Leveraging PPPs for smart city infrastructure

July, 2018

Core messages today

1 Smart cities are delivering measurable impact

- Layers of applications and new devices are being overlaid onto existing infrastructure
- Cities are applying this tech to mobility, security, and utilities
- Adoption and usage by citizens is enabling a better quality of life

2 Many PPP models are feasible

- Powerful option to finance smart infrastructure
- Cities have to trade off control/ownership, transfer of risk, and capital requirements of projects
- More than 45 assets and services could be candidates for PPPs

3 Fast & effective is possible

- Pune is a leading example, successful at planning and execution
- Intensive and early vendor engagement led to minimal queries, no extension of deadlines, and large participation of private parties
- Be clear on scope, governance across departments, and impact

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Urban cities are rapidly embracing changes to conventional infrastructure assets and services to make cities smart

ILLUSTRATIVE SET OF SOLUTIONS

Building

HOME
- Appliance automation
- Indoor air quality

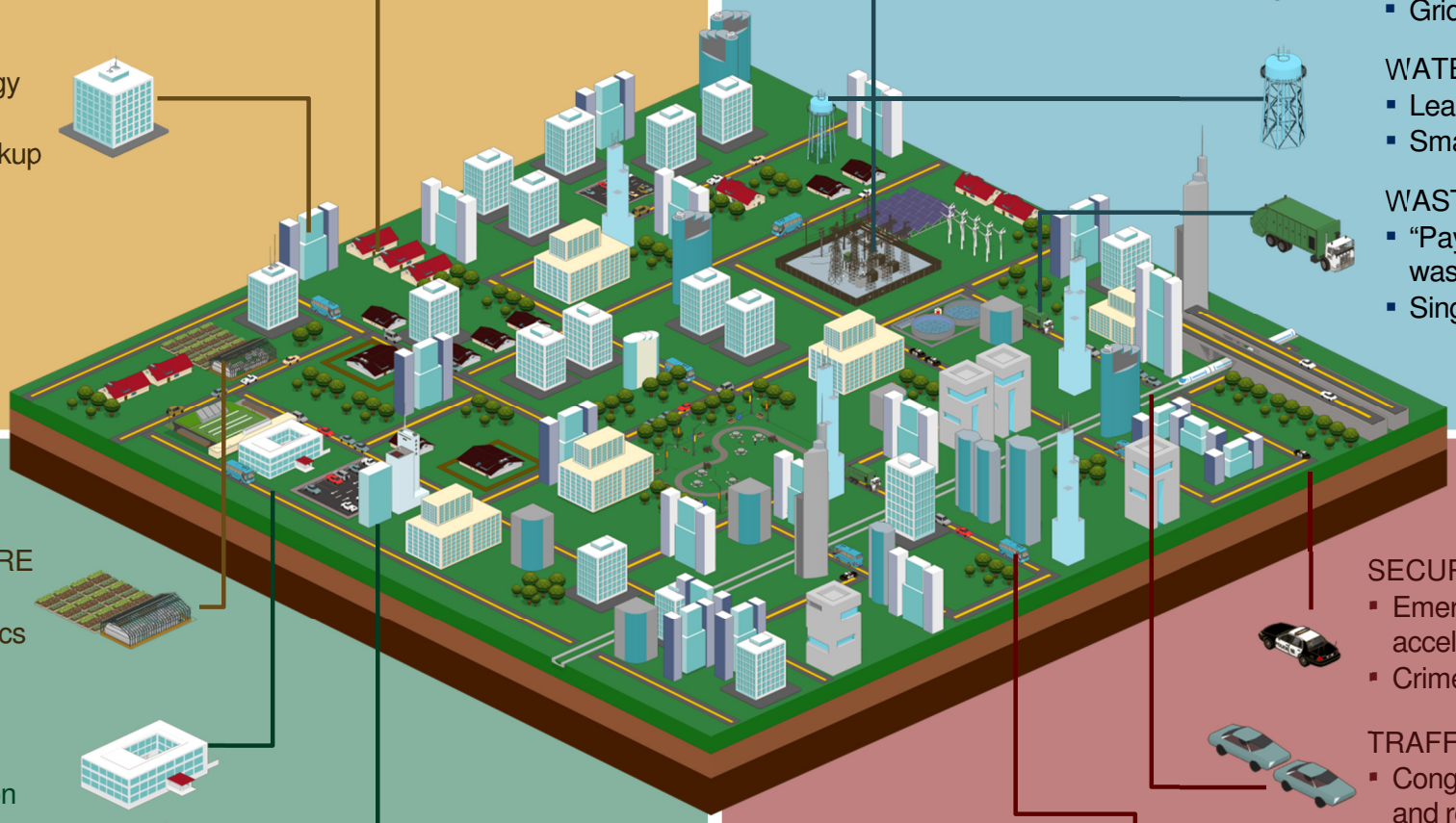
BUILDING ENERGY
- Self-monitoring energy controls
- Industrial battery backup

