TOILET BOARD COALITION

SMART SANITATION CITY

The Sanitation Economy at City Scale

A THOUGHT PIECE FROM THE TOILET BOARD COALITION
IN PARTNERSHIP WITH THE PUNE MUNICIPAL CORPORATION & PUNE SMART CITY, INDIA
NOVEMBER 2018

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THE FUTURE OF SANITATION IS

SMART

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INTRODUCTION

Smart Sanitation Cities present a significant opportunity to design future sanitation systems leveraging Smart City growth trends to address the global sanitation crisis

The Government of India is investing $7.3 billion in 100 Smart Cities[1]

Smart Cities are reinventing how we design cities of the future. By 2050 68% of the world's population will live in cities[2]. Rapid urbanisation is leading to smarter cities that improve the lives of citizens through technology. **Yet sanitation is rarely considered as a priority in smart city strategies.**

In India, the Government's Smart Cities Mission launched in 2016 seeks to develop 100 cities across the country making them citizen friendly and sustainable. There is a focus on efficiency, improved public services, goods, spaces, and modernisation of pubic services. At the same time, in 2014 the Government of India launched its Swachh Bharat Mission with the objectives of eliminating open defecation through the construction of household-owned and community-owned toilets, while establishing an accountable mechanism of monitoring toilet use. Linking the two national priorities presents a unique opportunity to make the sum greater than the whole of its parts. **By linking Smart City and Clean India initiatives, we can boost economic growth, while addressing the sanitation crisis - and contributing to the Sustainable Development Goal 6.2 for universal access to safely managed sanitation.**

Pune Smart Sanitation City Steering Group

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The Sanitation Economy is estimated to be a $62 billion market annually in India by 2021[3]

Smart Sanitation is a new way of looking at sanitation designed for cost recovery, revenue generating business opportunities and future system resilience. It leverages innovative technologies based on the collection and monitoring benefits of real-time data that are already reshaping most industrial sectors via the Fourth Industrial Revolution[4]. Sanitation is no different – it too can be transformed by technologies such as the Internet of Things (IoT), and Artificial Intelligence (AI). The Smart Sanitation Economy – part of the Toilet Board Coalition's transformative vision of the Sanitation Economy – puts sanitation systems at the centre of a reservoir of data and information that has been virtually untapped, and that could un-lock new insights about human health and behaviour.

There is an opportunity now for business, city and technology leaders to adopt SMART SANITATION in SMART CITIES to add additional value and growth into the future.

The Toilet Board Coalition (TBC) and the Pune Municipal Corporation (PMC) are collaborating to develop the roadmap for the world's first Smart Sanitation City. This report presents interim findings, half-way through that 21-month project.

Pune Smart Sanitation City Steering Group

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FOREWORDS

From the CEO of Pune Smart City

Pune Smart City Development Corporation Limited's (PSCDCL) vision is to transform the area of Aundh-Baner-Balewadi (ABB) in Pune, into a model Smart City area, through groundbreaking, innovative and novel waste management initiatives. A number of strategies are being implemented in parallel to fulfill this vision:

Sanitation: providing smart, clean and accessible public and community toilets to the resident and floating populations.

No visible waste: to clear waste from streets, chronic spots and containers as fast as possible.

Zero-waste policy: to significantly minimise the movement of waste from ABB to landfill by adopting in-situ composting, neighbourhood level conversion, and specialised processing of segregated waste.

Boosting efficiency: leveraging mechanisation IT, Internet of Things (IoT), Smart City Operations Centre etc. to improve efficiency and accountability. Advanced Management Information Systems and analytics to improve decision making.

Through its association with the Toilet Board Coalition (TBC), Pune Smart City has access to leverage and to discover leading solutions and technologies worldwide. Moreover, TBC has been instrumental in galvanizing the global scientific and corporate R&D community to invest in the scientific research of novel IoT based solutions and its implementation in Pune Smart City.

We welcome this interim report and look forward to the final conclusions in 2019.

Rajendra Japtap
CEO Pune Smart City

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PUNE SMART CITY DEVELOPMENT CORPORATION LTD.

From the European Space Agency

The European Space Agency (ESA) Business Applications Group has partnered with the Toilet Board Coalition (TBC) to assess the technical feasibility and viability of space-based services in support of sanitation for developing economies, and will establish a roadmap for service implementation through potential follow-on demonstration projects.

We see the domain of sanitation as an exciting area for the utilisation of space technology. Space assets integrated with terrestrial technologies can be an instrumental tool to addressing sustainable development.

Through our collaboration the ESA and TBC seek to explore the following sanitation system use cases with the utilisation of space technologies:

Smart Sanitation and Circular Sanitation Economies require in-situ (sewage/soil/water) sensors communication to data repositories; the remoteness of the targeted rural areas calls for networks based on **Satellite Communications (SatCom) or hybrid terrestrial-SatCom solutions**.

Toilet, Smart and Circular Sanitation Economies all require a great deal of environmental (landscape/land use, environmental risk, and water quality) and socio-economic data (number of households, size/growth of settlements and industrial activities) that can be provided from **Satellite Earth Observation (SatEO) imagery**.

Satellite Navigation (SatNav) can be used to geo-reference collected in-situ sensors' data in order to support geospatial processing.

Human Space Flight spin-in technology in the areas of water recycling and sanitation **(Melissa mission)** is a candidate smart sensor solution for both smart sanitation and circular sanitation cases.

Our first tender has been launched in Q3 2018. Successful applicants will enter into a 12 month feasibility study in 2019 with the ambition to create demonstration projects thereafter.

Davide Coppola
Downstream Business Applications Department,
European Space Agency

esa
European Space Agency

WHAT IS A SMART SANITATION CITY?

Sanitation as a big data opportunity

Smart Sanitation is a critical component of the Sanitation Economy – one of three mutually reinforcing "economies" (see opposite) that together make this a transformational model for sanitation. A key underlying principle of the Sanitation Economy is that sanitation is not a system apart, but an integral and visible part of wider infrastructure, services, and resource flows. When the Sanitation Economy is applied in a Smart City, the natural consequence is a single integrated model - the Smart Sanitation City.

A Smart Sanitation City expands the scope, of a Smart City to include sanitation systems. Sanitation can be included in Smart Cities' architecture through data monitoring of public and community toilet usage, sewage treatment operations, infectious disease circulation and other health indicators. It is the vision of the Smart Sanitation City that enhanced data collection will enable more efficient decision-making that will lead to cost savings for the city and revenue generating opportunities in partnership with the private sector.

At the centre of a Smart Sanitation City is the citizen. Smart sanitation is designed to provide information to make a citizen's daily life not only easier, but healthier as well. As governments and cities optimise sanitation solutions and have access to real-time data on all aspects of the system-creating a new sanitation intelligence - the citizen benefits from an environment that is clean, safe and sustainable.

