
Smart Citizens Behaviour – The Core of Smart Cities in India

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“Technology is the answer. But what is the question?” - Cedric Price

‘If you only focus on technology and not on human behaviour, you will not become smart’ – (Copenhagen Cleantech, 2013)

Today ‘Smart Cities’ are acclaimed, all over the world, as the answer to meet the challenges of massive urbanization. Developed as well as the developing countries are embracing the concept of smart cities to effectively meet challenges such as urban sprawl, environment, sustainability, transportation, energy constraints, among other things. India has also began the pursuit of its own vision of ‘Smart Cities’ with the cabinet approval of the Smart Cities Mission with an outlay of Rs. 48,000 crores on 29th May 2015. The curtain was raised for the race of SMART cities in India with the Prime Minister of India launching the ‘Smart cities Mission’ on 25th June 2015.

It is widely acknowledged that there is no universally accepted, agreed definition of a SMART city. Is it when every citizen in India is equipped with a SMART phone? Or is it when Wi-Fi is

freely available in public places through hot-spots? Or is it when all of us are enabled for on-line transactions like paying utility bills, order breakfast or buying anything using numerous apps on our mobiles. Are we smart if we consume only bottled mineral/RO purified water for drinking? It is indeed difficult to give a satisfactory and universally acceptable answer.

Conversely, it is easier to visualize, what a SMART city is NOT or when a city can never think of becoming a smart city. Municipal corporations adopt smart solutions (technology) like ‘Offsite Real Monitoring System’ for effective management of solid waste. Yet garbage piles up everywhere, even in the heart of the city. Public Private Partnerships (PPP) are forged to construct public toilets, which often fetch good advertising revenue to the contractor, but still fail to prevent people from urinating or defecating in open. A

city may have a GIS based property tax information system, yet fails to collect property tax arrears for many years, even from people living in posh colonies/areas of the city. Delhi and other mega cities have smart transportation namely metro and the smart part comes to an end with the metro ride. The reality sprouts once you step out of the metro as pan stained walls, street vendors freely throwing waste, haphazardly parked autos and minibuses, *etc.*, are common sights

The definition used by O P Agarwal, Executive Director, Punj Lloyd Institute for Infrastructure Management, Indian School of Business - A smart city is one that is socially, environmentally and financially sustainable and which strives to minimize waste of resources, like energy and water, in meeting the needs of its residents (PTI, 2015a) is more realistic and applicable in the Indian context. The ultimate indicator of a smart city is 'Quality of Life' (QoL) of their citizens. The Vision Statement of Andhra Pradesh, after the bifurcation on 2nd June 2014 has QoL as the focus (Government of Andhra Pradesh, 2014). Haryana, a state on fast lane in terms of smart city readiness, has identified citizens' readiness, as a key parameter and focuses on citizen centric solutions (PWC & CII, 2015). The 'Draft Policy on Internet of Things' (IoT) places emphasis on building answers for 'What Data will Service the Citizens'. It also adds that the goal should be 'Value Up' and 'Cost Down' (DeitY, 2015). There is

a need to understand how smart city implementation affects the social behavior of citizens towards more efficient and substantial utilization of city resources (Khansari, 2013).

In order to improve QoL the citizens of a city also have a significant and active role. Without change in the behavior of the people who live in the city, a city can never aspire to become a SMART CITY, no matter how many crores of public and/or private money are spent on smart solutions based on technologies such as IoT, Location Based Services, GIS *etc.*, (with mind boggling claims and each claiming better than their rivals) and creating SMART INFRASTRUCTURE. "Citizens, not technology makes a smart city" avers Karuna Gopal, President of Foundation for Futuristic Cities, who launched "Citizens for City" in Hyderabad in September 2009 (Express Features, 2015). One thing is clear: Citizens behavior is core to smart cities. Hence, this paper dwells on smart citizen behavior in light of smart cities in India.

Two major initiatives of the Government of India namely 'Swachh Bharat' and 'Digital India' contribute significantly to the development of Smart Cities in India.

Swachh Bharat

It addresses the ground realities like open defecation; waste management,

water, sanitation and hygiene among others.

Digital India

It is concerned with the aspirations of future India. This programme aims to transform India into a digitally empowered society and knowledge economy. Digital empowerment of citizens means

- (a) digital literacy,
- (b) access to digital resources in Indian languages,
- (c) availability of all documents on clouds,
- (d) collaborative digital platforms for participative governance, and
- (e) portability of entitlements through clouds.