Infrastructure

ENERGY
- Smart meters
- Microgrid solutions
- Grid automation

WATER
- Leak reduction
- Smart meters

WASTE
- "Pay as you throw" waste collection
- Single-stream recycling



URBAN AGRICULTURE
- Growing automation
- Multi-layer hydroponics

EDUCATION
- Security and emergency prevention

SENIOR CARE
- Platform for senior care providers to support patient health

Health, Food & Education

SECURITY
- Emergency response acceleration
- Crime monitoring

TRAFFIC
- Congestion monitoring and re-routing
- Congestion pricing

TRANSIT
- Route optimization
- Location-based advertising

City Security & Transportation

Smart cities add digital intelligence to the urban world, raising quality of life

Three layers of "smartness"

Adoption and usage, often leading to better decisions and behavior change

Smart applications and data analysis capabilities

The tech base includes networks of connected devices and sensors

Traditional infrastructure (physical and social)

SOURCE: McKinsey Global Institute

An overlay of technology & services improves the service delivery and efficiency, depending on the needs of the city

Concept	Specific technological setups
1 Smart energy management 	▪ Smart distribution & smart grid, smart metering, ▪ Street lighting, Energy efficient buildings
2 Network infrastructure 	▪ Public wi-fi connectivity ▪ High speed wired connectivity(OFC laying)
3 Smart transport 	▪ Public: Integrated multi-modal transport etc. ▪ Carpooling, eco-friendly vehicles etc.
4 Intelligent traffic management systems 	▪ Smart parking & Signaling ▪ Traffic surveillance, automated tolling etc.
5 Smart utilities management 	▪ Smart distribution & retrieval ▪ Smart metering
6 CCTV & surveillance projects 	▪ Integrated security command center, ▪ Monitoring & emergency mgmt. (auto & manual)\ ▪ Border & coastal monitoring
7 e-Governance 	▪ Centralized billing solutions ▪ Citizen dashboard and apps