What do we mean by Toilet Resources?
Human waste needs a new name. Containing nutrients, energy, water, and even providing data, these materials have real value. The Toilet Board Coalition has adopted a new name – **Toilet Resources.**

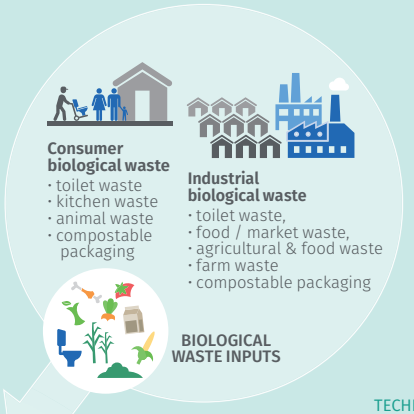
Toilet Economy
The Toilet Economy includes the toilets and the systems for maintaining them, for all contexts and incomes, together with a range of related products and services. The toilet collects Toilet Resources that can be reused as resources within the Circular Sanitation Economy, and acts as an interface to capture data about the user as part of the Smart Sanitation Economy. Data from toilets informs the users, operators, and other businesses, improving the user experience and operating efficiency, and widening the range of potential services.

Circular Sanitation Economy
The Circular Sanitation Economy connects the biological cycle, recovering nutrients, water and Toilet Resources creating value-adding products such as renewable energy, organic fertilisers, proteins, and more, and catering for multiple forms of biological waste. With the addition of digital technology, not only can Sewage Treatment Plants (STPs) increase their operational efficiency and yields of usable products, but also efficiently access markets for these products. Resource flow monitoring can input to re-use strategies that can provide a pathway towards cost recovery of sanitation infrastructure and new revenue streams.

Smart Sanitation Economy
The Smart Sanitation Economy aims to connect the information from sanitation systems to people making decisions, whether they are treatment plant operators, government, sanitation business operators, healthcare workers or individual citizens. With access to more information, such as footfall traffic of public toilets or nutrient and health indicators within Toilet Resources, each group of stakeholders can make more informed data-driven decisions.

THE SANITATION ECONOMY

Smart Sustainable Sanitation Business Solutions



PRODUCTS

CONSUMER USE DATA
Consumer insights data related to consumer behaviour and product usage. Customer relationship management, marketing, advertising and product decisions

HEALTH DATA
Nutrition & health data informs public health, the healthcare community , and individual users of health status, disease and pharmaceutical use

SYSTEM OPERATIONS DATA
Manufacturers, operators, and service companies can access status information to inform the need for maintenance, repair, cleaning, waste collection, etc.

DISTRIBUTION
Relevant data is communicated back to the user through mobile applications and services

User Experience & Product Apps Designed for Information Capture

Toilets & Products Designed for Reuse of Resources

SMART SUSTAINABLE SANITATION FOR ALL

SOFTWARE/DATA PROCESSING & ANALYTICS
Sensor sends molecular characterisation data to cloud based cognitive computing platform where data is analysed and organised

SMART SANITATION ECONOMY

Efficient Transparent Decentralised Systems with Functioning Re-Use Markets

CIRCULAR SANITATION ECONOMY

SENSORS & DATA TRANSMISSION
Sensors in household, business, community and public toilets capture molecular characterisations of waste and transmit data through connected networks and devices

COLLECT & TRANSPORT
Collection of biological waste
· human waste
· food waste
· agricultural waste
· farm waste

PROCESSING
Resource recovery plants process and refine the collected waste through various technologies to produce safe valuable products.

HOMES, BUSINESSES, FARMERS, MANUFACTURERS, CITIES
Upcycled products from Toilet Resources are sold back to businesses, cities and individuals to complete the loop.

TECHNOLOGIES

ANAEROBIC DIGESTION
WINDROWS
GREENHOUSE
DRYING
DEWATERING
ELECTRIC ENGINE GENERATOR
VERMI DIGESTION

PRODUCTS

ENERGY PRODUCTS
Fuel, electricity, heat
· Biogas for local factories & electricity to the grid
· Bio diesel for transport
· Bio charcoal to replace wood/coal

WATER
Water recovery and purification of wastewater
· Local agricultural irrigation
· Water intensive factory processes
· Further treatment to produce drinking water

AGRICULTURAL PRODUCTS
Compost, organic fertilisers, nutrients such as nitrogen and phosphorus
· Non-food crops: forest free fibre crops, flower crops, etc.
· Food crops

PROTEIN RICH MATERIALS
Such as oils and protein meal
· Protein oils for consumer toiletry goods and potentially cosmetics
· Protein "meal" for pet and farm animal feed

Materials for INNOVATIVE PRODUCTS
· Faecal matter for pharmaceutical (biome) regenerative health products and procedures
· Bio-plastics

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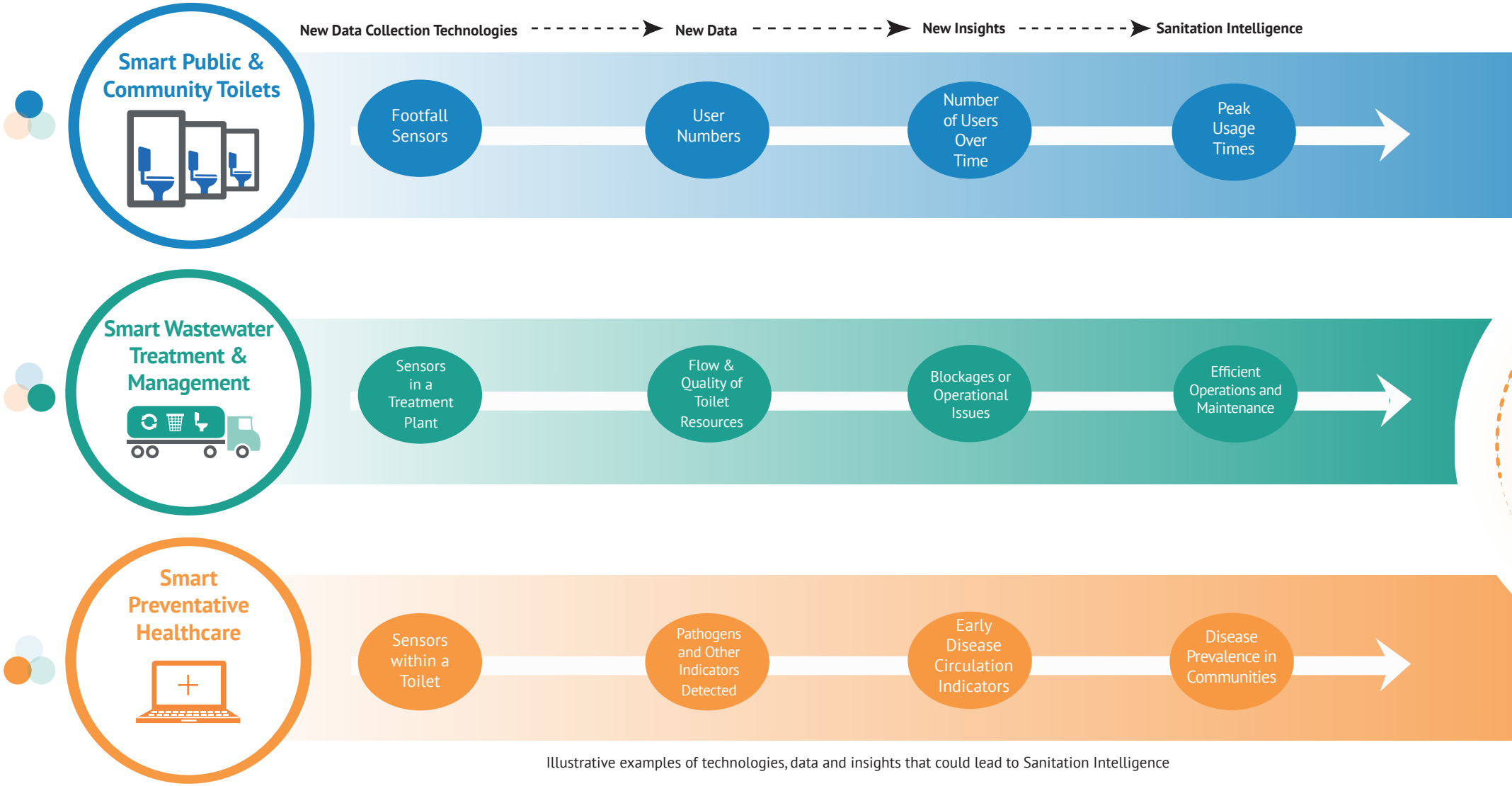
TOILET BOARD COALITION