This involves broadband highway for all, universal access to mobile connectivity, public internet access, electronic delivery of services, information for all, training for people for IT sector jobs, targeted mass messaging, public Wi-Fi hot spots, SMS based weather information and disaster alerts. Some of the digital applications/solutions hopefully can contribute to cities achieving the service level benchmarks for Swachh Bharat.

This paper presents a situational analysis with respect to 'Swachh Behaviour' and 'Technology/Digital Behavior' of Indian cities and their citizens. Role of technology and other facilitating and enabling factors and other

interventions for rendering behaviour of citizens SMART are explored. A strategy for smart behavior by citizens is offered.

Situational Analysis

Citizens with smart behavior *i.e.*, Smart Citizens are imperative to the emergence of smart cities in India. Applying basic marketing principles of identifying needs, understanding wants and estimating demand (willingness and ability to pay) for different services and products is the first step in behavior change process of people towards SMART CITIES. Two on-line surveys of consumers' satisfaction with 30 aspects of city life in 2011 and 2012, covering 27 major cities around the world (Ericsson, 2014) identified

- (a) traffic situation,
- (b) the mechanisms for communication with city authorities currently open to them and
- (c) aspects of health as the major sources of discontent. Hence, understanding citizens' needs and preparedness to accept smart solutions/technologies will be critical to their acceptance and optimal usage.

Swachh Behaviour

The situational analysis focuses on four cities *viz.*, Varanasi, Allahabad, Ajmer and Visakhapatnam, whose names were sounded as the first among the smart cities selected in India. It provides information

on the basic services available in these cities, which in turn influence the behavior of their citizens.

Water

Every citizen needs adequate and continuous supply of water at door step to meet various needs like bathing, hygiene, washing cloths and utensils, *etc.* The drinking water should be safe, potable and more importantly affordable. The table below presents the scenario with respect to these aspects of water supply in the proposed four smart cities first to be shortlisted for smart cities. (Table 1)

Affordability

Inability of Urban Local Bodies in India to supply safe water for drinking forces citizen to install water purifiers or to buy bottled water, increasing the cost of drinking water enormously.

Equity

Does supplying 135 lpcd, the service level bench mark set by the Government of India, makes a city smart? For example with about 280-300 lpcd, Delhi, as a city, ranks highest in per capita availability of water. However, the standard for different target groups vary widely – for (a) planned colonies is 225 lpcd; (b) resettlement colonies and urban villages it is 155 lpcd and (c) jhuggi-jhopdi (JJ) clusters it is only 50 lpcd. On the other hand, each room in a five-star hotel consumes on an average 1,600 liters of water every day. The

residence of prime minister, president and ministers consumes about 73,300, 67,000 and 30,000-45,000 liters per day (Singh, 2005). Such disparity in water consumption level by different groups of citizens is neither equitable nor sustainable. Obviously, such a city cannot be smart. Reaching equity and sustainability in a smart city also require significant and widespread changes in consumption behavior of people.

Sanitation

Lack of access to toilets (individual, community or public) is a major reason for people defecating in the open. Not using the accessible toilets is a more important factor. The sanitation scenario of the four proposed smart cities is given in the Table 2.

As a result about 13 per cent of the urban population in India defecate in open (WHO & UNICEF, 2013) resulting in sanitation and health hazards.

Solid Waste Management

Absence of arrangements for door-to-door collection of solid waste by the ULB results in citizens throwing waste on the streets and in open spaces. Lack of segregation of waste at source, especially by the households, render even systematic waste collection ineffective. The waste management scenario of four proposed smart cities is given in the Table 3.

In Varanasi, one of the first in India to be chosen for development as a smart

city, segregation of solid waste is nil and door to door collection covers only 7 per cent of the total population and 4 per cent of the city area (CEPT, 2011, p.95).

Clean Air

Prolonged exposure to Ambient Air Pollution (AAP), with pollutants such as sulphur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O₃) and Particulate Matter (PM₁₀ and PM_{2.5}) leads to increased rates of respiratory disease, chronic obstructive pulmonary disorder, and lung cancer. PM₁₀ is known to cause severe damage to the lungs. AAP is the fifth largest killer in India. Annual cost of AAP generated morbidity and mortality is estimated at Rs. 1,103 billion or 1.7 per cent of GDP in 2009 (Public Health Foundation of India, 2014). According to a 2014 WHO report, out of the 124 Indian cities monitored 63 (50.8 per cent) cities have critical level (>90) and another 33 (26.6 per cent) have high levels (61 to 90) of PM₁₀. Out of a total of 164 cities in the world with critical levels of PM₁₀, 63 are Indian cities. The air pollution scenario of three of the proposed smart cities is given in the Table 4.