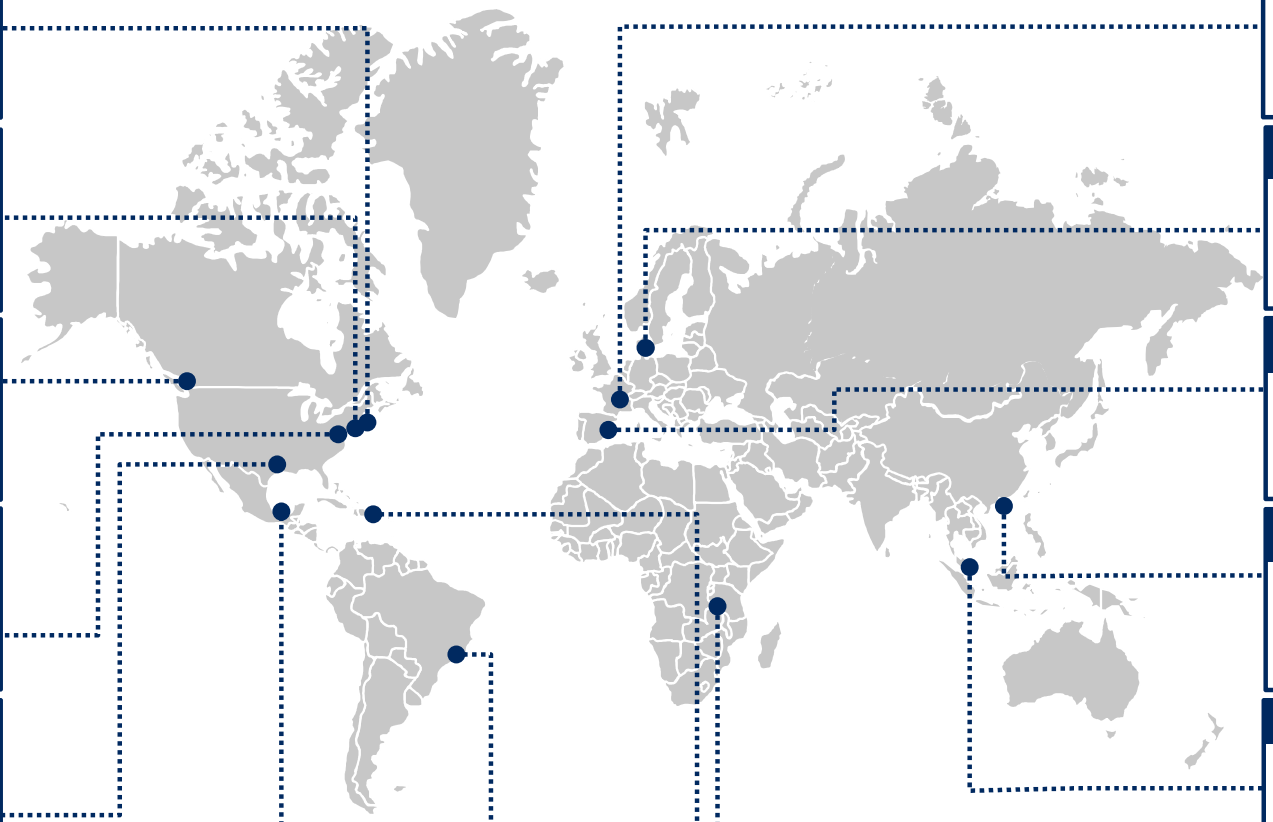
Each smart city could have a combination of these elements tailored to their needs depending on the timeline and capital investments available

SOURCE: Team analysis, Expert interviews

Smart City technologies are being deployed in cities around the world to improve municipal management and services

Deployments of Smart City Technology Solutions,

Case Examples, Not Exhaustive



Boston
- Sensors monitor energy usage across 350 facilities

New York City
- Sensors detect gunshots and locate them with 1m² accuracy

Vancouver
- >1M smart meters monitor energy usage and pinpoint outages

Philadelphia
- 500 solar trash compactors save city $1M annually in OpEx

Austin
- 56K connected street lights detect malfunctions, saving labor and fuel costs

Lyon
- 6M bike share trips are taken each year via 345-dock system

Copenhagen
- Road sensors detect approaching cyclists and turn signal to green

Barcelona
- 70K elderly citizens have one-click access to health call center

Hong Kong
- 47 buildings connected to produce nightly music & light show

Singapore
- Sensors predict congestion and adjust tolls to limit jams

Mexico City
- Sensors detect earthquakes, giving residents 90 seconds to evacuate

Rio De Janiero
- Command center integrates camera & sensor streams for emergency mgmt

