .594** | .395 | .454* | -.037 | -.483* | .461* | .529* | -.061 | -.492* | .418 | .031 | -.005 | .144 | -.043 | -.342 | 1 |
| Houshlds_with_Mobile | -.007 | -.131 | .060 | .242 | -.172 | .065 | .070 | .451* | .395 | .091 | .362 | -.141 | .041 | -.224 | -.519* | -.212 | .012 | -.207 | -.281 | .020 | 1 |

**. Correlation is significant at 0.01 level (2-tailed).

*. Correlation is significant at 0.05 level (2-tailed).

This correlation result shows both the primary DVs i.e. the ULB's_Property_Tax_Coverage and ULB's_Property_Tax_Collection are positively correlated with each other with the .804 at 1 % significant level. Similarly other two DVs i.e. Income_of_ULB and Expenditure_of_ULB are also positively correlated with each other with the .642 at 1 % significant level. Further the Income_of_ULB also positively correlates to the Approved_Cost_of_ULB with .647 at 1 % significant level. While, the IVs as Population_in_'000 positively correlates with most of the DVs having .603, .286, and .572 for Expenditure_of_ULB, Banking_Facilities, and Approved_Cost_of_ULB. It is strange to notice that the proportion of ULB's_Population is negatively correlated with the primary three IVs i.e. ULB's_Property_Tax_Coverage, ULB's_Property_Tax_Collection and Income_of_ULB's with the values of -.183, -.208, and -.083. Whereas, the IVs of Population_Growth_Rate and Working_Age-Group_15-59_% are positively correlated with most of the DVs, other two IVs as Area_of_City_in_Sq._Km. and Work_Participation_% are mixed correlated with the IVs.

Further, the Self_Employment_% is negatively correlated with all IVs, and the No._of_SEZ_in_City is positively correlated with all IVs. As far as the correlation between all CVs and IVs are concerned, the table shows mixed relationship which can be observed from the above table.

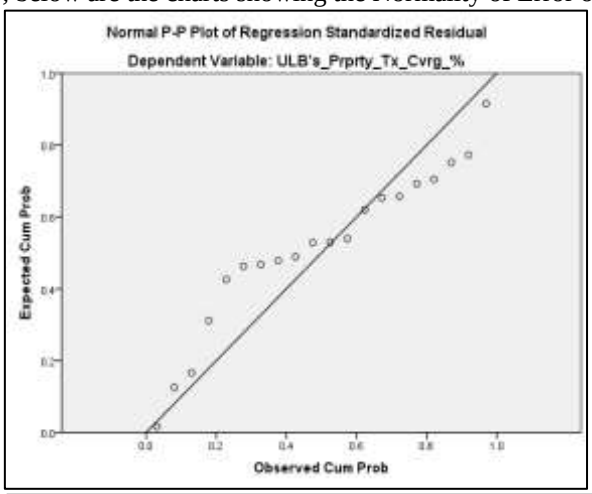
Below Para discusses on regression analysis for the variables entered into the study. The multiple and pooled regression are run to study the impact of the IVs and CVs on DVs. In the below table 6.3 demonstrates the impact of IVs on DVs through multiple regression as Model-1, while table 6.4 demonstrates the combined impact of IVs and CVs on DVs through pooled regression as Model-2.

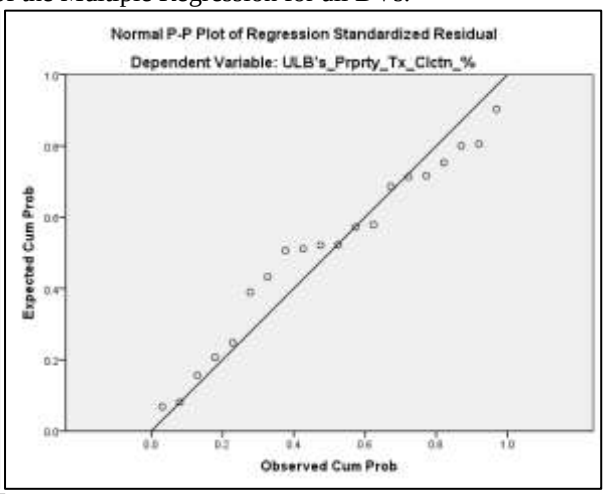
*3) Regression Analysis of Smart City Profiles and ULB Performance:*