HOW DOES SANITATION GET SMART?

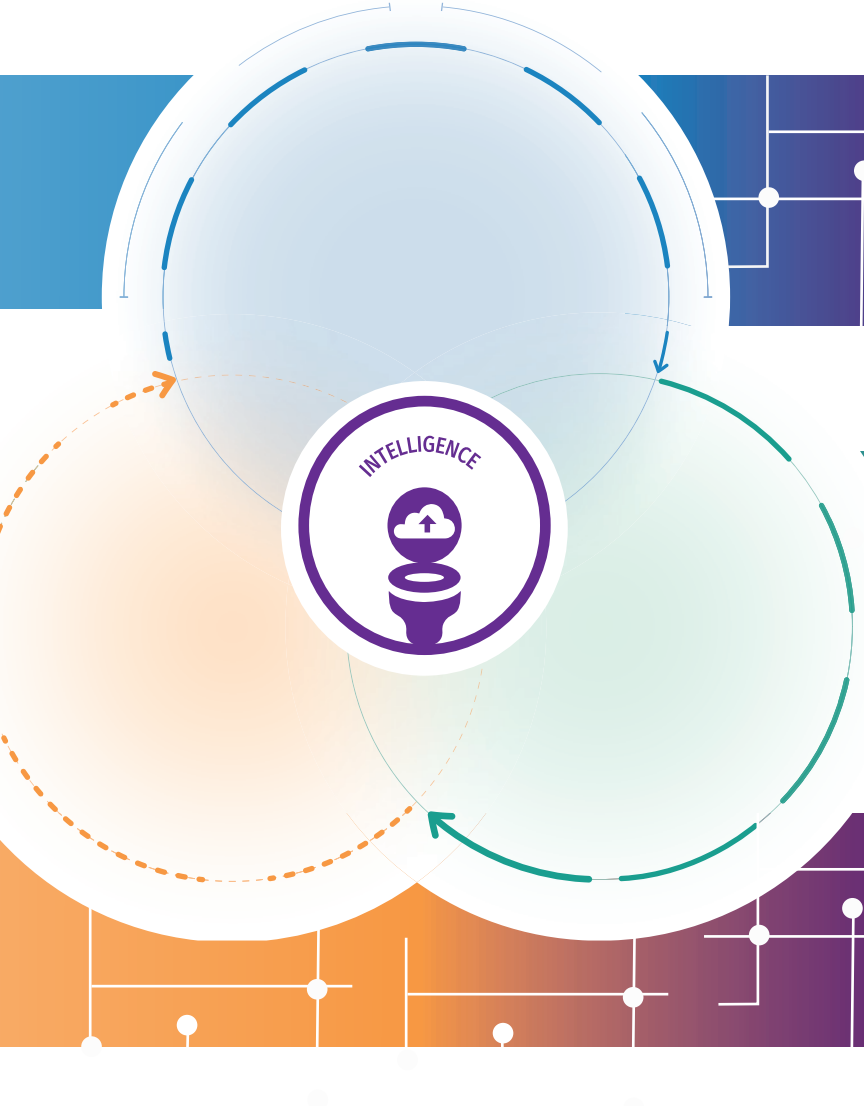
New technologies enabling the collection of new data, feeding new insights, and creating Sanitation Intelligence



Illustrative examples of technologies, data and insights that could lead to Sanitation Intelligence