Port au Prince
- Drones rapidly assess earthquake damage, identifying rubble with 92% accuracy

Nairobi
- 90K smart water meters combat theft and leaks

SOURCE: Municipal governments, press search

With measurable impact for citizens

30–300
lives saved each year in a city of 5 million

30–40%
fewer crime incidents

8–15%
lower disease burden

15–30
minutes shaved off the daily commute

25–80
liters of water saved per person per day

20–35%
faster emergency response times

SOURCE: McKinsey Global Institute

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Public Private Partnership extends across a broad spectrum

Infrastructure asset procurement options

Public	Public-Private Partnership				Privatization
▪ Restructuring & corporatization ▪ Civil works contract: DBB & DB ▪ Service contracts	Management contracts	Operational/ Service concessions	Construction concessions		Full divestiture
			▪ BOT type	▪ DBO type	
Public ownership and finance			Mix of public and private ownership and finance		Private ownership and finance
Public operations	Private operations				

Extent of private sector participation

DBB: Design Bid Build
DB: Design Build
BOT: Build Operate Transfer
DBO: Design Build Operate
DBFO: Design-Build-Finance-Operate

SOURCE: United Nations, Press

Level of private sector involvement and associated risk varies

Conditions	Management contracts	Operating Concession	Construction Concession	
			BOT	DBO
Duration	Short – 2-5 years	Long – 25-30 years	Varies	Varies – can be perpetual
Conditions	Input or output based	Output/ Performance Based	Focus on input	Focus on input
Payment	Government/fee payment	User fees (occasionally subsidized by grants)	Government – can be lump payment/fee payment	Government/fee payment
Construction Risk	N/A	N/A	Private sector	Private sector
Investment Risk	Public sector	Private sector	Private sector	Public sector
Operation Risk	Public sector	Private sector	Public/Private sector	Private sector

Risk

SOURCE: Team analysis, World Bank

Numerous variants of PPP's can be used to crash execution timelines – choose model most suitable to meet the needs of the city and the project

Model types		Sub variants used
1 Management contracts		▪ Long-term lease ▪ Management contracts ▪ Maintenance contracts
2 Operational/ Service concessions		▪ PFI Concessions ▪ PSA concessions ▪ OM concessions
3 Cons-truction Concess-ions	A BOT type	▪ Build-Operate-Transfer (BOT) ▪ Build-Own-Operate-Transfer (BOOT) ▪ Build-Lease-Operate-Transfer (BLOT) ▪ Build-Own-Operate (BOO)
	B DBO type	▪ Design-Build-Finance-Operate (DBFO) ▪ Design-Build-Own (DBO) ▪ Design-Build-Finance-Operate-Maintain (DBFOM)

- Most of these type of contracts are **termed PPP projects** and involve
  - Partial or full **private funding**
  - Private **delivery of a traditionally publicly provided service** or asset
  - **Sharing of risks** in at least one part of the value chain
- The models can be **consecutive** as e.g. in the case of Turkish airports which were first BOT deals and when constructed tendered as OM-type concessions

SOURCE: Team analysis; World Bank

Suitable PPP model for city based infrastructure can be evaluated based on revenue earning potential and capex expenditure involved

NOT EXHAUSTIVE

Sweet spot for cities

Examples of infrastructure projects executed by ULB's

Revenue earning capability

Capex involvement and need of private sector partnership	**Low** [Public service projects] e.g., streets	**Medium** [Direct to citizen services] e.g., utilities	**High** [Livability focused projects with operations and land monetization potential]
High		▪ Solid waste management ▪ 24/7 water supply ▪ Bus rapid transport	▪ Riverfront/public space development ▪ New bus/EV fleet ▪ Transit hub ▪ Affordable housing ▪ Optical fiber cable ▪ MRTS
Medium	▪ Security and surveillance ▪ Solar energy supply and installation	▪ Public bicycle sharing ▪ Waste to energy ▪ Smart street lights ▪ City hospitals	▪ Smart parking's (across city) ▪ Commercial sports complex/ Multidisciplinary sports stadium ▪ Meeting and convention centers/business parks
Low	▪ Placemaking and open spaces ▪ Fire stations ▪ Rain water harvesting ▪ Storm water and waste water recycling ▪ Public/service roads	▪ Integrated traffic management systems ▪ Smart metering	
Typical (potential)PPP model	**EPC + Service contract**	**Cost Rec + Annuity/Grant**	**BOT/Output based/ Revenue sharing**