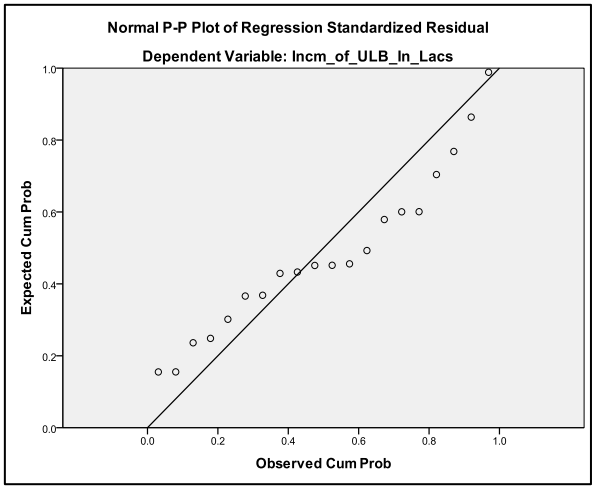
In the above Model-1, there is hardly any significant impact of Population Size on the Performance Indicators except on the Income of ULB. It has positive impact with 133.45 means increase of every unit of Population, there is increase of 133.45 units in the ULB's Income. ULB's Population Proportion in % has negative impact on most of the Performance Indicators. While Population Growth Rate in % creates high level of impact on most of the Performance Indicators; other predictors like the Area of City in Sq. Kms., Working Age Group, Working Participation in % and Self Employment in % don't create positively impact on these variables. No. of SEZ in City has high level of impact with 31013.19, 1073.33, and 6695.99 units on the Income of ULB, Expenditure of ULB, and Approved Project Cost of ULB respectively. Conversely, most of the Model F value represents the positive indication about the collective impact of all predictors on all Performance Indicators Variables of the Smart Cities under the study. Similarly, the Adjusted R Square also represents the positive values for all Performance Indicators except ULB's Property Tax Coverage and Property Tax Collection.

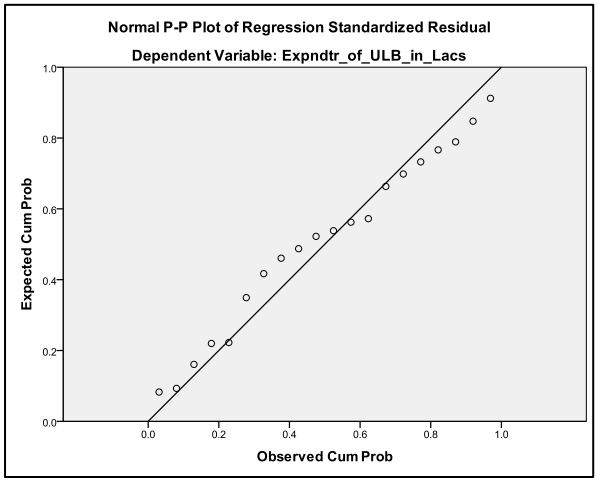
Below table examines the regression between the entered variables after entering additional set of Predictors i.e. control variables in the study. These are the variables represent the outcomes of the service efficiency of the ULB officials as far as making the citizens life more comfortable and easy along with the basic necessities and services availing is concerned.

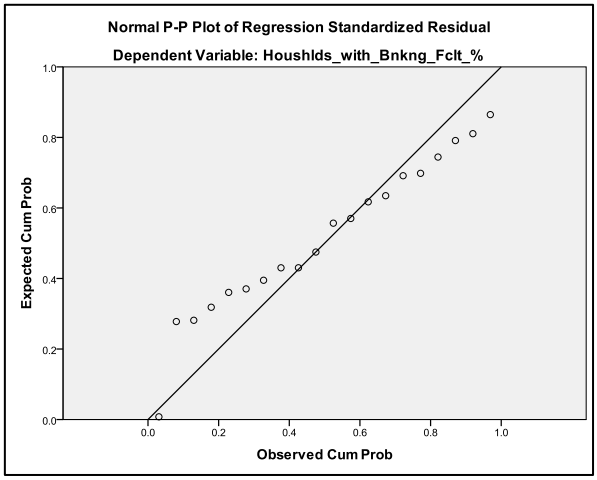
Further, below are the charts showing the Normality of Error of the Multiple Regression for all DVs.