According to the latest sources, Pollution Index of Varanasi is 157 (moderate) on May 1, 2015 and 127 (moderate) on June 27 2015 (CPCB, 2015).

Education

A smart city also means literate and well educated citizens. According to

Census 2011, about 74 per cent of 7+ yrs. are literate. Can India become digitally literate, in spite of illiterate population?

Transportation

Bus Rapid Transport System (BRTS) was adopted by some Indian cities with lot of fanfare and backing by transportation experts. In Delhi, BRTS failed due to a number of reasons. People driving other vehicles use BRTS corridor in peak hours and the traffic police looking the other way is a major cause. Now BRTS in Ahmedabad, which has been acclaimed and has learnt lessons from Delhi, is falling prey to a similar trend. The typical Amdavadi bothers little about the traffic rules devised for BRTS and prefers to pay fines for breaking into BRTS lanes rather than abide by the rules and wait in traffic jams. Cyclists are forced to travel in mixed-traffic lanes as dedicated cycle tracks are unsafe because of broken infrastructure, encroachment by hawkers, squatters and parked cars, as it is in Delhi (John, 2013). With such (unsmart) behavior of citizens, a potential smart solution to solve transportation problems of a city, will be rendered useless.

Technology/Digital Behaviour

Indian citizens are way ahead in Digital Behavior than in Swachh Behavior. An average Indian household may not have a toilet (and freely urinate & defecate in the open) but is more likely to own a mobile phone as shown by Census 2011.

While it took 10 years to reach from 10 to 100 million mobile users, the next 100 million were added in 3, whereas the last 100 million (from 200m to 300m) happened in just one year. India would reach 500 million users before end of 2016 (Desai, 2014). Policy of “calling party pays” (which helps to lower the costs of mobile phone ownership for users who make few outgoing calls); “ultra-low-cost handsets” (that reduce the barrier to mobile phone ownership) and prepaid accounts (enable users to keep their mobile service active with small amounts) have contributed to rapid growth in mobile subscribers in India (Aspen Institute of India, 2008). According to the ‘Internet India 2014 Report’ India is third, just behind the USA, with an estimated 302 million internet user by the end of 2014 of which 190 million are in urban areas. Mobile internet is used by 173 million Indian with 128 million in urban areas (IAMAI, 2014).

Smart Solutions

The illustrative list of the Mission Statement & Guidelines of Government of India (MoUD, 2015, p.6) has six sets of smart solutions viz., (a) e-governance and citizen services, (b) waste management, (c) water management, (d) energy management, (e) urban mobility and (f) others such as telemedicine and tele-education. Smart solutions, which have implications for citizen behaviour, are discussed in this paper as Swachh Solutions and Digital Solutions.

Swachh Solutions

Smart consumption of water and energy (electricity and fuels like LPG and petrol/diesel) are core to Swachh solutions.

Water

From the citizen’s point of view ‘Smart Water’ is continuous (24 x 7) availability of safe drinking water and water supply of acceptable quality for other uses. Simple measures to enable citizens to test the quality of drinking water and guidelines for taking simple and affordable steps, when the water needs to be purified, to make it suitable for drinking make smart water.

Sanitation

Washing hands with soap after going to the toilet and before eating food is one of the simple yet highly effective hygiene solutions. Availability of adequate water is the key to maintenance of public and community toilets, to encourage their usage. E-toilets and bio-toilets are innovative solutions in this regard.

Energy

According to Energy Efficiency Services (EELS) Ltd., use of Light Emitting Diode Bulbs (LED) by households could reduce energy consumption by 88 per cent (as compared to ordinary bulbs) and 50 per cent (as compared to CFLs). The Demand Side Management based Efficient Lighting

Programme (DELP) under which 4 LED bulbs will be provided, each household could save INR 648 per annum in its electricity bill, which is more than the LED bulbs cost. This scheme will result in annual reduction of energy consumption by 504 million units, which thus would be available for alternative purposes (<http://eeslindia.org/DELP-Delhi/> Accessed on 15 June 2015).

Similarly people need to use/switch over to household appliances with energy conserving features that are available today in the market.