SANITATION INTELLIGENCE

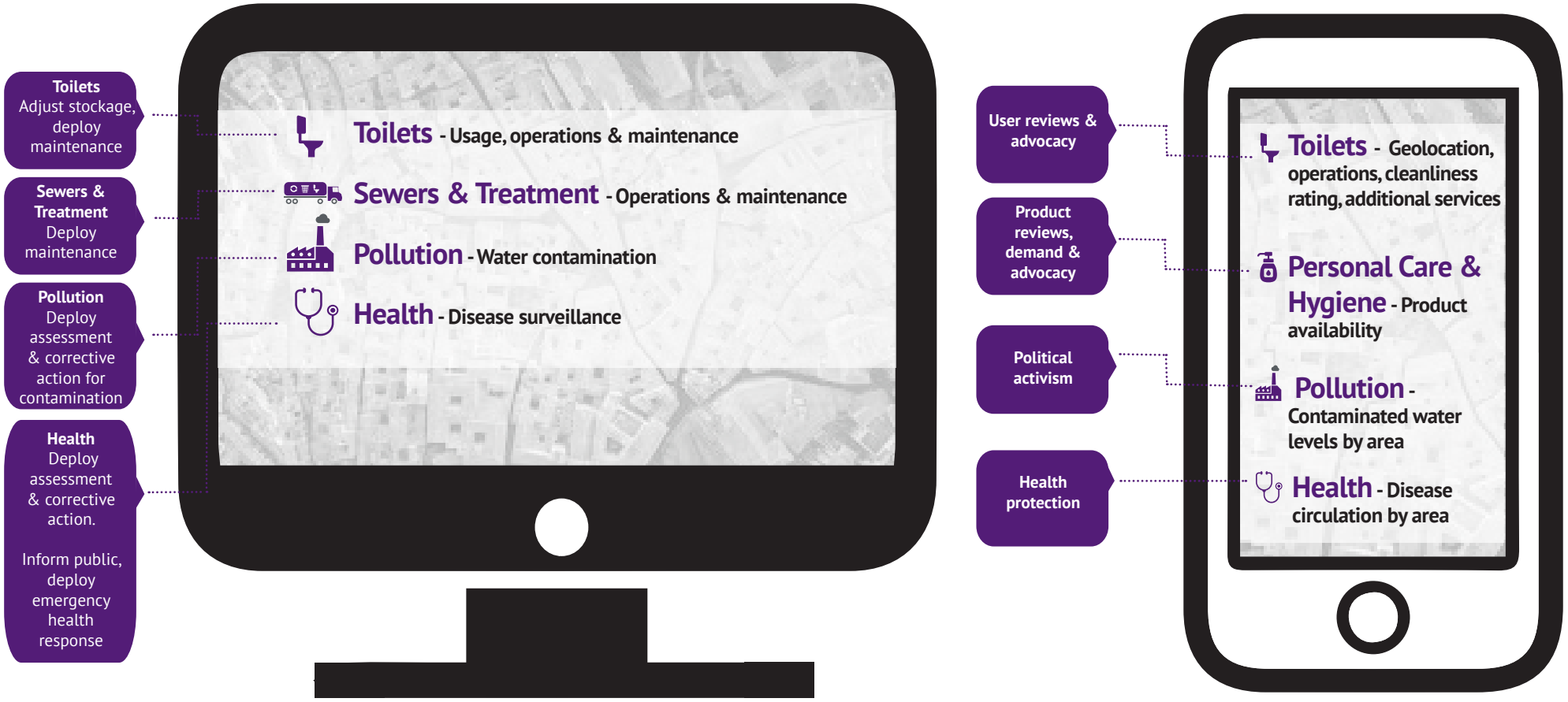
The Smart Sanitation City produces new intelligence for individuals, businesses and city authorities



	Smart Public & Community Toilets	Smart Wastewater Treatment & Management	Smart Preventative Healthcare
Citizen Intelligence	Toilet locations & usage Cleanliness User reviews of toilets Other services available at toilets or via WiFi	Pollution levels Oversight of the city's service provision	Community health information & advice
Business Intelligence	Scheduling maintenance Customer usage patterns Consumer insights (products and usage) Demographics of users Advertising seen by users	Efficient operations and preventative maintenance of collection and treatment Ability to more easily manage decentralised systems Quality of Toilet Resources Transport optimization Market demand for re-use products	Individual/community health insights Feedback on medical trials Potential medical product/service needs Sanitation market insights
City Intelligence	Operational status of toilets triggering maintenance and cleaning Increasing toilet usage Increasing Toilet Resource collection efficiency for the city	Increasing Toilet Resource management efficiency Overview of treatment plant operations and performance Pollution levels Location of road transport and roving maintenance staff	Community health indicators Early warning of disease outbreaks Public health information including toilet use, handwashing, nutrition, immunisations

SMART SANITATION DASHBOARDS FOR DECISION MAKERS

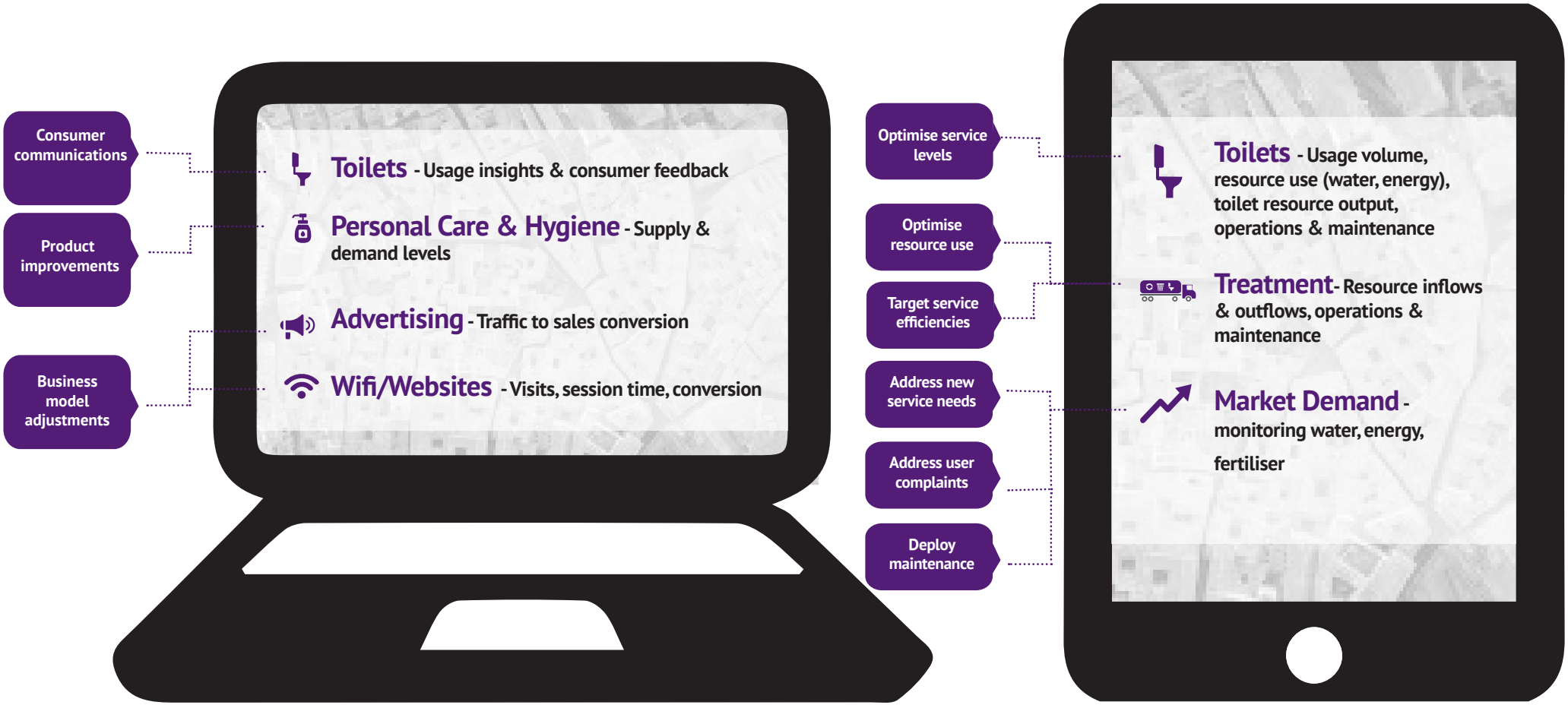
Tailored information informs a wide variety of decisions and responses



Illustrative examples of information for stakeholders via dashboards

City Screen
in the Smart City Operations Centre

Citizen Screen
on their Smartphone



Business Screen
in the Marketing Department

Operator Screen
in the Control Room

BUSINESS OPPORTUNITY IN A SMART SANITATION CITY

Extending far beyond traditional sanitation services

Smart Sanitation is a new way of looking at sanitation designed for cost recovery, revenue generating business opportunities and future system resilience.