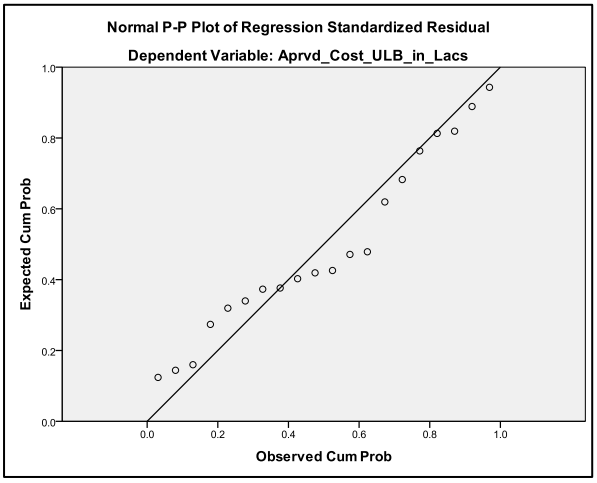





Interpretation: Thus, while running the multiple regression analysis for all DVs, all the above normal Probability (P-P) Plot of the Regression Standardized Residual roughly follow a straight lines so they do not violate the assumption of Normality of the test in the case of ULB's all Performance Parameters as Dependent Variables of the study.

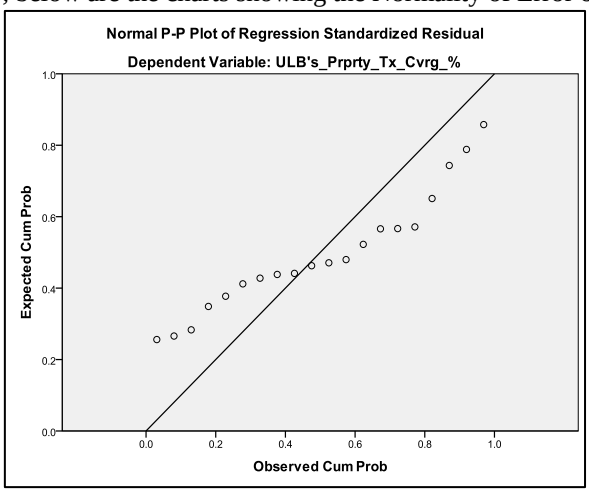
| | Dependent Variables | | | | | |
|---|---|---|---|---|---|---|
| Independent Variables | ULB's_Prprty_Tx_Cvrg_% | ULB's_Prprty_Tx_Clctn_% | Incm_of_ULB_In_Lacs | Expndtr_of_ULB_in_Lacs | Houshlds_with_Bnkng_Fclt_% | Aprvd_Cost_ULB_in_Lacs |
| Constant | 717.74 | 392.44 | -14324564.93 | -2437235.80 | 1040.94 | -648923.78 |
| | (755.03) | (582.26) | (18049897.13) | (1384416.37) | (1253.06) | (3559151.24) |
| Ppltn_in_000 | .02 | .01 | 139.51 | 26.06 | .00 | 86.89 |
| | (.01) | (.00) | (141.74) | (10.87) | (.01) | (27.95) |
| ULB's_Ppltn_% | -1.37 | -.53 | -6301.77 | 595.54 | -.65 | -228.85 |
| | (.56) | (.43) | (13392.58) | (1027.20) | (.93) | (2640.80) |
| Ppltn_Grwth_Rate_% | 17.28 | 7.59 | 187213.25 | 52540.38 | -.83 | 23270.75 |
| | (4.22) | (3.26) | (100963.14) | (7743.81) | (7.01) | (19908.32) |
| Area_of_City_Sq_Km | -.13 | -.04 | -1599.30 | -219.30 | .02 | -643.30 |
| | (.03) | (.02) | (694.39) | (53.26) | (.05) | (136.92) |
| Wrkng_Age_Grp_15-59_% | -14.77 | -9.42 | 137510.45 | 100.39 | -7.44 | 468.13 |
| | (7.01) | (5.41) | (167661.53) | (12859.54) | (11.64) | (33060.17) |
| Wrk_Prtcptn_% | 3.23 | 2.54 | -68987.69 | -4484.88 | 1.17 | -4154.85 |
| | (1.29) | (1.00) | (30920.04) | (2371.55) | (2.15) | (6096.94) |
| Self_Emplymnt_% | -.28 | .28 | -17593.86 | -715.76 | -.04 | -3668.00 |
| | (.68) | (.52) | (16194.56) | (1242.11) | (1.12) | (3193.31) |
| No_of_SEZ_in_City | -3.95 | -1.22 | -8760.89 | -5319.41 | -.15 | 1656.13 |
| | (1.13) | (.87) | (26910.62) | (2064.03) | (1.87) | (5306.34) |
| Houshlds_with_Wtr_Access_% | -3.23 | -1.60 | 10606.59 | -544.17 | -1.39 | -288.56 |
| | (.81) | (.63) | (19478.27) | (1493.97) | (1.35) | (3840.80) |
| Houshlds_with_Elctrct_Access_% | 10.52 | 6.79 | 87719.59 | 43695.23 | -7.33 | 15080.89 |
| | (5.55) | (4.28) | (132720.89) | (10179.61) | (9.21) | (26170.44) |
| Houshlds_with_Tlt_Fclty_% | -3.60 | -1.52 | -44494.75 | -9974.10 | .84 | -6411.49 |
| | (1.03) | (.79) | (24619.76) | (1888.32) | (1.71) | (4854.62) |
| Houshlds_with_Drng_Cnctvt_% | .54 | -.27 | 3373.54 | -6822.97 | 2.75 | -1506.68 |
| | (1.58) | (1.22) | (37846.59) | (2902.81) | (2.63) | (7462.74) |
| Houshlds_with_Onrshp_% | -1.58 | -1.17 | 18830.88 | -1142.87 | .19 | 245.62 |
| | (.49) | (.38) | (11633.04) | (892.25) | (.81) | (2293.85) |
| Houshlds_with_Cmptr | 4.19 | 1.72 | 37449.73 | 8933.15 | 1.38 | 5584.12 |
| | (1.10) | (.85) | (26287.57) | (2016.24) | (1.82) | (5183.49) |
| Houshlds_with_Mobile | -2.85 | -1.62 | 11108.87 | -4927.89 | -.37 | 639.76 |
| | (1.14) | (.88) | (27235.69) | (2088.96) | (1.89) | (5370.44) |

