



MMRDA

Mumbai Metropolitan Region Development Authority

Technical and Financial feasibility study for Intelligent BKC initiatives

June 2014

Acknowledgement

Core purpose of this Technical and Financial feasibility study for Intelligent BKC initiatives is to develop Mumbai Metropolitan Region as an area that focuses on service provision to its citizen through a robust public & private sector collaboration model that embeds technology to integrate multiple infrastructure services for efficient operation. Accenture was engaged to conduct this study by MMRDA.

We would like to express our gratitude to Shri UPS Madan (Metropolitan Commissioner), Shree Sanjay Sethi (Additional Metropolitan Commissioner - 1), Shree BV Gopal Reddy (Additional Metropolitan Commissioner - 2), MMRDA for entrusting Accenture with this important assignment and providing their guidance.

Our special thanks to Shree Shankar Deshpande, Joint Project Director (Town Planning) and In-Charge (IT Cell) without whose guidance and support this report would not have been possible. His focused inputs, clear vision and thought leadership has helped the team in delivering this report. Finally, we would fail in our duty if we fail to acknowledge the onsite MMRDA IT Cell for continuous support during the study.

Confidentiality Statement

- This document contains material proprietary to MMRDA and should not be used as reference without prior permission of MMRDA.
- The material, ideas, and concepts contained herein are to be used exclusively for purpose of understanding of Vision Smart BKC only and indicative in nature. The information and ideas herein may not be disclosed to anyone outside MMRDA or be used for purposes other than implementation of Smart BKC initiatives.
- The specifics of Legal Framework, Integration with Stakeholders and required support from MMRDA, Operational Model, Bandwidth requirements, SLA, Costing, Financing Model, Technical Specification of Hardware's, Software's, Setting up of Command center and its location, scope etc is indicative in nature.
- However during the RFP Stage, the bidder may carry out the site visit of BKC E & G Block after obtaining written permission of MMRDA and obtain for itself on his own responsibility all information on the existing Infrastructure, required structural and Technical changes, possible operational plan for implementation of the select 5 initiatives in BKC, that may be necessary for estimation, technical understanding and preparing the EOI response.
- The cost of such visits to the site(s) shall be at the Bidder's own expense whenever it is appropriate.

Executive Summary

Mumbai Metropolitan Region Development Authority (MMRDA)—an apex body for planning and coordination of development activities in one of the largest metropolitan regions in India—selected Accenture vide letter no. ITCCell/MMRDA/2014/68 dated 11.03.2014 to create an intelligent city business case for Bandra Kurla Complex (BKC), a commercial business district in Mumbai.

Bandra Kurla Complex (BKC):

BKC was instituted by MMRDA to create an easily accessible financial and business hub. BKC houses a number of financial & business houses including National Stock Exchange, SEBI, ICICI Bank, Citibank, Dena Bank, Bank of Baroda, State Bank of India, Jammu & Kashmir Bank National Business Centre, NABARD Head Office, IL&FS, Asian Heart Institute, Dow Chemicals, Bharat Diamond Bourse, Dhirubhai Ambani International School, American School of Bombay, Mumbai Cricket Association's cricket ground and the United States Mumbai Consulate.

BKC goals are to become a tenant friendly CBD that is intelligent, efficient and resilient hence is now envisages BKC to be developed into an intelligent district of Mumbai. It is also envisaged that BKC will be equipped with Strong ICT backbone for the area and seamless experience for tenants, employees, other stakeholders, reduced energy consumption and reduced environmental stress.

Executive Summary

Assessment Process

As part of the assessment, Accenture conducted feasibility of implementing smart parking, smart streetlights, secure public Wi-Fi, video analytics and surveillance, and a central information hub for stakeholders of BKC Services. Accenture also carried out stakeholder analysis, best practice survey and opportunity assessment during the study. The approach for this study is guided by citizen, businesses, economic and environmental. Based on Citizen Centricity, Impact on Climate & Reduction in Carbon footprint, User Friendliness & Ease of usage, Economic Sustainability of Projects, Citizen Privacy and Continuous Innovation.

Study Parameters

In addition, Accenture also conducted a detailed investment plan, cost-benefit analysis, solution details, location analysis, project timelines, procurement strategy and governance structure, as well as vendor landscape and strategic intent and benefits to stakeholders. The feasibility has been performed on following parameters:

- **Use Case (Now and Future)** - Illustrative scenarios comparing the lives of stakeholders with and without the foundational initiative
- **Design Architecture** - Technical feasibility of the initiative including solution overview, architecture and location analysis
- **Financial Viability** - Economic feasibility of the initiative including revenue modeling, Capex and Opex costs and cost benefit analysis
- **Stakeholder Benefits** - Qualitative benefits of important stakeholders including citizens, MMRDA and the environment
- **Vendor Landscape** - A brief description of vendors with the capability to implement the initiative
- **Case Studies** - Global best practices and instances where a similar initiative was implemented

Executive Summary

Impact Assessment

Few of the overall analyzed impacts of aforementioned initiatives are

Public Wi-Fi hotspots

- 5 MBPS High Speed Wireless Internet Connectivity:
- 175 Hectare Area Covered in Public Wi-Fi in BKC
- Seamless Wi-Fi Connectivity Across E& G Blocks
- 50,000 man days saved per year
- Public Wi-Fi as Value Added service for Business and Exhibition Use

Smart Parking

- 3000 Smart Parking Slots
- Parking Time Reduced from 20 minutes to 5 minutes
- 19000 Liters of Fuel saved annually
- 24 tonnes of Carbon Reduced Annually
- 7800 Man days saved per year
- Reduction in Unauthorized Parking

Smart Street Lights

- 841 Streetlights touched
- 800 tonnes of Carbon Reduced Annually
- Energy Consumption reduced by 40%
- 200KW of clean energy generated
- Reduced Maintenance Cost
- Reduced investment for Wi-Fi and CCTV

Video Analytics and Surveillance

- Complete E & G Block covered with 90 cameras
- Greater coordination among Security Agencies
- Reduced Street furniture Theft
- Improved Emergency Response

Central Information Hub (Citizen App)

- 33000 man-days saving due to ease of access of information
- 33000 man-days saving due to ease of access of information
- Improves Citizen Communication
- Improved Emergency Alert and Response

Executive Summary

Financial Viability

The estimated Capex for implementation of identified initiatives is INR 19.41 Cr. and Opex requirement for first year is INR 5.52 Cr. The estimated revenue to be generated is INR 7.91 Cr. for first year which in turn would be able to fund the OpeX requirements. Secondly, in the longer term, the total estimated revenue generated is sufficient to fund the Opex requirement in future to make the initiatives self-sustainable and financially viable.

Detailed approach for Technical and Financial Feasibility study, Revenue Model and Cost Benefit Analysis, Use Cases, Vendor Landscape are mentioned and Cumulative Cash Flow are mentioned in upcoming section of the report.

Recommendation

Post feasibility study, recommendation is to implement all five initiatives considering the consolidated technical/financial feasibility and stakeholder benefits. Details of each recommendation is placed under 'Consolidated Analysis and Recommendation' section of this report.

Way Ahead

Next steps include selection of smart city master system integrator to create the Request for Proposal, select vendors and program manage implementation.

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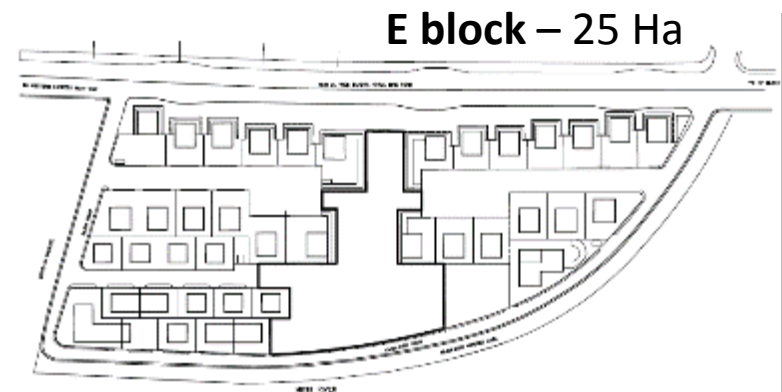
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MMRDA envisioned BKC to be an easily accessible, intelligent and sustainable International Financial & Business Hub

- **BKC** was instituted by **MMRDA** to create an easily accessible, intelligent and sustainable **International Financial and Business hub**.
- BKC houses a number of financial & business houses including **National Stock Exchange, SEBI, ICICI Bank, Citibank**, Dena Bank, Bank of Baroda, **State Bank of India**, Jammu & Kashmir Bank National Business Centre, **NABARD** Head Office, IL&FS, Asian Heart Institute, Dow Chemicals, **Bharat Diamond Bourse**, Dhirubhai Ambani International School, American School of Bombay & Fortune 500.
- It also is home to the **Mumbai Cricket Association's** cricket ground and the United States Mumbai Consulate.
- Open plots in the BKC area are given out on rent to host events and are known as the **MMRDA grounds**.



G block – 170 Ha



E block – 25 Ha

- Total number of employees in E & G – 640000
- Total available office area E & G – 6400000 sqm
- Total length of roads in E & G – 20km

The vision can be achieved by leveraging technology to address stakeholder needs and challenges

Vision for an Intelligent BKC

Developing MMR as an area that focuses on service provision to its citizen through a robust public & private sector collaboration model that embeds technology to integrate multiple infrastructure services for efficient operation.

BKC Ambitions

- BKC was instituted by MMRDA to create an easily **accessible, intelligent and sustainable International financial and business hub**
- BKC goals are to become a **tenant friendly** CBD that is intelligent, efficient and resilient

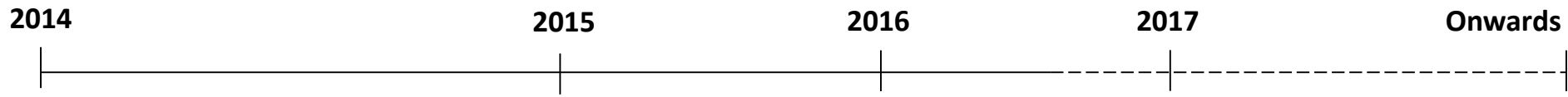
Issues

- Bottlenecks in growth due to lack of ICT enabled automation
- **Severe congestion** on roads
- **Increasing threat of crime and terrorist activities**
- **Intermittent wireless connectivity**
- **Parking management** is a difficulty
- **No central channels** for **efficient information dissemination**

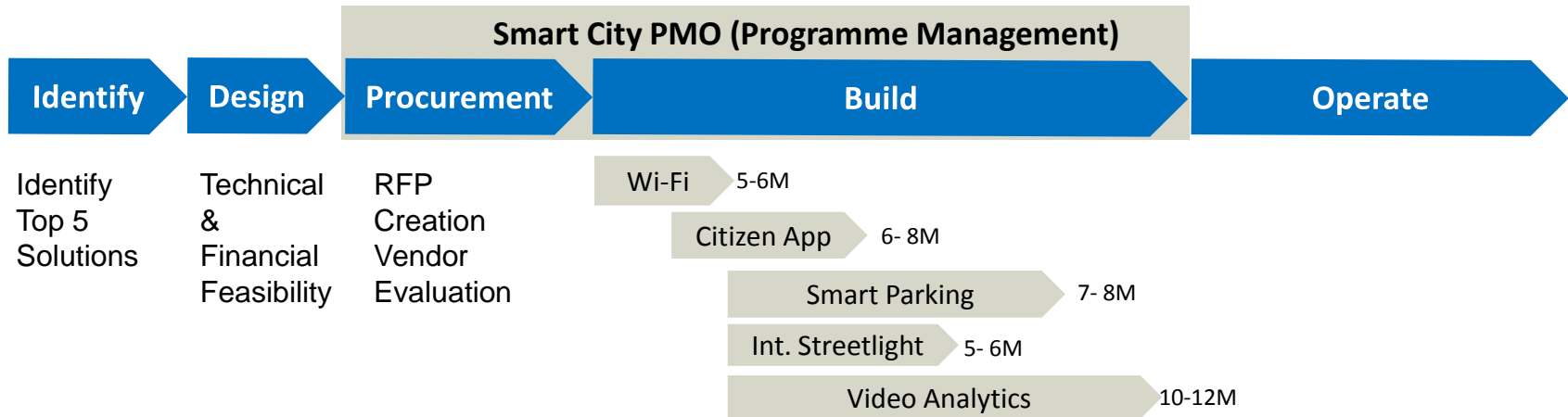
Desired Outcomes

- Strong **ICT backbone** for the area
- **Automated services** making resources available for other value added tasks
- **Seamless experience** for tenants, employees, other stakeholders
- **Increased safety and security**
- **Reduced energy consumption**
- **Reduced environmental stress**

To achieve the vision a 3 phased approach is defined – Installation of intelligent infrastructure being the 1st phase



Phase 1: Intelligent Infrastructure at BKC



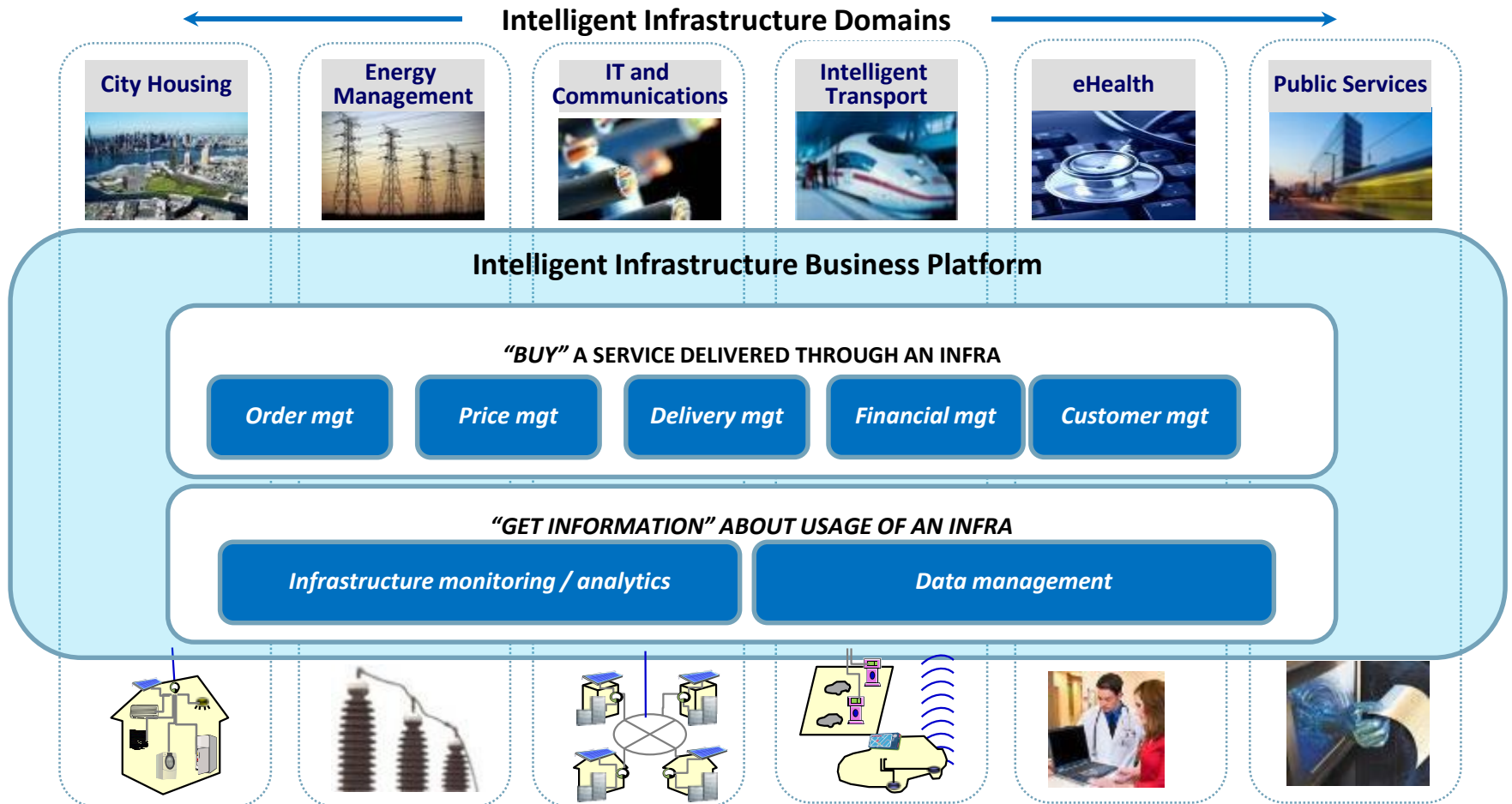
Phase 2: Maturing Technology at BKC



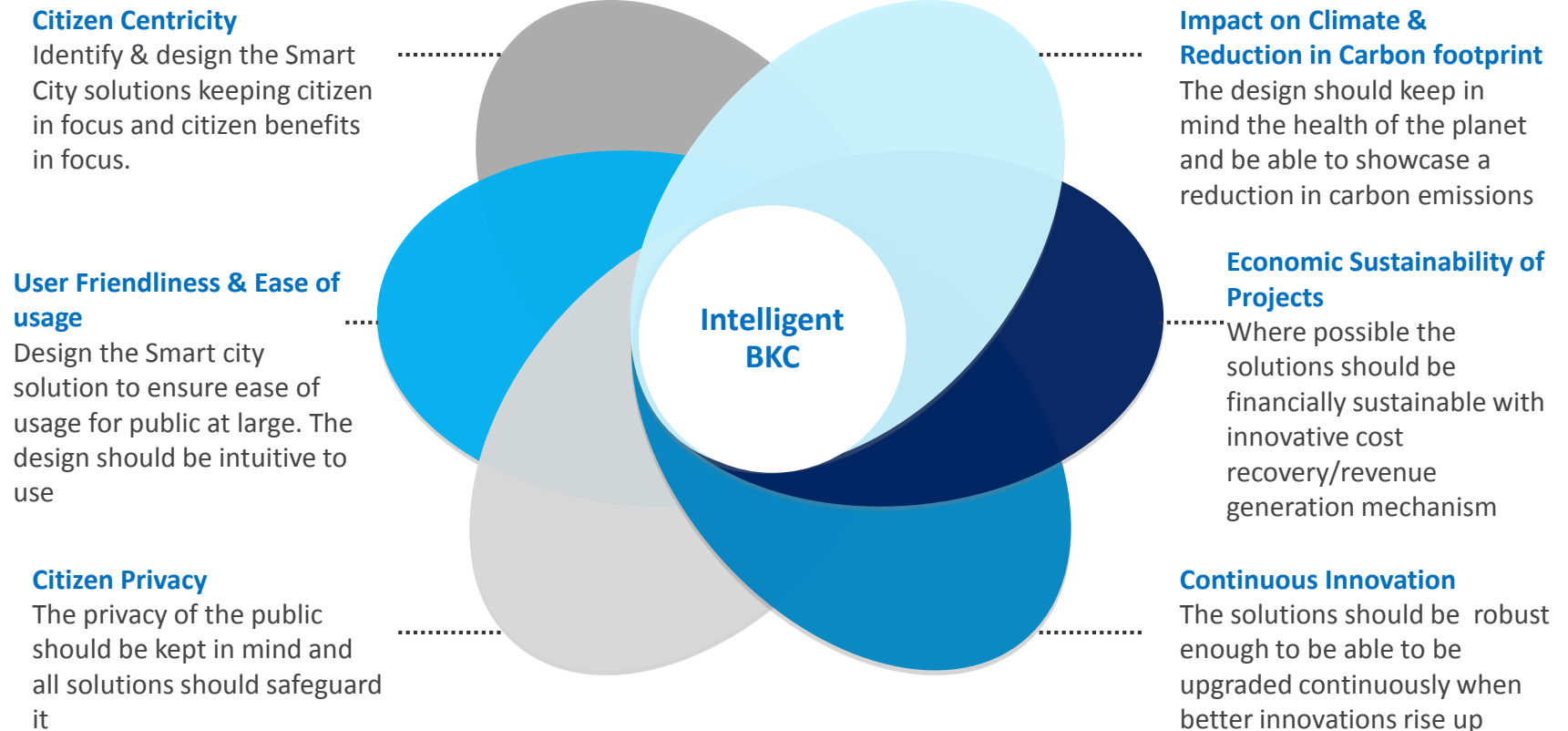
Phase 3: Intelligent Infrastructure at other MMR area and Futuristic Initiatives



Intelligent Infrastructure provides a common approach to respond to each city's sustainable attractiveness imperative



For BKC the approach is guided by citizen, businesses, economic and environmental needs to select, shortlist and design the Initiatives



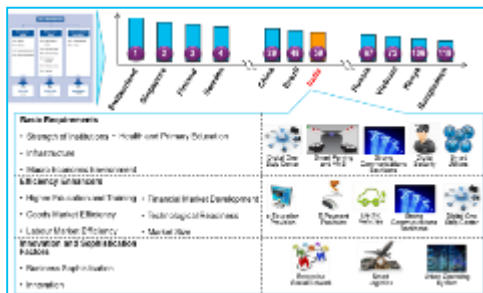
Leveraging stakeholder analysis, best practices and opportunity assessment the five Intelligent Cities initiatives are shortlisted

1 Stakeholder Analysis & Best Practices Survey

- Stakeholder analysis to understand the needs and requirements of
 - residents,
 - visitors,
 - commercial tenants and
 - MMRDA Officials.
- Conducted In Person interviews and fact finding surveys



- Best Practice Analysis and Benchmarking



2 Opportunity Assessment

- Opportunity Analysis to identify long list of initiatives

Corporate & Business	• More Conferencing • Online Collaboration	• Smart Mailboxes • Interactive Displays
Commercial Services	• Mobile Devices • Wireless Displays	• Mobile Displays • Data Management Services
Classical Services	• Digital Signage • Digital News Kiosk	• Ticket Display • Metro Information System
Public Services	• Mobile Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Security	• Mobile Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Building Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart City Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Home Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Office Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays

- Initiatives are prioritized to arrive at top 5 quick wins for BKC region on consultation held with MMRDA officials, BKC tenant stakeholders and fact finding surveys

Corporate & Business	• More Conferencing • Online Collaboration	• Smart Mailboxes • Interactive Displays
Commercial Services	• Mobile Devices • Wireless Displays	• Mobile Displays • Data Management Services
Classical Services	• Digital Signage • Digital News Kiosk	• Ticket Display • Metro Information System
Public Services	• Mobile Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Security	• Mobile Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Building Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart City Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Home Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays
Smart Office Solutions	• Smart Mailboxes • Mobile Displays	• Smart Mailboxes • Interactive Displays

3 Phase 1 Initiatives for BKC

- Identified five Solutions and Solution



Wi-Fi



Smart Parking



Intelligent Streetlights



Video Analytics

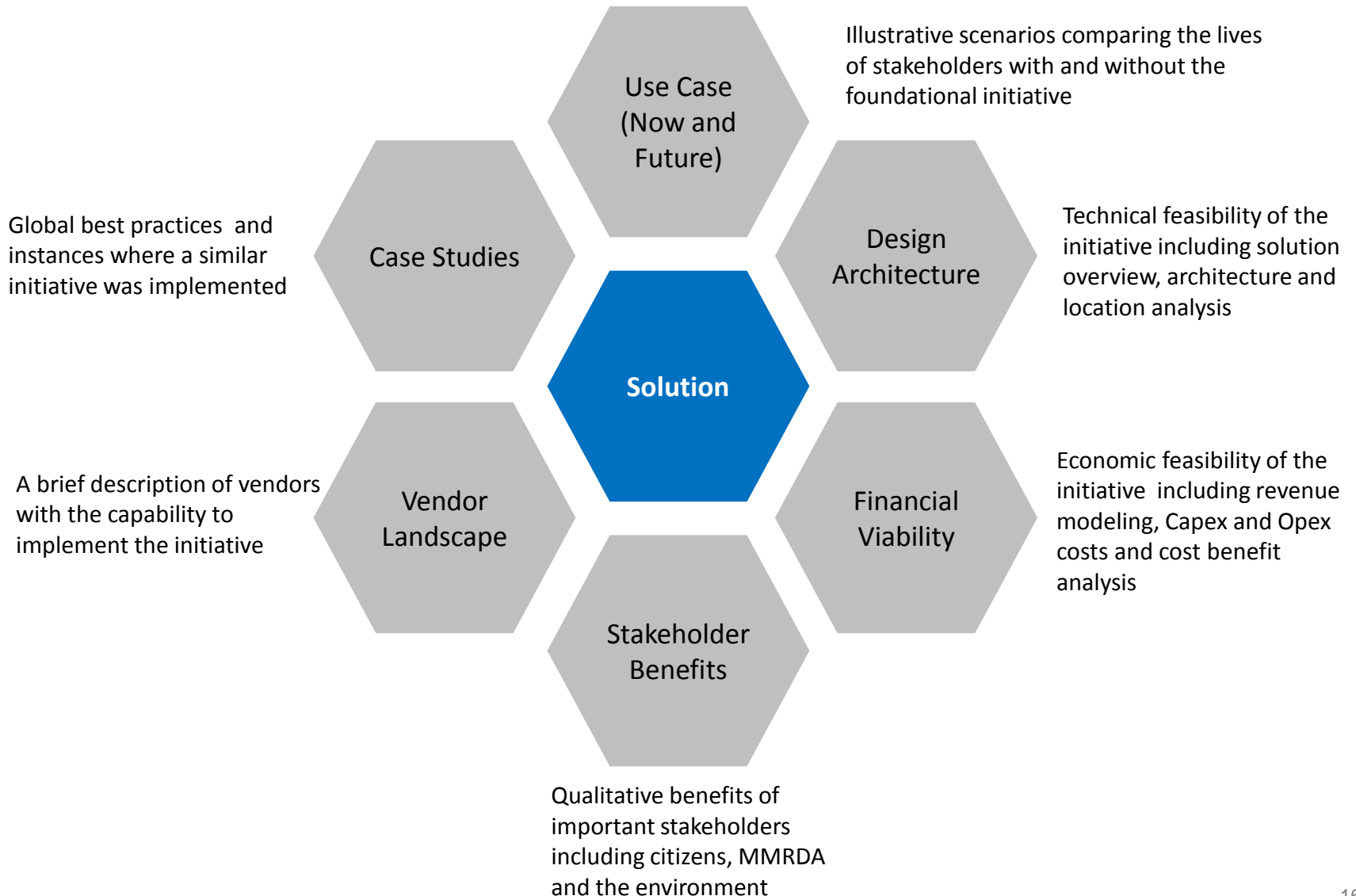


Citizen App

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In order to gauge the overall feasibility, each of the 5 foundational initiatives will be evaluated on the following key parameters



To assess the financial feasibility of the initiatives two approaches were used

- Equity based Discounted Cash Flow Analysis (DCF) followed by Economic Value Added Analysis (EVA)

Discounted Cash Flow Analysis

- A valuation method used to estimate the attractiveness of an investment opportunity.
- Discounted cash flow (DCF) analysis uses future free cash flow projections and discounts them to arrive at a present value, which is used to evaluate the potential for investment
- If the value arrived at through DCF analysis is higher than the current cost of the investment, the opportunity may be a good one
- The Cash Flows (Revenues and Savings – Costs) are discounted
- Cost of capital/ Discount rate applied is 8.73% which is the 10 year Government bond yield for India
- Analysis is done over a ten year period with capital expenses incurred in year 0 and revenues as well as operating expenses considered from year 1 to 10
- Net Present Value (NPV) is calculated which is the addition of all the discounted cash flows
- The NPV rule states that an investment should be accepted if its net present value is greater than zero and rejected otherwise
- Simple payback period is also calculated which determines the length of time required to recover the cost of an investment.