SOURCE: Team analysis

45+ assets and services are candidates for PPP in cities based on global evidences

Candidates based on global benchmarks

Asset-based PPPs

- Parking management
- Transit hubs
- Parks & playgrounds
- Petrol stations
- Asset management (leasing/sale)
- Optical fiber cable
- Municipal buildings
- Public markets
- Non-revenue generating infrastructure[3]

Service-based PPPs

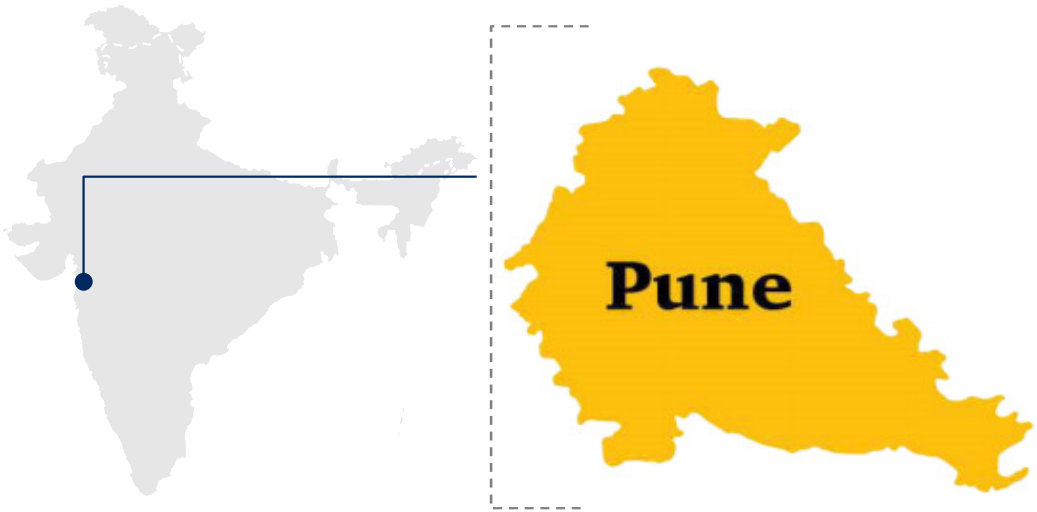
- Solid waste recycling
- CDW recycling
- Inspection
- Licensing
- Integrated city operations
- service center
- Land registry
- Revenue collection
- Surveying
- Pest control
- Land management
- 24*7 water supply and smart metering
- Power utility connection
- Festive / cultural events
- Urban planning
- Pedestrian crossings[2]
- Street/road landscaping
- Public squares management
- Geo-spatial mapping
- Mortuary and burial services
- Road and building signage
- Street lighting
- Smart citizen services
- Toll infrastructure[1]
- Street/neighborhood cleaning
- Waste collection
- Traffic management
- Slum management
- Data gathering & management
- Quality assurance
- Outdoor billboards
- Public transport
- Lavatories
- Road water disposal network
- Storm water protection

1 Includes street fixing 2 Over the road bridges 3 Includes bridges, tunnels, etc.

Source: Press search, World Bank, Team analysis

Contents

Pune is the 9th most populous city in India; currently ranked 2nd in execution of its smart cities mission in India



Total Area

332.17 (km)²

Population density

11,304 per (km)²

Total population

3.4 million

GDP (2011 USD)