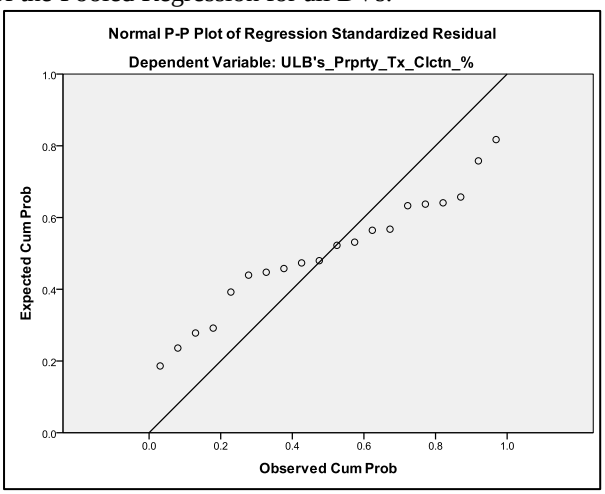
| | | | | | | |
|---|---|---|---|---|---|---|
| Overall Model F | 3.69 | 1.95 | 3.58 | 15.18 | .93 | 7.01 |
| Adjusted R Square | .68 | .43 | .67 | .92 | -.06 | .83 |

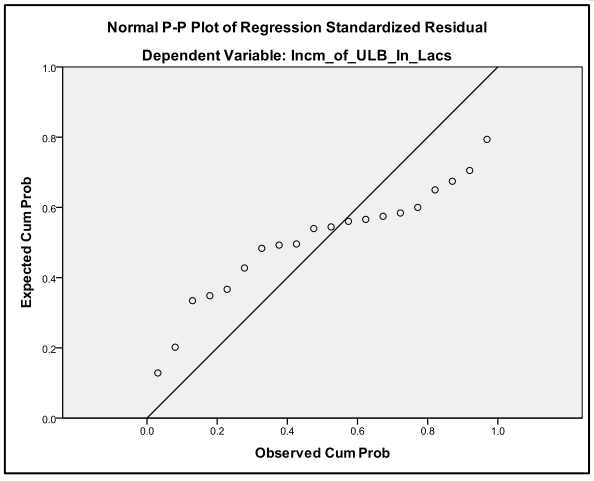
Table 6.4: Smart City Profiles and ULB Performance: Pooled Regression (Model-2)