Economic Value Added Analysis

- A valuation method that goes beyond financial data and measures the non-financial benefits of the project
- It is most suitable to use for Government and social projects because the objective is not pure profit but doing a social good
- EVA is similar to DCF in that the costs and benefits are taken and discounted at the cost of capital
- Where it differs from DCF is in formulating benefits
- Instead of measuring cash flows, EVA measures the total financial and non-financial benefits and subtracts the costs from this to arrive at Net Economic Value Added
- This is then discounted to arrive at the NPV – but NPV is not the right metric to consider for social projects
- The non financial benefits include tangible productivity benefits in terms of time saved, fuel saved as well as environmental benefits such as amount of carbon reduced
- The non financial benefits that are intangible like a feeling of safety, lesser hassle due to parking availability, etc., have not been quantified

To assess the financial feasibility of the initiatives first the options were assessed according to DCF. The selected option was then analyzed according to EVA because EVA is better suited for Govt. projects

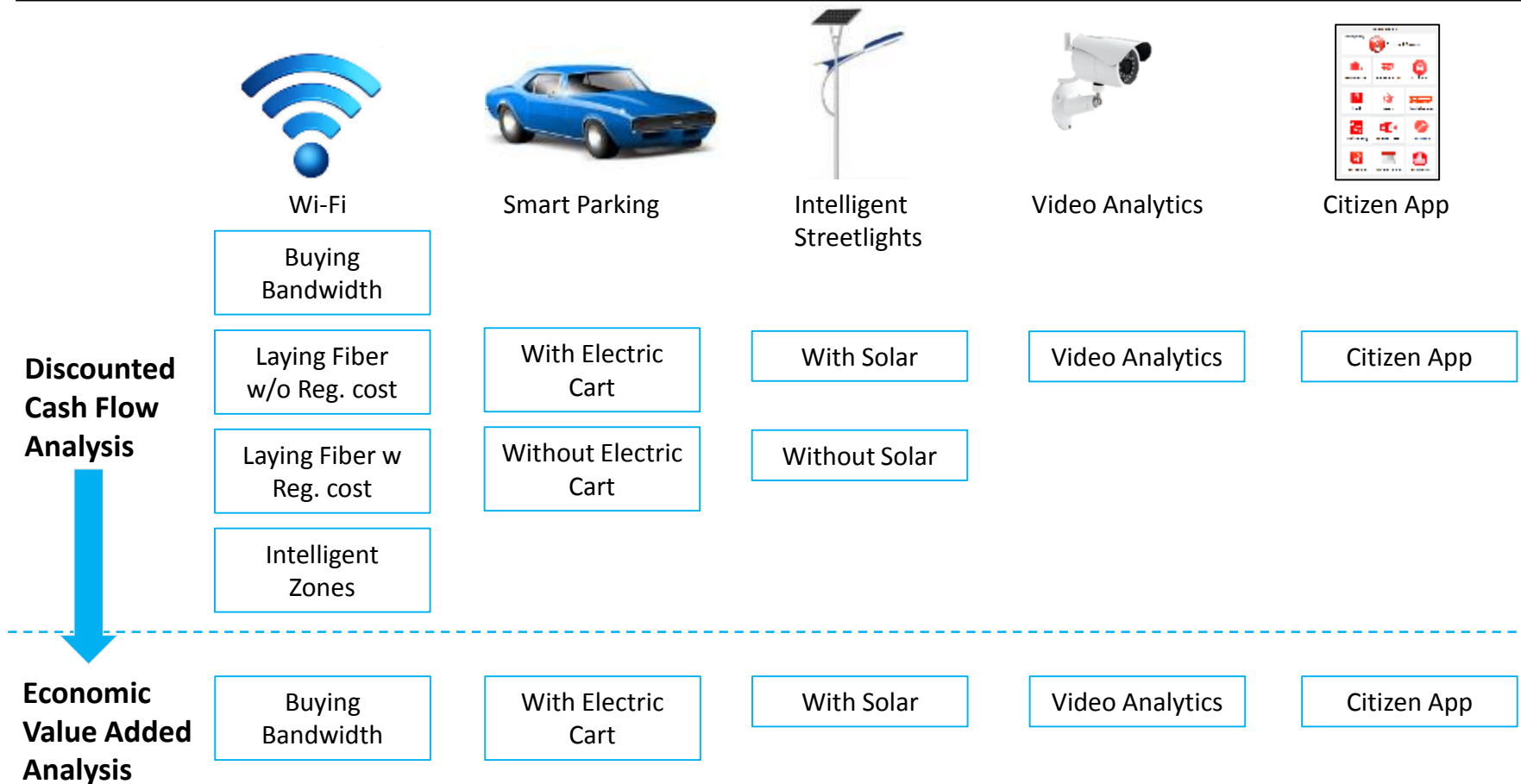


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The 6.4 Lakh employees and a large floating/visitor population travelling from long distances need fast affordable internet connectivity to collaborate and do business

Location

- There are **6,40,000 employees** working in the BKC area
- About **64000 people** is assumed to be the **floating population** that comes to BKC everyday
- Apart from this about **1,560,0,000 people** visit the **MMRDA exhibition grounds** every year
- Currently visitors to the BKC area or employees working in the area log in to the internet via their **personal data connections** on their smart devices which is not reliable and fast enough to collaborate and do business on the go.

Technology

- Currently the BKC E and G blocks are **not Wi-Fi enabled**
- Each building within these blocks may have wired or wireless internet available for the building itself
- GPRS & 3G speed are very slow limiting the business & personal communication on go the go.

Plan

- The plan is to either have **BKC wide Wi-Fi** or **Intelligent hot spots**
- In BKC wide Wi-Fi, E and G blocks will be provided carpet coverage
- In Intelligent hot spots high catchment areas will be provided Wi-Fi coverage
- This will be an example of **excellent infrastructure** provided in BKC
- The Wi-Fi coverage will be advertised for the first few months on hoardings in BKC, radio/FM and sms ads

Issues

BKC Wide Wi-Fi

- **High upfront capital costs** which will take many years to amortize
- First time such a project will be executed in India

Intelligent Zones

- Will **not be able to act as a backbone** for the other initiatives like smart parking, lighting, citizen app and video analytics

Currently with the absence of Wi-Fi an employee/visitor gets impaired due to poor connectivity ; With high-speed Wi-Fi connectivity, a day in the life of a person in Intelligent BKC will be transformed



BEFORE



AFTER



To address the connectivity needs BKC Wide Wi-Fi Access and Intelligent Zones options need to be evaluated to select the best option



Solution Details

BKC Wide Wi-Fi

- BKC wide Wi-Fi will enable **wireless access to internet** to public for certain duration.
- **SMS based authentication** based **security** will be implemented as per **DoT guidelines**
- **Innovative revenue models** can help in recovering cost of O&M.
- **Wi-Fi** will be used as **Communication backbone** for Sensors & Smart applications.

Intelligent Zones

- Intelligent zones will provide free Wi-Fi access to public at certain locations in BKC.

Benefits

- BKC wide Wi-Fi will **provide high speed seamless connectivity**
- It will serve as a **backbone** for **intelligent city applications and sensors**.
- **Incremental revenue streams** from several **subscription models**
- Job creation within the area for managing, maintaining and supporting the networks
- Development of robust IT infrastructure and effective channel of communication across MMRDA focus areas

Conceptual View

BKC Wide Wi-Fi



- The **entire BKC E & G Block** will be **Wi-Fi enabled**
- Public can use the Wi-Fi after registration and authentication for some free period.
- Premium users can get dedicated bandwidth and high speed internet
- Wi-Fi will also be used **communication backbone** for applications like **parking, CCTV etc.** Separate VPN will be created for backbone

Intelligent Zones

Parks



Food Courts



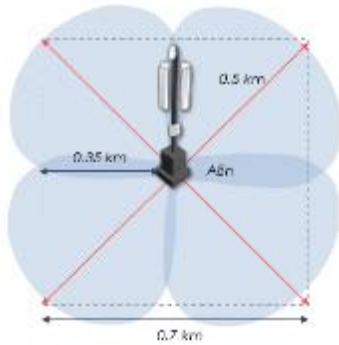
Bus Stops



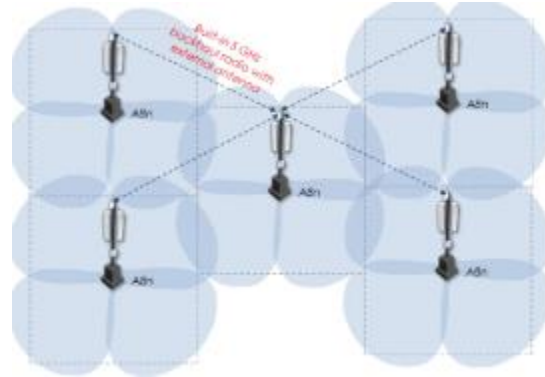
- In case of Intelligent Zones, major hubs like **bus stops, public buildings, parks, food courts**, etc. would be covered with Wi-Fi internet services
- Public can use the Wi-Fi zones for free internet access after registration for 30 min.

For both the options Wi-Fi Access points will provide last mile connectivity with fiber backbone to ensure high bandwidth

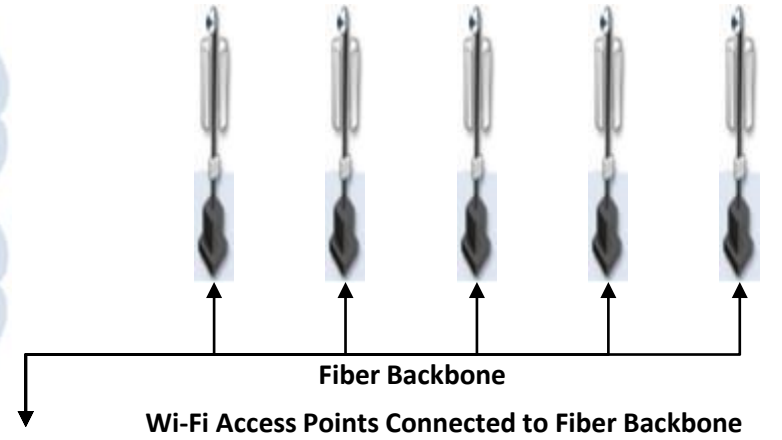
Access Points



Signal Coverage



Typical Cluster Structure

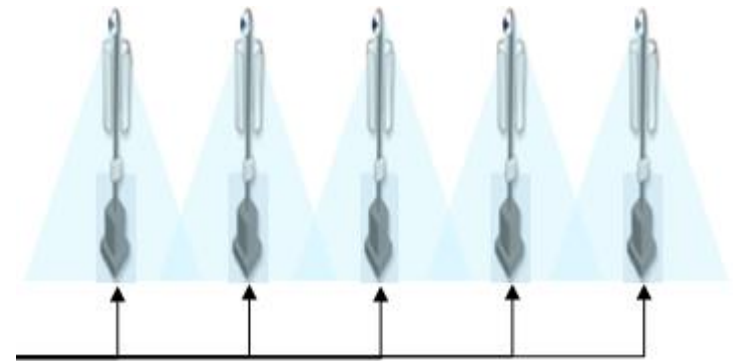


Architecture Options



Cellular Architecture

Require less no. of Access Points but users may face disruption in service in overlap regions. Due to non reliability of Wi-Fi , it cannot be used for communication backbone for Smart City.



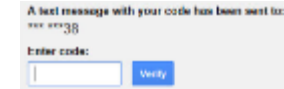
Mesh Architecture With Fiber Backbone (Preferred)

Require more no. of Access Points to create mesh and users will get seamless connectivity all across without disruptions Preferred for Smart City application.



The options have also been designed considering the DoT Guidelines on Wi-Fi Security

Users with Indian Mobile Number



1. User Connect to Wi-Fi Network

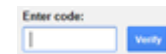
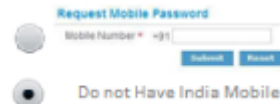
2. Social/Web Identity Authentication: User Ask to Sign-in using one of the below Account

3. SMS Authentication: User Ask to Enter Mobile no.

4. SMS with Code is sent from Server

5. User Enter SMS code and Start internet browsing after successful authentication

Users Without Mobile Number/International Number



1. User Connect to Wi-Fi Network

2. Social/Web Identity Authentication: User Ask to Sign-in using one of the below Account.

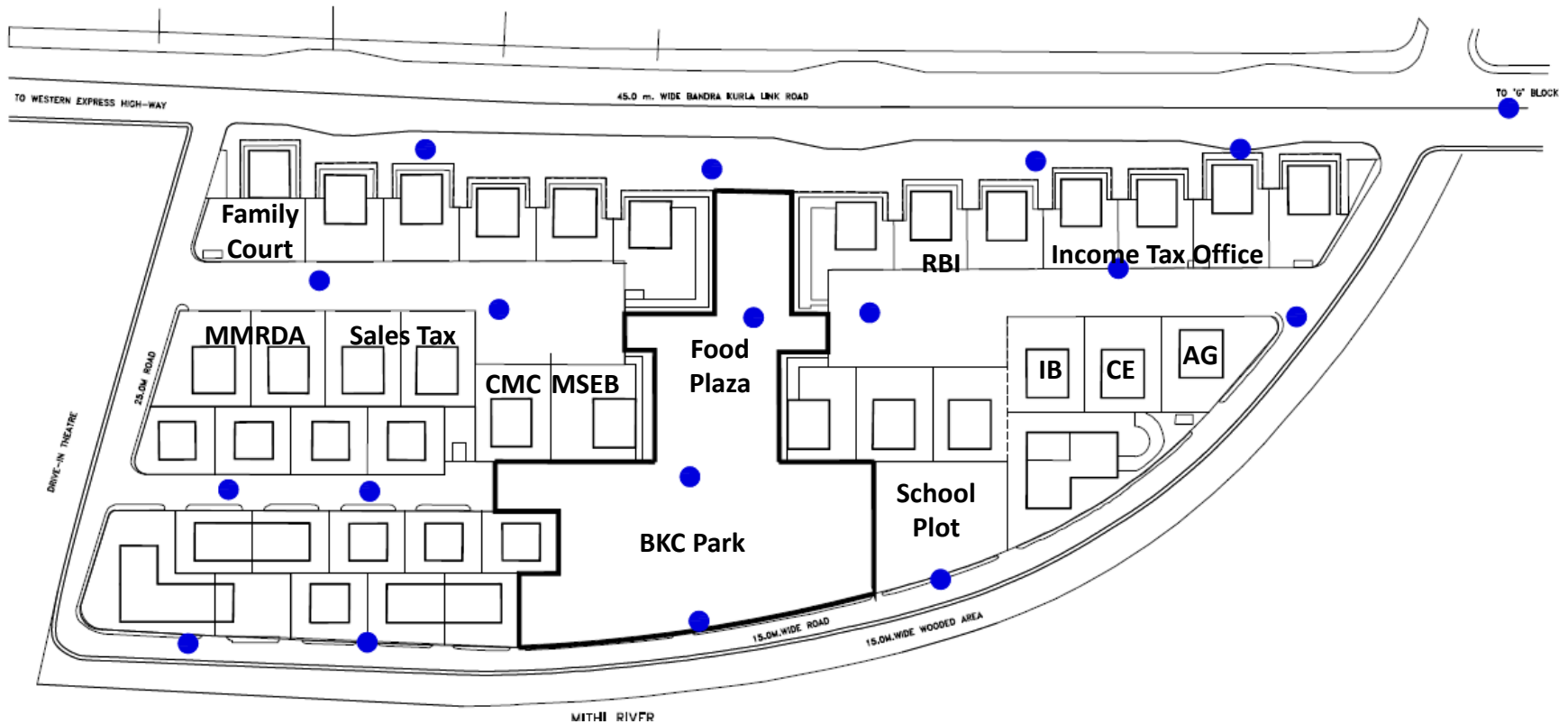
3. Manual Authentication: User Select do not have India mobile

4. Server shows nearest retail store to get coupon. User go-to retail store and submit valid ID proof to get manual code

5. User Enter Manual code and Start internet browsing after successful authentication



Location Analysis is performed to identify the Wi-Fi access points locations in E- Block to ensure carpet coverage



● Wireless Access Points*: 18

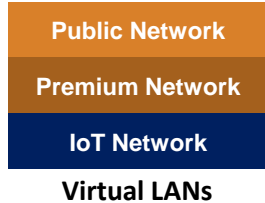
**Wireless access points have been identified in consultation with telecom service provider. Detailed feasibility study will be done during implementation*

The first option - BKC Wide Wi-Fi architecture will enable secure access to internet after SMS authentication as per DoT guidelines



Secure V-LAN with dedicated bandwidth will provide seamless connectivity for Intelligent BKC sensors

Wireless@BKC



Public Network

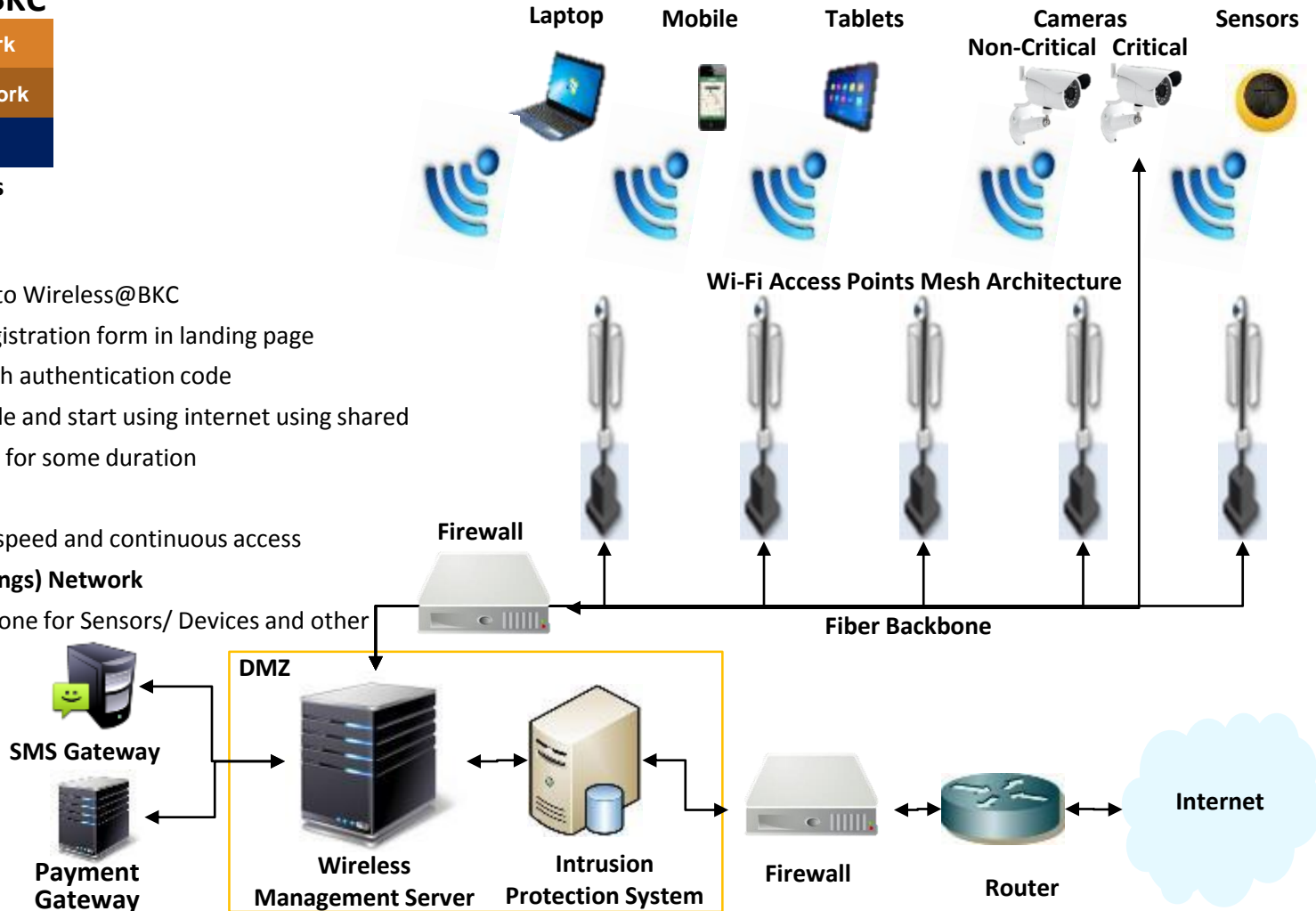
- Users Connect to Wireless@BKC
- User Fill the registration form in landing page
- SMS is send with authentication code
- User enters code and start using internet using shared bandwidth free for some duration

Premium Network

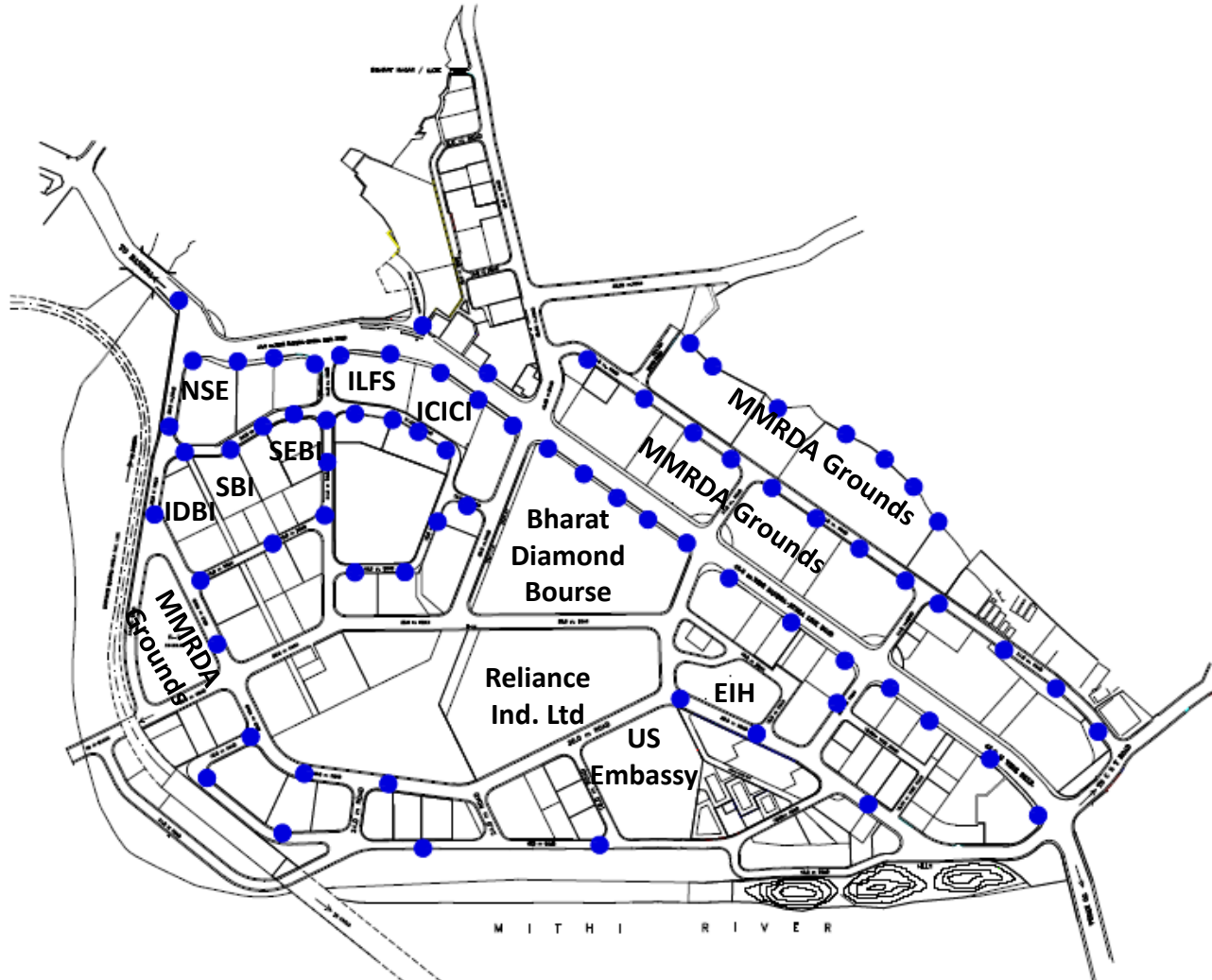
- Users get high-speed and continuous access

IoT(Internet of Things) Network

- Network Backbone for Sensors/ Devices and other Applications



Location Analysis is also done for G Block to identify Wi-Fi access points locations to ensure carpet coverage



● **Wireless Access Points*: 74**

**Wireless access points have been identified in consultation with telecom service provider. Detailed feasibility study will be done during implementation*

For BKC wide Wi-Fi, there are 3 options – Buying bandwidth from an ISP and MMRDA laying its own fiber (with and without collecting its regulatory fees)



	Buying Bandwidth		Laying Fiber With Regulatory Cost		Laying Fiber Without Regulatory cost	
	Wi-Fi	Consolidated	Wi-Fi	Consolidated	Wi-Fi	Consolidated
Capital Expenses (INR in lakhs)	523	1,941	1,571	2,989	553	1,971
Operating Expenses (INR in lakhs per year)	132	552	138	557	188	607
Revenue (INR in lakhs per year)	273	791	273	791	273	791
NPV (INR in lakhs)	469	823	(600)	(398)	1	238
IRR	25%	16%	NA	6%	9%	11%
Simple Payback (in years)	3.42	5.98	NA	7.51	7.64	6.66
Discounted Payback (in years)	5.65	7.38	NA	NA	9.98	10.08

- Buying bandwidth has the highest NPV and the highest IRR when the consolidated view is looked at – Hence buying bandwidth is recommended
- Laying fiber becomes a financially viable option if the regulatory fees owed to MMRDA is waived off.
 - The capex costs of buying bandwidth and laying fiber then become comparable.
 - The opex costs for laying fiber is 56 lakhs higher than buying bandwidth because maintenance of the fiber needs to be done by MMRDA.
 - However in the future this opex may become more competitive than buying bandwidth because of increasing bandwidth requirements needed for additional intelligent city initiatives
 - But in this model MMRDA may needs to takes an ISP License to resell internet bandwidth to public
 - Fiber optic network require specialized team for operations and maintenance
- **Considering the regulator requirements (ISP license), maintenance needs & financial feasibility, we recommend to go for buying bandwidth option**



To ensure economic self-sustainability for BKC wide Wi-Fi a detailed revenue model is created

Assumptions

- Total number of BKC employees: 6,40,000
- Total visitors coming to BKC (-exhibition): 64,000
- % of BKC employees using Wi-Fi free per day: 3%
- Average time of usage provided for free daily: 30 min
- Advertising: cost per thousand impressions rate: INR 250
- Average number of time user connects to Wi-Fi: 2
- % of free internet users buying a prepaid recharge card: 10%
- Average cost of prepaid card per hour of data usage: INR 30
- % of recharge coupons sold as gifts: 10% with a 5% increase each year
- Revenue inflation rate per year: 5%
- MMRDA exhibition grounds visitors per year: 1,56,00,000
- % of people visiting MMRDA grounds using Wi-Fi: 3%
- Excess tariff per square meter charged for providing a bouquet of services like Wi-Fi to the MMRDA grounds: INR 1
- Total area of MMRDA grounds for renting: 3,28,177sqm

Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Launch page tie up		26.40	27.72	29.11	30.56	32.09	33.69	35.38	37.15	39.00	40.96
Advertising - text, video		79.20	83.16	87.32	91.68	96.27	101.08	106.14	111.44	117.01	122.87
Prepaid recharge cards sold in businesses in the area		39.60	43.66	46.76	50.08	52.58	55.21	57.97	60.87	63.91	67.11
Recharge coupons to be sold to businesses in the area that they can then give to their customers as gifts (e.g., half an hour free Wi-Fi coupon will be given to a pizza customer if he buys a pizza)		15.84	17.46	19.25	21.23	23.40	25.80	28.45	31.36	34.58	38.12
Integrate 4Square type check-ins with businesses. If user posts check-in to Facebook/twitter, he automatically gets access to Wi-Fi. Cost to be borne by business based on usage		15.84	16.63	17.46	18.34	19.25	20.22	21.23	22.29	23.40	24.57
MMRDA grounds - providing people with a bouquet of services with a fixed premium on the land cost		95.99	100.79	105.83	111.12	116.68	122.51	128.64	135.07	141.82	148.91
Total		272.87	289.43	305.73	323.01	340.28	358.52	377.80	398.18	419.74	442.54

An investment plan is also created to identify budgetary Capex and Opex



Assumptions

- Rate of increase of expenses: 5%
- Software AMC: 22% of Software costs
- Hardware AMC: 20% of hardware costs
- 50 lakhs for 150mbps internet bandwidth
- INR 65 lakhs for 300mbps local connectivity on fiber
- IPS, Firewall: INR 20 lakhs
- Buffer of 15% for all costs

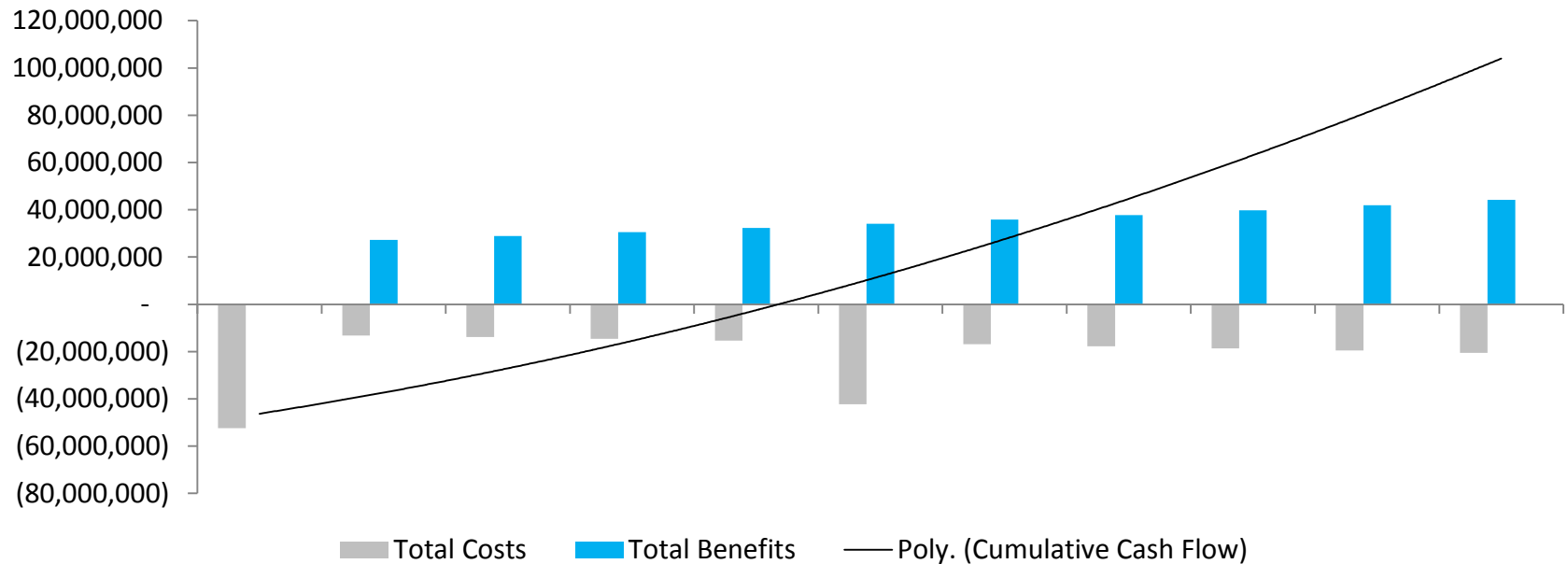
Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Hardware: Wi-Fi Access Points, Routers, Switches, Server, etc..	385.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Software: Authentication, Firewall, IPS, Wireless Management System	51.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Services: System Integration, Installation	86.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Capital Expenses	523.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capex Refresh	0.00	0.00	0.00	0.00	0.00	261.63	0.00	0.00	0.00	0.00	0.00
Opex											
Internet Bandwidth: 150 mbps and 300 mbps	0.00	132.25	138.86	145.81	153.10	160.75	168.79	177.23	186.09	195.39	205.16
Total Operating Expenses	0.00	132.25	138.86	145.81	153.10	160.75	168.79	177.23	186.09	195.39	205.16
Total Costs	523.25	132.25	138.86	145.81	153.10	422.38	168.79	177.23	186.09	195.39	205.16