Transportation

Smart Fuel

Compressed Natural Gas (CNG) and battery operated personal vehicles are less polluting and more environmental friendly. Payback period of cost of conversion to CNG, of Rs. 40,000 for a private car of an average 50 km run per day is 10 and 7 months in Delhi and Mumbai, respectively. The cost advantage of CNG (at likely price of INR 59.8/kg) over petrol is about 40 per cent and 20 per cent over diesel (AF-MERCADOS EMI, 2013, p.30). Reduction in the gap of price of CNG and petrol / diesel, led to drop in demand for CNG cars in 2013 (Chauhan, 2014). High initial costs, volatile prices of CNG and inadequate fueling stations are some of the barriers preventing people from shifting to or from buying vehicles using alternate

fuels which are more environmental friendly. In the USA, Texas offered a rebate of \$2,500 to motivate its citizen to shift to or purchase qualified alternative-fuel vehicles – CNG, liquefied petroleum gas and electric vehicles (Cunningham, 2014).

Public Transport

Share of buses in all registered motorized vehicles in India fell from 11.1 per cent in 1951 to 0.9 per cent by 2011 (Tiwari, 2012). Safe, convenient, dependable, affordable and environmental friendly public transportation is one smart solution Indian citizens need in the context of smart cities.

Cycle Sharing

It is a flexible form of personal public transport. Rojas-Rueda (2011) affirms that the health benefits from cycling in the bicycle sharing scheme are greater compared with the risks from inhalation of air pollutants and road traffic incidents with benefit: risk ratio 77. In consonance with the spirit of India's National Urban Transport Policy – “moving people, not vehicles” - MoUD brought out a planning toolkit for Indian cities promoting ‘Public Cycle Sharing Systems’. Namma Cycle, in Bangalore IISC campus logged 4500 km in 2012, preventing a ton of CO₂ emissions because 300 liters of petrol were not used and saved 25,000 rupees (<http://www.nammacycle.in/>).

Digital Solutions

NASSCOM (2015) has collaborated with a number of organizations to come out with 'Integrated ICT and Geospatial Technologies framework for 100 Smart Cities Mission. The framework covers (a) physical infrastructure (energy, water, waste, mobility and real estate); (b) social infrastructure (health, education, safety, culture and citizen services); (c) environment (climate change, pollution, disaster management,) and (d) governance (policies, municipalities, operations,). Key issues and challenges have been identified for each smart element (smart energy, smart water, smart mobility/transportation, solid waste management, smart urban planning, smart social infrastructure, smart education, smart public safety, smart citizen services, smart climate change, etc., Accordingly, ICT enablers and smart solutions have been identified for overcoming them. Stanislawski (2014) alleges that new solutions vigorously pushed by ICT companies often fail to deliver the promised benefits – or sometimes any benefits –because they ignore behavioural factors associated with the problems. Even if there are formal policy commitments, behavioural norms or organizational constraints may well be significant.

Smart Water Meters

Adoption of Automated Meter Reading (AMR) technology in Malkapur, Maharashtra for all 4,200 water

connections enabled the municipality to charge households for actual consumption, instead of fixed annual tariff. This helped the utility to earn a profit of Rs. 3 lakh, whereas it suffered a loss of Rs 32 lakh in 2008. Also, citizens will be more prudent in usage of water when they are charged for actual consumption, compared to when they are levied a flat rate. However, Brihanmumbai Municipal Corporation (BMR) faced problems in maintenance and picking up remote meter readings and decided to be more conservative as replacing a stolen/damaged sensor (due to unsmart behavior of people) costs Rs. 5000 (Seth, 2012).

Sanitation and Hygiene

Indigenous technology has been developed for e-toilets, which are portable, hygienically maintained, and eco-friendly by using solar energy. They can be (a) GPS enabled to allow entry to only authorized persons and (b) programmed to clean themselves at pre-determined intervals. They are well ventilated, and have independent water and sewerage systems. They use convergent technologies - electronics, mechanical, web-mobile technologies –are remotely monitored and can adopt multiple revenue options. The insertion of a coin opens the door of the e-Toilet for the user, switches on a light-thus saving energy-and even directs the person with audio commands (Pareek, 2014). Such mechanisms enable citizens use public toilets and avoid open defecation and urination.