$48 billion

Successful in both planning and execution

- Ranked second during the selection process for smart city plans of India
- Ranked second in smart city projects execution in the last 3 years

Population growth rate (AEGR, 20012011)
2.1%

Per Capita (2004-05)
INR 88,341

Literacy rate
89.6%

Working population
67.2%

Pune's project *Smart Element* comprises critical IT infrastructure, a Smart City Operation Centre, and third party applications

6 key elements created as a part of Smart Element

Smart city operations center 	**State of art command and control centre** which will seamlessly integrate with all elements to monitor & manage entire city operations from single command centre.
Wi-fi 	**200+ Wifi hotspots to be created across strategic locations** including parks, hospitals, other important public spaces. Limited free access to citizens supporting digital transformation.
Environment sensors 	**50+ Environmental monitoring systems at various locations** to monitor critical parameters across sound, temperature, air quality, noise pollution etc.
PA systems 	**125+ Public announcement system** at key locations to broadcast general and emergency messages for public awareness
Emergency box 	**Emergency response system** for citizen safety, to seek help in case of emergency situations and accidents
Variable messaging 	**150+ Variable Message System** for broadcasting informative messages, alerts and city updates supported with commercial

Some of the key use cases from external & internal systems

External IT systems

- Traffic Information System
- Smart Street Light System
- SAFAR system (IITM)