Cost Benefit Analysis for BKC Wide Wi-Fi initiative is positive and has a simple payback period of 3.42 years



Investment credentials

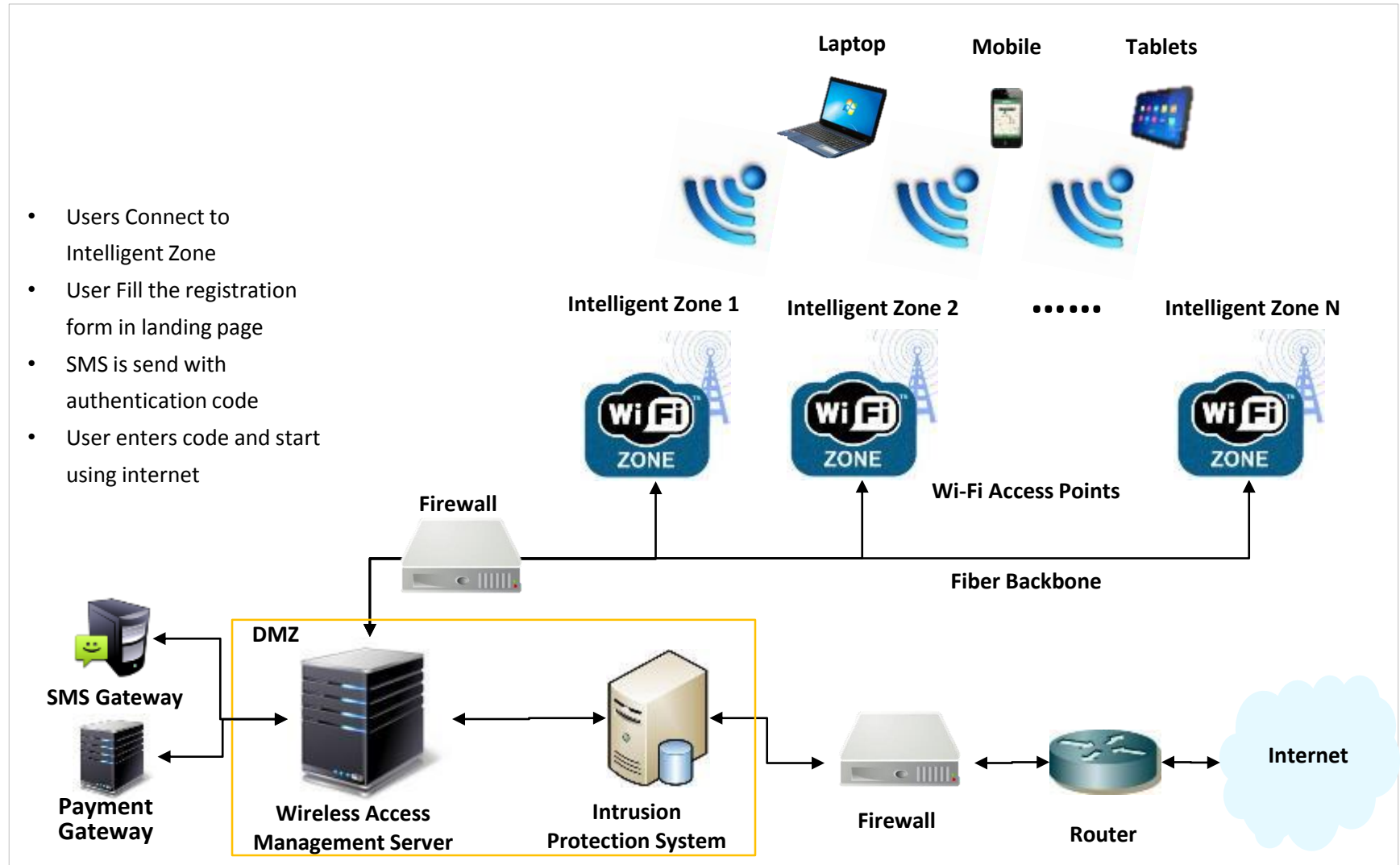
- NPV: INR 4.69 Cr.
- IRR: 25%
- Simple payback period: 3.42
- Time-adjusted payback period: 5.65



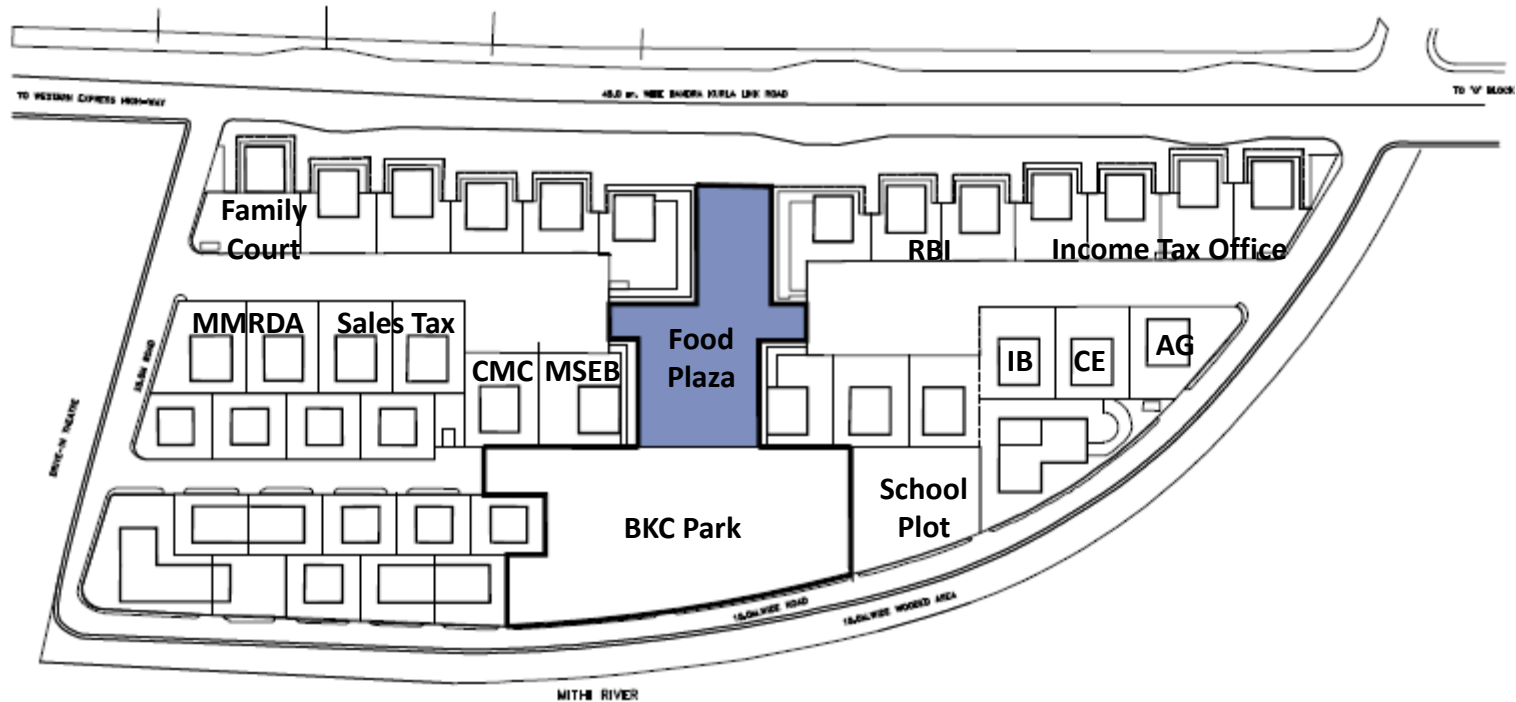
The second option - Intelligent Zones Architecture enables internet access at specified locations in BKC with secure authentication



- Users Connect to Intelligent Zone
- User Fill the registration form in landing page
- SMS is send with authentication code
- User enters code and start using internet

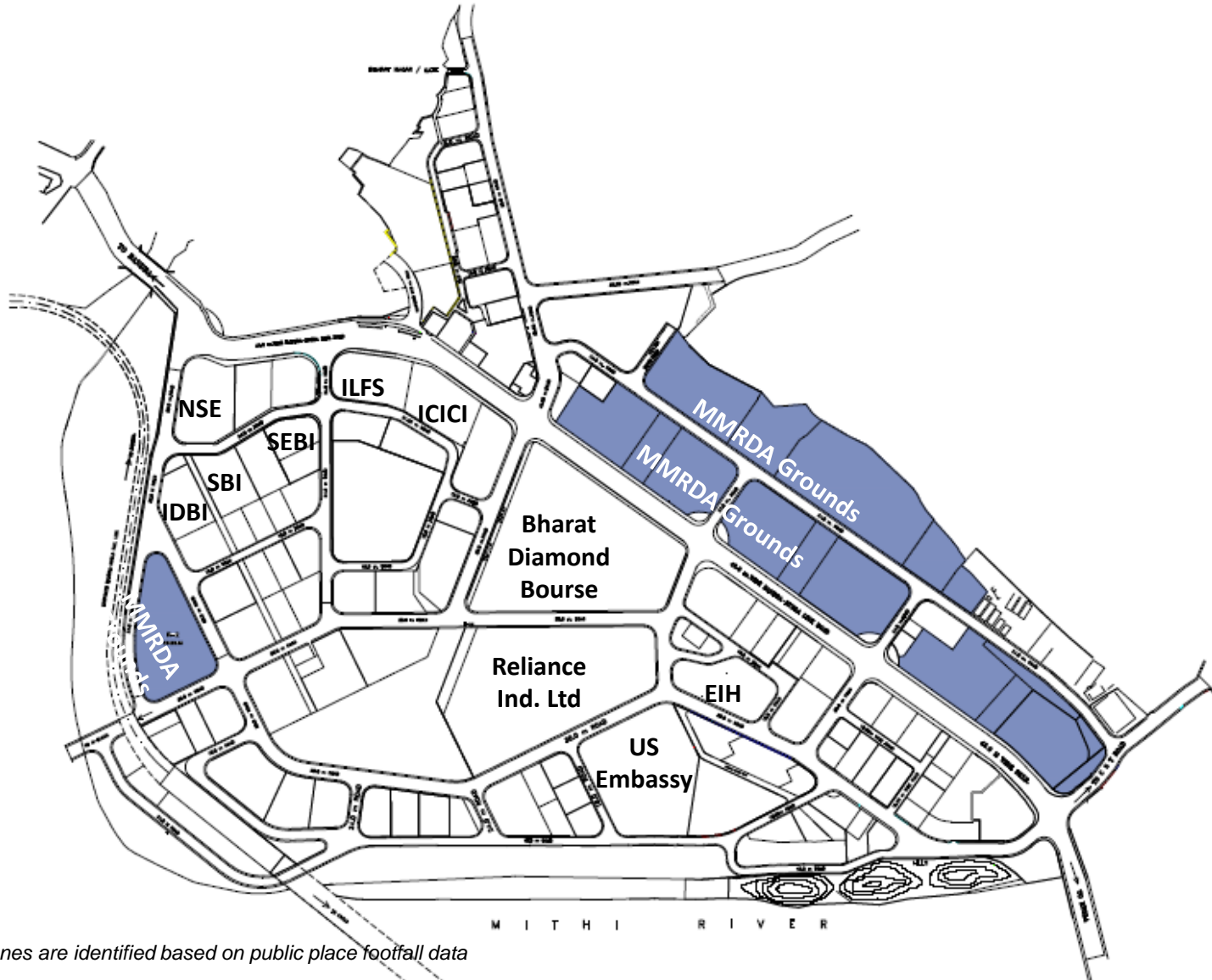


Location Analysis is performed to identify the possible intelligent zones in E Block



Intelligent zones are identified based on public place footfall data

Location Analysis is performed to identify possible intelligent zones in G Block



Intelligent zones are identified based on public place footfall data



A detailed revenue model is created for Intelligent Zones option

Assumptions

- Total number of BKC employees in E block: 25000
- Total visitors coming to BKC (-exhibition): 2500
- % of people who visit E block food court: 2%
- % of BKC employees using Wi-Fi free per day: 0.06%
- Average time of usage provided for free daily: 30 min
- Advertising: cost per thousand impressions rate: INR 250
- Average number of time user connects to Wi-Fi: 2
- % of free internet users buying a prepaid recharge card: 10%
- Average cost of prepaid card per hour of data usage: INR 30
- % of recharge coupons sold as gifts: 10%
- Revenue inflation rate per year: 5%
- MMRDA exhibition grounds visitors per year: 1,56,00,000
- % of people visiting MMRDA grounds using Wi-Fi: 3%
- Excess tariff per square meter charged for providing a bouquet of services like Wi-Fi to the MMRDA grounds: INR 0.5
- Total area of MMRDA grounds for renting: 3,28,177 sqm

Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Launch page tie up		0.0206	0.0217	0.0227	0.0239	0.0251	0.0263	0.0276	0.0290	0.0305	0.0320
Advertising - text, video		0.0619	0.0650	0.0682	0.0716	0.0752	0.0790	0.0829	0.0871	0.0914	0.0960
Prepaid recharge cards sold in businesses in the area		0.0309	0.0341	0.0376	0.0415	0.0457	0.0504	0.0556	0.0613	0.0675	0.0745
MMRDA grounds - providing people with a bouquet of services with a fixed premium on the land cost		48.00	50.40	52.92	55.56	58.34	61.26	64.32	67.54	70.91	74.46
Total		48.11	50.52	53.04	55.70	58.49	61.41	64.49	67.71	71.10	74.66

An investment plan is also created to identify Capex and Opex requirements for Intelligent Zones option



Assumptions

- Rate of increase of expenses: 5%
- Software AMC: 22% of Software costs
- Hardware AMC: 20% of hardware costs

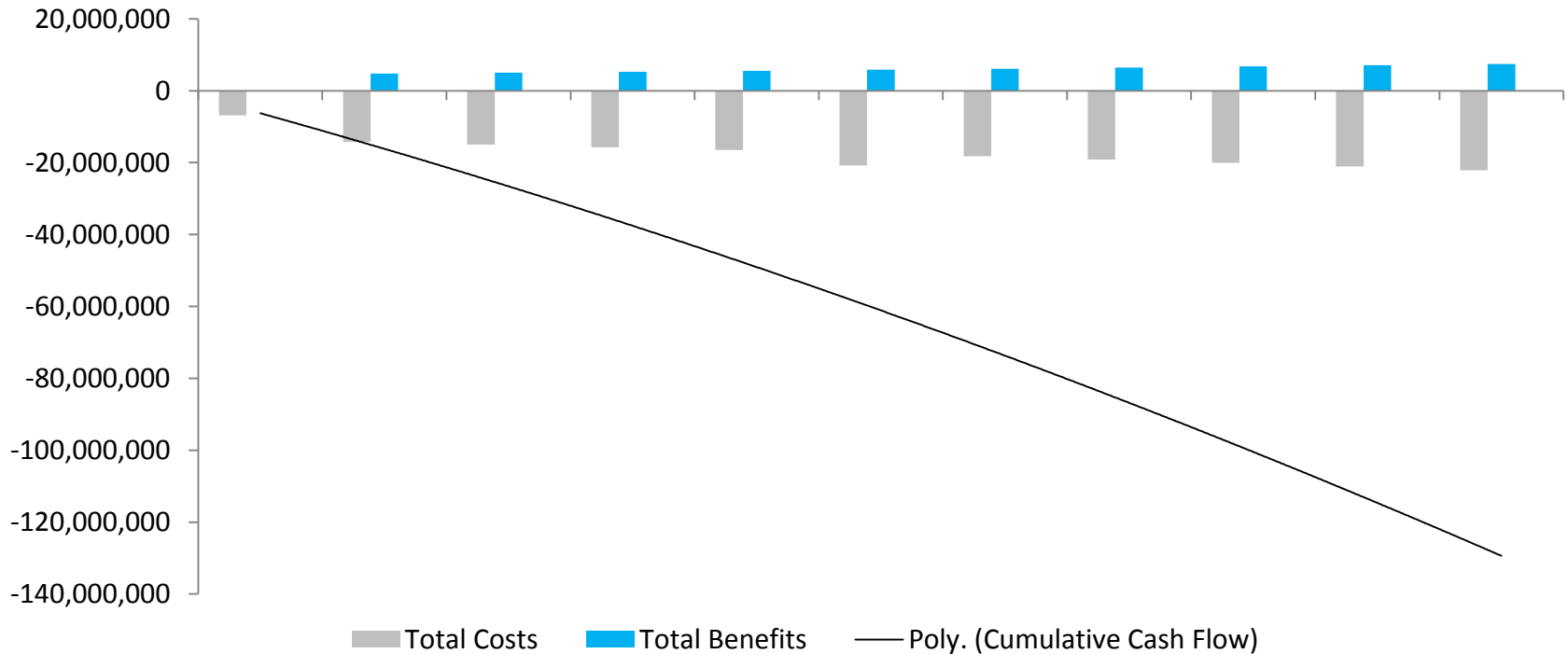
Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Hardware: Wi-Fi Access Points, Routers, Switches, Server, etc.	56.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Software: Authentication, Firewall, IPS, Wireless Management System	7.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Services: System Integration, Installation	4.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Capital Expenses	68.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capex Refresh	0.00	0.00	0.00	0.00	0.00	34.26	0.00	0.00	0.00	0.00	0.00
Opex											
Internet Bandwidth	0.00	8.43	8.86	9.30	9.76	10.25	10.76	11.30	11.87	12.46	13.08
Network connectivity for smart city initiatives	0.00	115.00	120.75	126.79	133.13	139.78	146.77	154.11	161.82	169.91	178.40
AMC - Onsite support	0.00	4.22	4.43	4.65	4.88	5.13	5.38	5.65	5.93	6.23	6.54
AMC - Software	0.00	1.92	2.02	2.12	2.22	2.33	2.45	2.57	2.70	2.84	2.98
AMC - Hardware	0.00	13.00	13.65	14.33	15.04	15.80	16.59	17.42	18.29	19.20	20.16
Total Operating Expenses	0.00	142.57	149.69	157.18	165.04	173.29	181.95	191.05	200.60	210.63	221.17
Total Costs	68.52	142.57	149.69	157.18	165.04	207.55	181.95	191.05	200.60	210.63	221.17



Cost Benefit Analysis for the Intelligent zones option showcases a negative NPV and the investment will not be paid back

Investment credentials

- NPV: INR **-8.37 Cr.**
- IRR: -NA
- Simple payback period: NA
- Time-adjusted payback period: NA





Considering Qualitative and Quantitative assessment of the two options BKC Wide Wi-Fi option is recommended

BKC Wide Wi-Fi

Pros

- Provides **Internet connectivity** to users all across BKC
- **Communication backbone** for Smart BKC applications like Smart Parking, CCTVs, Sensors, Smart Meters, Intelligent Traffic Systems, Air/Water quality meters, Flood sensors etc..
- Wi-Fi Communication backbone significantly reduces the new initiatives implementation time by saving time and inconvenience due to digging of roads for laying network cable.

Cons

- High Capex investment

Quantitative Analysis

- Capex Cost: INR 5.23 Cr.
- NPV: INR 4.69 Cr.
- Opex Cost: INR 1.32 Cr. Per year
- Payback period: 3.42
- Revenue: INR 2.73 Cr. per year

Intelligent Zones

Pros

- Provides **Internet connectivity** to users in a defined area
- Low Capex investment

Cons

- Usage limited to internet access
- High Opex investment
- Limited internet access at certain areas also limits the population using the Wi-Fi

Quantitative Analysis

- Capex Cost: INR 68.5 lakhs
- Opex Cost: INR 1.43 Cr. per year
- Revenue: INR 48 lakhs per year
- NPV: INR -8.37 Cr.
- Payback period: NA

Recommendations

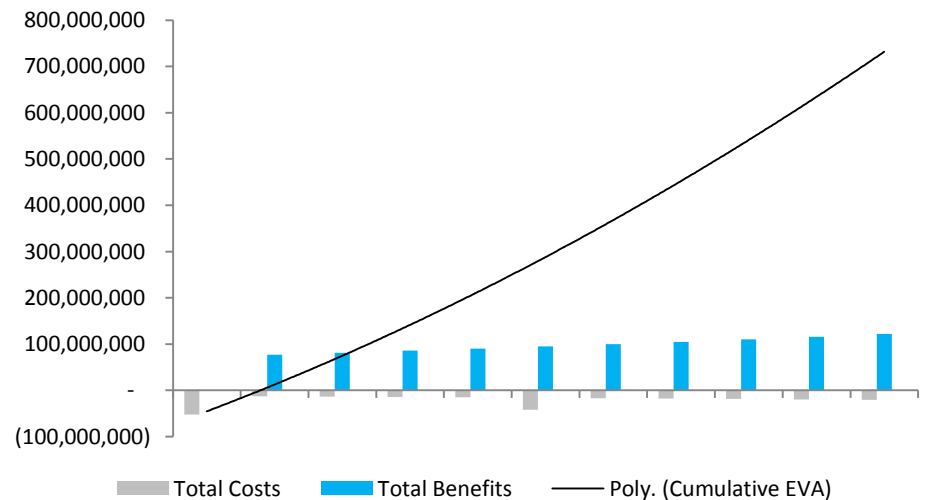
- BKC-wide Wi-Fi is recommended even though the cost benefit analysis is negative because stakeholder benefits like publicly available, wide internet connectivity is crucial to the realization of the smart city BKC vision of becoming an international financial hub.

The net economic value added by using BKC-wide Wi-Fi makes the payback period to be 0.82 years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(523.25)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(523.25)
Capex Refresh	0.00	0.00	0.00	0.00	0.00	(261.63)	0.00	0.00	0.00	0.00	0.00	(240.62)
Total Operating Expenses	0.00	(132.25)	(138.86)	(145.81)	(153.10)	(160.75)	(168.79)	(177.23)	(186.09)	(195.39)	(205.16)	(1044.74)
Total Costs	(523.25)	(132.25)	(138.86)	(145.81)	(153.10)	(422.38)	(168.79)	(177.23)	(186.09)	(195.39)	(205.16)	(1740.15)
Financial Benefits	0.00	272.87	289.43	305.73	323.01	340.28	358.52	377.80	398.18	419.74	442.54	2209.00
Non-Financial benefits	0.00	500.00	525.00	551.25	578.81	607.75	638.14	670.05	703.55	738.73	775.66	3949.85
Total Benefits	0.00	772.87	814.43	856.98	901.82	948.03	996.66	1047.85	1101.73	1158.46	1218.20	6158.85
Net EVA	(523.25)	640.62	675.56	711.18	748.73	525.65	827.87	870.62	915.64	963.07	1013.04	4418.71
Cumulative EVA	(523.25)	117.37	792.94	1504.11	2252.84	2778.49	3606.36	4476.98	5392.62	6355.69	7368.73	0.00

Assumptions	
8.73%	Discount rate based on 10 year Government bond yield
640000	employees
3	% of BKC employees using wifi free per day
19200	Employees using wifi
30	min of free wifi every day
10	min saved because wifi is faster than mobile internet
50000	days saved per year
1000	INR average per day salary
50000000	INR. Productivity benefits to citizens from using wifi



For the selected option there are additional stakeholder benefits which make it a preferred option



Citizens/Businesses

- Improvement in the quality of experience for visitors and employees in BKC
- Seamless Internet access in BKC
- Various smart apps like the parking app, CIP app etc.. can send push notifications

MMRDA/ Govt.

- Wi-Fi will be the backbone for other services like smart parking, intelligent streetlights etc..
- New revenue stream



Others (Environment etc..)

- Model for rest of the world

There are multiple vendors available to implement the BKC wide Wi-Fi option



Juniper	<ul style="list-style-type: none"> • Headquarters: Sunnyvale, California, USA. • Core business: <u>Juniper Networks</u> designs, develops, and sells products and services that together provide its customers with network infrastructure. Its Infrastructure products include its Internet protocol (IP) routing, carrier Ethernet routing portfolio, and Ethernet switching portfolio, along with a complete wireless local area network (WLAN) solution.
HP	<ul style="list-style-type: none"> • Headquarters: Palo Alto, California, USA. • Core business: <u>HP</u> specializes in developing and manufacturing computing, data storage, and networking hardware, designing software and delivering services. Its intelligent interoperability solutions enable a seamless Wi-Fi to cellular customer experience from hotspots along with business intelligence, authentication, policy control, and charging.
Cisco	<ul style="list-style-type: none"> • Headquarters: San Jose, California, USA • Core business: <u>Cisco</u> is a manufacturer of hardware, software, networking, and communications technology services. Among its solutions portfolio are personalized Wi-Fi through its aggregation services routers, intelligent services gateways, mobility services engine, 802.11n access points , wireless LAN controllers and access registrars.
Tata Teleservices	<ul style="list-style-type: none"> • Headquarters: Mumbai, India • Core business: One of India’s largest telecom operators(Tata DOCOMO) and wireless mobile broadband providers (Tata Photon). Also the largest private fixed wireless telephony provider. <u>Tata Teleservices</u> plans to set up nearly 4,000 Wi-Fi hotspots in nine cities across India in the next two years.
Sify	<ul style="list-style-type: none"> • Headquarters: Chennai, India • Core business: In addition to being one of India’s largest ISPs with over 900 points of presence in 400 cities in India, <u>Sify</u> is also a provider of an array of services like uninterrupted connectivity, dedicated speeds, value added features and 24x7 support to enterprises.

City wide Wi-Fi has proven to be a successful model globally and would serve as a foundation for achieving the BKC intelligent city vision



Wireless@SG, Singapore



- Singapore government's initiative, Wireless@SG, launched in 2006, to accelerate the deployment of high-speed wireless broadband, promote wireless broadband lifestyle amongst citizens and catalyze the wireless broadband market in Singapore
- The access speed was doubled to 1 Mbps in September 2009 and the Seamless and Secure Access ("SSA") was implemented in 2010 to simplify the log-in process and gives users the "always-on" function in a hassle-free manner
- As of December 2012, there are 2.26 million subscribers. Usage hours have also increased to an average of 31 hours per user per month in 2012
- Several enhancements are being planned over the next phase of expansion for the service

Blanket Wi-Fi in CBD, Perth

- The City of Perth offers free public Wi-Fi around their Central Business District (CBD). The service allows users to connect to the internet for basic browsing
- The 'Perth Wi-Fi' internet service provides blanket coverage over the CBD area which means once you connect you can roam the city streets and remain connected
- This is enabled through a series of hubs around the city that extend the Wi-Fi from one area to another
- It has cost \$300,000 to install with a further \$150,000 set aside annually for improving services
- Users have a download limit of 50mbps per connection. Once this limit is reached users will need to reconnect to the service
- If users do not exceed their download limit they can remain connected to the network for an hour. After an hour users will need to reconnect



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Commuters spend on an average 20 mins. looking for parking slots, which amounts to 92 tonnes of CO2e every year; also leading to unauthorized parking



Location

- There are currently **1070 four-wheeler parking spots, 350 two-wheeler spots and 166 bus spots** spread over **eight parking lots**
- There are **3000** additional parking spots that are currently under construction and will take 2-3 years to be available
- The demand for parking spaces far outstrips the supply of them
- Parking during peak timings in BKC is a frustrating experience with over **18-20 minutes spent circling** looking for a parking space

Plan

- Smart parking will reduce the hassle that commuters to BKC currently have – the difficulty in finding a parking spot.
- This will be addressed by the introduction of **parking sensors in parking spots** which detect the presence of a vehicle and then transmit this information to a smart parking server
- **A well designed app with a map** that points out available parking spots
- The smart parking initiative will be **advertised** during the first few months

Technology

- The parking lots were tendered. The current parking process is manual. The parking attendant **over charges people** (INR 80 or INR 105 instead of INR 60).
- Some of the parking lots are very far from the commercial area thus their tender process was not fulfilled because they **could not meet revenue potential**
- A lot of **street parking goes on illegally** because of unavailability of parking spots
- While towing of some cars happens, several cars remain parked thus making this a **non-optimal way of realizing revenue**

Issues

- Smart parking solution suggested does not cover non-tendered spots where a large fraction of illegal parking goes on
- Uptake of the mobile application for smart parking might not find too many users unless it is designed with users ease of use in mind

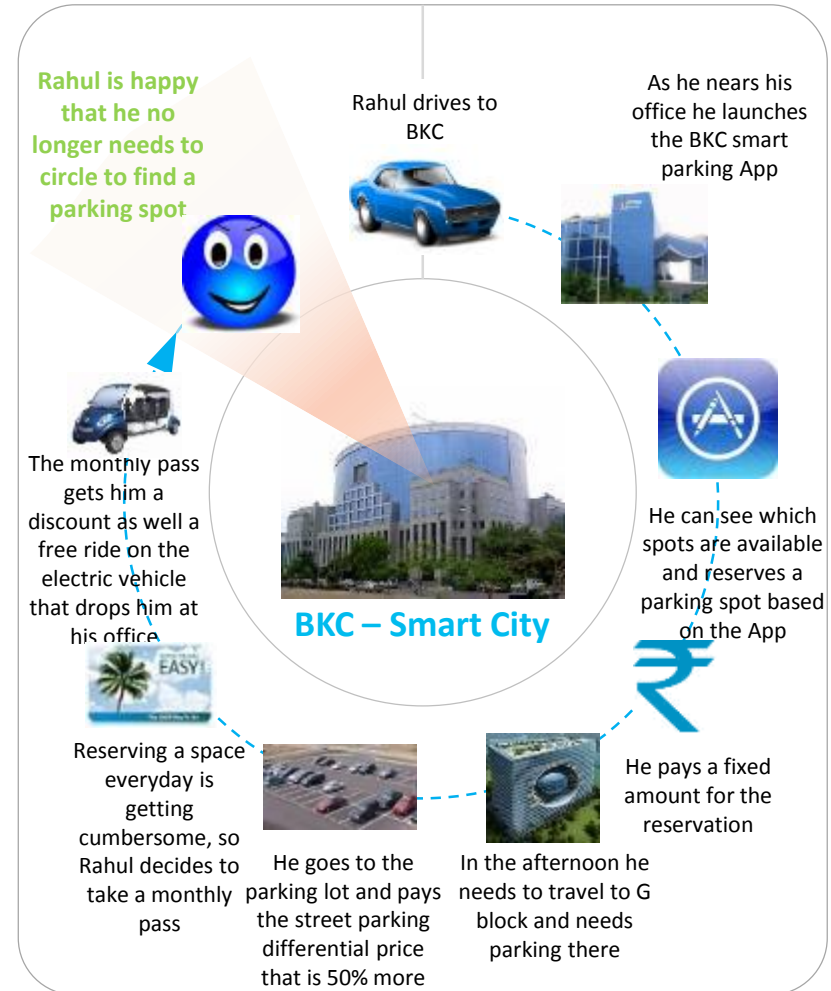
Currently ease of finding a parking slot is a major pain area for commuters and causes unauthorized parking; smart parking will address both the issues



BEFORE



AFTER





To address the parking needs smart parking with and without electric cart options are evaluated

Solution Details

- Smart Parking solution will manage **indoor, open and street parking**.
- **Parking guidance mobile app** will help users to locate **free parking, block free parking and navigation** to parking. Guidance App will be available on all iPhone, Android and web platforms.
- **Premium users can register** for hassle free parking experience.
- Parking operator can access the software for revenue collection, reporting etc..
- **Electric cart** will provide connectivity from parking to key locations at nominal fee which could be embedded in parking fee.