Smart Energy Meters

They can help understand and quantify energy use by providing accurate real time data to households on an in-home display about consumption of electricity and low and high demand periods, so that citizens can use appliances in home at times when demand is low and cost is less. The information can also be accessed by the energy supplier remotely. Wide disclosure of energy consumption data could also stimulate favourable changes in behavior. Historical information on energy use and cost will allow consumers to compare current and past use. A load limiter in the smart meter can send command to users to reduce electricity usage when the demand for energy gets out of control. New smart systems would protect consumers from power shutoffs by notifying them about scheduled load shedding/a power outage by sending text messages to a cell phone or to the in-home display on the smart meter. Empowerment of consumers with easy and free-of-charge access to real-time data on historical energy consumption with the help of more accurate individual metering will enable them to manage their energy consumption more efficiently (European Commission, 2014).

e-Governance

In a number of states in India, a number of citizen's services like payment of taxes, applying and obtaining

certificates and licenses etc., are available online either through a central state level portal or websites of respective ULBs. Some of them are mobile based also. One needs to understand the access to and usage of such services by citizens and if it in consonance with the ownership/usage of mobiles and internet. If not, understand the barriers for their more effective usage and plan for overcoming them to encourage smart behavior. New technologies can foster new relationship between local government and citizens. Behavior (acceptance/rejection/apathy) of citizens has significant impact on the services offered using new technologies.

e-commerce

Similarly, while there are a large number of apps and opportunities for ordering/buying numerous things online, how many citizens actually use them. Normally, it is argued that a typical Indian would like to touch and feel the product, be it rice, fruits, clothes or more expensive items like jewelry. Do they see the value addition in terms of time and costs saved compared to going to a store.

e-Health

Tele-medicine/remote consultation enable citizens to consult doctors and other health care staff over telephone/internet/video conferencing to overcome the shortage of qualified medical and paramedical staff, avoid time delay and reduce distance barriers to Quality Care.

m-Health can deliver information (schedule appointments), monitor patients (access blood glucose levels) and offer consultation and advice with a mobile phone or a connected device. Barriers such as poor network (which becomes crucial when you are monitoring a heart patient); security and privacy of health care information, too complex to adopt (such as vast number of languages) need to be understood and addressed to make m-health more acceptable in India. Willingness to pay and a lack of value were cited half as often as other barriers (Lunde, 2013).

e-education

Digital India needs to look for digital solutions which can motivate the illiterate to learn writing and reading and get educated. The differentiating element between digital city and smart city is smart people, who are well educated. New technologies enable virtual education offering benefits like low cost, flexible hours and greater interaction (Resurgent India & CEDAI, 2014).

Smart Behaviour Change Interventions

In light of the above situational analysis and potential smart solutions, desirable Swachh and Digital behavior of citizens and necessary enabling and facilitating environment, which are conducive to the development of smart cities in India are given in the tables below

Swachh Behaviour Change

The Table 5 describes important Swachh behaviours and corresponding facilitators and enablers.

An evaluation in Delhi (Schlebusch, 2010) identified issues coming in the way of wider acceptance of bicycle sharing along the BRT corridor in Delhi. They include (a) the policy of returning the bicycle from the place of hiring, (b) uniform cost and no financial incentive for short trips, (c) need for depositing documents every time and (d) low bicycle occupancy and utilization rate and others. Recently launched Delhi Metro Rail Corporation (DMRC) limited cycle sharing service between the Saket metro station and the nearby Neb Sarai area, addresses some of the limitations of earlier schemes by allowing registered users to check out a cycle using a smart card and ride for a flat fee of Rs 10 per hour (<http://www.cyclesharing.in/delhi-metro-launches-cycle-sharing-pilot/>). In June 2015 the Delhi Development Authority (DDA) formulated a cycle-sharing policy to encourage use of bicycles for last-mile connectivity. It allows a hired cycle to be used and returned by multiple users and uses a smart card, linked to the user identity and accepted by Metro, DTC cluster buses, and in shops. Land-owning agencies will provide lanes for non-motorised transport (NMT) and related infrastructure for ensuring safety and mobility of cyclists and pedestrians (PTI, 2015b).

Digital Behaviour Change

The Table 6 describes important Digital behaviours and corresponding facilitators and enablers.

Technology alone will not be sufficient to change the way people consume energy and smart meters need to be accompanied by some incentives and support systems to make us change our behavior according to Christie, coordinator of the Sustainable Lifestyles Research Group at the University of Surrey (Portilla, 2013). However, Nunes (2014) argues that using only economic incentives may not lead to a considerable and lasting consumption behavior in the context of smart grids and recommends creation of emotional incentives. Awareness and trust are crucial to induce customers to trigger a different behavior. The six Es of emotional incentives are explore, experience, ease, exemplify engage and empower.

Communication Strategies

The Behaviour Change Communication (BCC) should focus on using multi-media for making people aware of need for change, availability of smart solutions and the benefits that would accrue to them due to adoption of new technology and consequent smart behavior. This should be followed by use of citizen groups for disseminating information as well as use of the peer pressure. Finally, Inter Personal

Communication to motivate people for actually adopting the new technologies and behavior. Demonstration of various tools and application, at places where people still are using manual methods; and enable users to tryout the methods also will be useful for early adoption of technologies and behavior change. Information needs to be communicated through user-friendly platforms using multi-media.