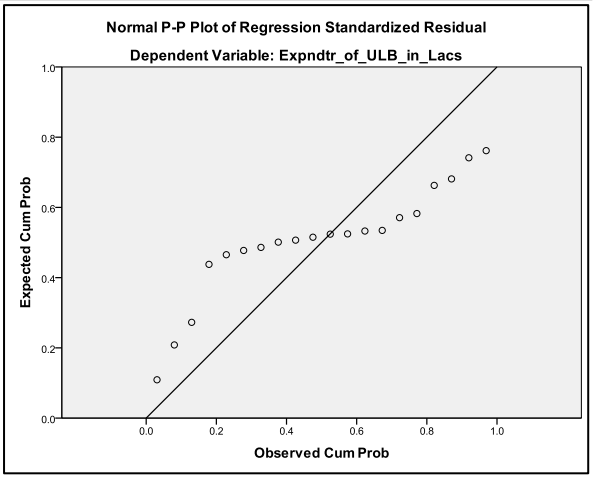
The above table elaborates the impact of the predictors on the ULB's Performance Indicators after entering the set of control variables into the regression analysis. This has increase the impact of Population Growth in % with almost double the units on ULB's Income i.e. every unit increment in Population Growth % will increase the 187213.25 units in the ULB's Income. Similarly, the impact of Working Age Group has been drastically changed from negative to positive with 137510.45 units on ULB's Income. Further, the ULB's Income has been positively regressed by most of the Control Variables in this study. Equally, Approved Project Cost of ULB has also been positively regressed by many predictors in the study. Likewise the Model-1 study, all Model F value represents the positive indication about the collective impact of all predictors on all Performance Indicators Variables of the Smart Cities under the study. Adjusted R Square also represents the positive values for all Performance Indicators except Housing with Banking Facility.

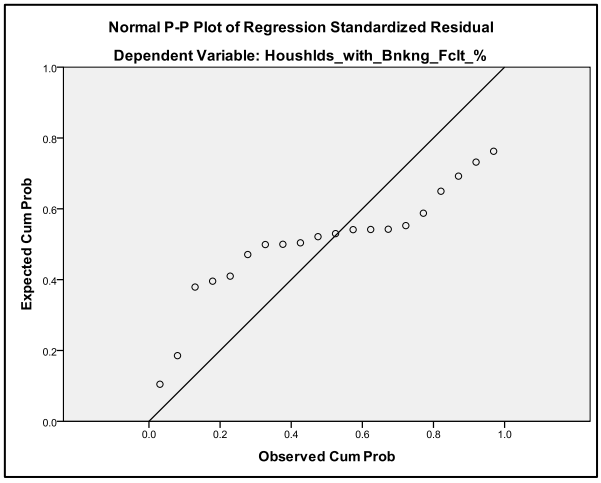
Further, below are the charts showing the Normality of Error of the Pooled Regression for all DVs.

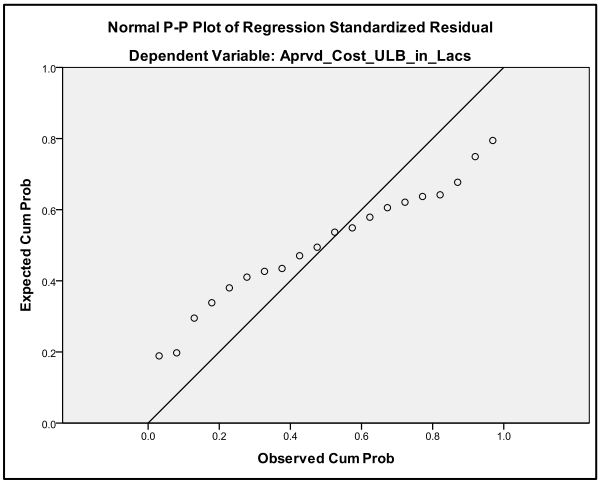





Interpretation: Thus, while running the pooled regression analysis for all DVs, all the above normal Probability (P-P) Plot of the Regression Standardized Residual roughly follow a straight lines so they do not violate the assumption of Normality of the test in the case of ULB's all Performance Parameters as Dependent Variables of the study.