Benefits

- Streamline the parking operations
- **Reduction** in time to **find parking** is from **20mins to 5 mins**.
- **Reduction in unauthorized parking**
- **Increased revenue** from parking services through real time parking pricing
- **Hassle free parking for premium and normal users**.
- **Convenient connectivity** to key locations by **electric vehicle**.

Conceptual View



- Parking sensors captures free/ occupied status
- Digital Message board & maps will provide real time status of parking
- Parking operator can use terminal for ticketing, revenue collection & reporting



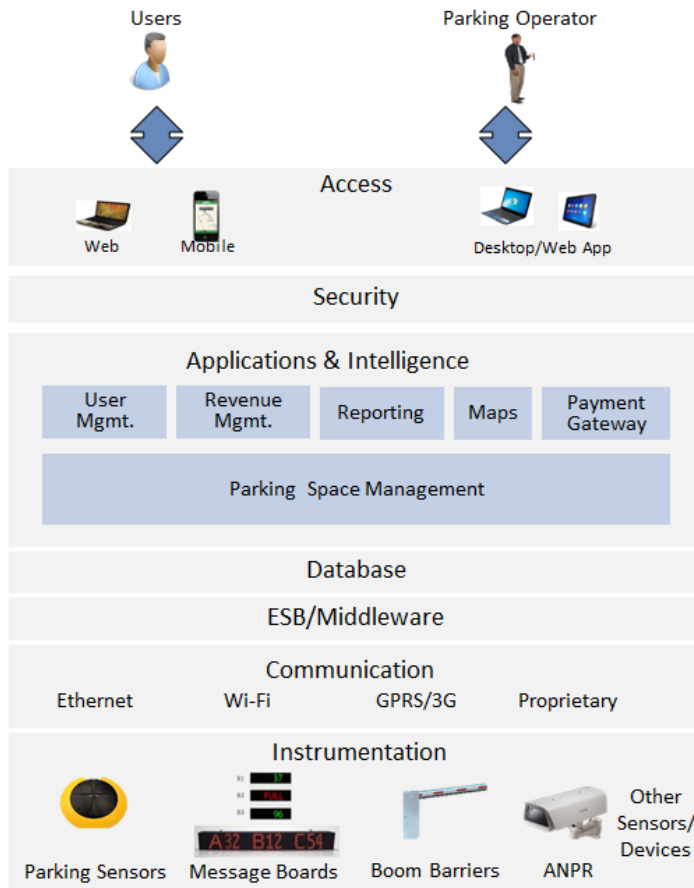
Electric Cart can ferry passenger from parking area to offices at nominal fee



- Users can use mobile app maps to find available parking slots and maps will help them navigate to the respective parking.
- Premium users will pass through premium entry and CCTV/RFID will detect user and boom barrier will open automatically.
- Normal users will have to take ticket and while exit need to pay by cash

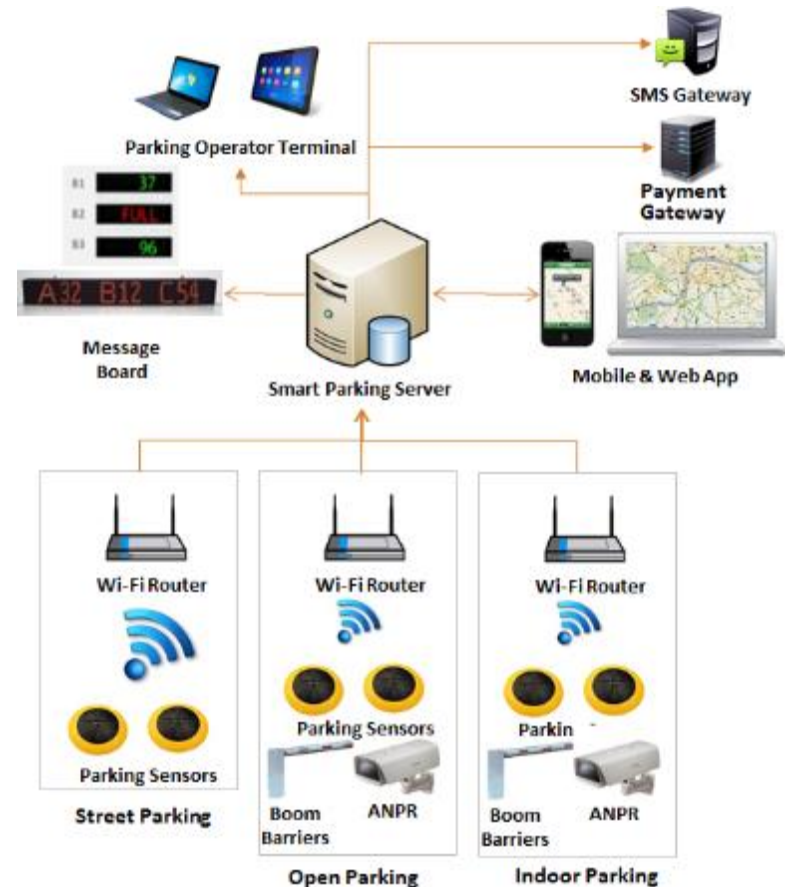
For both the options the smart parking base architecture has to be designed

Application



- Parking space management, maps engine, user mgmt., revenue mgmt., reporting and payment gateway are key modules for Smart Parking application architecture.

Infrastructure



- Sensors data will be captured through Wi-Fi routers and transmitted to parking server. Parking server will update the message board and maps frequently to provide real time parking space availability.

For the option with electric cart, additional GPS enabled tracking system has to be provided



Traveler can login into web/mobile app to find out real time status of cart.



Cart Route, Arrival, Departure information can be displaced in Message board in Parking area and key locations in cart route



Cart Information Server

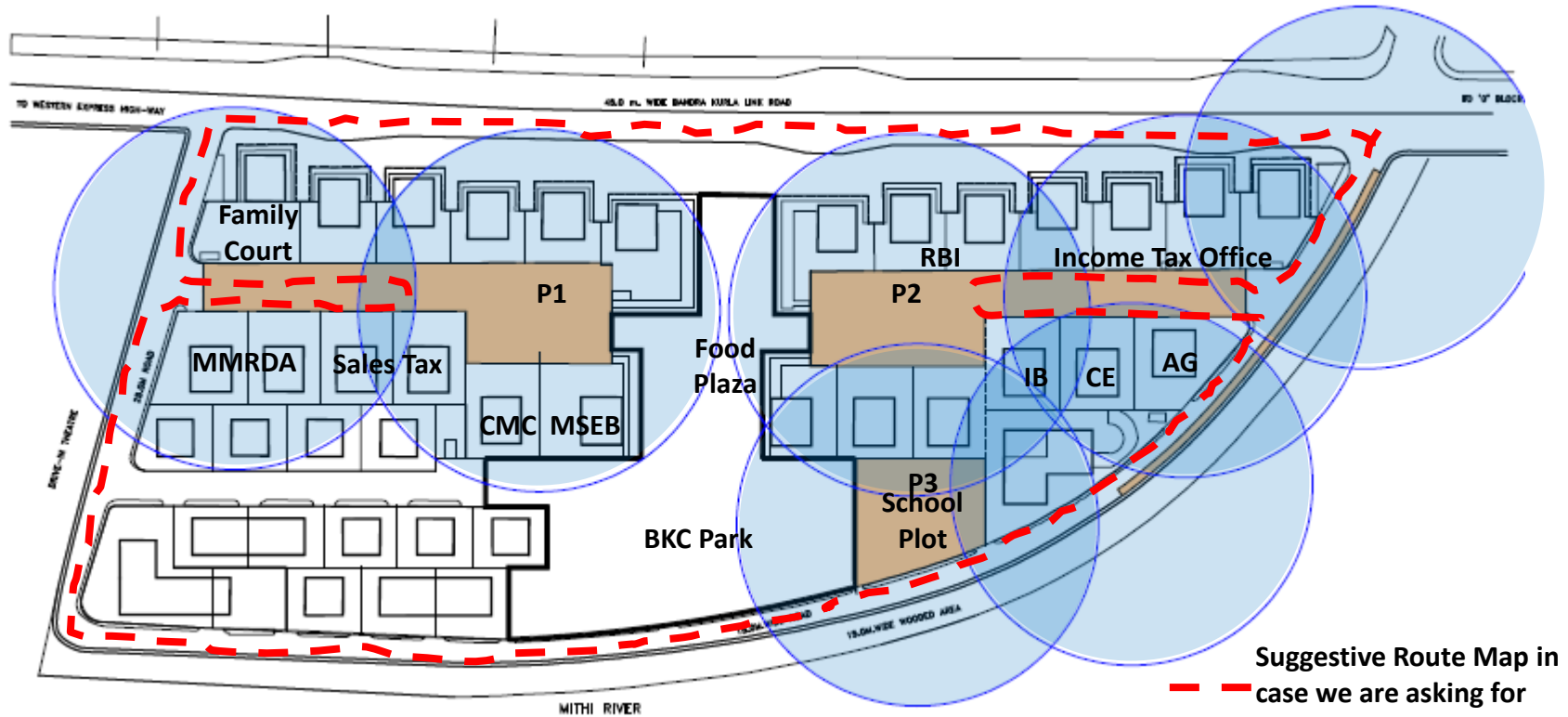
- Cart Operator**
- Cart Scheduling
 - Route Tracking
 - Route deviations
 - Arrival Predictions

Wi-Fi



Electric Cart with GPS

Location analysis is performed to identify the electric cart route in E-block

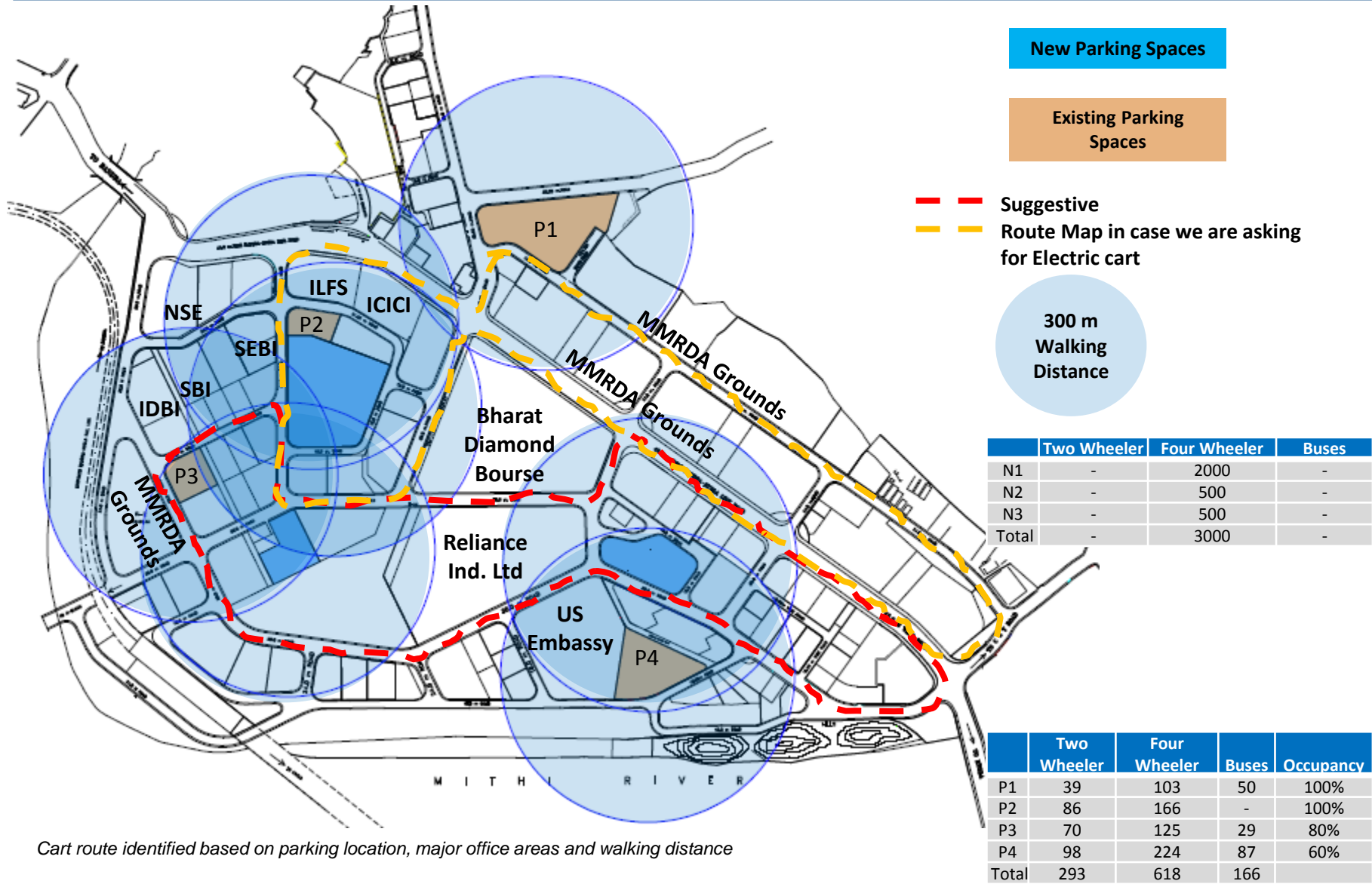


	Two Wheeler	Four Wheeler	Buses	Occupancy
P1	-	91	-	80%
P2	57	60	-	70%
P3	-	201	-	10%
P4	-	100	-	10%
Total	57	452	0	

300 m Walking Distance

Cart route identified based on parking location, major office areas and walking distance

Location analysis is performed to identify the electric cart route in G Block



Cart route identified based on parking location, major office areas and walking distance

A detailed revenue/benefits model has been developed for the first option - smart parking with electric cart



Assumptions

- No. of hours parking spot is active (9am to 9pm): 12 hours
- Average parking spot occupancy during a day: 70%
- Average combined daily parking spot fixed price for four, two wheeler and bus at 70% occupancy: INR 69969.2
- Revenue inflation rate per year: 5%
- % of parking spots that take a monthly pass (Assuming that they are BKC employees who will park all day): 20%
- Discount of monthly pass below normal cost: 30%
- % of parking spots that will be reserved (Assuming that they are BKC employees who will park all day): 10%
- Reservation price: INR 50 for cars, INR 20 for two wheelers, INR 100 for buses
- Street Parking Markup: 150%
- Number of electric vehicles : 12 (4 in E and 8 in G Block)
- Cost of electric vehicle: INR 250000
- Revenue from advertising on electric vehicle @INR 15000 per vehicle per month for a year

Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Fixed parking prices		174.92	183.67	192.85	202.50	212.62	223.25	234.41	246.13	258.44	271.36
Monthly parking pass		37.86	39.76	41.74	43.83	46.02	48.32	50.74	53.28	55.94	58.74
Ability to reserve a parking spot ahead of time for a premium		14.70	15.43	16.20	17.01	17.86	18.75	19.69	20.68	21.71	22.80
Differential parking price for locations - street parking near offices		30.10	31.61	33.19	34.85	36.59	38.42	40.34	42.36	44.48	46.70
New parking addition @ Fixed prices			77.00	154.00	462.00	485.10	509.36	534.82	561.56	589.64	619.12
Advertising from electric vehicles proposed to move from parking to hubs in places where street parking is not allowed		21.60	22.68	23.81	25.00	26.25	27.57	28.95	30.39	31.91	33.51
Total	0.00	279.18	370.14	461.80	785.19	824.45	865.67	908.96	954.40	1002.13	1052.23

Capital expenditure of INR 3.3 Cr. will be required to implement smart Parking with Electric Cart



Assumptions

- Annual Maintenance Contract includes replacing 10% of batteries and sensors every year or as required
- Internet connectivity is included
- Also includes service costs
- No of parking spots (cars + buses) for 1st year: 1236
- No of additional parking spots in year 2: 500
- No of additional parking spots in year 3: 500
- No of additional parking spots in year 4: 2000

Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Instrumentation: Sensors	263.01										
Software: Online and mobile	10.93										
Services: System Integration, Commissioning of instrumentation	26.30										
Electric Cart	30.00										
Total Capital Expenses	330.23										
Capital Refresh			86.25	86.25	345.00	394.51		129.38	129.38	517.50	
Opex											
AMC - Instrumentation		32.74	36.02	43.53	51.11	70.50	77.55	85.31	93.84	103.22	113.55
AMC - Service		1.04	1.14	1.25	1.38	1.52	1.67	1.83	2.02	2.22	2.44
AMC - Software		1.73	1.90	2.09	2.30	2.53	2.78	3.06	3.36	3.70	4.07
AMC - Electric Cart @10% of cost per year		3.45	3.62	3.80	3.99	4.19	4.40	4.62	4.85	5.10	5.35
Electric Cart Charging	0.00	150.00	157.50	165.38	173.64	182.33	191.44	201.01	211.07	221.62	232.70
Total Operating Expenses	0.00	188.95	200.18	216.05	232.42	261.06	277.84	295.84	315.14	335.86	358.11
Total Costs	330.23	188.95	286.43	302.30	577.42	655.57	277.84	425.21	444.51	853.36	358.11

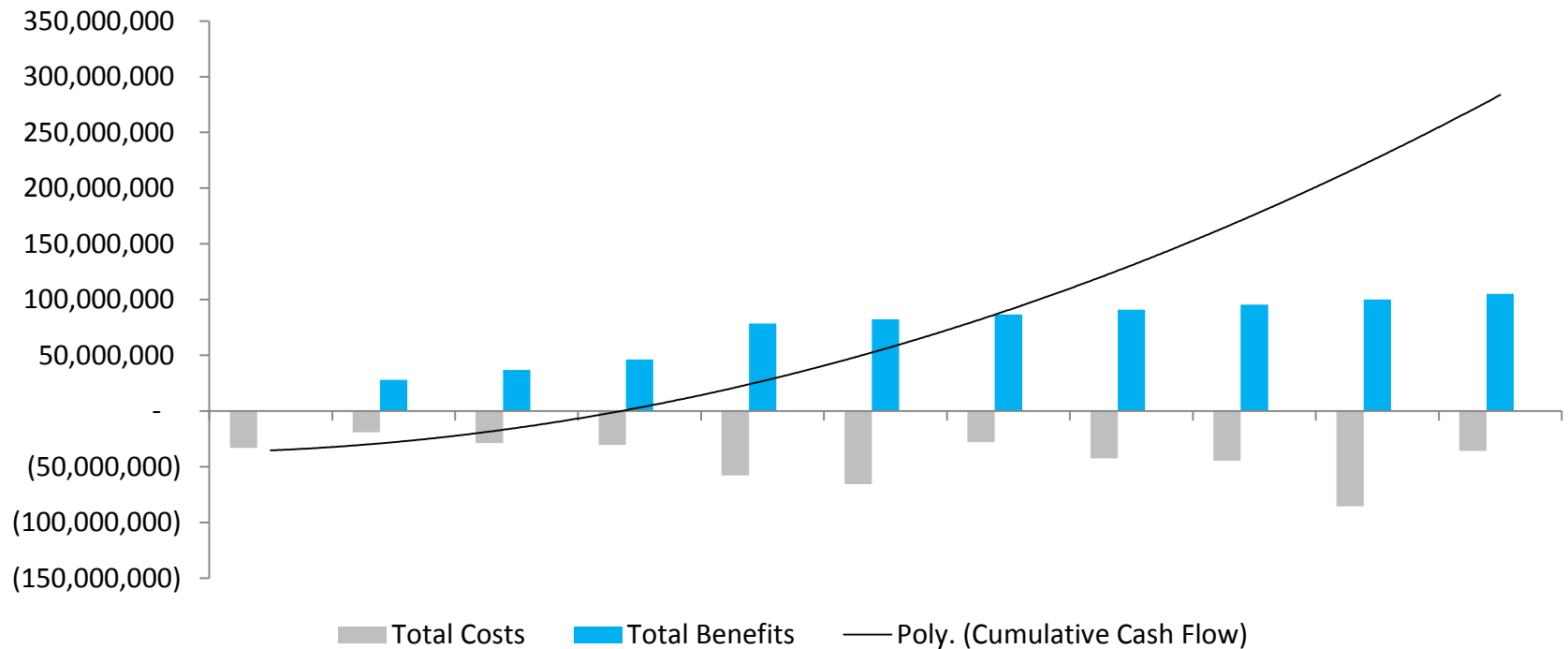
*Y1, Y6, do not have any additional parking sensors being added or replaced



Based on the cost benefit analysis, smart parking with electric cart payback period has been estimated as 3 years

Investment credentials

- NPV: INR 14.64 Cr.
- IRR: 49%
- Simple payback period: 3 years
- Time-adjusted payback period: 3.4 years





For Option 2 - smart parking without electric cart option, multiple revenue stream options have been identified

Assumptions

- No. of hours parking spot is active (9am to 9pm): 12 hours
- Average parking spot occupancy during a day: 70%
- Average combined daily parking spot fixed price for four, two wheeler and bus at 70% occupancy: INR 69969.2
- Revenue inflation rate per year: 5%
- % of parking spots that take a monthly pass (Assuming that they are BKC employees who will park all day): 20%
- Discount of monthly pass below normal cost: 30%
- % of parking spots that will be reserved (Assuming that they are BKC employees who will park all day): 10%
- Reservation price: 50 for cars, 20 for two wheelers, 100 for buses
- Street Parking Markup: 150%

Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Fixed parking prices		174.92	183.67	192.85	202.50	212.62	223.25	234.41	246.13	258.44	271.36
Monthly parking pass		37.86	39.76	41.74	43.83	46.02	48.32	50.74	53.28	55.94	58.74
Ability to reserve a parking spot ahead of time for a premium		14.70	15.43	16.20	17.01	17.86	18.75	19.69	20.68	21.71	22.80
Differential parking price for locations - street parking near offices		30.10	31.61	33.19	34.85	36.59	38.42	40.34	42.36	44.48	46.70
New parking addition @ Fixed prices			77.00	154.00	462.00	485.10	509.36	534.82	561.56	589.64	619.12
Total	0.00	257.58	347.46	437.99	760.19	798.20	838.11	880.01	924.01	970.21	1018.72

Capital expenditure of INR 3.0 Cr. will be required to implement smart parking without electric cart



Assumptions

- AMC includes replacing 10% of batteries and sensors every year or as required
- Internet connectivity is included
- Also includes service costs
- No of parking spots (cars + buses) for 1st year: 1236
- No of additional parking spots in year 2: 500
- No of additional parking spots in year 3: 500
- No of additional parking spots in year 4: 2000

Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Instrumentation: Sensors	263.01										
Software: Online and mobile	10.93										
Services: System Integration, Commissioning of instrumentation	26.30										
Total Capital Expenses	300.23										
Capital Refresh			86.25	86.25	345.00	394.51	0.00	129.38	129.38	517.50	
Opex											
AMC - Instrumentation		32.74	36.02	43.53	51.11	70.50	77.55	85.31	93.84	103.22	113.55
AMC - Service		1.04	1.14	1.25	1.38	1.52	1.67	1.83	2.02	2.22	2.44
AMC - Software		1.73	1.90	2.09	2.30	2.53	2.78	3.06	3.36	3.70	4.07
Total Operating Expenses		35.50	39.05	46.87	54.78	60.26	66.28	72.91	80.20	88.22	97.04
Total Costs	300.23	35.50	125.30	133.12	399.78	454.76	66.28	202.29	209.58	605.72	97.04

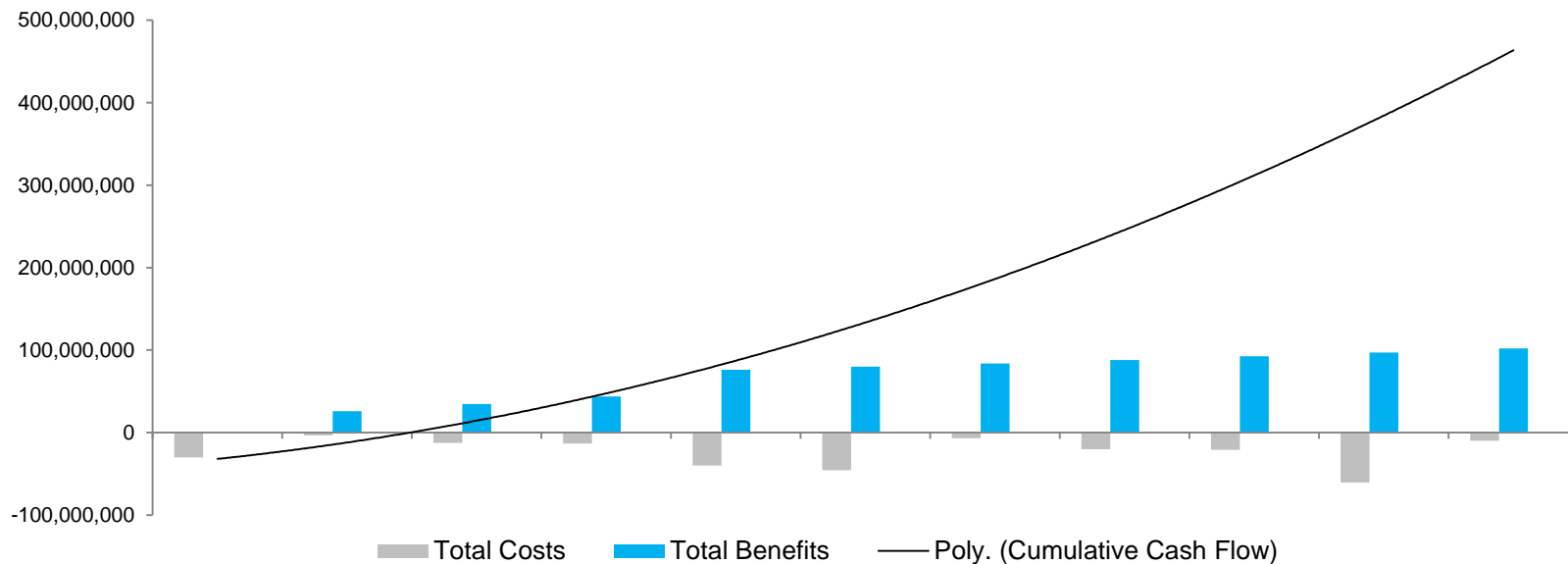
New parking lots being commissioned 3 to 5 years from now
 Parking sensors needs replacement in every five years

Based on the cost benefit analysis, smart parking without electric cart payback period has been estimated as 1.4 years



Investment credentials

- NPV: INR 25.93 Cr.
- IRR: 89%
- Simple payback period: 1.4 years
- Time-adjusted payback period: 1.5 years



New parking lots being commissioned 3 to 5 years from now
Parking sensors needs replacement in every five years

Although cost benefit analysis may favor the without cart option, electric cart fulfills key stakeholder need of last mile connectivity and reduction in unauthorized parking



With Electric Cart

Pros

- Provides last mile connectivity to citizens who park their cars in parking lots situated in E&G blocks
- Electric carts can have advertisements that earn revenue
- Low capex investment
- Low maintenance cost - no fossil fuels are required

Cons

- Additional complexity added to parking – who will manage it?