Smart Sanitation embodies the **disruptive effect of new digital technologies,** as found in many sectors, from finance to healthcare. As a result it opens up multiple new business opportunities beyond traditional sanitation services.

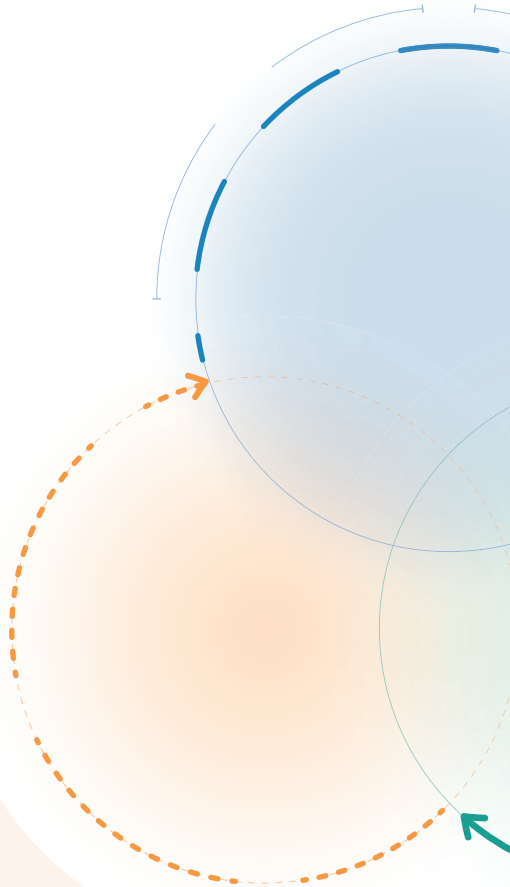
There are three drivers of this expanded opportunity:

New technologies applied to sanitation enable increased efficiencies, new revenue streams, environmental sustainability, and direct citizen and consumer engagement.

Digital sanitation business models create **new sources of value.** New services are made possible by digital capability, in effect adding value to the toilet itself; digital technologies help to monetise the value in the Toilet Resources flowing through the sanitation system; and data itself can have value where it is the vital ingredient unlocking new products and services.

Data capture and monitoring throughout the system offers continuous data streams that can be a game-changer, revealing previously unknown information. This feeds **new insights** such as what is in our Toilet Resources, what they can be used for, where they go after treatment, and what they can tell us about our health. This new information can lead to new products, services, access to renewable resources, and preventative health interventions.

Applying these drivers in a Smart Sanitation City opens up three new business opportunities. Each goes beyond traditional sanitation operations and services, and beyond the perspective that, for business, sanitation is mainly a matter of Corporate Social Responsibility (CSR).



The Smart Sanitation Economy.

Preventative Healthcare leverages new trends in healthcare, for example in genomics, based on digital technologies. **The sanitation system, as a source of data, becomes an early warning system for health, generating value through more efficient and effective health services.** Early use cases are focused on efficiencies in healthcare delivery and more precise and tailored medications. Sensors applied directly into Toilet Resources via the toilet, sewage system or treatment plant enable the monitoring of basic health indicators, biomarkers and infectious disease surveillance. Environmental sensors deployed outside or around the toilet enable the monitoring of environmental conditions such as moisture, heat, or vector activity that can also be linked to health indicators.

The Toilet Economy.

Smart Toilets leverage the importance of toilet use as an element of consumers' daily lives. **The sanitation system, as a source of consumer insights, can shape understanding of hygiene and health, generating value by informing innovation in new products and services.** Toilets equipped with wifi and smart city sensors enable both the continuous capture of consumer data, and the provision of multiple additional services to be bundled with the toilet.

The Circular Sanitation Economy.

Smart Treatment & Management leverages the abundant biological and water resources captured by the toilet, provided on a continuous and daily basis by the entire population, with the leverage being further enhanced by digital technology. **The sanitation system, as a source of renewable resources, generates value from the resources themselves and from mitigating other waste and pollution problems.** Sanitation can generate renewable energy, re-usable water, feedstock for organic fertilisers, and creates a new biological waste pathway, together building a biological resource system that grows as the population grows. Digital capability enhances efficiency throughout the system, enables more decentralised operations, creates working markets for re-use products, and makes the whole system transparent to citizens, operators, and authorities.

CASE STUDY: PUNE, INDIA

An ideal testbed for Smart Sanitation

Pune is a rapidly developing Smart City with a population of approximately 4 million and a floating population of 200,000 people a day. Nearly 38% of the population lives in slums occupying about 2% of the land[5]. While the city has performed well in the annual Swacch Sarvekshan rankings (ranked 11th in sanitation in 2018)[6] there is much to be achieved in terms of provision of clean, accessible and sustainable sanitation facilities, processing of toilet resources, and introducing new business models for a sustainable and resilient sanitation sector.

Pune generates about 750 MLD (million litres per day) of sewage and has a capacity to process 477 MLD[7]. The Government of India in partnership with the Japanese International Cooperation Agency (JICA) are investing $170 million to create additional treatment capacity of 396 MLD by constructing 11 new sewage treatment plants (STPs). The proposed tenders for these STPs have kept the technology open. This provides scope for proposing innovative technologies which could have various revenue generating streams from the sale of by-products derived from Toilet Resources.

Under the Government of India's Smart Cities Mission, Pune has been one of the fastest moving Smart City developments. Since 2016 Pune has deployed over 200 free wifi hot spots for citizens around the city, and has placed environmental and user sensors to monitor pollution levels, transportation and mobility. Further plans include smart parking, lighting and water metering.

To manage all of this new data coming into the city, Pune has built an elaborate Command and Control System. All data captured from various sensors and monitoring devices placed in the city end up here. This is the place where data becomes information to drive more effective decision-making. It is a large digital map of the city that shows where each sensor is and what information it is telling us. A traffic light system alerts monitoring technicians to areas of the city that may need attention or response to be deployed. **The Toilet Board Coalition has worked with Pune Smart City to have Pune's public toilets also show up on this digital map, enabled by sensors, and feeding in information about toilet usage, environmental conditions in the toilets, and soon disease surveillance and sewage treatment monitoring.**

Pune has the distinction of being one of the world's first Smart Sanitation Cities working in collaboration Toilet Board Coalition.

