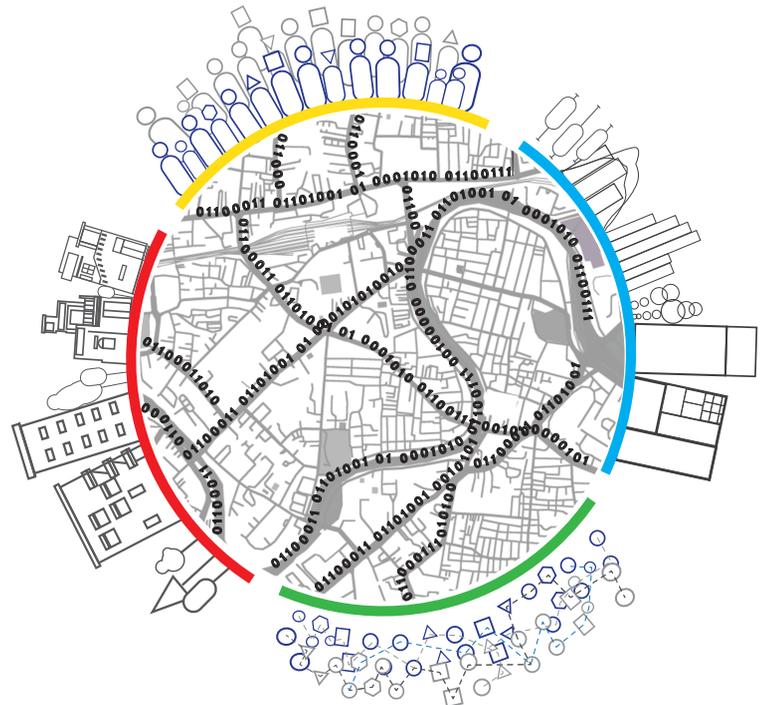




Monitoring Air Quality through Smart Poles

Case of Bhopal Smart City

CASE STUDY 6 | JULY 2019



POWERED BY

TATA TRUSTS

Data Driven Governance

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ABOUT TATA TRUSTS

Tata Trusts are amongst India's oldest, non-sectarian philanthropic organisations. Since its inception, Tata Trusts have played a pioneering role in transforming traditional ideas of charity and introducing the concept of philanthropy to make a real difference to communities. Through grant-making, direct implementation and co-partnership strategies, the Trusts support and drive innovation in the areas of healthcare and nutrition; water and sanitation; energy; education; rural livelihoods; natural resource management; urban poverty alleviation; enhancing civil society and governance; media, arts, crafts and culture; and diversified employment. The Trusts engage with competent individuals and government bodies, international agencies and like-minded private sector organisations to nurture a self-sustaining eco-system that collectively works across all these areas.

ABOUT DATA DRIVEN GOVERNANCE

The Data Driven Governance (DDG) Initiative of the Tata Trusts works with rural and urban decision making systems to enable inculcation of data as a way of life in the planning and delivery of government schemes – thereby creating significant impact for underserved and marginalized communities. This has been demonstrated through deployment of inclusive data and technology processes at district and city levels, through large scale partnerships with governments, central planning entities, foundations and philanthropies such as the Niti Aayog, Ministry of Housing and Urban Affairs and Tata Steel Rural Development Society.

The Urban Engagements under the DDG Initiative of the Tata Trusts provides directed technology and capacity building support to urban administrations at central and city levels through effective fore-grounding of city data policies, data standardization models, implementation of inclusive open data portals, improved civic engagement and skill building of municipal officials in data and technology practices

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CONTEXT

Keywords: Smart Poles, Air Quality, Pollution, Environmental Sustainability, Big Data Analysis, Big Data, Smart Cities, Urban Local Bodies

This case study illustrates how the city of Bhopal has successfully tackled an environmental challenge by installing smart poles in the city to capture data about air quality parameters. Verifiable, real time datasets coupled with analysis has led the city of Bhopal to establish an in-depth understanding of its environmental issues, leading to a spate of initiatives to overcome the same.