Quantitative Analysis

- Capex Cost: INR 3.3 Cr.
- Opex Cost: INR 1.89 Cr.
- Revenue: INR 2.79 Cr. per year
- NPV: INR 14.64 Cr.
- Payback period: 3 years

Without Electric Cart

Pros

- Hassle of managing electric carts are avoided

Cons

- Last mile connectivity is not provided which may lead to citizens parking in convenient but illegal parking spots because the parking lots are too far away from their offices

Quantitative Analysis

- Capex Cost: INR 3.0 Cr.
- Opex Cost: INR 35.5 lakhs
- Revenue: INR 2.57 Cr. per year
- NPV: INR 25.93 Cr.
- Payback period: 1.4 years

Recommendations

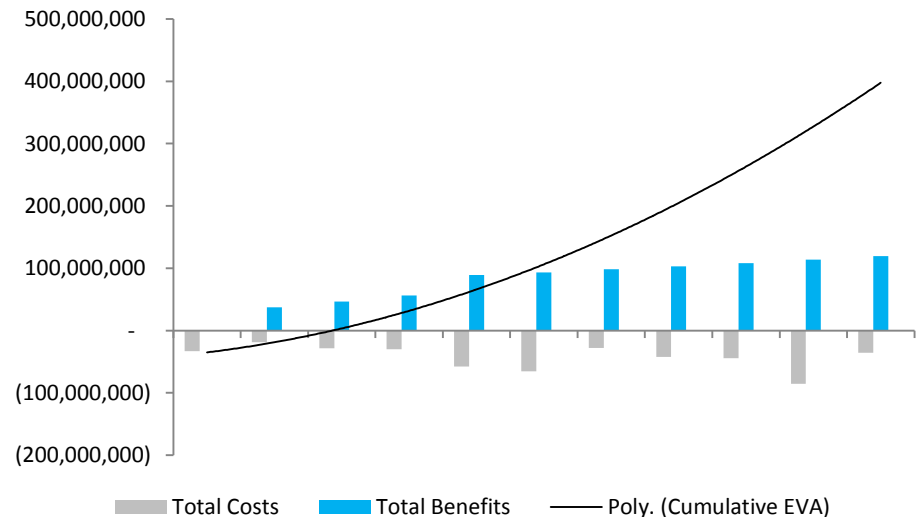
- Recommendation is based on qualitative and quantitative analyses and considering the citizen benefits we would like to suggest Smart Parking with Electric Cart

The economic value added by computing the time and fuel saved by smart parking makes the option even more appealing than a pure financial model with a payback period of 1.83 years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(330.23)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(330.23)
Capex Refresh	0.00	0.00	(86.25)	(86.25)	(345.00)	(394.51)	0.00	(129.38)	(129.38)	(517.50)	0.00	(1028.39)
Total Operating Expenses	0.00	(188.95)	(200.18)	(216.05)	(232.42)	(261.06)	(277.84)	(295.84)	(315.14)	(335.86)	(358.11)	(1656.61)
Total Costs	(330.23)	(188.95)	(286.43)	(302.30)	(577.42)	(655.57)	(277.84)	(425.21)	(444.51)	(853.36)	(358.11)	(3015.23)
Financial Benefits	0.00	279.18	370.14	461.80	785.19	824.45	865.67	908.96	954.40	1002.13	1052.23	4479.32
Non-Financial benefits	0.00	90.78	95.32	100.08	105.09	110.34	115.86	121.65	127.73	134.12	140.83	717.12
Total Benefits	0.00	369.96	465.46	561.88	890.28	934.79	981.53	1030.61	1082.14	1136.25	1193.06	5196.45
Net EVA	(330.23)	181.01	179.04	259.58	312.86	279.22	703.69	605.40	637.63	282.89	834.95	2181.22
Cumulative EVA	(330.23)	(149.22)	29.82	289.40	602.26	881.48	1585.17	2190.57	2828.19	3111.08	3946.04	

Assumptions		
Discount rate	8.73%	10 year Govt bond yield for India
CO2 reduced due to smart parking	24	TCO2e
Total man days lost per year	7813	days
Total fuel wasted per year	19375	liters
Quantified benefits for CO2	1918	INR
1 TCO2e	1	Euro
Euro exchange rate	81.45	INR (13 May 14)
Quantified benefits for man days lost	7812500	INR
Average salary per day	1000	INR
Quantified benefits for fuel saved	1263443.75	
Cost of 1 liter diesel	65.21	INR (13 May 14)



For the with electric cart option there are additional stakeholder benefits which make it a preferred option



Citizens/Businesses

- Lesser time spent looking for parking - 5 minutes instead of 18-20 min
- Lesser fuel spent in circling around looking for parking thus reducing carbon footprint as well
- Reduction in frustration of finding parking thus keeping commuters happy
- Lesser hassle of towing due to illegal parking



MMRDA/ Govt.

- Increase revenue from Parking operations
- Decongest traffic (30% of traffic is created due to traveler looking for parking space)
- Reduced unauthorized parking

Others (Environment etc..)

- If 1 lakh people used a smart parking app 3 times a week, annually 3.14 million pounds of carbon will not be emitted

There are multiple vendors available to provide the smart parking solution



Streetline	<ul style="list-style-type: none"> • Headquarters: Foster City, California • Core business: Streetline, Inc. is the leading provider of smart parking solutions to cities, garages, airports, universities and other private parking providers. Streetline aims to make smart cities a reality through the use of sensor-enabled mobile and web applications. Through a combination of various real time apps, Streetline provides drivers the ability to find parking easily.
Schneider Electric	<ul style="list-style-type: none"> • Headquarters: Rueil-Malmaison, Île-de-France, France • Core business: Schneider Electric India Pvt. Ltd (SEI) is a 100% subsidiary of Schneider Electric Industries SAS, a global specialist in energy management. With a strong force of over 17,000 employees, the company is well known for its unique vision, progressive management and above all, its exemplary Quality.
Faac	<ul style="list-style-type: none"> • Headquarters: Rockledge, Florida • Core business: FAAC's mission is to produce the longest life, most reliable and safest opening systems on the market. Its products include Gates Automation and Barriers as well as Access Control Systems. FAAC provides traffic bollards, Vehicle and pedestrian access control systems and Automatic Barriers
Bharatiya Global Infomedia Limited	<ul style="list-style-type: none"> • Headquarters: Noida, India • Core business: BGIL is a product based IT company with focus on R&D. It has spent last few years into innovation and building few path-breaking solutions around 'RFID' & 'Smart Card' technologies. Its range of offerings includes products/services around Electronic Security & Surveillance, Enterprise Process Automation, and System Integration & Design.
Xerox	<ul style="list-style-type: none"> • Headquarters: Norwalk, US • Core business: Xerox Corporation Ltd. is an American multinational document management corporation. It also provides services like parking management. Their goal is to deliver intelligent parking solutions. From smart parking integration to violation processing to meter operations, they help reduce costs and street congestion.



Smart parking has proven to be a successful model globally and would reduce inconvenience for commuters

SFpark, San Francisco



- SFpark uses a combination of technology and governance structures to improve parking in the downtown San Francisco region. Using real-time information, SFpark finds available parking spaces for drivers, which decreases the time spent driving around the city centre. In addition, parking is dynamically priced to match demand, which help encourages drivers to park in underused areas and garages, reducing demand in the city centre.
- SFpark also has extended time limits and additional payment options for drivers which is expected to lead to a decrease in parking violations and fewer parking tickets. Data from the sensors may also be used to adjust parking enforcement officers schedules and routing.
- SFpark is currently being trialed at 7,000 out of the total 28,000 of San Francisco's metered parking spaces, and 12,250 spaces in 15 of the 20 city-owned parking garages.

Smart Parking Trial, London

- The City of Westminster in London is trialing a new smart parking system to help alleviate traffic and direct drivers to unoccupied spaces. Currently Westminster has 12,000 parking spaces, and it is estimated that 30% of traffic flow is due to motorists looking for a parking space. In addition, 15% of spaces remain unoccupied because drivers are unaware of their location.
- The trial solution involves wireless sensors monitoring the occupancy of each parking space, which transmit the information to a smartphone app, allowing users to see the number of parking spaces available on any given street, in real time.
- With this information, drivers can plan their route to available parking spaces which reduces the time spent looking for a spot. As a result, congestion caused by circling is significantly decreased.



http://www.translink.ca/~media/Documents/plans_and_projects/regional_transportation_strategy/Research/Parking_Management.aspx
<http://www.dailymail.co.uk/news/article-2184174/The-app-parking-space-Street-sensors-alert-drivers-bay.html>

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Currently street lights in BKC consume around 850 kW of electricity resulting in INR 6.5 lakhs of electricity costs and 900 tonnes of CO₂e emissions



Location

- In total there are **841 streetlights with 1325 bulbs** of differing wattages (150, 250 and 70W)
- The street furniture is maintained and owned by Reliance which is the electricity provider.
- The total electricity bill for the month comes up to nearly **INR 6.5 lakhs**
- In addition to the electricity bill, MMRDA pays maintenance costs which brings the total to **INR 14-16 lakhs**
- The lights remain on for 12 hours approx.

Technology

- The streetlights in BKC are currently **ordinary ones without any sensors**
- There are **4 types of streetlights** with the number of bulbs ranging from one to four
- The bulbs used are **High Powered Sodium Vapor (HPSV)** lamps.
- The lights are **turned on manually** with no time or light sensitivity taken into consideration

Plan

- With the addition of light and motion sensors the energy costs will reduce by about **40%**
- There is also a recommendation to **replace the HPSV lamps with LEDs** which will reduce the energy costs by **40%**
- Additionally **solar panels** can be placed on the streetlights and the energy generated fed back to the grid

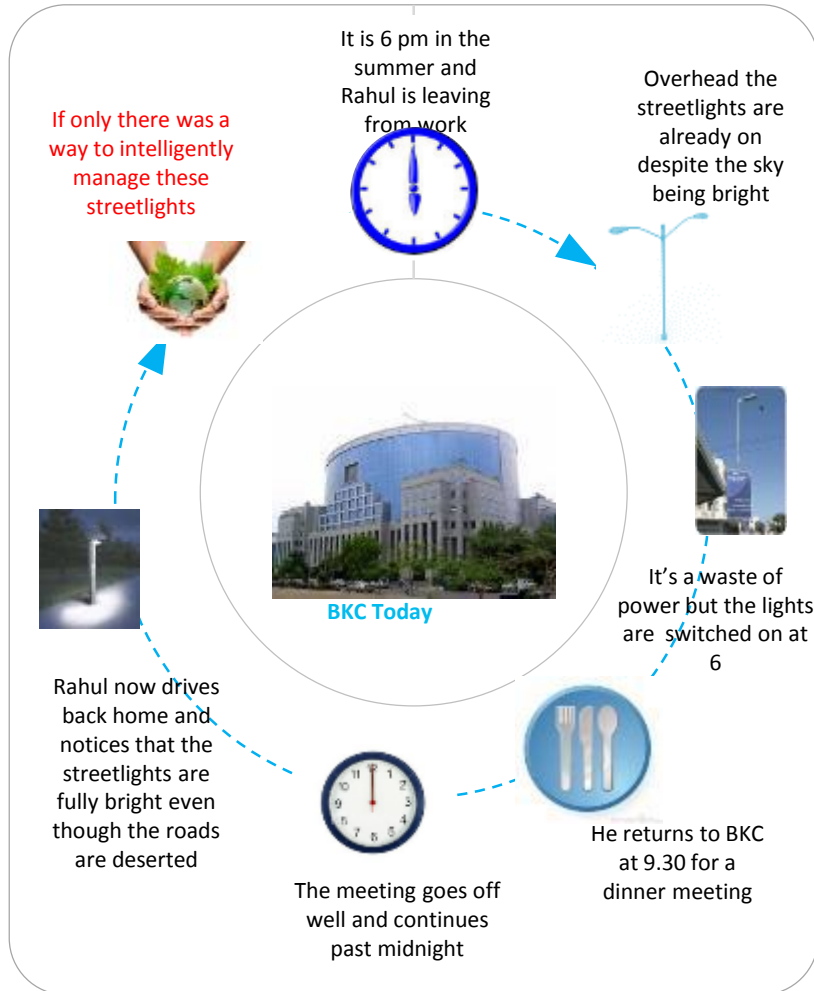
Issues

- Differing illumination levels may cause accidents
- Reliance may not agree to purchase the solar power generated and supplied back to the grid
- Panel needs to withstand the wind pressure and be cleaned on daily basis to ensure generation performance.

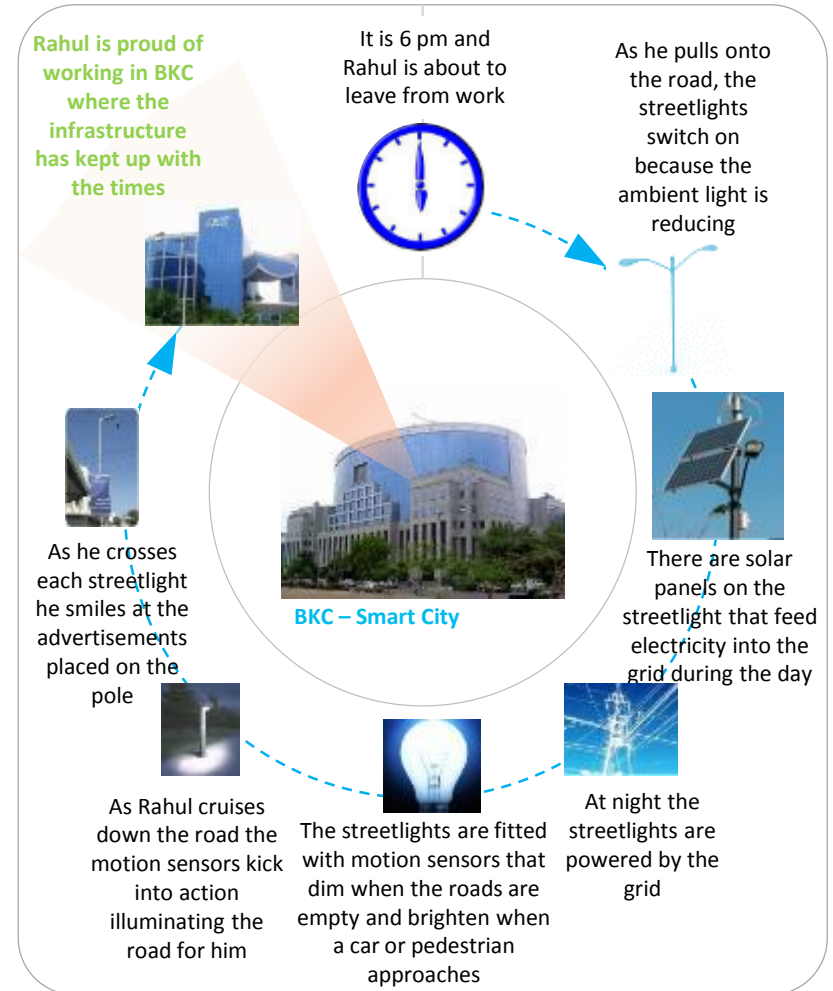
As of now, streetlights at BKC work for more than 12 hrs., irrespective of the need, leading to high electricity and cost. With intelligent streetlight, lighting hrs. and consumption will be optimized



BEFORE



AFTER



To address the lighting needs Sensor based lighting control with or without Solar panel options are evaluated

Solution Details

- **Light & Motion** sensors will turn on/off and adjust light brightness in night based on people/car movement.
- **Grid Tied Solar PV** will **generate electricity** and feed to the grid. Grid can offset the payment based on electricity consumed vs generated.
- **LED lighting** will **reduce electricity consumption** and offer **more life** thus reducing O&M.
- **CCTV cameras** can be installed on same pole to monitor road.
- **Wireless routers** can be installed on streetlight poles as necessary.

Solution Options

- Sensor based lighting control + Grid Tied Solar PV
- Sensor based lighting control

Benefits

- **Reduction in energy consumption by 40%**
- **Solar panel will generate clean energy** sufficient to cover approx. **25% of current street light energy requirement**
- Reduce maintenance costs for lighting equipment by replacing HPSV lamps to LED
- **Reduction in carbon footprint by 641 tons**

Conceptual View



1. Sensors

- Sensors for light, motion and object detection
- Can be used for parking, streetlights or lumen adjustment

2. Grid Tied Solar PV

- PV generates electricity which can be feed to grid
- Grid can pay for power generated

3. LED Lights

- LED lights consumes much less electricity to produce same amount of light as compared to HPSV lamps
- LED lights have 4 times more life then HPSV.

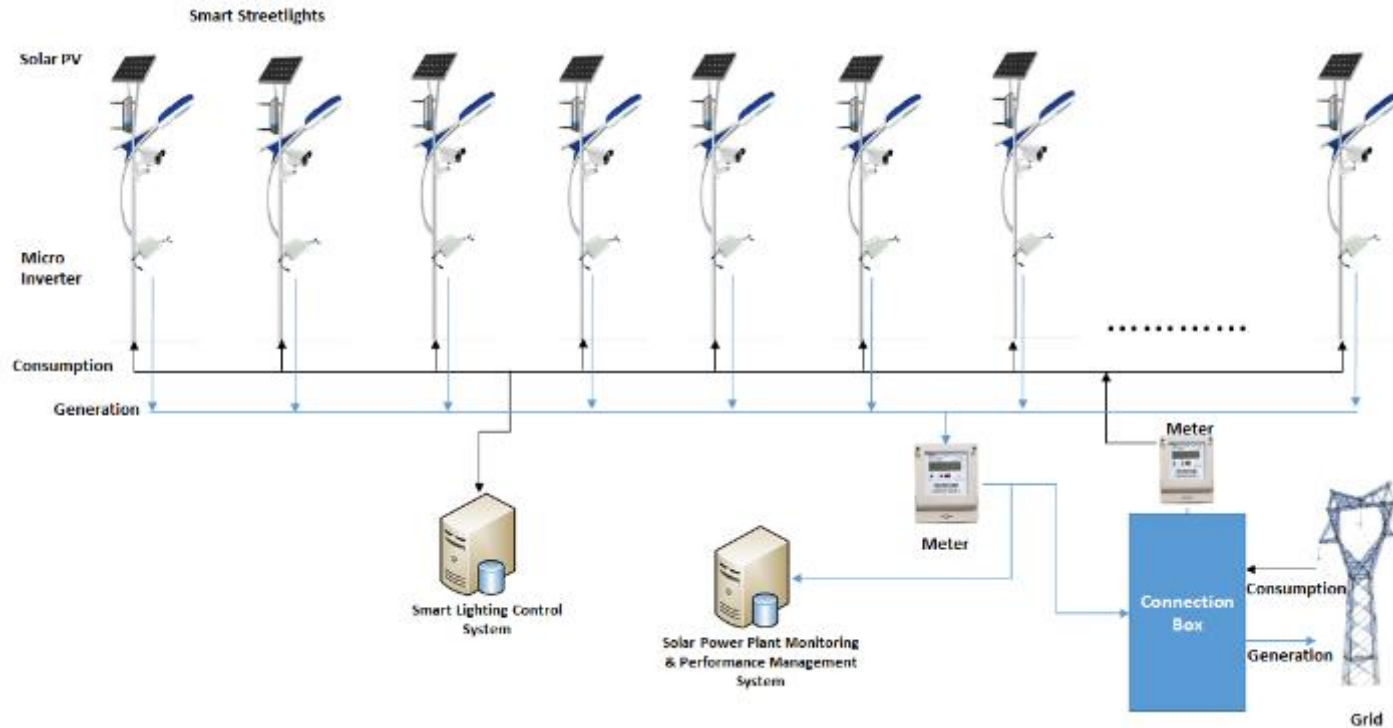
4. CCTV Camera

- Camera for video surveillance
- Can be used for security and monitoring

5. Wireless Router

- Wireless router for Wi-Fi Hotspots
- The could be installed as necessary in areas

For the solution including solar panel, additionally solar panel and micro-inverter will need to be added to the basic street light set-up



- **Light and Motion sensors** automatically switch on/off light during day and night. Depending on movement of people/ vehicle lights will be dim/ brighten which will save electricity.
- Public lights which are connected to and powered by the electricity grid (electricity consumption).
- **Solar photovoltaic panels** that are located on each light pole and are individually hard wired through an inverter to the electricity grid (electricity generation).



A detailed revenue/benefits model has been developed for the intelligent streetlights with solar panel option

Assumptions

- Savings % by using light and motion sensors : 40%
- Number of 2X1m² solar panels per streetlight: 1
- Number of streetlights on which solar panels are installed: 423
- Wattage of 2X1m² solar panel: 200 W
- No. of hours of sunlight in the day: 4
- Amount of solar energy generated per day per panel: 0.8kWh
- Cost of energy per kWh: INR. 5
- Revenue inflation rate per year: 5%
- 100 sqft of space - 1 kW of solar; 1 kW will give us 4 units of sunshine (From a solar expert)
- Replacement of bulbs as follows
 - 24W LED Vs 70W HPSV
 - 91W LED Vs 150W HPSV
 - 132W LED Vs 250W HPSV
- Savings % by using LED lights: 40%

Savings and Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Feed excess solar power back into the grid		9.78	10.27	10.78	11.32	11.89	12.48	13.11	13.76	14.45	15.18
Cost savings from light and motion sensors		30.76	32.30	33.92	35.61	37.39	39.26	41.22	43.29	45.45	47.72
Cost savings from replacing existing bulbs with LED lights		30.76	32.30	33.92	35.61	37.39	39.26	41.22	43.29	45.45	47.72
Total	0.00	71.31	74.87	78.61	82.55	86.67	91.01	95.56	100.33	105.35	110.62



Capital expenditure of INR 6.76 Cr. will be required to implement the intelligent streetlights with solar panel option

Assumptions

- Light and motion sensor data provided by Maven Systems: WiART LC – R1 (Solution with 1 relay and 1 diming output support) and WiART LC – R2 (Solution with 2 relays and 2 diming output support)
- 5% of Solar Project cost for AMC
- 20% of Solar Project cost for installation
- Wind analysis costs are factored in the installation cost
- Pole foundational strength is considered to be adequate to bear the weight of the Solar Panel and the Wind load
- LED AMC:1%

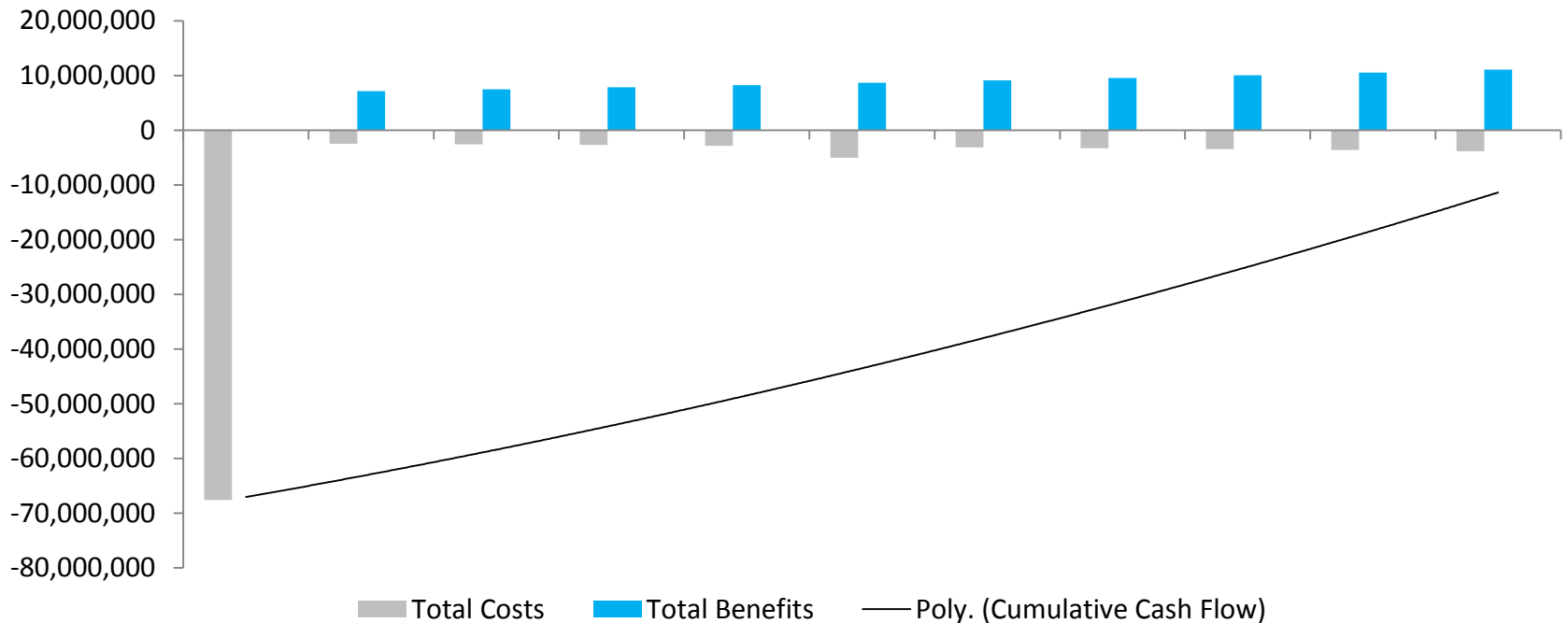
Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Instrumentation and Hardware (Light and motion sensors, solar panels, LED lights)	600.60										
Software	5.75										
Commissioning Cost and Installation	69.66										
Total Capital Expenses	676.01										
Capital Refresh						20.28					
Opex											
AMC - Light and motion sensors		6.68	7.02	7.37	7.74	8.12	8.53	8.96	9.40	9.88	10.37
AMC - LED lights		2.04	2.14	2.25	2.36	2.48	2.60	2.73	2.87	3.01	3.16
AMC - Solar panels		15.99	16.79	17.63	18.51	19.43	20.41	21.43	22.50	23.62	24.80
Total Operating Expenses		24.71	25.94	27.24	28.60	30.03	31.53	33.11	34.77	36.51	38.33
Total Costs	676.01	24.71	25.94	27.24	28.60	50.31	31.53	33.11	34.77	36.51	38.33

Based on the cost benefit analysis, intelligent streetlights with solar panel will not be paid back within the ten year period but the upward trend of the cumulative cash flow suggests a longer payback period



Investment credentials

- NPV: INR -3.21 Cr.
- IRR: NA
- Simple payback period: NA
- Time-adjusted payback period: NA





Multiple revenue stream options have been identified for the intelligent streetlights without solar panel option

Assumptions

- Savings % by using light and motion sensors : 40%
- Cost of energy per kWh: INR. 5
- Revenue inflation rate per year: 5%
- Replacement of bulbs as follows
 - 24W LED Vs 70W HPSV
 - 91W LED Vs 150W HPSV
 - 132W LED Vs 250W HPSV
- Savings % by using LED lights: 40%

Savings Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Cost savings from light and motion sensors		30.76	32.30	33.92	35.61	37.39	39.26	41.22	43.29	45.45	47.72
Cost savings from replacing existing bulbs with LED lights		30.76	32.30	33.92	35.61	37.39	39.26	41.22	43.29	45.45	47.72
Total	0.00	61.52	64.60	67.83	71.22	74.78	78.52	82.45	86.57	90.90	95.44



Capital expenditure of INR 2.9 Cr. will be required to implement intelligent streetlights without solar panel option

Assumptions

- Light and motion sensor data provided by Maven Systems: WiART • LED AMC:1%
- LC – R1 (Solution with 1 relay and 1 diming output support) and WiART LC – R2 (Solution with 2 relays and 2 diming output support)

Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Instrumentation and Hardware (Light and motion sensors, LED lights)	280.85										
Software	5.75										
Commissioning Cost and Installation	5.71										
Total Capital Expenses	292.30										
Capex Refresh						20.28					
Opex											
AMC - Light and motion sensors		6.68	7.02	7.37	7.74	8.12	8.53	8.96	9.40	9.88	10.37
AMC - LED lights		2.04	2.14	2.25	2.36	2.48	2.60	2.73	2.87	3.01	3.16
Total Operating Expenses		8.72	9.16	9.61	10.09	10.60	11.13	11.69	12.27	12.88	13.53
Total Costs	292.30	8.72	9.16	9.61	10.09	30.88	11.13	11.69	12.27	12.88	13.53

Based on the cost benefit analysis, intelligent streetlights without solar panel option payback period has been estimated as 5.3 years



Investment credentials

- NPV: INR 1.11 Cr.
- IRR: 16%
- Simple payback period: 5.3 years
- Time-adjusted payback period: 7 years

Although cost benefit analysis may favor the without solar option, solar panels option is recommended as it helps to produce 200kW of green energy and reduces 98 tonnes of CO₂e



With Solar Pros

- Feather in the cap of BKC that it produces green power
- Revenue from electricity fed back into the grid
- Carbon emissions savings from solar power

Cons

- Reliance which manages the street furniture may not agree to place panels
- Reliance may not agree to purchase the solar power
- High Capex and installation costs

Quantitative Analysis

- Capex Cost: INR 6.76 Cr.
- Opex Cost: INR 24.7 lakhs
- Revenue: INR 71.3 lakhs per year
- NPV: INR -3.21 Cr.
- Payback period: NA

Without Solar Pros

- No Capex expenditure for solar
- No hassle of maintaining solar panels

Cons

- Opportunity for producing green power is missed

Quantitative Analysis

- Capex Cost: INR 2.92 Cr.
- Opex Cost: INR 8.7 lakhs per year
- Revenue: INR 61.52 lakhs per year
- NPV: INR 1.11 Cr.
- Payback period: 5.3 years

Recommendations

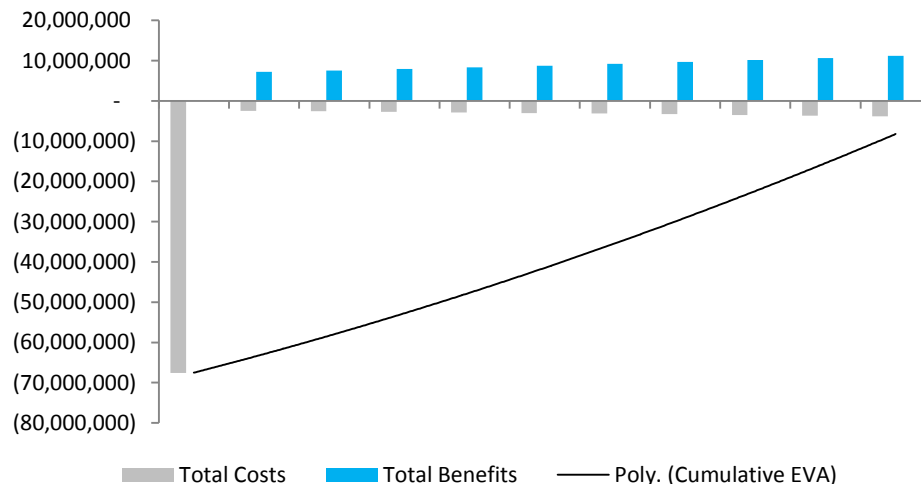
- Recommendation is based on qualitative and quantitative analyses and considering the environmental benefits we would like to suggest Intelligent Streetlights with Solar

While the EVA analysis is done for ten years, the break even point is beyond it which should not matter because the lifetime of solar and LED lights are beyond ten years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(676.01)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(676.01)
Capex Refresh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Operating Expenses	0.00	(24.71)	(25.94)	(27.24)	(28.60)	(30.03)	(31.53)	(33.11)	(34.77)	(36.51)	(38.33)	(195.19)
Total Costs	(676.01)	(24.71)	(25.94)	(27.24)	(28.60)	(30.03)	(31.53)	(33.11)	(34.77)	(36.51)	(38.33)	(871.20)
Financial Benefits	0.00	71.31	74.87	78.61	82.55	86.67	91.01	95.56	100.33	105.35	110.62	563.30
Non-Financial benefits	0.00	0.67	0.70	0.74	0.77	0.81	0.85	0.90	0.94	0.99	1.04	5.29
Total Benefits	0.00	71.98	75.57	79.35	83.32	87.49	91.86	96.45	101.28	106.34	111.66	568.59
Net EVA	(676.01)	47.27	49.63	52.11	54.72	57.45	60.33	63.34	66.51	69.84	73.33	(302.62)
Cumulative EVA	(676.01)	(628.75)	(579.12)	(527.00)	(472.29)	(414.83)	(354.51)	(291.16)	(224.65)	(154.82)	(81.49)	0.00

Assumptions		
Discount rate	8.73%	10 year Government bond yield for India
CO2 reduced due to LED lighting	362	Tons of CO2e
CO2 reduced due to light and motion sensors	362	Tons of CO2e
CO2 reduced due to solar power being produced	98	Tons of CO2e
Quantified benefits for CO2	66937	INR
1 TCO2e	1	Euro
Euro exchange rate	81.4513	INR As of 5/14



For the with solar panels option there are additional stakeholder benefits which make it a preferred option



Citizens/Businesses

- Better lit roads leading to road safety

MMRDA/ Govt.