Pune's Sanitation Needs	Smart Sanitation City Vision
Increase public toilet usage and maintain Open Defecation Free status	Public and community toilets become smart community service hubs, bundling several services together with toilets to attract footfall. Sensor enabled toilets and new technologies ensure optimised operations, maintenance and hygiene, keeping toilets clean, safe, healthy and ready to use.
Reduce the costs of sewage and wastewater treatment and optimise operational effectiveness	Circular sanitation models, applied to Toilet Resource collection and treatment, offset cost of operations with monetisation of the re-use of resources. Metering of Toilet Resource flows enables efficient recovery and conversion to reuse products (i.e. compost, water and energy).
Engage the private sector to deliver services more efficiently	Financially viable and sustainable business models to provide all elements of a smart circular sanitation system.
Monitor top priority public health concerns such as diarrhoea, typhoid, dysentery, diabetes and hypertension	Real-time surveillance for infectious disease circulation via sensors and sampling in public toilets that provide early warning of potential public health outbreaks.

THE PUNE SMART SANITATION CITY PROJECT

A collaboration between the Pune Municipal Corporation and the Toilet Board Coalition

January 2018 – September 2019. The project will produce a roadmap for how to implement a Smart Sanitation City. In the process it will create an integrated demonstration of the Sanitation Economy at city scale.

Workstream	Smart Public & Community Toilets	Smart Preventative Health
Description	Sustainable business models using data to optimise toilet usage and adoption of safe sanitation practices.	Efficient early-warning systems using data from sanitation to drive preventative healthcare.
Initial Data	Average footfall and customer feedback from public toilets for women.	List of diseases reported at PMC hospitals. Environmental data from public toilet blocks such as moisture, temperature, and vector activity.
Current Work in Progress	PMC is partnering with entrepreneurs to pilot various sanitation business models that bundle services to transform public and community toilets to a community hub. PMC will be opening a tender for the maintenance and operation of all public and community toilets in the city. TBC and PMC are exploring further opportunities for city scale and implementation of various business models starting within the Smart City area, to be followed by pan city implementation.	The TBC is starting to build preventative health use cases, with Pune as a potential testbed. A detailed list of most frequently reported diseases at Pune municipal health facilities has been compiled. The project is currently trialing various methods and technologies to detect diseases at the community level, including ambient air quality parameters and paper-based diagnostics. The TBC is currently collaborating with: the European Space Agency exploring the commercial viability of using space technology in preventative health via sanitation as well as Massachusetts Institute of Technology (MIT) research for sensors, sewage robotics, genomics and analytics.

Smart Treatment and Resource Recovery

Efficient treatment and resource recovery systems enabled by operational data.

Operational efficiency of each of the 9 existing STPs and quantity of solid biological waste at each STP.

To better identify business opportunities within Pune city, TBC has commissioned studies to identify and quantify the market size for re-use products from Toilet Resources, including feasibility for processing solids from existing STPs. The findings of these studies could support the bidders of the JICA tender with new smart sanitation solutions. TBC is also working with the Pune Smart City in preparing a tender document for tertiary treatment at one of the STPs within the Smart City area.

Smart Village Toilets and Sanitation Systems

Decentralised sanitation systems made efficient by data flows.

Information collection in progress.

In November 2017, PMC added 11 new villages to its jurisdiction, thereby increasing the municipal boundaries. PMC has selected a survey agency to identify and map the existing sanitation systems in these villages. The PMC has asked TBC to provide inputs to the agency to explore implementation of various decentralized sanitation systems that could lead to business opportunities and reduce the cost of operations for the Municipal Corporation.

Smart Sanitation Data Architecture

A data map specific to sanitation systems - all data points captured from the system and how that data is converted into information for decision-makers.

Toilet usage and environmental indicators captured at the Pune Smart City Operations Centre.

The TBC is helping to develop a detailed data architecture for the project; integrating data - toilet locations, footfall, user feedback, number of wifi users, heat, light, humidity, and other indicators with the Smart City Operations Centre; developing data policy frameworks for data security, storage, and monetization.

SMART PUBLIC AND COMMUNITY TOILETS

A new source of consumer insights

Data could drive new business models for sustainable operation of public and community toilets, transformed into community hubs offering multiple services. By bundling services and selling products driven by consumer insights, entrepreneurs are discovering ways to cover their operating costs. Some services are enabled by wifi and real-time sensors, others informed by ongoing consumer research. Citizens and operators can act directly on the information, and businesses can benefit from new insights for innovation and product development.

toilet integration

Ti: Toilets for Her

Old buses become smart toilets for women

Toilet Integration (Ti): Toilets for Her is a new connected hygiene centre business model concept introduced by the PMC with the help of Saraplast to provide public toilets for women throughout Pune. The Ti Bus is a converted out-of-service city bus that provides a clean and safe pay-per-use facility for women to use in public areas. The Ti business model generates revenue by providing additional services at the public toilet such as laundry and a café as well as selling goods such as sanitary pads and products that provide health information. The Ti bus has proved an insightful new base for consumer research, informing potential new product and service innovation. Ti Bus is beginning to implement sensors with the vision to integrate digital heath and personal care services to provide ongoing value added information to their consumers. Launched in 2017, there are currently ten operational buses in Pune, serving approximately 275 people per day.

Unilever

Suvidha, a Community Hygiene Centre

Laundry services help the finances of community toilets

Developed through local consumer insights, Unilever, with the support of Municipal Corporation of Greater Mumbai and Pratha Samajik Sanstha, built the Suvidha Centre in Mumbai in 2016. It is a pay-per-use toilet facility. The centre also offers a laundry facility, which has been one of the main revenue drivers, while releasing time for women in the community to pursue productive tasks. Grey water from the laundry is treated and used for toilet flushing, reducing the overall water footprint. Users can also utilise shower facilities, and safe drinking water through vending machines. The Centre also provides job opportunities to the local community, employing eight people.

Applying the learnings from Pune Smart Sanitation City, a Suvidha Centre could be enhanced with additional data collection, optimising the operations and revealing further consumer insights.

Rohit Pathak
Global Brand Director, Domestos, Unilever

As the Toilet Board Coalition's work has progressed, more and more evidence has emerged that the Sanitation Economy can transform sanitation and at the same time create business opportunity. This goes beyond CSR projects, and beyond businesses directly providing sanitation products and services, valuable as those are. We're seeing sanitation open up as a new consumer space, a part of consumers' lives where they spend time, and have needs and preferences for a wide range of products and services, and where we can gather data to develop much better consumer understanding. The sweetspot is to meet a fundamental human need for sanitation, especially for the poorest people, to do that in a way which makes sanitation more affordable and sustainable, and in the process to provide growth opportunities for large and small businesses.