Sustenance of changed behavior will depend on how successful the smart solutions are, in delivering the tangible benefits, promised by them and people enjoy the rewards of behavior change advocated.

Citizen Consultation and Participation

Citizens in Chennai carried GPS units while travelling in buses to help Transparent Chennai in mapping routes (Governance Knowledge Center and One World Foundation India, 2010). Another important behavior change of citizens is actively participating in the consultations, development and implementation of smart solutions for the building of smart cities. The cities should make necessary provisions for participation such as easily accessible platforms and by giving feedback and encouragement.

Crowd-sourcing is an important means of encouraging citizens to report issues related water, electricity, waste, bad roads, dysfunctional street lights etc., which need urgent attention from authorities.

Smart City Champions

There are a number of unifying factors behind these “city champions.” Citizens are empowered through active participation to create a sense of ownership and commitment. Participative environments, in turn, facilitate and stimulate businesses, the public sector and citizens to contribute.

Regulatory and Penal Mechanisms

Punishing the people who are responsible for littering waste, polluting air with high levels of emission, can also work, when the fines are very heavy compared to the benefit they get by not behaving smartly like urinating and defecating in the open; dumping waste on roads and in open spaces, not segregating waste; not paying user charges, water and electricity bills, etc., In case of violations like private vehicles using BRTS corridors, the monitoring and penal mechanisms should be such that the violators think twice before entering BRTS lane again.

Sweden (Swedish Energy Agency, 2014) adopted a gamut of policy instruments to promote smart energy behavior. They include (a) Economic – energy and CO₂ taxes and Eco car subsidy; (b) physical – comprising biking road, road bumps to reduce speed; (c) behavioural - as people are influenced by social norms and by information which is novel, accessible and of relevance to individuals in questions; (d) Information

and Communication (energy labelling for home appliances which supports consumer’s choice and compels manufacturers to manufacture more energy efficient products).

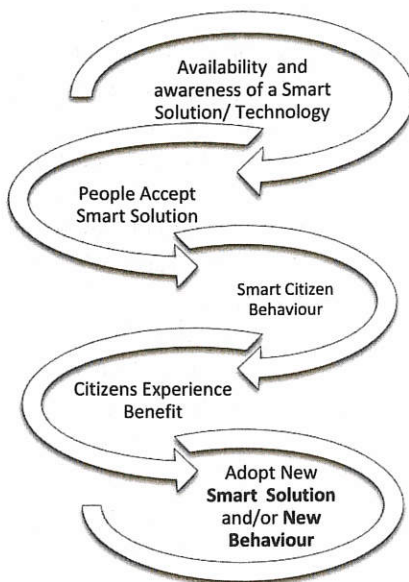
Smart Citizens Traits

Smart citizens share traits such as - take responsibility; value access over ownership, contribution over power; ask forgiveness; know where they can get the tools, knowledge and support they need; value empathy, dialogue and trust; adapt technology, rather adopt it; help the people that struggle; ask questions, then more questions, before they come up with answers; actively take part in design efforts to come up with better solutions; work agile; will not stop in the face of huge barriers; unremittingly share their knowledge and their learning. Smart citizens are those who take action and work with the Government and redefine what “government” actually means Hemment & Townsend (2013). Smart Citizens make consumption decisions based on their real-time energy use (i.e. smart meters) and selecting different travel options based on real-time traffic information (Harrison and Donnelly, 2011).

Technology & Behavioural Change Spiral

In general, people resist change. Hence, it is necessary to understand why they resist change, may it be using toilets instead of defecation in open or switching

to CFL bulbs in place of fluorescent tubes in houses. The causes for resistance vary widely – which could be fear of facing a new situation, or initial costs, or lack of knowledge of benefits, or simple apathy. Hence, analyzing and understanding human behaviour is a key component of any applied research in Smart Cities.



On one hand acceptance of smart technology/solution requires behavior change of citizens and on the other hand use of smart technologies can lead to further behavior changes. In this chain, it is important that the so called smart solutions deliver the tangible benefit promised to the citizens.

For example, adoption of automated water Reading Meter technology, will lead to a behaviour change namely paying for

water they actually consume, rather than a fixed annual tariff. This in turn is likely to trigger another behavior change, namely using water more judiciously as they realise, they have to pay for water, which they also waste. Such acceptance and behavior change is also likely to facilitate acceptance of similar technologies like smart electricity meters.