- Reduction in operational costs – e.g. reduced energy requirements for street lighting
- Lower manpower costs incurred for switching utility electricity



Others (Environment etc..)

- Greener Eco system
- Reduction in Carbon Footprint

There are multiple vendors available to provide the smart parking solution



<p>Philips</p>	<ul style="list-style-type: none"> • Headquarters: Amsterdam, Netherlands. • Core business: Philips' wide range of lighting solutions include Solar LED street lighting including its GreenLine, Minigreen and Selina line of solar arrays. The street lights have a lifetime of > 50000 hours with dimming capabilities for power-save management, deep discharge batteries and algorithms to autonomously determine sunrise and sunset.
<p>Maven System</p>	<ul style="list-style-type: none"> • Headquarters: Pune, India. • Core business: Maven Systems Pvt. Ltd. was founded in Oct 2009 and provides end-to-end (hardware to embedded to web / mobile) technology solutions. Maven's primary focus is on M2M solutions such as Automatic meter reading / smart metering solutions for electricity and water, based on ZigBee, RF, PLC, Wi-Fi, Bluetooth, etc..
<p>Echelon Smart Streetlight</p>	<ul style="list-style-type: none"> • Headquarters: San Jose, USA. • Core business: NASDAQ-listed Echelon Corporation develops energy control networking solutions for smart cities and smart buildings. Smart Street Lighting easily schedules lights on or off and sets dimming levels of lights to intelligently adjust light levels by time of day, season, or weather conditions. Cities using Echelon's solution reduce their street lighting energy use by ~30%.
<p>Autonic</p>	<ul style="list-style-type: none"> • Headquarters: Mumbai, India. • Core business: Autonic is an important brand in the renewable energy Products and Solutions. It is a technology agnostic and knowledge intensive consulting and implementation agency, led by an experienced team offering innovative services & technology solutions in the field of Solar Photovoltaic & Solar Thermal Collectors.
<p>Su-Kam</p>	<ul style="list-style-type: none"> • Headquarters: Gurgaon, India. • Core business: Su-Kam was founded in the year 1988 and is one of the leading power back up, generation & monitoring company in India. The company has now forayed into the solar sector. In this sector as well, Su-Kam has introduced highly useful and value-for-money products for the common man and executed large projects for commercial and industrial applications

Intelligent streetlights have proven to be a successful model globally and would reduce unnecessary energy consumption and cost



Adaptive Street lighting in Eeneind, Netherlands



- The historic village of Eeneind in the municipality of Nuenen, Netherlands is a scenic town with rural surroundings
- The challenge was to install motion sensors in the streetlights while maintaining the 19th century feel of the place
- To meet this challenge, sensor based units (CitySense) were installed on street lights throughout the village
- The units dim the lights (to 20%) when there is no activity in the streets, and increase the brightness to 100% upon the detection of a pedestrian, cyclist or a car
- The CitySense units communicate with neighboring units over a wireless mesh network telling them to also increase their brightness
- Using Twilight's web-based remote management software, CityManager, the municipality now has the ability to control the dimming levels, the lamp hold time and other settings, ensuring comfortable and safe light levels while achieving excellent energy savings

Grid Connected Streetlights in Victoria, Australia

- A sustainable Mornington Peninsula housing estate has installed grid connected solar powered residential street lighting in Victoria, Australia
- The solar panels above each light feed electricity into the grid during the day
- At night the lights take a smaller amount of power back out of the system to illuminate the streets
- Public lighting is responsible for 30 per cent of local government greenhouse pollution
- It is also estimated the solar lights in the estate will save around \$700 in energy costs every year
- The Orchard Grove estate street lights are driven by clean, green renewable energy, so will contribute significantly to the shire's sustainability



<http://www.twilight.com/projects/city-nuenen/>
ftp://seav.vic.gov.au/news_old/media_releases/20030908_2.pdf

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BKC is home to various corporate offices including Diamond Bourse and the U.S. Consulate and needs to be provided top notch security



Location

- There are currently about **ten security cameras in the BKC** area installed at important junctions
- The raw feed is monitored by the **police**
- **Mumbai CCTV initiative** has proposed the setting up of cameras in the BKC area. The footage will be monitored by the police
- MMRDA **annually loses about INR1.5 Cr.** of street furniture including manhole covers

Technology

- **Fixed cameras and PTZ cameras** will be used
- **No video analysis is done for the cameras** currently installed

Plan

- **90 number of cameras** will be placed at all junctions which will cover a large area of E and G blocks
- Surveillance will **increase the overall safety** of the BKC area
- It will also **restrict the theft of street furniture** if intelligent surveillance is in place

Issues

- Inadequate internet connectivity can cause jitter which may inhibit video analytics

Security is a major concern at BKC currently due to absence of proactive surveillance; video analytics will provide intelligent surveillance for proactive threat detection



BEFORE



AFTER



To address security issues it is proposed to install an advanced video analytics solution

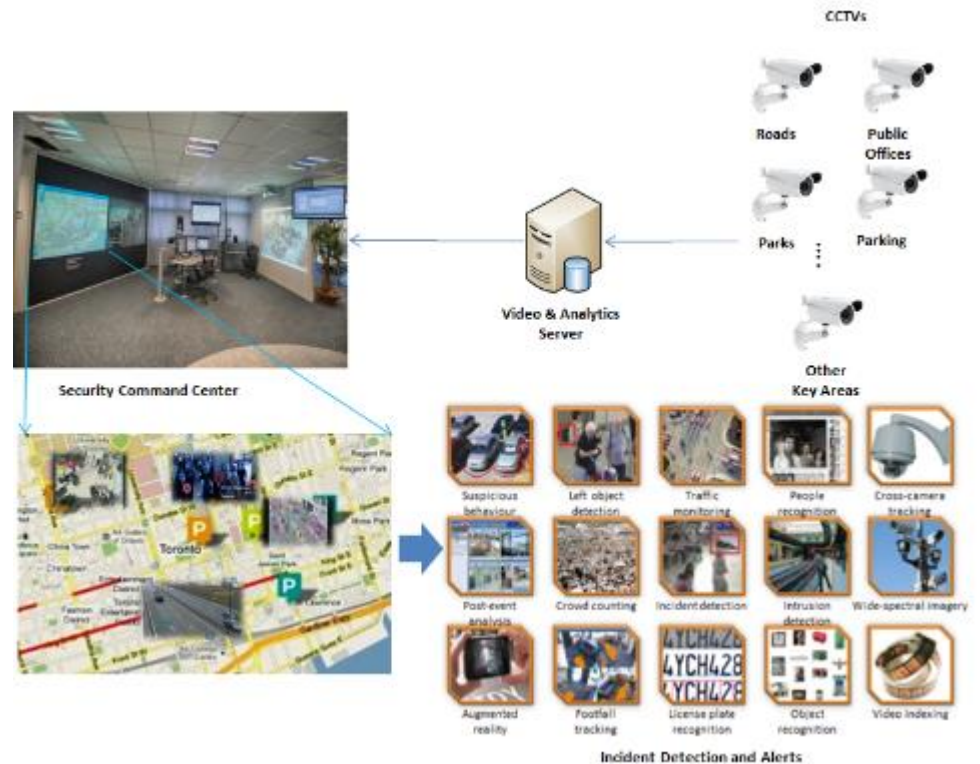
Solution Details

- Smart surveillance consists of **cameras** overlaid with **video analytics** that **analyze the feed** supplied by the cameras in **real time** and point out anomalies based on the instances programmed in it.
- The **video analytics** server will process the information and **display** the outcomes in the **command center**.
- Auto traffic monitoring, crowd counting, people and object recognition, Street furniture theft, left baggage** etc.. would augment existing security measures

Benefits

- Video Analytics will provide **proactive threat detection**
- Help in **reducing** the **street furniture theft**
- Help security agencies spot incidents, respond quickly, and gather evidence
- Improve operations and effectiveness: Detected events are automatically analyzed, and aggregated into meaningful business alerts, enabling the Operation Centre to respond in a quick and efficient way

Conceptual View

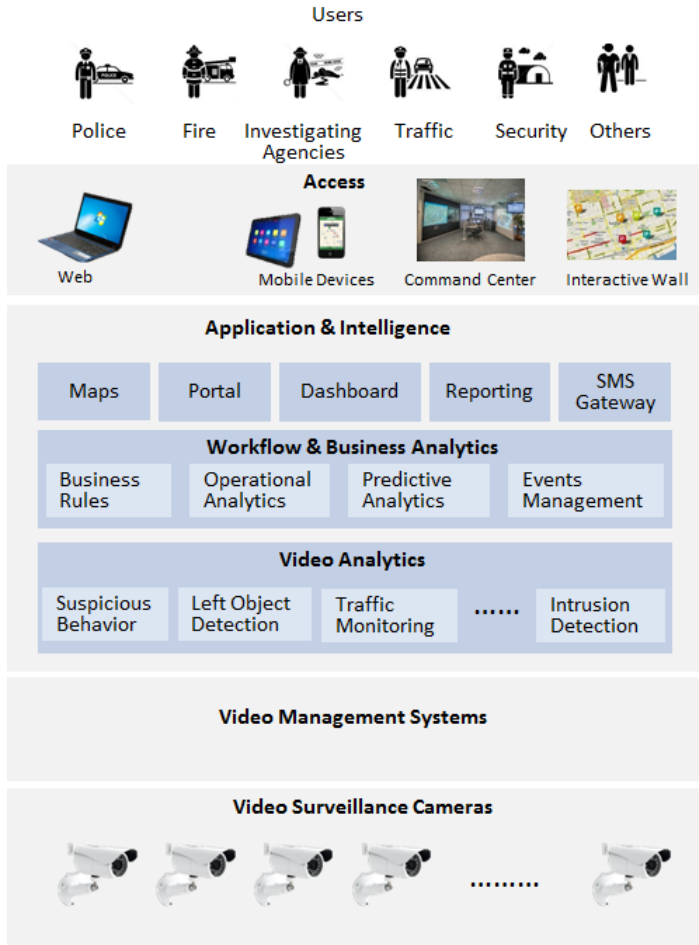


- These video services can **help monitor footfall, security incidents, detect left objects, report suspicious activities** etc..
- Video Feed** can be shared by **multiple agencies** like MMRDA, Police, Fire etc..
- SMS alert will alert respective agency in case of emergency situation

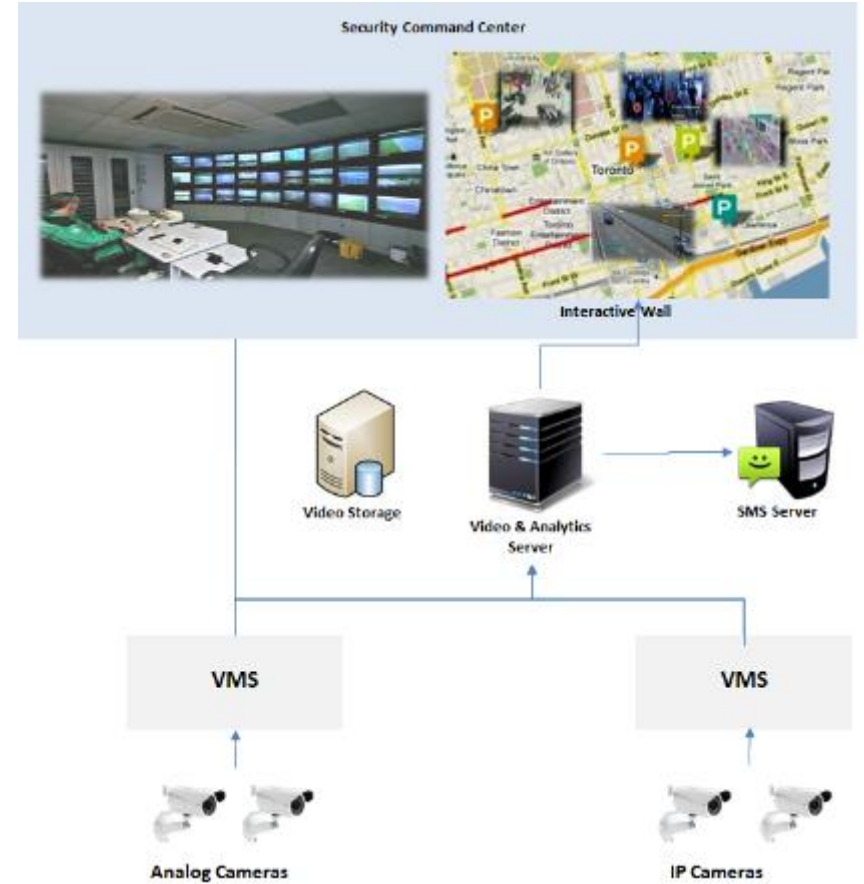
Video analytics architecture would enable integration of multiple VMS and both analog and IP cameras based analytics



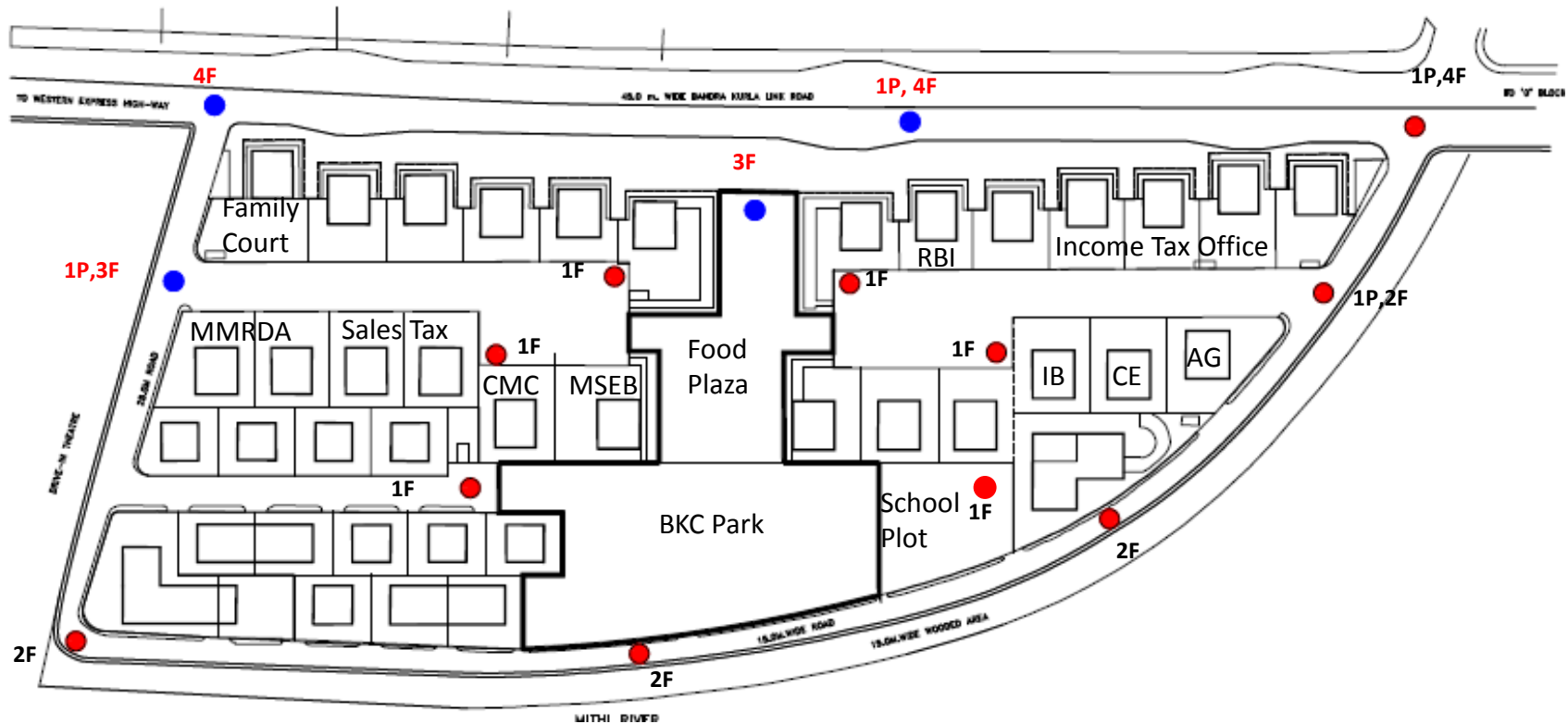
Application



Infrastructure



Location analysis is performed to identify the placement of security cameras in E-Block to ensure optimum video surveillance



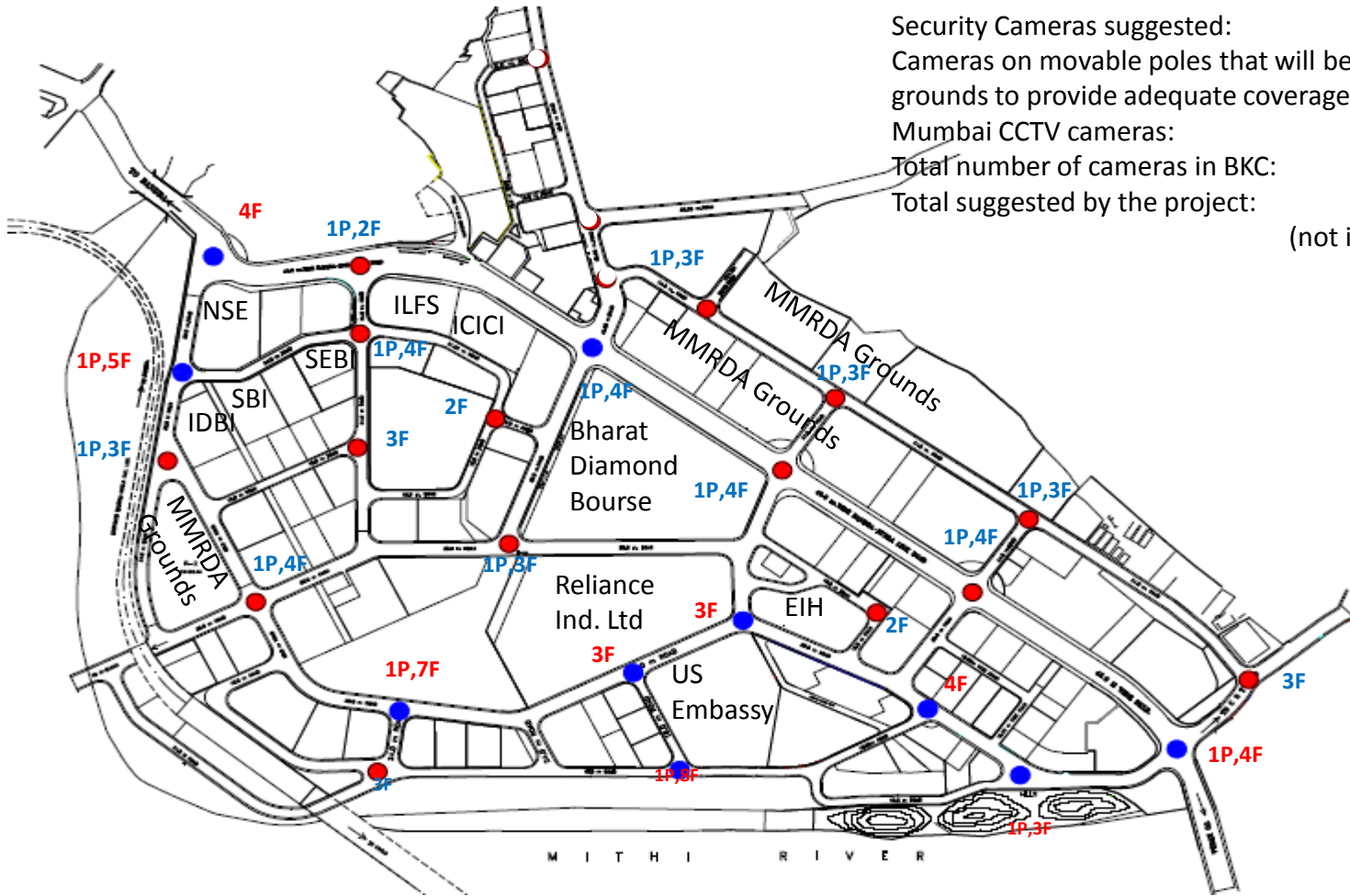
- Security Cameras suggested
- Mumbai CCTV Security Cameras

Security cameras suggested:	2 PTZ + 18 fixed cameras
Mumbai CCTV cameras:	2 PTZ + 14 fixed cameras
Total cameras in BKC:	4 PTZ + 32 fixed cameras
Total cameras suggested in this project:	2 PTZ + 18 fixed cameras (not including Mumbai CCTV)

Camera locations are decided based on field visit and office area coverage
 We are proposing analytics for 20% of cameras. For Mumbai CCTV 1% of the cameras are proposed to have video analytics but it is unknown whether any BKC cameras will be among them

Similar analysis is done to identify the placement of security cameras in G-Block

Security Cameras suggested:	10 PTZ + 42 fixed
Cameras on movable poles that will be reserved for MMRDA grounds to provide adequate coverage:	5 PTZ + 10 fixed
Mumbai CCTV cameras:	6 PTZ + 41 fixed
Total number of cameras in BKC:	21PTZ + 93 fixed
Total suggested by the project:	15 PTZ + 52 fixed
	(not including Mumbai CCTV)



- Security Cameras suggested
- Mumbai CCTV Security Cameras

Camera locations are decided based on field visit and office area coverage
 We are proposing analytics for 20% of cameras. For Mumbai CCTV 1% of the cameras are proposed to have video analytics but it is unknown whether any BKC cameras will be among them

A detailed revenue/benefits model with multiple revenue stream options has been developed for video analytics



Assumptions

- Revenue inflation rate per year: 5%
- Excess tariff per square meter charged for providing a bouquet of services like Wi-Fi and security cameras to the MMRDA grounds: INR 2
- Total area of MMRDA grounds available for renting: 328177sqm
- Occupancy % of MMRDA grounds per week: 25%
- Total number of security guards employed by MMRDA: 50
- Annual salary of security guard: INR 144000
- % of security guards made redundant by video surveillance: 50%

Revenue Stream' (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
MMRDA grounds - providing people with a bouquet of services with a fixed premium on the land cost		21.33	22.40	23.52	24.69	25.93	27.23	28.59	30.02	31.52	33.09
Cost savings in terms of reduction in security guards		21.60	22.68	23.81	25.00	26.25	27.57	28.95	30.39	31.91	33.51
Loss prevention of street furniture		45.00	47.25	49.61	52.09	54.70	57.43	60.30	63.32	66.49	69.81
Total	0.00	87.93	92.33	96.94	101.79	106.88	112.23	117.84	123.73	129.91	136.41



A total of INR 3.42 Cr. worth of capital expenditure will be required to implement video analytics

Assumptions

- Rate of increase of expenses: 5%
- Software: 15% per year AMC.
- Hardware: Server + 25 TB of storage
- Instrumentation: AMC of 20% per year

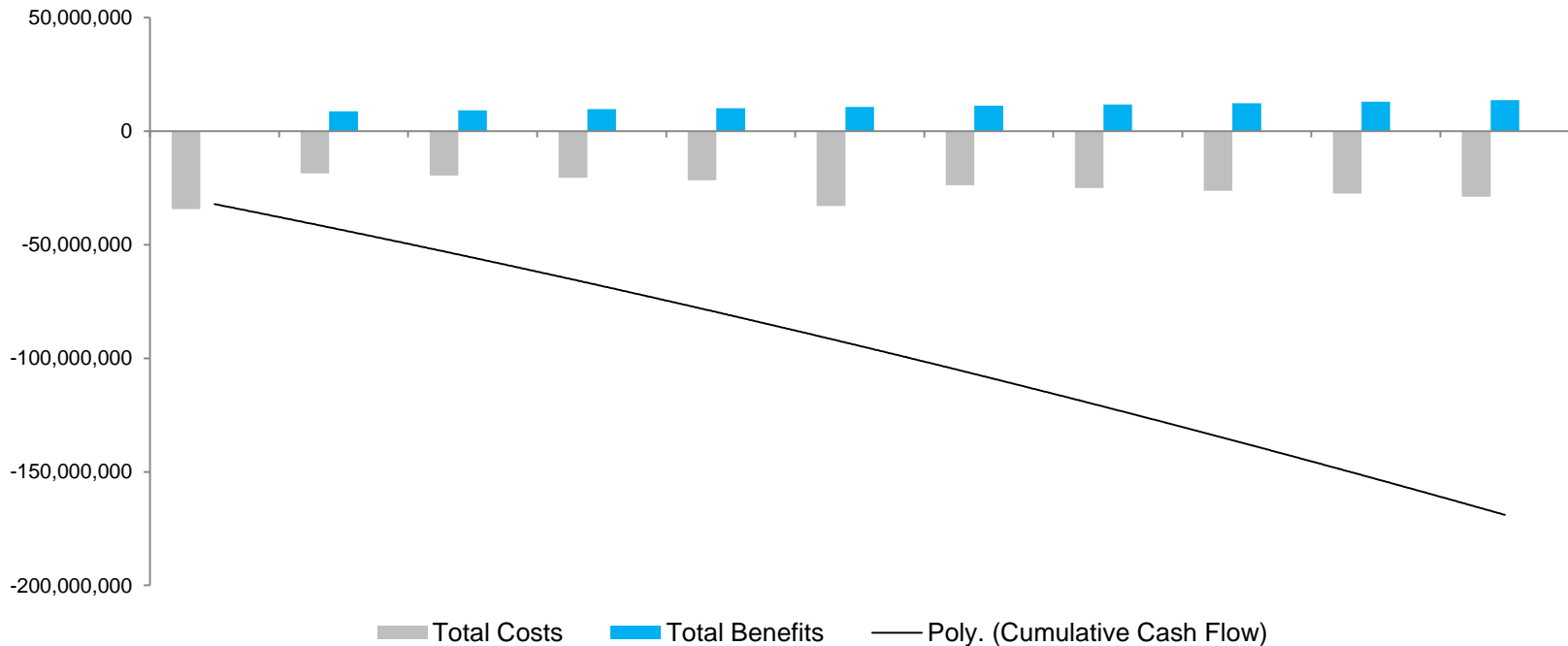
Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Instrumentation: Cameras, VMS	94.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hardware: Server, Switches, Storage	138.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Software: Video Analytics	28.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Services: System Integration, Commissioning of Cameras	80.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Capital Expenses	342.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capex Refresh	0.00	0.00	0.00	0.00	0.00	102.64	0.00	0.00	0.00	0.00	0.00
Opex											
AMC - Instrumentation	0.00	18.98	19.92	20.92	21.97	23.06	24.22	25.43	26.70	28.03	29.44
AMC - Hardware	0.00	27.60	28.98	30.43	31.95	33.55	35.23	36.99	38.84	40.78	42.82
AMC - Software	0.00	4.31	4.53	4.75	4.99	5.24	5.50	5.78	6.07	6.37	6.69
Networking	0.00	135.00	141.75	148.84	156.28	164.09	172.30	180.91	189.96	199.46	209.43
Total Operating Expenses	0.00	185.89	195.18	204.94	215.19	225.95	237.24	249.11	261.56	274.64	288.37
Total Costs	342.13	185.89	195.18	204.94	215.19	328.58	237.24	249.11	261.56	274.64	288.37