Unilever Transform's work with the Ti buses in Pune, part of the TBC's 2018 Toilet Accelerator programme, is a great example. This is helping an innovative local business, Saraplast, to address the particular sanitation needs of women and girls. Our consumer research helps the Ti buses do a better job in meeting these needs, making the business more sustainable and providing new ideas for products and services they could offer, some of them not things traditionally found in a toilet. In a Smart Sanitation City, not only can such consumer data be gathered in a one-off study, but there is a continuing stream of data which can facilitate ongoing research, innovation, and product testing. *Toilets could turn out to be a surprising new hotbed of innovation opportunities!*

Data Enhancing Operational Efficiency

With self-driving cars and vacuums that automatically clean a house, could a public or community toilet clean not only itself but the entire stall? Current toilet automation consists mostly of automatic flushing aimed at creating a more positive experience for the next user. However, community and public toilet models are beginning to incorporate automatic washing that washes the entire base of the stall, reducing the amount of waste that would have to be cleaned by hand. This also serves a dual purpose, by capturing the number of users of the toilet per day. Devices are also being installed in the pipes and water tanks to be able to remotely monitor water levels and potential blockages. This could decrease the number of staff needed to maintain a toilet and improve the response time to maintenance issues, both decreasing operational costs.

GARV Toilets
Efficient Management of Smart Toilets

Smart toilets, in terms of self-cleaning, are becoming more popular throughout India. Located in Delhi, GARV Toilets are stainless steel portable smart public bio-toilets equipped with an RFID-IoT powered mobile app that can tell how many people have used a toilet, the amount of water available and how often the toilet has been cleaned. It is equipped with smart technologies like sensor based flushing systems, which clean the toilet floor and lavatory pan, depending on requirement-post every usage. While GARV Toilets has traditionally been a toilet production and sales company, it is now transforming into a sanitation service company that seeks to provide a rich sanitary experience to urban slum communities through its vandal-proof fabrication and smart design.

SMART TREATMENT AND RESOURCE RECOVERY

Digital capabilities enhancing new and existing facilities

Data could enable more cost-effective collection and treatment systems, enhancing both existing plants and the new facilities needed as a city expands. Operators can use real-time data to run operations with efficient use of resources, citizens can make informed choices based on accurate information on pollution and the performance of their city's infrastructure.

Digital Enablement of the Circular Sanitation Economy

Modern Sewage Treatment Plants (STPs) carry instrumentation and control systems like any industrial process. Pune's new STPs will be equipped with Supervisory Control and Data Acquisition (SCADA) systems. These will enable operational control of the processes and resulting outflows. Beyond operational control, and in the context of a Smart City, what additional digital capabilities will enable and enhance these systems?

With systems serving the peri-urban areas, and also solids treatment, the sanitation system will involve road transport as well as sewer pipes. Some transport will be directly serving the public – for emptying septic tanks. The transport can be planned and optimised using well-established techniques in the logistics sector.

Decentralised STPs could have the disadvantage of inefficient manning. This can be overcome by automating the plant itself, and data capture detecting faults, overflows, etc triggering a maintenance visit.

Markets for water and fertiliser may exist in principle, but are not organised today in a form which the city's sanitation system can reach easily. Digital marketplace solutions could be applied in Pune to trade materials and mobilise distribution.

A study completed in 2018[8] found that, of the total estimated demand for water, electricity and compost for Pune in 2022, reuse products could meet two per cent of the total demand, yielding savings of 42 million USD.

BORDA

Reprocessing Solids from Sewage Treatment Plants to produce Energy or Fertiliser

Pune city generates about 750 million liters per day (MLD) of sewage and has capacity to process 567 MLD. The sewage treatment plants produce solids which today have to be disposed of as waste. TBC member BORDA is currently assessing the feasibility of processing these solids and converting them into usable products, such as energy or fertiliser. This includes the feasibility of treating multiple biological materials, derived from both sanitation (specifically the existing sewage treatment plants) and Municipal Solid Waste systems, together yielding re-use products. The report will include a situation analysis, technology options, sustainability plan, and implementation outline.

SMART PREVENTATIVE HEALTHCARE

21st century Smart Sanitation - the new early warning system for health

Emerging technologies can detect diseases and other health conditions in the sanitation system, and this data could drive cheaper, more effective healthcare. Business models which place value on health data could then help to fund the sanitation system itself.

Digital Health in India

Digital health[9] is the merging of genomic and digital technologies with health care to improve the efficiency of healthcare delivery and make medications more precise and tailored. Healthcare providers and other supporters are using digital health in their efforts to decrease inefficiencies, reduce costs, improve access, increase quality, and make more customised care for patients.

Digital technology acceptance is growing in India's medical industry, with backing from both the private and public sectors. The industry has created mobile applications, telemedicine, devices, and set up innovation centres among other initiatives. The government has launched several initiatives such as Aadhaar and Digital India, in some cases with support from the private sector. These initiatives and programs have drawn many digital health start-ups.

Digital healthcare facilities can allow dissemination of specialised knowledge among the medical community through advanced networks, technology enabled peer-to-peer reviews, emergency medical consultations during epidemic or crises. Some of the production technologies that are gaining prominence in the Indian health care industry are big data analytics, Smart Cities and Electronic Medical Records (EMR).

Pune's Health Priorities

The PMC identified Pune's top 5 most prevalent diseases as diarrhoea, typhoid, dysentary, diabetes and hypertension. Sensors, such as the terMITes are beginning to be implemented throughout the city with the aim of capturing information that will help to address these diseases.

IBM

Partha Dey

Healthcare Leader for India and South Asia

India's healthcare system has seen significant progress in recent years. A strong economy, expanding medical options and longer lifespans are contributing to greater demand for high-quality healthcare services. But to fulfil this demand, the major stakeholders in India's healthcare system must address shortcomings in areas such as infrastructure, insurance coverage and availability of skilled medical professionals. New ecosystems are beginning to redefine the way healthcare is organised and delivered in India where participants can collaborate in new ways to promote better outcomes and improve the patient experience[10].

mit media lab

terMITes

terMITes are ambient air quality sensors developed by MIT Media Labs. In Pune, a few basic version terMITes have been installed in public toilets for women. Currently these are capturing heat, light, proximity and humidity in the toilets. The data is further integrated with the Pune Smart City Operations Centre. The MIT team is working on enhancing the capabilities of these terMITes for sanitation systems.

SMART SANITATION DATA ARCHITECTURE

Sanitation data integrated into the Smart City Control Centre

Pune's vision is to become a model Smart City. When sanitation information is integrated within the larger data architecture of a Smart City, it becomes part of the wider transformation of the city, with citizens, businesses and authorities able to make data-driven decisions, reinforcing the image of sanitation as an integral part of a clean, safe and healthy city.

The power of integrating multiple data streams

Citizens' daily commuting might be helped both by information on bus services, and by knowing the location and condition of a convenient toilet.

The government reviewing the contract with a sanitation operator might look at the number of pollution incidents, at online customer ratings and at the measured river pollution.