This has been put together as a part of the urban engagements within the Data Driven Governance realm of work at Tata Trusts, in partnership with Bhopal Smart City Development Corporation Limited. It is a part of a series of caselets illustrating the meaningful use of data in various city functions. The objective of this series is to showcase best performing data initiatives in Indian cities, while promoting sharing of best practices across cities.

Data Driven Governance at Tata Trusts provides directed technology, strategic and capacity building support to strengthen both rural and urban decision making systems. The objective is to improve government planning and delivery for inclusive development. Employing data centric tools, technology and planning provides insights into quantitative and qualitative development indicators, makes room for informed policy making, measurable performance indicators, facilitates meaningful collaborations and improves overall governance.

With the specific motive to create a 'culture of data' in cities across India, Tata Trusts launched the City Data for India Initiative in partnership with Canada-based World Council for City Data (WCCD) to enable cities to get ISO certified.

ISO 37120 includes 100 indicators structured around 17 themes, including economy, governance, education, health, shelter, transportation, environment etc. This exercise has been implemented in 8 cities, including the city of Bhopal.

This case is based on observations of how the city of Bhopal has used data from smart poles placed selectively across the city and meaningfully utilized aggregation at the Integrated Command and Control Centre to look at important aspects of air quality and particulate matter levels. Since such centers are being set up by smart cities across the country, it would be useful for other cities that are considering such efforts, to examine the process and its impact.

MOVING TOWARDS SMART ENVIRONMENT MONITORING

The Challenge

The [Smart Cities Mission](#) aims to make 100 cities across the country citizen friendly and sustainable. It is an initiative by the Government of India to drive economic growth and improve the quality of life of its citizens by enabling local development and harnessing technology as a means to create smart outcomes for citizens. Each city has a component of setting up an Integrated Command and Control Centres (ICCC). Bhopal, the capital city of Madhya Pradesh, is one of the 100 smart cities.

Bhopal has had a satisfactory level of air quality, but increase in population is leading to rising environmental stress on the city. Vehicular exhaust, untreated open sewage, construction activities, among other causes contribute to air pollution in the city. It has become crucial to balance the environmental limitations of the city with the socio-economic development plans of the city.

In order to reduce the carbon footprint of the city and devise an all-inclusive, sustainable and environmentally sound action plan, there is a need to collect, monitor and analyze data on the air quality of the city. When city objectives are driven by data, they can present opportunities for better governance through early warning systems, timed interventions and responsible scalability of operations.

The Solution

A. Deployment of Smart Poles

400 smart poles have been installed at different locations in the city of Bhopal.

These smart poles have multiple purposes- Wi-Fi hotspots, camera surveillance, electronic vehicle charging, optical fibers, LED street lights etc. In order to maintain good levels of air quality, overcome the problem of data availability and authenticity, and establish a more in-depth understanding of the environmental problem of Bhopal, 100 of the 400 multi- purpose smart poles have been fitted with environmental sensors.

Only 100 out of 400 smart poles have been installed with environmental sensors in order to prevent repetition of data and avoid areas where the variation in air quality will be minimal. The areas were identified by Bhopal Smart City Corporation, in accordance with the information available with the Pollution Control Board sensors about air quality in different parts of the city.

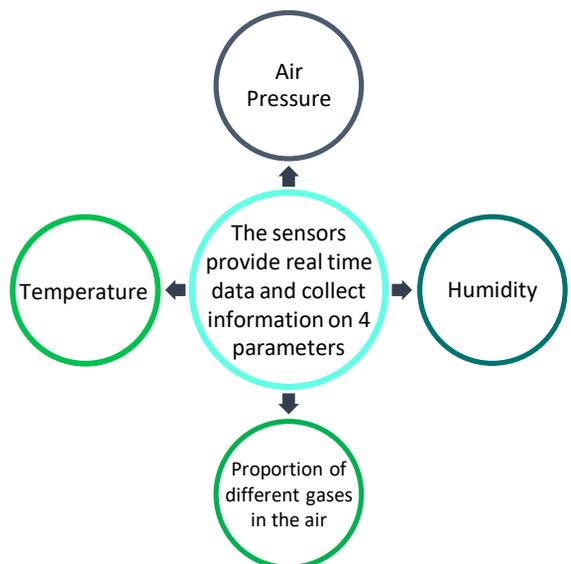


Figure 1: Parameters of air quality monitored by the smart pole

The environmental sensors monitor real time environmental data from identified locations and provide statistics for preventive actions, emergency, immediate actions and long term actions.