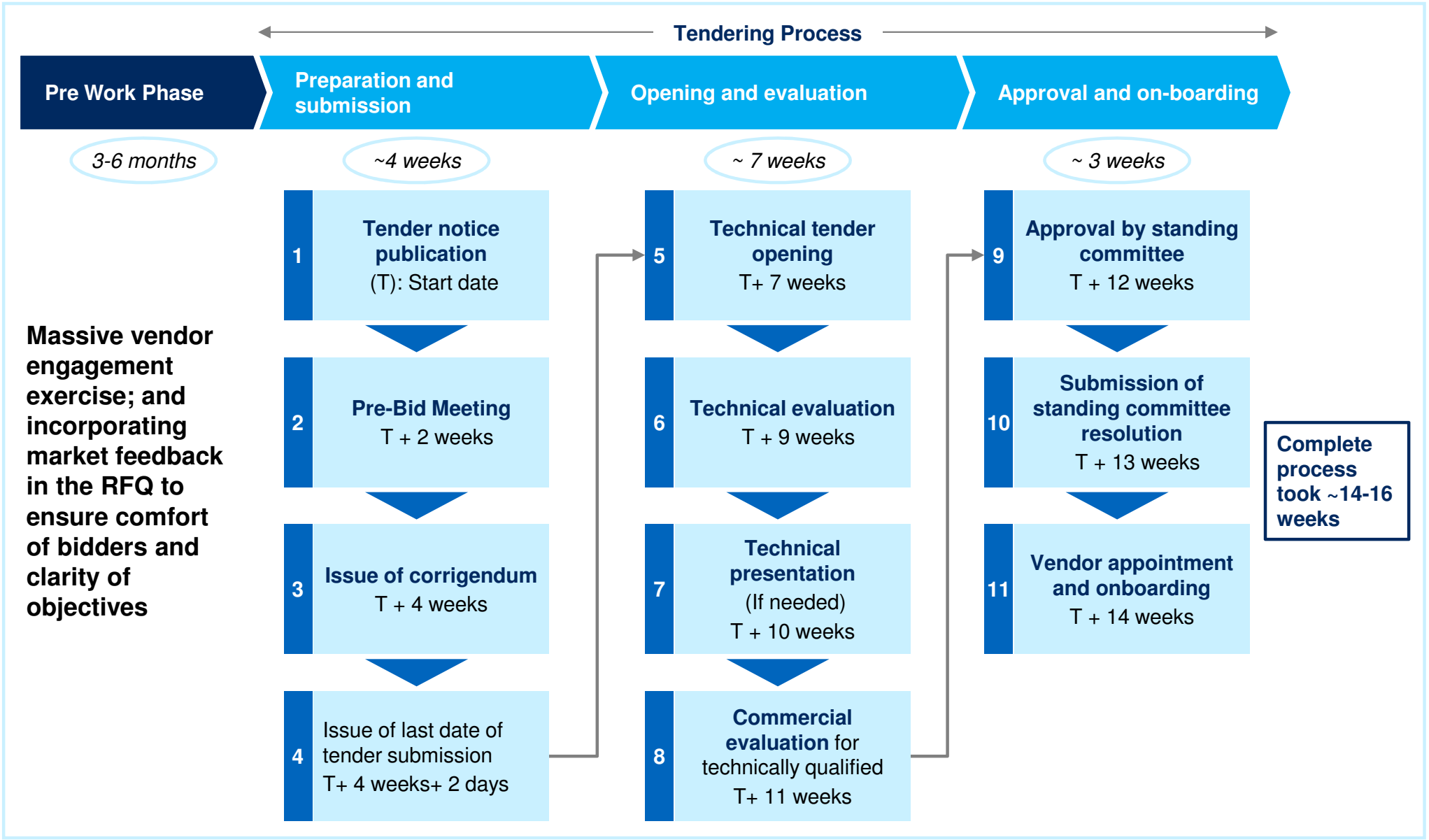
Internal IT System

- Variable Message Displays
- Public Address System
- Environmental & flood sensors
- Emergency Call Box

Smart City Operation Centre

- Real-time estimated travel time information from multiple routes to strategic city locations
- Sending alerts for switching on/off street light based on the ambient light condition
- Display of AQI level with health advisory on VMD
- Display of real-time environment condition data like humidity, temp on VMD
- Broadcast pre-recorded traffic warning messages using the specified schedule and location.
- Operator-assisted emergency call handling with response coordination with multiple govt. agencies using the ECB

The tender followed a competitive bidding process over 3-4 months



A management contract model with upfront capex investment by the developer was finalized as the PPP structure for the project

Vendor engagement
0-2 months

- Pune Smart City Development Corporation ran multiple vendor engagement sessions with possible vendors across construction and IT players to find out:
  - Interest of participants
  - Feedback on execution timelines
  - Revenue potential of the project
  - Potential PPP models which can make the project viable
  - Service delivery model

Economic structure incorporating market feedback
2-3 months

- Design, Build, Implement, Operate and Maintain for 5 years chosen as final execution model
  - Provision of network bandwidth for a period of 5 years
  - O&M of the entire ICCC for a period of 5 years
  - Capex payments on milestone basis
  - Opex payments on quarterly basis subject to SLA compliance

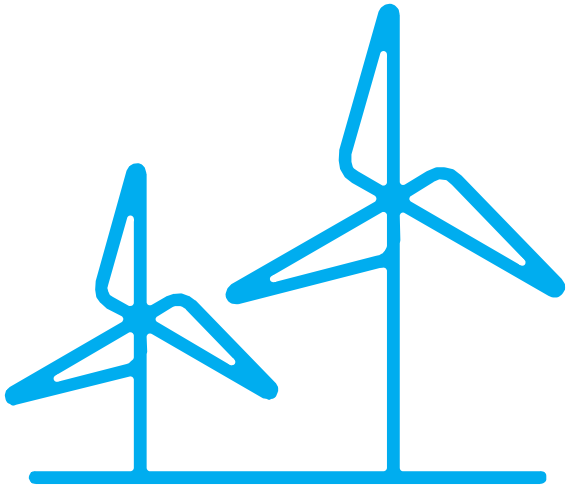
Intensive vendor engagement effort led to minimal queries, no extension of bid submission deadline, and large participation of private parties