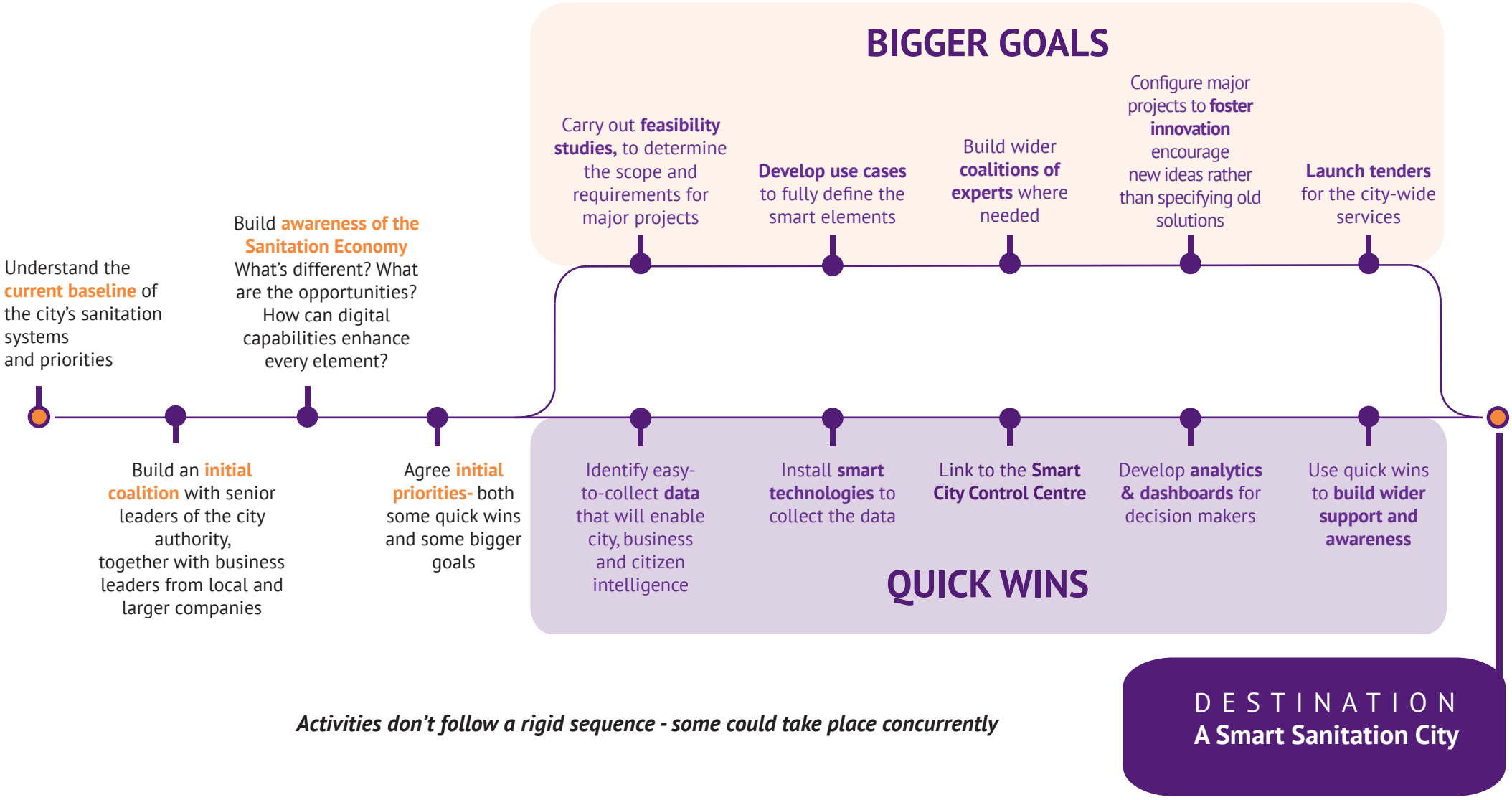
A company emptying septic tanks might check online for today's levels of the tanks and at the same time take account of traffic congestion.

This "joining of the dots," done manually by individuals or through apps, perhaps assisted by Artificial Intelligence, potentially transforms the quality of decisions made at every level.

Pune is currently integrating sanitation components into the city's detailed data architecture. The current sanitation data available within the city such as the location of toilets, levels of pollution, user footfall, consumer feedback, and number of wifi users at a toilet are built into dashboards at the Smart City Control Centre.

HOW CAN OTHER CITIES GET STARTED?

Learnings from the Pune Smart Sanitation City project so far



Activities don't follow a rigid sequence - some could take place concurrently

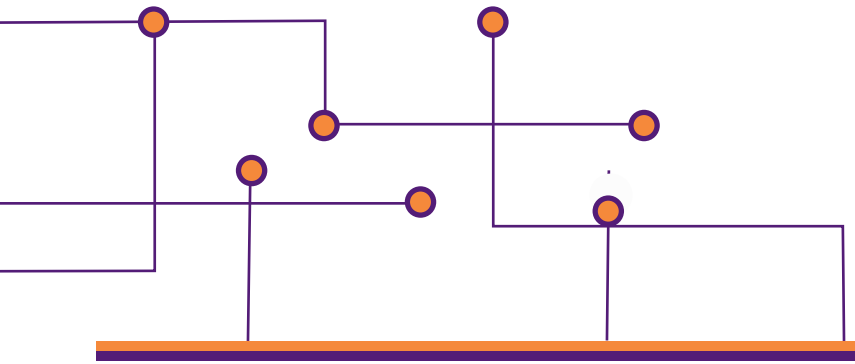
FUTURE OF THE SMART SANITATION CITY PROJECT

Smart Sanitation City Roadmap 2019 – and how to get involved!

At the end of the project in September 2019, **the Toilet Board Coalition will produce a roadmap detailing the path other cities can take to implement a Smart Sanitation City.** We welcome learnings from any other cities already starting this journey.

In Pune, the **TBC project will inform a series of PMC tenders which realise multiple parts of the Sanitation Economy**, particularly various elements of toilets and treatment. Large companies and small entrepreneurs can bid and play a part in building Pune into a city-scale demonstrator of the Sanitation Economy, and in particular the smart elements.

In Pune, there is still room at the table for innovators, entrepreneurs and other cities to share ideas, solutions and learnings to develop the Smart Sanitation City.



If you are interested in learning more or collaborating,
Please reach out to **secretariat@toiletboard.org**

ABOUT THE TOILET BOARD COALITION

Founded in 2014, the Toilet Board Coalition (TBC) is a unique business-led partnership with the ambition to address the global sanitation crisis by accelerating the Sanitation Economy. The TBC is enabling private sector engagement; connecting large and small companies; and ensuring close collaboration between private, public and non-profit sectors with the common goal to achieve Sustainable Development Goal 6 (SDG6), universal access to sanitation. The TBC runs the Toilet Accelerator, the world's first Accelerator Programme dedicated to sanitation entrepreneurs in low-income markets. The members of the Toilet Board Coalition believe that accelerating the Sanitation Economy will deliver significant impact to business and society.

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Additional resources can be found online at **http://www.toiletboard.org/resources**

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