B. Implementation Modalities

The environmental sensors in smart poles have been installed across the city, and cover all areas - high & low traffic zones, industrial areas, residential areas. The sensors provide comprehensive and real time data of the air quality in all parts of the city.

The real time data that is collected is passed onto the Smart City Command and Control Centre for it to be monitored centrally as a part of the city's governance strategy framework.

The sensors provide a dual feed: One for centralized command and control display. A Statement of Purpose has been articulated that outlines how data collected will be transferred and utilized through different stages. At the Command and Control Centre, the incoming data is analyzed and if it contains any alarming factors pertaining to air quality and the particulate matter level is higher than the prescribed limit by National Ambient Air Quality Standards, 2009, then an alert is shared with the Bhopal Smart City Corporation by email, sms or phone call depending on the level of urgency.

Bhopal Smart City then shares the data with the appropriate municipal department to action responses. The Command and Control Centre is manned for 24 hours a day.

The other feed is on the smart pole itself, which is installed with a digital board that reflects the data collected for the citizens to view. The colors on the display board change to red, yellow or green depending on the air quality. The citizens can also view the data collected through the Bhopal Smart City app on their phones.

Figure 2 shows the data captured by the environmental sensors. The data captured is location specific and has details about the date and time at which the data was collected. The sensors collect information on temperature, humidity, CO2 concentrate, PM levels an air pressure. Based on this data, appropriate steps are actioned.

The implementation has been through a public-private partnership. The installation, maintenance and repair of the smart poles is done by the private vendor. The data is collected on a minute to minute basis and on the basis of the data collected, it is possible to do a trend analysis for the quality of air in the city.

The data is stored in a cloud based application and is owned by Bhopal Smart City Corporation. It can be used for any public purpose and is available for research and academic purposes upon request after approval from Bhopal Smart City Corporation.

Bhopal Smart City								
SiteName	Hours/Day	Date	Temperature	Humidity	CO2	PM 2.5	PM 10	PRESSURE
10 No Market	0	14-Mar-19 00:00:00	25.22	45.94	417.74	28.09	28.38	960.38
10 No Market	1	14-Mar-19 00:00:00	24.47	45.33	422.68	29.28	30.97	958.81
10 No Market	2	14-Mar-19 00:00:00	24.04	46.40	421.79	25.62	26.23	956.83
10 No Market	3	14-Mar-19 00:00:00	23.17	48.38	422.28	29.70	32.47	956.86
10 No Market	4	14-Mar-19 00:00:00	23.17	51.84	426.48	36.11	40.69	956.63
10 No Market	5	14-Mar-19 00:00:00	22.74	53.23	432.71	38.70	46.56	958.00
10 No Market	6	14-Mar-19 00:00:00	22.10	56.66	437.03	40.70	46.42	958.65
10 No Market	7	14-Mar-19 00:00:00	22.37	55.73	441.80	51.77	63.88	960.09
10 No Market	8	14-Mar-19 00:00:00	25.13	48.67	428.72	51.29	64.10	959.95
10 No Market	9	14-Mar-19 00:00:00	26.66	44.98	417.90	44.23	54.12	959.91
10 No Market	10	14-Mar-19 00:00:00	29.31	38.60	412.75	39.83	47.51	961.17
10 No Market	11	14-Mar-19 00:00:00	30.73	30.40	414.37	30.43	34.23	959.92
10 No Market	12	14-Mar-19 00:00:00	31.04	27.47	413.60	27.28	29.04	959.91
10 No Market	13	14-Mar-19 00:00:00	32.88	23.29	410.10	20.76	22.11	957.73
10 No Market	14	14-Mar-19 00:00:00	32.79	21.31	412.52	14.92	15.97	956.65
10.5 number Chouraha	0	14-Mar-19 00:00:00	25.66	40.57	0.00	0.00	0.00	956.88
10.5 number Chouraha	1	14-Mar-19 00:00:00	25.19	40.98	0.00	0.00	0.00	956.35
10.5 number Chouraha	2	14-Mar-19 00:00:00	24.76	41.49	0.00	0.00	0.00	955.80
10.5 number Chouraha	3	14-Mar-19 00:00:00	24.29	43.02	0.00	0.00	0.00	955.40
10.5 number Chouraha	4	14-Mar-19 00:00:00	23.89	44.31	0.00	0.00	0.00	955.22
10.5 number Chouraha	5	14-Mar-19 00:00:00	23.56	45.76	0.00	0.00	0.00	955.40