Targeted communication tackled three strategic audiences

PRELIMINARY

Who	Why	What	How
1 **Government entities and other ministries**	Syndicate in order **gain support in pushing PPP enablers**	▪ Issues regulatory approval and exemptions	▪ One-on-one meetings with key stakeholders ▪ Set up Supervisory Committee ▪ Communicated to Government committees/meetings
2 **Investors**	Maximize **investor excitement and participation** in/ for PPPs	▪ Provide a comprehensive view of PPP strategy and project portfolio (pipeline) ▪ Provide project specific details ▪ Educate on process and levers available to engage in PPPs	▪ Investor conferences & Investor roadshows ▪ Pre-bid conferences ▪ Business journals/Newspapers (online and paper)
3 **General Public**	Inform on **changes resulting from PPP** and gain buy-in	▪ Share overall PPP strategy and objectives ▪ Educate on benefits reasons and expected changes resulting from engaging in PPPs ▪ Disseminate project specific information e.g. operational guidelines, benefits, etc.	▪ TV news ▪ TV sponsored Ads ▪ Newspapers ▪ Billboards ▪ Universities ▪ Flyers ▪ Social Media

Progress made in the last 1-1.5 years



85%

Percentage of smart elements live

5

# of internal & external systems integrated with platform

7

# of Stakeholders met for external integration

6

# of use cases implemented

4

# of months since operationalization of SCOC

* Stakeholders including Sinchan/dam authority, Disaster Management, Police/Traffic, Fire Department, Lights, Vehicle Tracking and Surveillance

The implementation was not challenge-free

Scope of work unclear and too broad

- Unclear definitions of exact work to be implemented on physical construction and technology integration, leading to challenges on interface of installations and command center
- Pan city execution/big-bang execution approach led to distribution of resources and slow progress

Lack of accountability in governance

- Non-existence of clear list of approvals from the multiple government agencies involved [central, state government] delayed physical works
- Unclear project acceptance structure i.e., absence of a third-party evaluator to verify project delivered as per RFP condition

Did not consider how to measure impact early enough

- Absence of well-defined use cases for citizen impact
- Difficulty in evaluation of impact

Most challenges were due to 1st time execution of such a project in India, so no existing best practices to learn from

Important lessons from the project

1 Win stakeholder engagement and buy in

- Breaking silo based working is a huge challenge
- Extensive vendor engagement critical to designing the right PPP structure
- Deliver ‘quick wins’ before addressing more complex landscapes by prioritizing projects appropriately

2 Be citizen centric

- Important to measure benefit to citizens from each initiative
- While quality of data is a key to success, privacy and confidentiality should not be compromised

3 Use tech effectively

- Important not to underestimate revenue potential on visual messaging display units and WIFI
- System integrator essential to build sustainable capacity within the operator of the ICCC
- Use public infrastructure to create e-connectivity corridor at scale for the citizens

Private participation enables 5 specific advantages to city leaders

NOT EXHAUSTIVE

Advantages to the city leaders

A Improve municipal finances

- Diversifying the access to financial resources and capital without increasing local governments' indebtedness

B Manage risks

- Transferring them to the party that is more capable of managing and reducing risks.
- Avoiding political volatility and ensure project continuity through a long-term commitment.
- Shifting from capex to opex by paying for services instead of having to invest to set up an infrastructure

C Capability building

- Leveraging the expertise and resources of the private sector while preserving strategic control over the project or service
- Guaranteeing skills transfer from the private to the public partner through training of municipal officers.

D Local economic development

- Through PPPs that involve local actors, allowing for faster project implementation and a more palpable impact for the population
- Local job creation through the mobilization of local banks, resources and firms

E Foster innovation

- Encourages competition with private participants willing to propose innovative solutions to win a bid when competition is hard and follows a competitive bidding process

SOURCE: ADB, Philippines National Productivity Commission 2014

Read more in our recent reports from the McKinsey Global Institute (online)

Thank you!

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