One needs to be wary of unintended and harmful behaviour changes of ICT implementation also. Bhoomi, an e-governance initiative in Bangalore, which is expected to reduce, if not remove, corruption in land dealings, resulted in some people monopolizing land holdings through rapid access to land records in a newly centralized digital clearing house Townsend (2013). Is this smart behavior that we require in order to build smart cities.

Framework for Smart Behaviour

No amount of water audit or energy audit will help to reduce the problem related to water or energy, when citizens, do not close the tap, when water is overflowing or switch off lights, fans and TV, when not in use or required. In many big government office buildings it is not uncommon to see that all lights are still switched on in the corridors, even after all people have left in the night and the place is locked up. What energy audit will be able to do or what replacement with LED bulbs will save? CCTV monitoring may help to identify a wrong doer, but may

not be able to prevent a crime be it rash driving or molesting a woman, as it will take quite some time, before help arrives. Hence, cities in India need to give top priority to Behavior Change Communication (BCC) and other facilitators and enablers and invest substantially, if they want to become really smart. Change in behavior requires change in thinking of citizens.

A framework for Swachh and Digital Behaviour of citizens in the advent of Smart cities in India is depicted in Figure 1.

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Table 1

S. No.	City	Number of Properties	Water Supply Connections (%)	Per Capita Water Supply (Lpcd)	Water Supply (Hrs.)	Samples Passed Quality Tests (%)	Cost Recovery (%)
1	Allahabad	2,06,874	73	253	10	DNA	81
2	Ajmer	82,000	90	135*	1 to 1.5	DNA	DNA
3	Visakhapatnam	4,44,667	85	100-110	1	100	115
4	Varanasi	1,75,897	69	275	7-8	DNA	61

Note: DNA – Data Not Available; * - supply status. Availability to end user is lower; *lpcd* – liters per capita per day;

Source:

- 1) MoUD (2014). Rapid Baseline Assessment - Allahabad City, p. 35.
- 2) MoUD (2014). Rapid Baseline Assessment - Varanasi City, p. 38
- 3) MoUD (2014). Rapid Baseline Assessment – Visakhapatnam, p. 21
- 4) Government of Rajasthan (2006). City Development Plan for Ajmer and Pushkar, p. 60

Table 2

S. No.	City	Properties	Coverage of Toilets (%)	Coverage of Sewerage Network (%)	Reuse and Recycling of Sewerage Water(%)	Quality of Sewerage Treatment	Extent of Cost Recovery (%)
1	Allahabad	2,06,874	DNA	20	0	DNA	81
2	Ajmer	82,000	DNA	DNA	DNA	DNA	DNA
3	Visakhapatnam	4,44,667	56	26	3	100	60
4	Varanasi	1,75,897	92	31	0	DNA	160*

Note: DNA – Data Not Available; * - Water and sanitation details not segregated

Source:

- 1) MoUD (2013). Rapid Baseline Assessment - Allahabad City – Draft Report, p. 36-37.
- 2) MoUD (2013). Rapid Baseline Assessment - Varanasi City – Draft Report, p. 39-40.
- 3) MoUD (2013). Rapid Baseline Assessment - Visakhapatnam – Draft Report, p. 21.

Table 3

S. No.	City	Properties	Household Coverage (%)	Efficiency of Collection of SW (%)	Extent of Segregation (%)	Extent of Scientific Disposal (%)	Extent of Cost Recovery (%)
1	Allahabad	206,874	50	80	0	100	DNA
2	Ajmer	82,000	0*	DNA	0	0	DNA
3	Visakhapatnam	4,44,667	77	91	0-5	0	26
4	Varanasi	1,75,897	0	80	0	0	0

Note: DNA – Data Not Available; * - Thrown on roadside heaps

Source:

- 1) Rapid Baseline Assessment - Allahabad City – Draft Report, MoUD, p. 37-38
- 2) Rapid Baseline Assessment - Varanasi City – Draft Report, MoUD, p. 41
- 3) Rapid Baseline Assessment - Visakhapatnam – Draft Report, MoUD, p. 22
- 4) City Development Plan for Ajmer and Pushkar, Government of Rajasthan, p. 78

Table 4

CITY	SO ₂	NO ₂	PM ₁₀
Allahabad	4 (L)	24 (M)	218 (C)
Varanasi	18 (L)	20 (L)	127 (C)
Visakhapatnam	7 (L)	16 (L)	71 (H)

Note: L – Low; M- Medium; H – High; C – Critical

Source: Central Pollution Control Board (2012). National Ambient Air Quality Status & Trends in India - 2010, pp 17-22.