Figure 2: Data Captured by the Environment Sensor

One example of how the data can be potentially used: if the environmental sensors capture poor levels of air quality in the mornings while citizens are out on the street for morning walks, the digital board signals the same in red, alerting citizens. Surveillance cameras can assist in problem identification, pointing towards the presence of increased dust particles due to cleaning of streets in the morning, or increased auto rickshaws plying children to school, or any other plausible reason. Accordingly, appropriate actions can be taken.

C. Solution Enablers

This project has been built on a public private partnership model. The private agency provides services and has a monetization model in place for the smart pole for the first 15 years¹. The revenue generated is shared with the Bhopal Smart City Corporation based on a mutual agreement. It is mutually beneficial for the government & the private agency to have a self-sustainable and revenue generating project, which has tremendous potential for creating an improved quality of life for citizens of the city.

The Impact

1. 100 environmental sensors have already been installed. These environmental sensors provide live feeds which are available at the command and control center.
2. 6 other cities in Madhya Pradesh have taken this up and tendered smart poles in their cities.
3. The project is self-sustainable as it entails infrastructure investment and improvement. Further, it includes multiple stakeholders, and has a long term investment model with a revenue model in place for the first 15 years. It can be replicated and scaled in any other city / area in the same city .
3. Technology enabled interventions such as smart poles offer the potential of developing pro-active solutions to reduce particulate matter, and other harmful pollutants which can drastically improve the quality of life of citizens in a city, by reducing respiratory diseases, improving lung capacities, increasing longevity and the like.
4. Such datasets are currently benchmarked against the National Ambient Air Quality Standards, and have the possibility of being benchmarked against air quality levels in similar cities nationally and internationally. This provides insights on what leading cities are doing in order to increase environmental sustainability and reduce pollution levels, and can bring in replicability of best practices.

Lessons Learned

1. The execution of a smart pole is a time intensive activity. In order to achieve maximum benefits of the installation, it is crucial to choose representative sites for installation, such as industrial and residential zones, low and high population areas and the like.
1. The data insights from the smart poles would offer higher value when triangulated with the sensor results from the Pollution Control Board, and any other private or research entity offering IoT installations in other locations in the city.
5. The Integrated Command and Control Centre (ICCC) is an important tool in the hands of the municipal administration, to not only collect data or utilize for disaster related surveillance, but also to be leveraged in a comprehensive manner for city level planning and decision making

Endnotes

1. Modes of monetization of the smart pole include: (i) Monetize cellular sites through mobile towers on smart poles (ii) Host advertisements (iii) Public hotspots, after 20 mins or exhaustion of 200 mbps, whichever is higher, data becomes chargeable (iv) Other methods.

Abbreviations

ICCC	Integrated Command and Control Centre
ISO	International Organization for Standardization
PCB	Pollution Control Board
NAAS	National Ambient Air Quality Standards
ULB	Urban Local Body
WCCD	World Council for City Data

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