*4) One Sample T–test of Smart City Profiles & ULB Performance – All Variables:*

| One-Sample Test | | | | | | |
|---|---|---|---|---|---|---|
| Variables | Test Value = 0 | | | | | |
| | t | Df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference | |
| | | | | | Lower | Upper |
| ULB's_Prprty_Tx_Cvrg_% | 19.59 | 19.00 | .00 | 82.66 | 73.83 | 91.48 |
| ULB's_Prprty_Tx_Clctn_% | 33.67 | 19.00 | .00 | 82.00 | 76.90 | 87.10 |
| Incm_of_ULB_In_Lacs | 1.67 | 19.00 | .11 | 165784.06 | -42449.76 | 374017.87 |
| Expndtr_of_ULB_in_Lacs | 4.46 | 19.00 | .00 | 68144.92 | 36145.67 | 100144.17 |
| Houshlds_with_Bnkng_Fclt_% | 17.47 | 19.00 | .00 | 67.37 | 59.30 | 75.44 |
| Aprvd_Cost_ULB_in_Lacs | 3.80 | 19.00 | .00 | 102445.64 | 45970.01 | 158921.26 |
| Ppltn_in_000 | 4.02 | 19.00 | .00 | 2307.59 | 1104.73 | 3510.45 |
| ULB's_Ppltn_% | 13.98 | 19.00 | .00 | 70.83 | 60.23 | 81.44 |
| Ppltn_Grwth_Rate_% | 4.98 | 19.00 | .00 | 2.01 | 1.17 | 2.85 |
| Area_of_City_Sq_Km | 3.91 | 19.00 | .00 | 277.25 | 128.99 | 425.50 |
| Wrkng_Age_Grp_15-59_% | 139.47 | 19.00 | .00 | 67.37 | 66.36 | 68.38 |
| Wrk_Prtcptn_% | 45.22 | 19.00 | .00 | 36.63 | 34.94 | 38.33 |
| Self_Emplymnt_% | 17.82 | 19.00 | .00 | 38.77 | 34.21 | 43.32 |
| No_of_SEZ_in_City | 3.91 | 19.00 | .00 | 4.90 | 2.27 | 7.53 |
| Houshlds_with_Wtr_Accss_% | 23.69 | 19.00 | .00 | 81.41 | 74.21 | 88.60 |
| Houshlds_with_Elctrct_Access_% | 145.16 | 19.00 | .00 | 96.99 | 95.59 | 98.39 |
| Houshlds_with_Tlt_Fclty_% | 42.93 | 19.00 | .00 | 85.19 | 81.04 | 89.35 |
| Houshlds_with_Drng_Cnctvt_% | 56.59 | 19.00 | .00 | 90.48 | 87.13 | 93.83 |
| Houshlds_with_Onrshp_% | 16.87 | 19.00 | .00 | 59.89 | 52.46 | 67.32 |
| Houshlds_with_Cmptr | 13.55 | 19.00 | .00 | 25.28 | 21.37 | 29.18 |
| Houshlds_with_Mobile | 53.29 | 19.00 | .00 | 63.82 | 61.32 | 66.33 |
| T-test is significant at level of .05 (2-tailed). | | | | | | |

Table 6.5: T–test for comparison of All Kinds of Variables of Smart Cities:

Table no. 6.5 shows assorted differences in the T – test values between the entered and studied variables of the Smart Cities Profile Parameters as well as their Performance Indicators. Whereas, the T-test values of most of the variables of these three subsets of Variables of the study find no difference among themselves. This finding rejects the Hypothesis H4 and hence it infers that there is no significant difference between the mean proportions of studied variables except that in Income of ULB in Lacs with .11 as the significance value of all these subsets.