As per the cost benefit analysis, video analytics is not a feasible initiative however is a must-have from the safety and security perspective



Investment credentials

- NPV: INR **-11.83 Cr.**
- IRR: NA
- Simple payback period: NA
- Time-adjusted payback period: NA

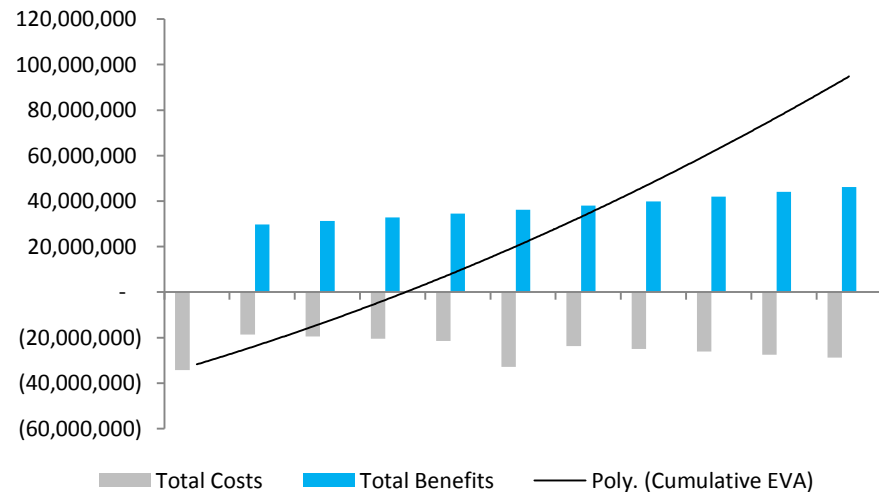


The EVA analysis for video surveillance and analytics shows a positive NPV which is a better result than that of a purely financial analysis with a payback period of 2.91 years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(342.13)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(342.13)
Capex Refresh	0.00	0.00	0.00	0.00	0.00	(102.64)	0.00	0.00	0.00	0.00	0.00	(67.54)
Total Operating Expenses	0.00	(185.89)	(195.18)	(204.94)	(215.19)	(225.95)	(237.24)	(249.11)	(261.56)	(274.64)	(288.37)	(1468.46)
Total Costs	(342.13)	(185.89)	(195.18)	(204.94)	(215.19)	(328.58)	(237.24)	(249.11)	(261.56)	(274.64)	(288.37)	(1878.12)
Financial Benefits	0.00	87.93	92.33	96.94	101.79	106.88	112.23	117.84	123.73	129.91	136.41	694.63
Non-Financial benefits	0.00	210.00	220.50	231.53	243.10	255.26	268.02	281.42	295.49	310.27	325.78	1658.94
Total Benefits	0.00	297.93	312.83	328.47	344.89	362.14	380.24	399.26	419.22	440.18	462.19	2353.57
Net EVA	(342.13)	112.04	117.65	123.53	129.70	33.55	143.00	150.15	157.66	165.54	173.82	475.45
Cumulative EVA	(342.13)	(230.08)	(112.43)	11.09	140.80	174.35	317.35	467.50	625.16	790.70	964.51	

Assumptions		
Discount rate	8.73%	10 year Government bond yield for India
Built up area in sqft in BKC	10,500,000	Sq ft
Lease rate per square foot	220	per sq ft a month
Increase in square foot rental due to security cameras and video analytics	2	INR. per sq ft a month
Increase rental due to security cameras and video analytics	21,000,000	INR



There are stakeholder benefits especially for MMRDA in implementing the video analytics solution

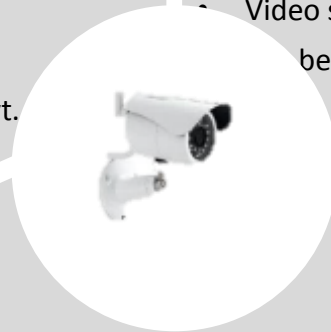


MMRDA/ Govt.

- Law enforcement and crime prevention
- Improved city maintenance by reactive and proactive measures for public safety
- Faster response time in case of emergencies
- Visibility over traffic violators/ unauthorized parking
- Reduction in street furniture & other public/govt. assets theft
- Improved post event investigation

Citizens/Businesses

- Improved public safety
- Improved road safety
- Response time to address an issue will decrease by administration, police,
- Video surveillance can tell whether a car has been towed or stolen



Others (Environment etc..)

- Model for rest of the world

There are multiple vendors having the required capability to provide the video analytics solution



<p>Accenture</p>	<ul style="list-style-type: none"> • Headquarters: Dublin, Republic of Ireland • Core Business: Accenture is a global management consulting, technology services and outsourcing company. Accenture Video Analytics Service Platform can automatically identify and analyze events related to security , safety, operational efficiency, customer behaviors and can also help operation centers gain deeper understanding of current operations, including new event notifications
<p>IBM</p>	<ul style="list-style-type: none"> • Headquarters: Armonk, New York, USA • Core Business: IBM is a multinational computer technology and consulting corporation. Video correlation and analysis suite (VCAS) from IBM provides the ability to view, monitor and digitally record activity . It provides real-time alerts for suspicious behaviors, enhanced forensic capabilities that allow unique indexing and attribute-based search, identity through facial recognition etc..
<p>CISCO</p>	<ul style="list-style-type: none"> • Headquarters: San Jose, California, USA • Core business: Cisco is a manufacturer of hardware, software, networking, and communications technology services. Cisco IP Video Surveillance designs provide access to video at any time from any network location, allowing remote monitoring, investigation, and incident response by remote physical security staff or law enforcement personnel.
<p>HP</p>	<ul style="list-style-type: none"> • Headquarters: Palo Alto, California, USA. • Core business: HP specializes in developing and manufacturing computing, data storage, and networking hardware, designing software and delivering services. HP Autonomy provides intelligent end-to-end surveillance systems with comprehensive surveillance, situational awareness, and advanced recognition technologies
<p>Schneider Electric</p>	<ul style="list-style-type: none"> • Headquarters: Rueil-Malmaison, Île-de-France, France • Core business: Schneider Electric India Pvt. Ltd (SEI) is a 100% subsidiary of Schneider Electric Industries SAS, a global specialist in energy management. With a strong force of over 17,000 employees, the company is well known for its unique vision, progressive management and above all, its exemplary Quality.

With threat to public places becoming a source of concern for authorities, video analytics is an important tool for ensuring safety



Singapore Safe City Testbed



- The Singapore Safe City Testbed is a government initiative seeking industry partners to integrate advanced analytics into existing sensors and systems owned by different agencies, in order to maximize situational awareness, streamline operations and enhance response to a wide spectrum of safety and security concerns
- Accenture will deploy its Video Analytics Service Platform, a layered service-based solution that will connect to existing and new sensor infrastructures – including 70 CCTV cameras owned by four different organizations, apply computer vision and predictive analytics to surveillance video feeds to detect various events, and generate business alerts that will be sent to the relevant government agencies
- Leveraging many different sensor-based and advanced data analytics, this system will enable to detect and monitor a variety of situations, such as crowd movement anomalies, urban traffic, disturbance to public order, etc.. – enabling agencies to gain situational insights from systems otherwise not accessible to them

UK Police Force Riot Investigation

- In 2011 when the riots occurred in the UK the police had large amounts of CCTV footage and photos of known suspects but police search mainly relies on manual inspection and tips from the public
- Accenture assessed the feasibility of automating the search using biometrics. The UK police provided 800,000 custody photos and 250 CCTV images
- Biometric search and adjudication tools narrowed the suspect list from 800,000 to 800 which was further whittled down to 8 by manual adjudication
- Biometric search also helped link custody images thus identifying new repeat offenders



http://www.mha.gov.sg/news_details.aspx?nid=MjgyNg%3D%3D-WVlit5hncaY%3D
<http://www.accenture.com/SiteCollectionDocuments/Accenture-Business-Biometrics.pdf>

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There exists no mechanism currently which provides a single window of information for BKC



Location

- People who want to find information about BKC currently have no way to find in a centralized manner
- There is also no unified method to provide **information to the public** on a consistent basis or to **declare emergency information**
- There is no forum for citizens to **issue complaints** about things like missing manhole covers etc..

Plan

- A Citizen Mobile Application will serve as a platform to **deliver services online** while providing an **avenue to disseminate information** to citizens
- It will also serve as a **complaint redressed forum**
- The app will be developed in an **open platform**
- Advertisements will be done for the citizen app for the first few months on hoardings in BKC, radio/FM and sms ads

Technology

- There is currently **no centralized online method to gather information** about BKC
- Most information resides on **third party apps like Zomato, Just Dial etc.,**
- There is no unified way to disseminate information

Issues

- Not enough people use the Citizen Mobile Application because they are **not aware of it**
- Not enough people use the Citizen Mobile Application unless it is **user friendly**

At BKC currently there is no single information channel for citizens/ businesses; citizen App will bridge this communication gap

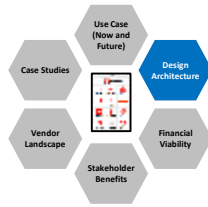


BEFORE



AFTER





A smart BKC app is proposed to be designed to provide ease of access to all information related to the complex

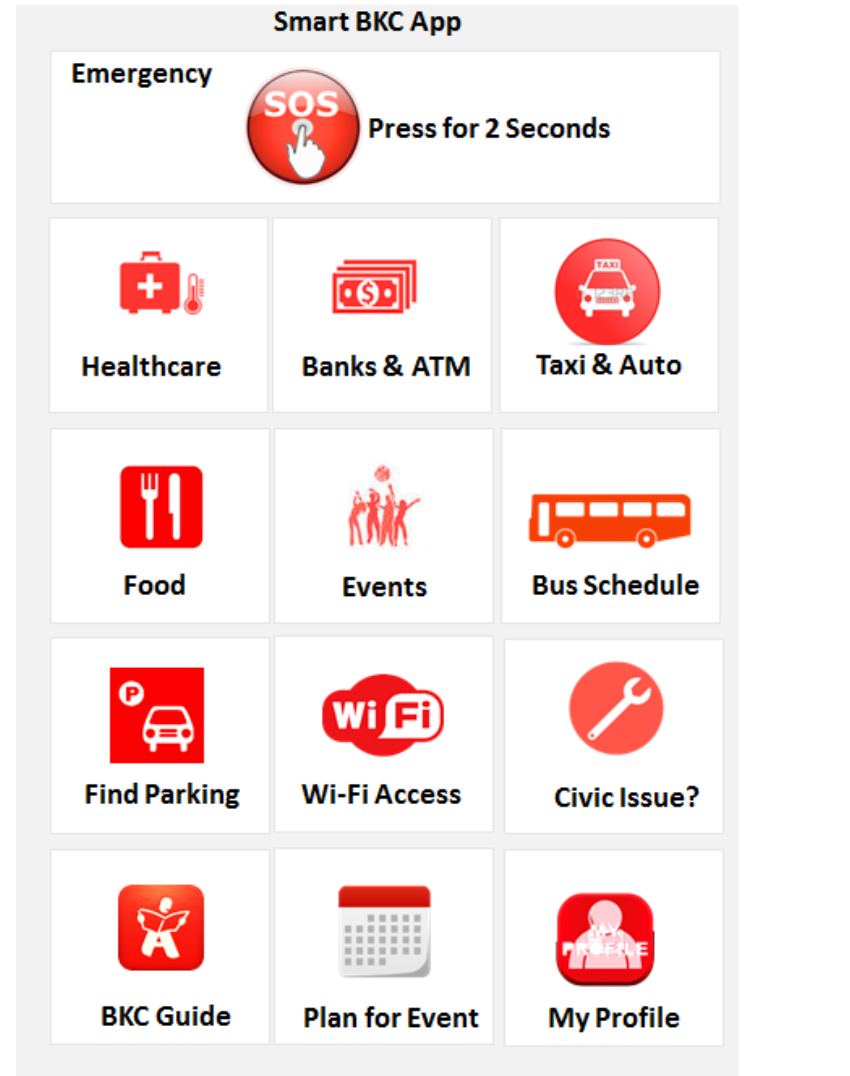
Solution Details

- Citizen App provides **single window access** to all BKC Guide, Events, Civic Issues, Smart City Applications like Parking.
- **SoS button** for generating alerts in any emergency situation to control center, police, hospital & family
- SoS can also be triggered by clicking start button for 3 times
- **Hybrid HTML5 mobile application** will be available for Web, iOS, Android, Blackberry & Windows Platform

Benefits

- **One Stop single window** for all information related to BKC.
- **Promotion of brand MMRDA** as planning and development which manages and disburses information efficiently
- Centralized communication channel for **emergency services**
- MMRDA gains **better control** on information capture and outflow
- Integration with utilities and other services

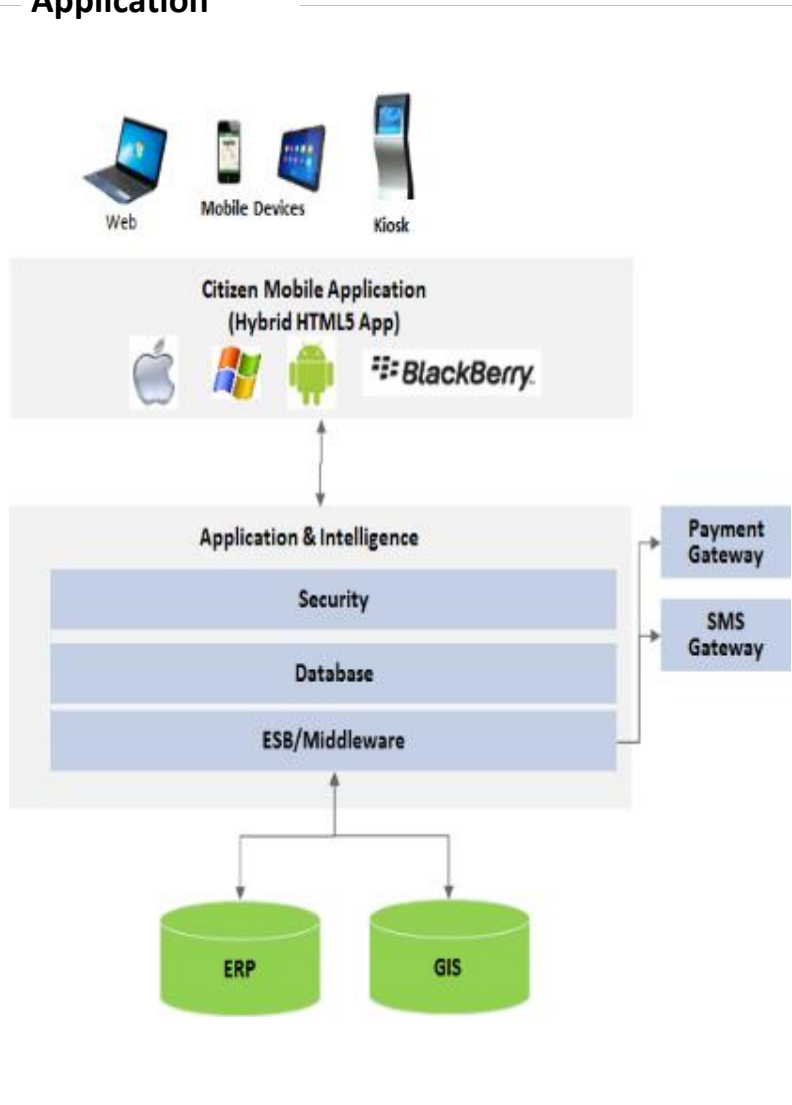
Conceptual View



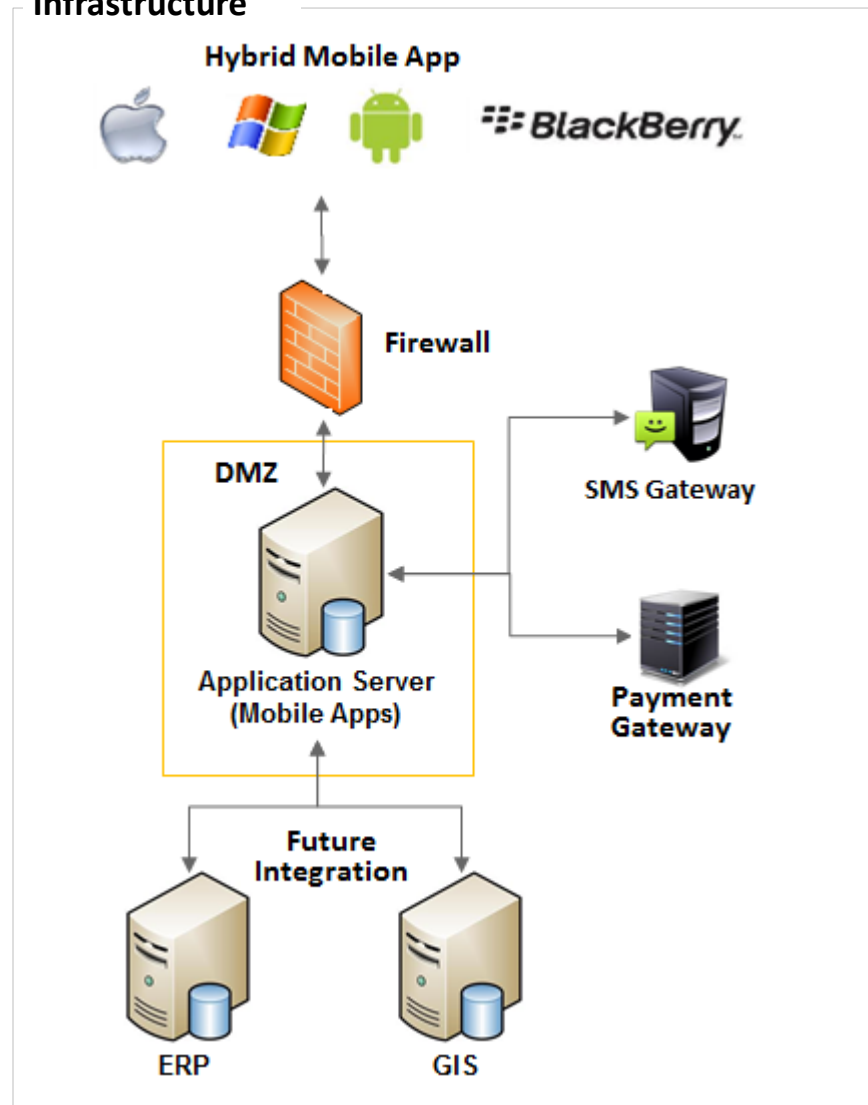
The technical architecture of the Citizen App will leverage the open App development platform which reduces the development effort for multiple platform



Application



Infrastructure



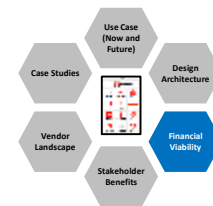
The Citizen App is expected to generate revenues from advertisements



Assumptions

- Number of People working in BKC: 117433 people
- % of people downloading the app: 20%
- Total number of people with app downloaded: 23487 people
- Average number of times app is visited per day per unique user: 2 visit/people
- Advertising: cost per thousand impressions rate: INR 250 /1000 impressions
- Number of impressions per day: 46973
- Revenue inflation rate per year: 5%
- Number of days per year where app is used: 250

Revenue Stream (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Advertisements on Citizen App		80.00	84.00	88.20	92.61	97.24	102.10	107.21	112.57	118.20	124.11
Total		80.00	84.00	88.20	92.61	97.24	102.10	107.21	112.57	118.20	124.11



The design and implementation of the App will involve an capital investment of INR 69 lakhs

Assumptions

- Capex: Apps Development – INR 50 lakhs
- Capex: Server: INR 10 lakhs
- Capex: Apps Development Platform: 0 (Open Source like phone gap)
- Opex: 25% of capex
- Increase in costs: 5%
- Number of use cases: 15
- Overall cost buffer: 15%

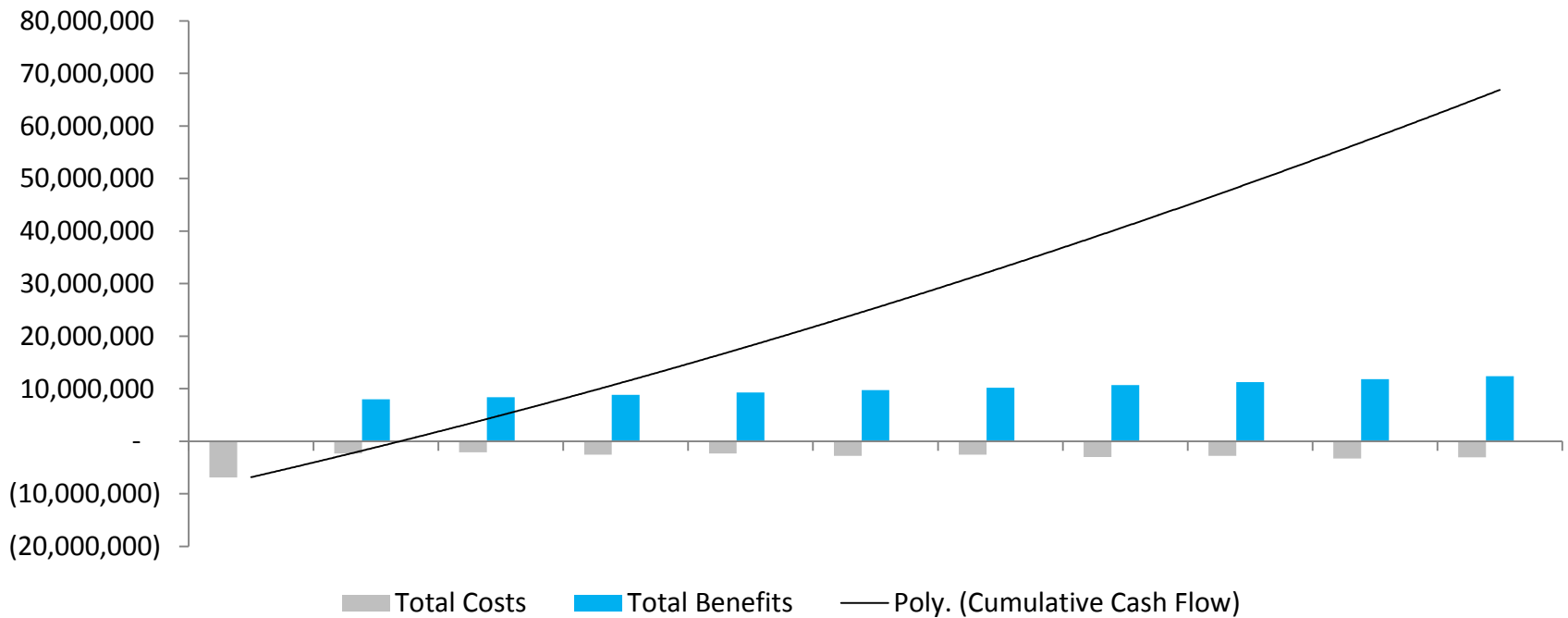
Cost Element (INR in lakhs)	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capex											
Hardware: Server, Switches	11.50										
Software: App development, Apps development platform	57.50										
Total Capital Expenses	69.00										
Capital Refresh		3.45		3.45		3.45		3.45		3.45	
Opex											
AMC - Hardware		3.31	3.47	3.65	3.83	4.02	4.22	4.43	4.65	4.88	5.13
AMC - Software and onsite support		16.53	17.36	18.23	19.14	20.09	21.10	22.15	23.26	24.42	25.65
Total Operating Expenses		19.84	20.83	21.87	22.96	24.11	25.32	26.58	27.91	29.31	30.77
Total Costs	69.00	23.29	20.83	25.32	22.96	27.56	25.32	30.03	27.91	32.76	30.77



Payback period for the Citizen App solution is expected to be 1.2 years

Investment credentials

- NPV: INR 3.95 Cr.
- IRR: NA
- Simple payback period: 1.2 years
- Time-adjusted payback period: 1.3 years

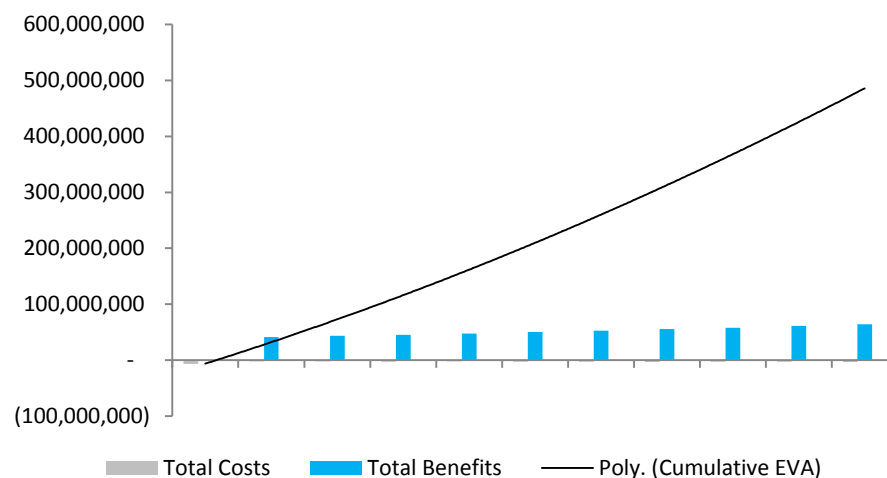


The EVA analysis for citizen mobile app shows a positive NPV which is a better result than that of a purely financial analysis with a payback period of 0.18 years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(69.00)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(69.00)
Capex Refresh	0.00	0.00	0.00	(6.90)	0.00	0.00	0.00	(6.90)	0.00	0.00	0.00	(9.21)
Total Operating Expenses	0.00	(19.84)	(20.83)	(21.87)	(22.96)	(24.11)	(25.32)	(26.58)	(27.91)	(29.31)	(30.77)	(156.71)
Total Costs	(69.00)	(19.84)	(20.83)	(28.77)	(22.96)	(24.11)	(25.32)	(33.48)	(27.91)	(29.31)	(30.77)	(234.92)
Financial Benefits	0.00	80.00	84.00	88.20	92.61	97.24	102.10	107.21	112.57	118.20	124.11	631.98
Non-Financial benefits	0.00	333.33	350.00	367.50	385.88	405.17	425.43	446.70	469.03	492.49	517.11	2633.24
Total Benefits	0.00	413.33	434.00	455.70	478.49	502.41	527.53	553.91	581.60	610.68	641.22	3265.21
Net EVA	(69.00)	393.50	413.17	426.93	455.52	478.30	502.21	520.42	553.69	581.37	610.44	3030.29
Cumulative EVA	(69.00)	324.50	737.67	1164.60	1620.12	2098.41	2600.62	3121.05	3674.73	4256.11	4866.55	0.00

Assumptions		
Discount rate	8.73%	10 year Government bond yield for India
Time saved due to app	1	min per day
Number of days used	250	days
Number of people who download the app	64,000	people
Number of days saved per year	33333	days
Average salary per day	1,000	INR
Productivity savings per year	33,333,333	INR



Citizens as well as MMRDA is set to derive benefits from having this single window of information

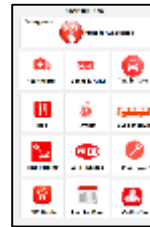


MMRDA/ Govt.

- Ease of getting information for citizens on MMRDA services, etc..
- Ease of disseminating information like emergency alerts to citizens through website and app
- Increase revenue
- Decongest Offices
- History of services provided, complaints received and complaints redressed
- Improved Operational Efficiency

Citizens/Businesses

- Availability of all information related to BKC on a single platform
- Improved Citizen/ Business satisfaction
- Convenient access and payment to all MMRDA services
- Time savings for citizens as many services become available online



Others (Environment etc..)

- No need to physically come to MMRDA due to online services thereby reducing travel and having a positive effect on the environment

Accenture is one of the vendors with relevant and rich experience in developing a single window App



Accenture	<ul style="list-style-type: none"> • Headquarters: Dublin, Republic of Ireland • Core Business: Accenture is a global management consulting, technology services and outsourcing company. Information management services focus on integrating and managing all the diverse information assets necessary to plan and run an organization. They include services in business intelligence, portals and content management and data management and architecture.
IBM	<ul style="list-style-type: none"> • Headquarters: Armonk, New York, USA • Core Business: IBM is a multinational computer technology and consulting corporation. IBM Worklight helps extend business to mobile devices. It is designed to provide an open, comprehensive platform to build, run and manage HTML5, hybrid and native mobile apps. It reduces both app development and maintenance costs, and enhances mobile app governance and security
Rolta	<ul style="list-style-type: none"> • Headquarters: Mumbai, India • Core Business: Rolta is a leading provider of innovative IT solutions for many vertical segments, including Federal and State Governments, Defense and Homeland Security, Utilities, etc.. Rolta provides services for design, development and implementation of custom solutions for unique business and process needs
Dell Services	<ul style="list-style-type: none"> • Headquarters: Round Rock, Texas • Core Business: Dell Inc. is a computer technology company that develops, sells, repairs and supports computers and related products and services Dell's Custom Application Development process supports multiple mobile device types and includes Requirements assessment, Collaborative architecture and design, Comprehensive testing and deployment and Full rollout support.
HP	<ul style="list-style-type: none"> • Headquarters: Palo Alto, California, USA. • Core business: HP specializes in developing and manufacturing computing, data storage, and networking hardware, designing software and delivering services. HP Anywhere is a mobile app platform designed to mobilize the enterprise, connecting users with corporate systems and with each other on their device of choice. It uses the open standards of HTML5 and JavaScript.