Table 5

S. No.	Smart Behaviour	Facilitator	Enabler
A	Sanitation		
1	Use community/ public toilets; pay user charges for their maintenance	Construct public community toilets using appropriate technology (e-toilets; bio toilets)	Moderate user charges and good maintenance of the toilets
2	Segregate recyclable waste. Dispose waste appropriately	Provide bins for segregation. Reliable arrangements for door to door collection, community waste bins	Appropriate user charges. Penalty for violators (Polluter pays is the fundamental principle of India's Environmental Laws and Rules).
3	Wash hands with soap after going to the toilet and before eating food	Access to clean water and cheap soap	School education, multi-media promotion
B	Water		
1	Use water optimally. Boil water before drinking		Incentives for using less water
2	Rain water harvesting	Easy access to material required	Subsidies. Policy measures & Penal mechanisms for those who do not adhere

C Electricity			
1	Switching off lights. TV etc., when not required		Incentives for using less electricity (as in Delhi 50 per cent off the bill if consumption is less than 400 units per household)
2	Use more energy efficient and environmentally friendly household appliances such as refrigerators, washing machines, and microwaves,	Such appliances are manufactured and are easily available.	Such appliances are affordable
3	Replace existing tungsten and mercury based bulbs with LED bulbs	The bulbs are easily accessible as being done in Delhi by EESL, a joint venture of PSUs of Ministry of Power, Government of India	Under the Demand Side Management based Efficient Lighting Programme (DELP) programme in Delhi, 4 LED bulbs are being supplied at an upfront cost of Rs.10 each, to overcome the cost barrier by adopting on-bill financing model.
D Transport & Air Pollution			
1	Switch to vehicles based on less polluting fuels like CNG, electricity	Adequate availability of kits which facilitates the conversion of existing vehicles. Encourage manufacture of such vehicles	Alternate fuels are priced comparatively lower than petrol and diesel. Provide incentives to those who shift such as tax credits as in case of the USA
2	Use public transport (for longer distances), car pooling, use of bicycles (sharing) or	Convenient and safe public mode of transport. Provide safe walking and cycle lanes	Rates are affordable and access is not cumbersome

	walk for first and last mile connectivity		
3	Air Quality - maintaining vehicles properly (e.g., get PUC checks, replace car air filter, maintain right tyre pressure), following lane discipline & speed limits, avoiding prolong idling and turning off engines at red traffic signals.	Monitor and disseminate real time data on AQI based on 'One Number-One Colour-One Description' which enables people to judge air quality.	Inform people as to what precautions to be taken based on the AQI
E	OTHERS		
	Pay municipal tax regularly		Early bird discount for those full amount in the first month of financial year like in Hyderabad

Table 6

S. No.	Smart Behaviour	Facilitator	Enabler
A	Sanitation		
1	Accept and adopt smart water meters Pay for actual consumption (This in turn is likely to modify the water consumption behavior)	Water supply agencies procure and supply smart meters to households to replace existing meters	1. Provide reliable and accurate information about the tangible benefits of smart water meters 2. Make people understand the calculations and that charging according to meters is in the interest of people, as they pay only what they use' (Kulthe, 2012).

2	Test the quality of drinking water	Testing methods are developed which can be easily used at homes	The methods are free or affordable and easily accessible
B	Sanitaitaion		
1	Inform municipality about garbage piling, drains overflowing etc. using mobile based apps	Municipalities develop such apps as is done in Karnataka	Such apps are easily accessible on all types of mobilesAction is initiated on the information provided by citizens
C	Energy		
1	Install smart electricity metersChange usage patterns depending on non peak and low cost periods of supply	Electricity distributing agencies procure and supply smart meters to households to replace existing meters	Enable households by offering payment by instalments
D	Transport		
1	Use smart card wherever available for public transport	Smart cards are available	Smart cards are affordable
E	Health		
1	Use monitoring devices for checking blood glucose levels, blood pressure	Such mechanisms are easily available	Such mechanisms are affordably priced
2	Use mobile based systems to schedule appointments, transmit vital data to physician	The health system is equipped to receive such data and provide timely advice to patients	Such mechanisms are easily used on mobiles and are fee
F.	Others		
1	Make use of services like bill/fee payment; certificates/documents offered through e-Governance/ m-governance	e-Governance/ m-Governance solutions are easily accessible	Such solutions are affordable, reliable and secure

Figure 1
Behavioural Change Frame Work for Smart Citizens for Smart Cities