## VII. FINDINGS & CONCLUSIONS

### *A. Findings:*

Overall result of the above analyses indicates that the Predictor Variables 'Population in '000', 'Population Growth Rate in %', Working Age Group in 15-59 %', and 'No. of Sanctioned SEZs' establish very positive correlation with most of Dependent Variables in the case of Multiple Regression Analysis. This results confirm the Hypothesis H1, H2, H4, and H6 as not to be rejected stating that the all these Predictors are significantly and positively related to the Smart Cities' Performance.

In the case of 'Area of City in Sq. Kms.', and 'Self Employment in %' set the negative correlation with most of the Dependent Variables in the case of Multiple Regression Analysis. This results confirm the Hypothesis H3 and H5 as rejected stating that the all these Predictors are significantly and negatively related to the Smart Cities' Performance.

While, referring the result of the Pooled Regression from the above table, it is understood that only Predictor Variable 'Population in '000' 'Population Growth Rate in %', and 'Working Age Group in 15-59 %' establish very positive correlation with most of Dependent Variables in the case of Multiple Regression Analysis. This results confirm the Hypothesis H1, H2, and H4, as not to be rejected stating that both these Predictors are significantly and positively related to the Smart Cities' Performance while running the Pooled Regression. In the case of 'Area of City in Sq. Kms.', 'Work Participation in %', 'Self Employment in %" and 'No. of Sanctioned SEZs' set the negative correlation with most of the Dependent Variables in the case of Pooled Regression Analysis. This results confirm the Hypothesis H3, H5 and H6 as rejected stating that the all these Predictors are significantly and negatively related to the Smart Cities' Performance.

Referring last Table 6.5 above, it implies that mean proportion of Smart Cities Profiles variables show no difference among all. On the other hand, the 'Income of ULB' is significantly difference than those of other profiles. Hence, it is the only profile variable not supporting to the Hypothesis H7. Rest of all dependent, independent and control variables also don't ascertain any significant difference among themselves throughout all subsets. Thus, this result also supports the Hypothesis H7.

### *B. Conclusion:*

This paper discreetly examines effectiveness of the most considerable Smart City Profile Parameters falling under all three categories i.e. Demographic Profiles, Economic Profiles, and the Infrastructure Profiles. It is concluded from this examination that these profiles plays very significant role in identifying the Indian Smart Cities. This paper has also covered the extant literatures that divulge their impact on the Smart Cities Performance. This paper investigates the importance of both the Independent Predictors as well as the Control Predictors on their performance Indicators. It further examines the moderating effects of these variables on the city performance of round-1 of Indian Smart Cities. The relationship analysis with the help of selected sets of variables has been otherwise lacking in the previous researches in the Indian context. The major findings of this study are yet to estrange with the literature produced till now by many scholars within India as well as globally.

Finally, it is also found that the 'Households with Water Access', 'Households with Electricity Facility', 'Households with Drainage Connectivity', 'Households with Ownership', 'Households with Computer/laptop', and 'Households with Mobile' plays very significantly in increasing the 'ULB's Income'. These variables also affects to the 'Approved Project Cost of the City' under JNNURM Project. Therefore, it can be concluded that these control predictors have a great role to play as far as the determination and identification of the future Smart Cities of India is concerned.

## VIII. LIMITATIONS & SCOPE OF FUTURE STUDY

### *A. Limitations of the Study:*

The major limitation of the study has been the no. of Cities falling into respective category as identified Smart Cities of India. The study of relationship between selected variables precludes other important parameters as influential variables and their contribution into the developing the Smart Cities. The oldness of the data i.e. for the year 2011, extracted from the Smart City Mission website, has been another constraint of the study. Last but not the least constrain of the study is that the declared Indian Cities are the first set of Smart Cities in India and hence no historical research data are available in the Indian context.

### *B. Scope of Further Study:*

Considering the Indian Smart Cities – round-1 as reliable, pioneer and progressively growing Smart Cities of the Indian Economy and leading to all other Cities of the nation, below listed major scopes of further study are looked forward to be initiated.

To make the detailed study on Indian Smart Cities – round 1 and their performance with latest information to be collected through the primary research.

To initiate a comparative study of Indian Smart Cities with the Smart Cities of advanced countries separately.

The unfold facts of this study may become supportive evidence to the regulatory policies framing and improvement as well as the governance of Indian Cities and Towns for future excellence and competency among the world economy flattering towards healthy and wealthy Smart social and corporate life of the citizens.

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