With high penetration of mobile phones in India, an App solution is one of the most effective ways to access information

Birmingham City Council mobile web app, UK



- The free BCC mobile app provides the following services:
 - Browse council jobs
 - Find and get directions to any leisure centre, library, school, museum, or household recycling centre in the city
 - Keep up with BCC news and any disruption to services
 - Get contact details for your councilor
 - Report a problem with rubbish bags or recycling boxes
 - Request street cleaning
 - Report faulty street lights and street name plates
 - Request recycling boxes if you are a new occupier
 - Report dumped rubbish (fly-tipping)
 - Report a missed rubbish collection
 - Report a pot hole

My Croydon App, UK

- The new My Croydon app is a faster way to report issues to the city using a smartphone.
- Using the app citizens can report a variety of local issues such as fly-tipping, defects on the highway or problems with trees and high hedges.
- All that needs to be done when a problem is seen is:
 - Select the issue that one wants to report (such as graffiti) from a drop-down list and add any other relevant information that the city needs to know
 - Take a photo of the problem
 - Add the location
 - Submit the report
- For people without a smartphone they can also report issues to the city using the website at any time that suits them by signing up to My Account.



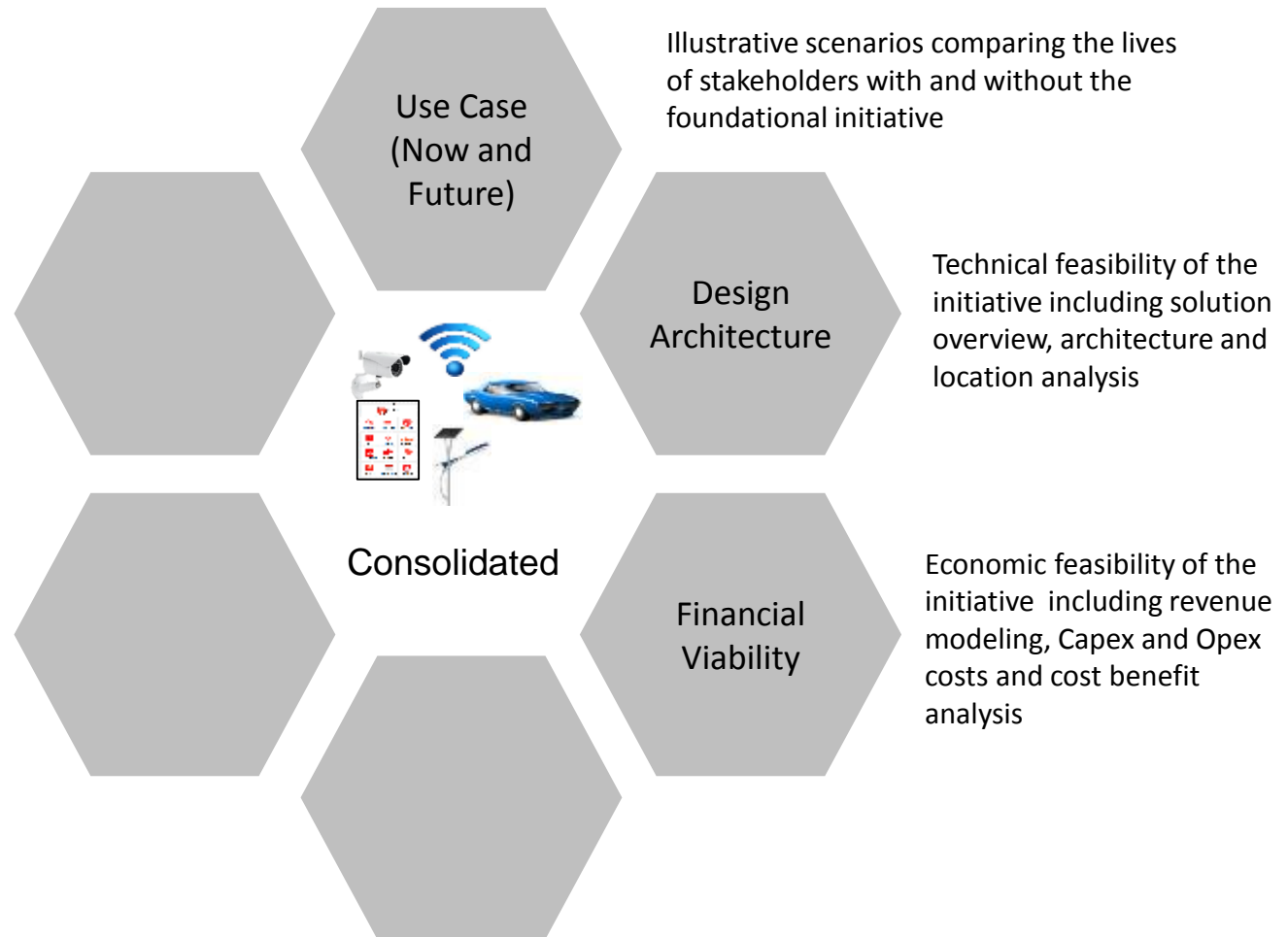
<http://www.birmingham.gov.uk/app>

<http://croydon.gov.uk/democracy/communications/app>

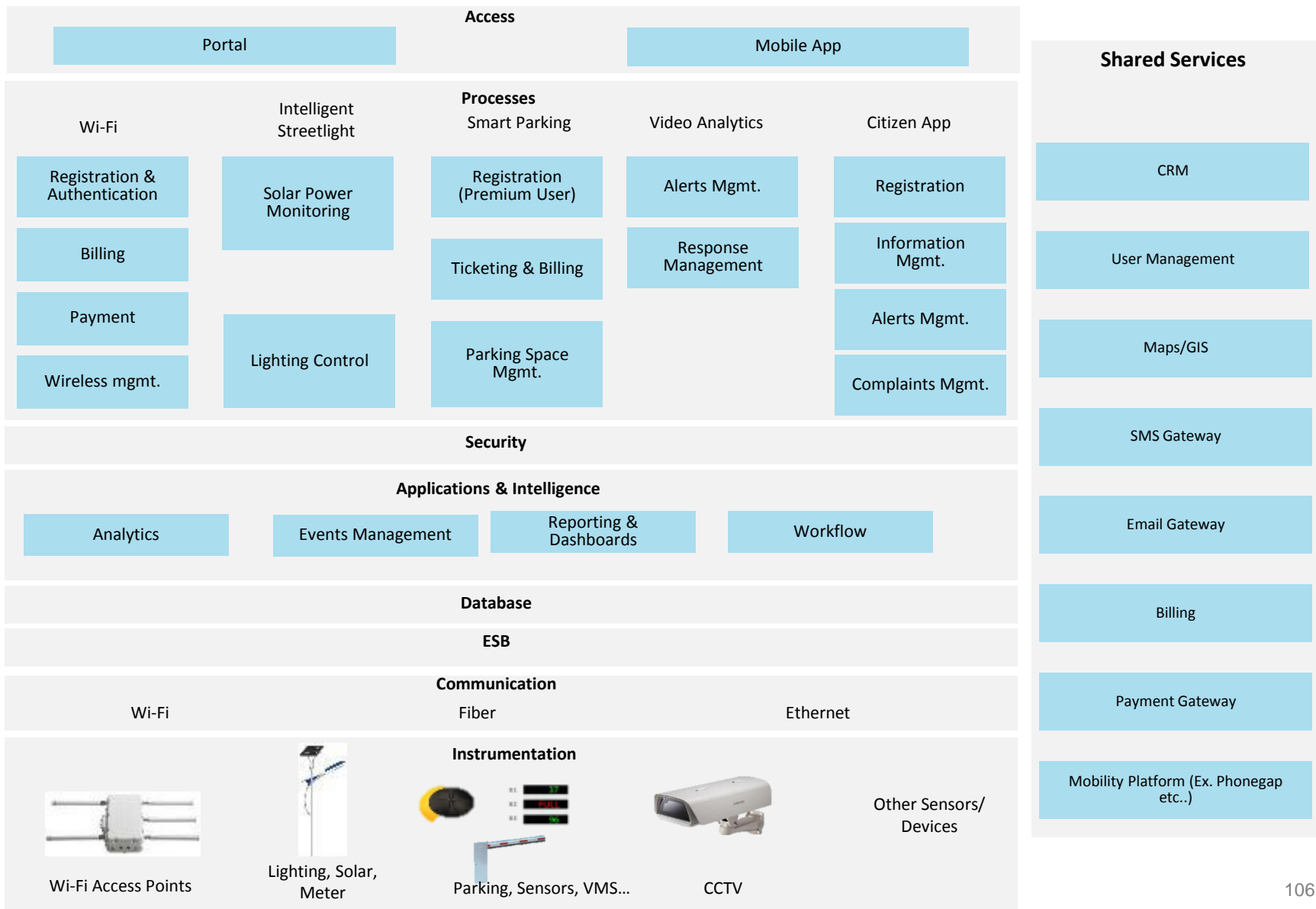
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With all 5 initiatives being beneficial and feasible there is also a need to evaluate the consolidated view on relevant parameters



The design architecture for the combined solution will be based on an open platform



From the consolidated solution the total revenue is expected to be INR 5.59 Cr. which is sufficient to cover the overall Opex. requirement making them self sustainable in the long term



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Wifi - BKC Wide	523.25	132.25	138.86	145.81	153.10	422.38	168.79	177.23	186.09	195.39	205.16
Smart Parking	330.23	188.95	286.43	302.30	577.42	655.57	277.84	425.21	444.51	853.36	358.11
Smart Streetlights	676.01	24.71	25.94	27.24	28.60	50.32	31.53	33.11	34.77	36.51	38.33
Video Analytics	342.13	185.89	195.18	204.94	215.19	328.58	237.24	249.11	261.56	274.64	288.37
Citizen App	69.00	23.29	20.83	25.32	22.96	27.56	25.32	30.03	27.91	32.76	30.77
Total Costs	1940.62	555.09	667.24	705.61	997.27	1484.41	740.73	914.69	954.85	1392.65	920.75
Wifi - BKC Wide	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Smart Parking	0.00	272.87	289.43	305.73	323.01	340.28	358.52	377.80	398.18	419.74	442.54
Smart Streetlights	0.00	279.18	370.14	461.80	785.19	824.45	865.67	908.96	954.40	1002.13	1052.23
Video Analytics	0.00	71.31	74.87	78.61	82.55	86.67	91.01	95.56	100.33	105.35	110.62
Citizen App	0.00	87.93	92.33	96.94	101.79	106.88	112.23	117.84	123.73	129.91	136.41
Total Benefits	0.00	80.00	84.00	88.20	92.61	97.24	102.10	107.21	112.57	118.20	124.11
Cash Flow	0.00	791.29	910.77	1031.29	1385.15	1455.52	1529.53	1607.36	1689.22	1775.32	1865.91
Cumulative Cash Flow	(1940.62)	236.21	243.53	325.68	387.88	(28.89)	788.79	692.66	734.37	382.67	945.16
Discounted Cash Flow	(1940.62)	(1704.41)	(1460.88)	(1135.20)	(747.32)	(776.21)	12.58	705.25	1439.62	1822.29	2767.45
Cumulative Discounted Cash Flow	(1940.62)	217.24	205.99	253.36	277.52	(19.01)	477.38	385.55	375.94	180.17	409.27

The payback for the consolidated solution is expected to be 7 years with total carbon footprint reduction equivalent to 914 trees planted

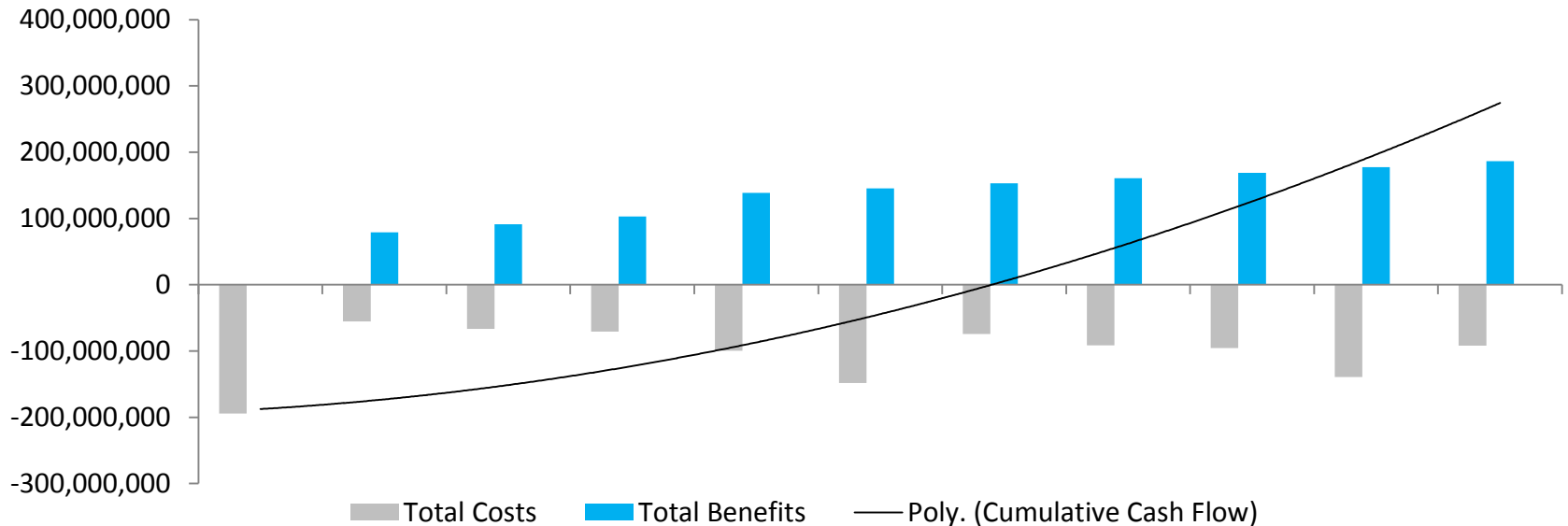


Investment credentials

- NPV: INR 8.23 Cr.
- IRR: 16%
- Simple payback period: 6 years
- Time-adjusted payback period: 7.38 years

Other benefits

- CO2 reduced due to LED lighting: 362 Tons of CO2
- CO2 reduced due to light and motion sensors: 362 Tons of CO2
- CO2 reduced due to solar power being produced: 98 Tons of CO2
- CO2 reduced due to smart parking: 24 Tons of CO2
- Total man days lost per year due to parking issues which are now saved: 7813 days

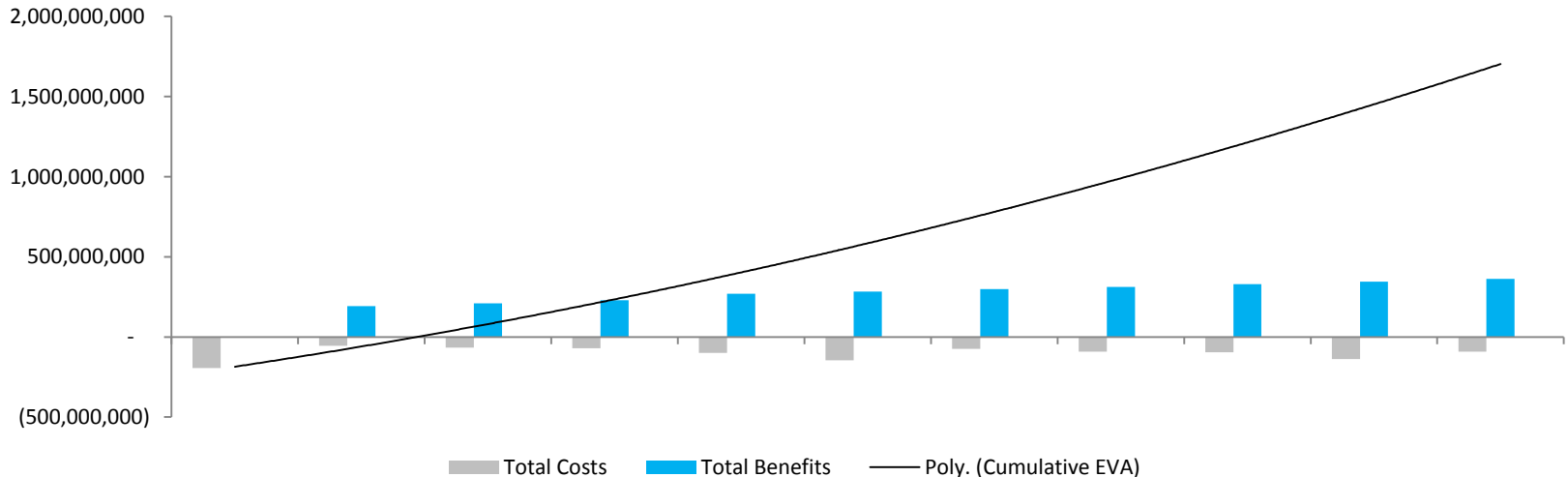


Zigzag pattern in the costs is due to capex refresh

While the consolidated EVA analysis shows a positive NPV of 98 Cr., the NPV of total costs < NPV of total financial benefits which makes this financially self sustaining with a payback period of 1.39 years



(INR in lakhs)	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	NPV
Total Capital Expenses	(1940.62)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(1940.62)
Capex Refresh	0.00	0.00	(86.25)	(93.15)	(345.00)	(758.77)	0.00	(136.28)	(129.38)	(517.50)	0.00	(1277.30)
Total Operating Expenses	0.00	(551.64)	(580.99)	(615.91)	(652.27)	(701.91)	(740.73)	(781.87)	(825.47)	(871.70)	(920.75)	(4521.70)
Total Costs	(1940.62)	(551.64)	(667.24)	(709.06)	(997.27)	(1460.68)	(740.73)	(918.14)	(954.85)	(1389.20)	(920.75)	(7739.61)
Financial Benefits	0.00	791.29	910.77	1031.29	1385.15	1455.52	1529.53	1607.36	1689.22	1775.32	1865.91	8578.23
Non-Financial benefits	0.00	1134.78	1191.52	1251.10	1313.65	1379.33	1448.30	1520.72	1596.75	1676.59	1760.42	8964.44
Total Benefits	0.00	1926.08	2102.29	2282.39	2698.80	2834.85	2977.83	3128.07	3285.97	3451.91	3626.32	17542.67
Net EVA	(1940.62)	1374.44	1435.05	1573.33	1701.53	1374.18	2237.10	2209.93	2331.12	2062.71	2705.58	9803.06
Cumulative EVA	(1940.62)	(566.18)	868.87	2442.20	4143.73	5517.91	7755.00	9964.93	12296.05	14358.76	17064.34	0.00



To achieve the vision for an intelligent BKC it is recommended that MMRDA implements all five initiatives as part of phase 1 – this will improve the quality of life for stakeholders of BKC



Wi-Fi

Smart Parking

The consolidated solution is beneficial to stakeholders from a Use case perspective



Intelligent Streetlights

Video Analytics

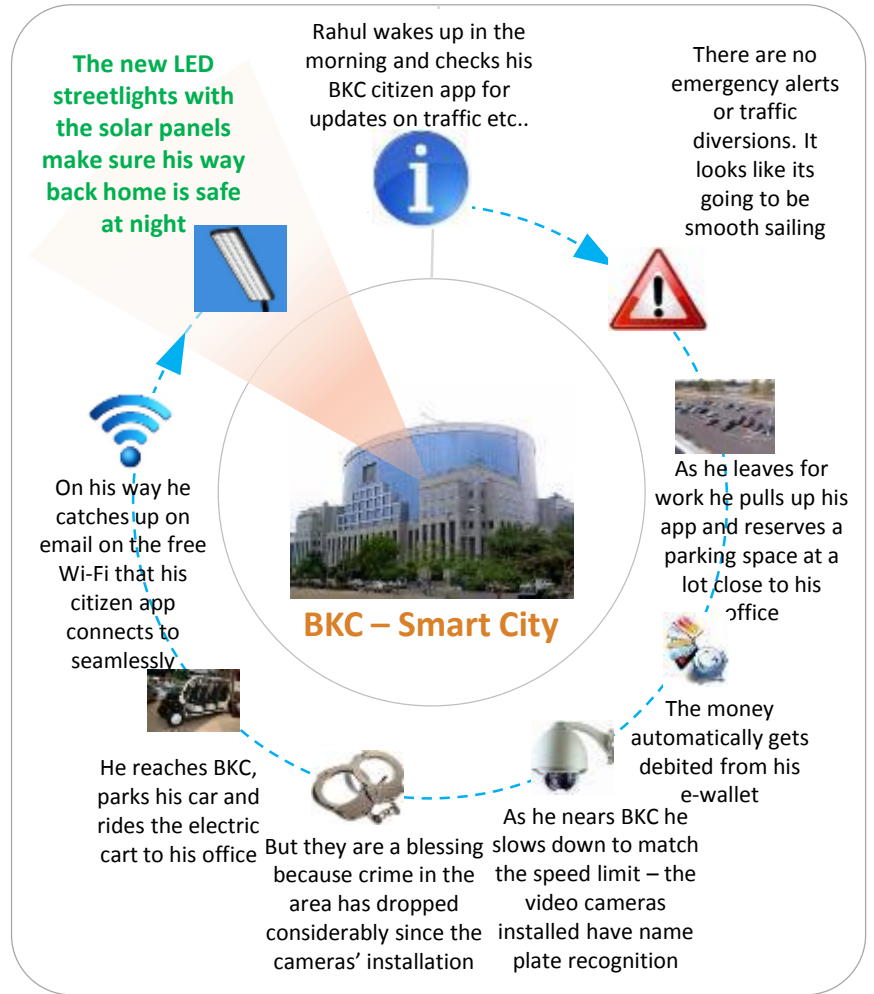
The consolidated solution is financially self sustainable in the long term



Citizen App

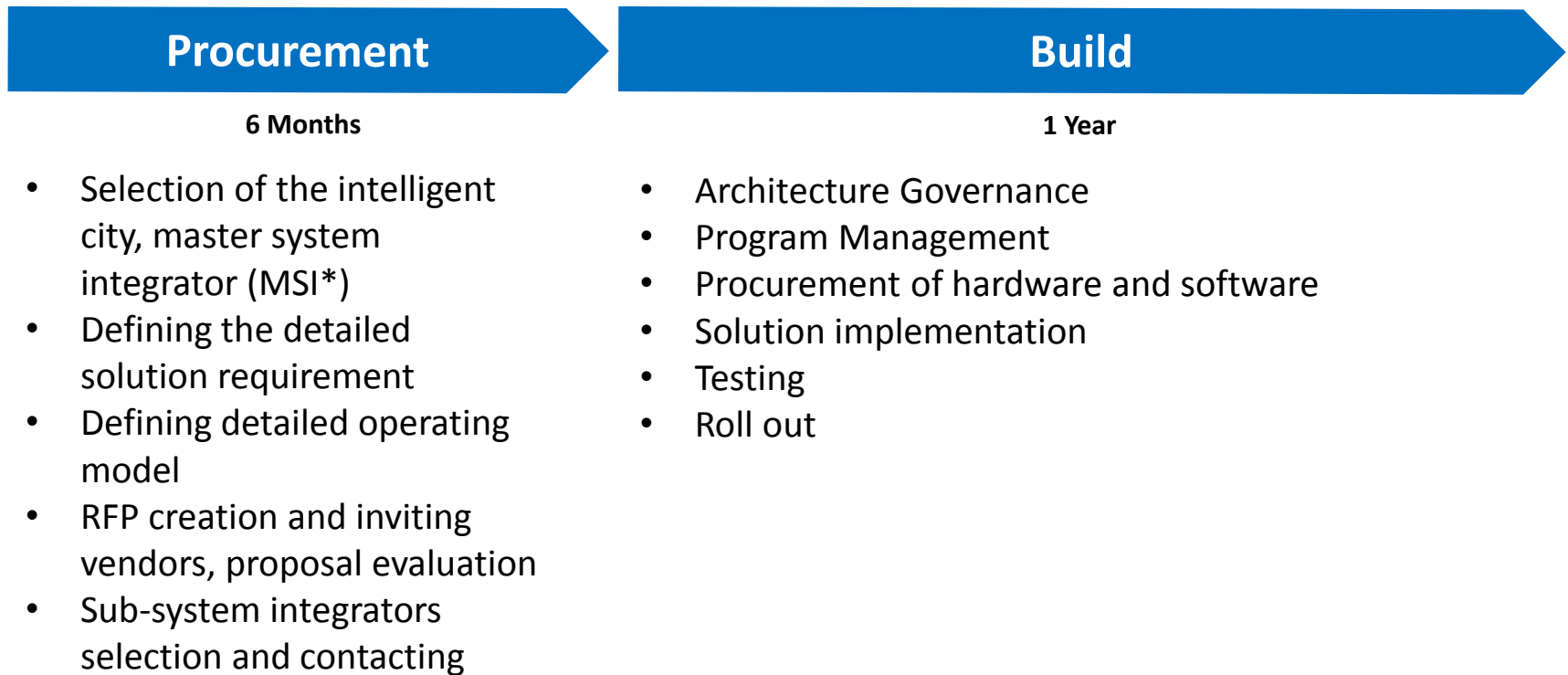
Use of combined architecture ensures seamless experience and synergetic cost saving opportunity

AFTER



On boarding of Intelligent City Consultant

MMRDA should board intelligent city consultant for RFP preparation, vendors selection and program management. The tentative timelines for procurement and implementation should be approximately 18 Months.

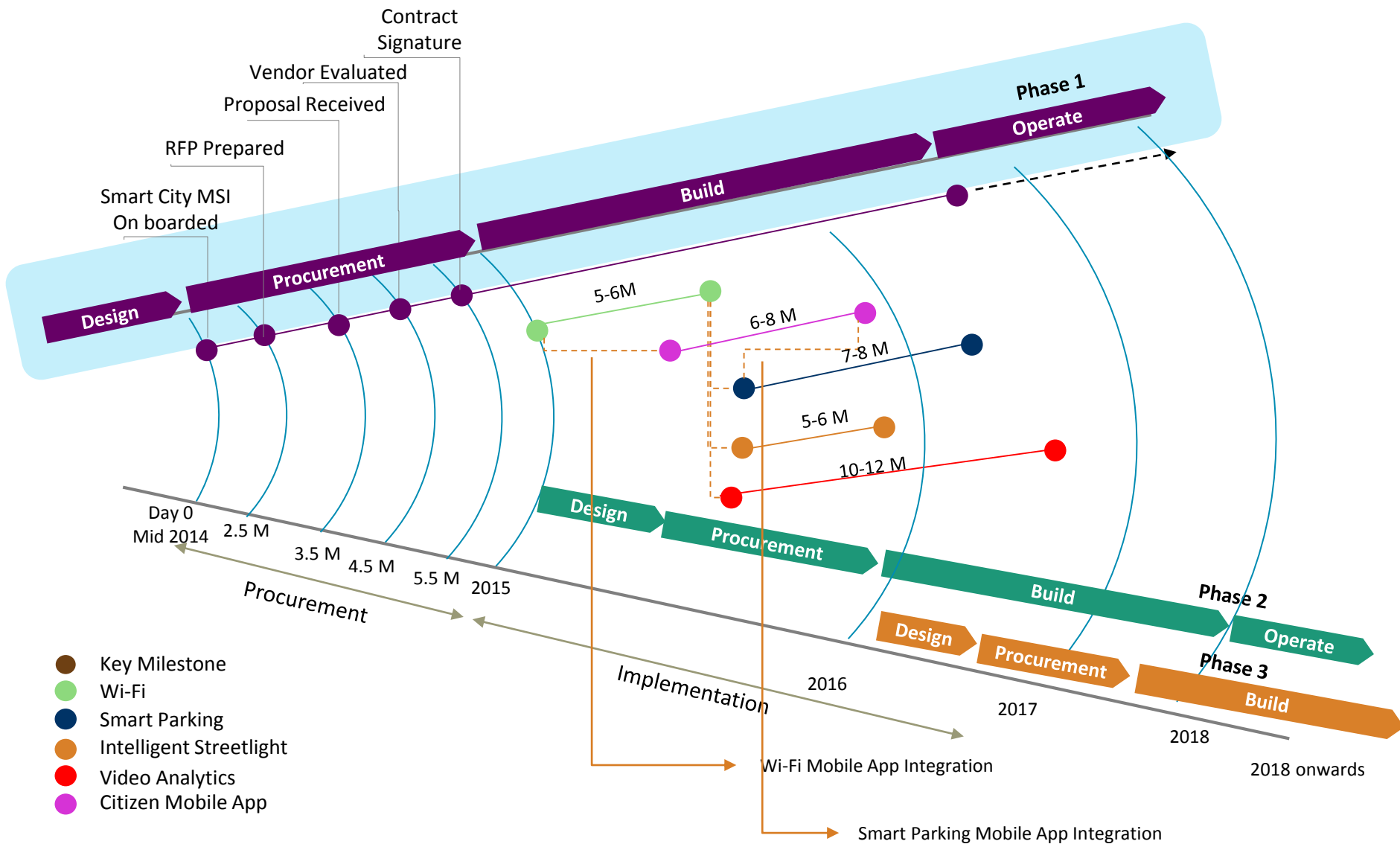


* MSI roles and responsibilities illustrated in the next slide

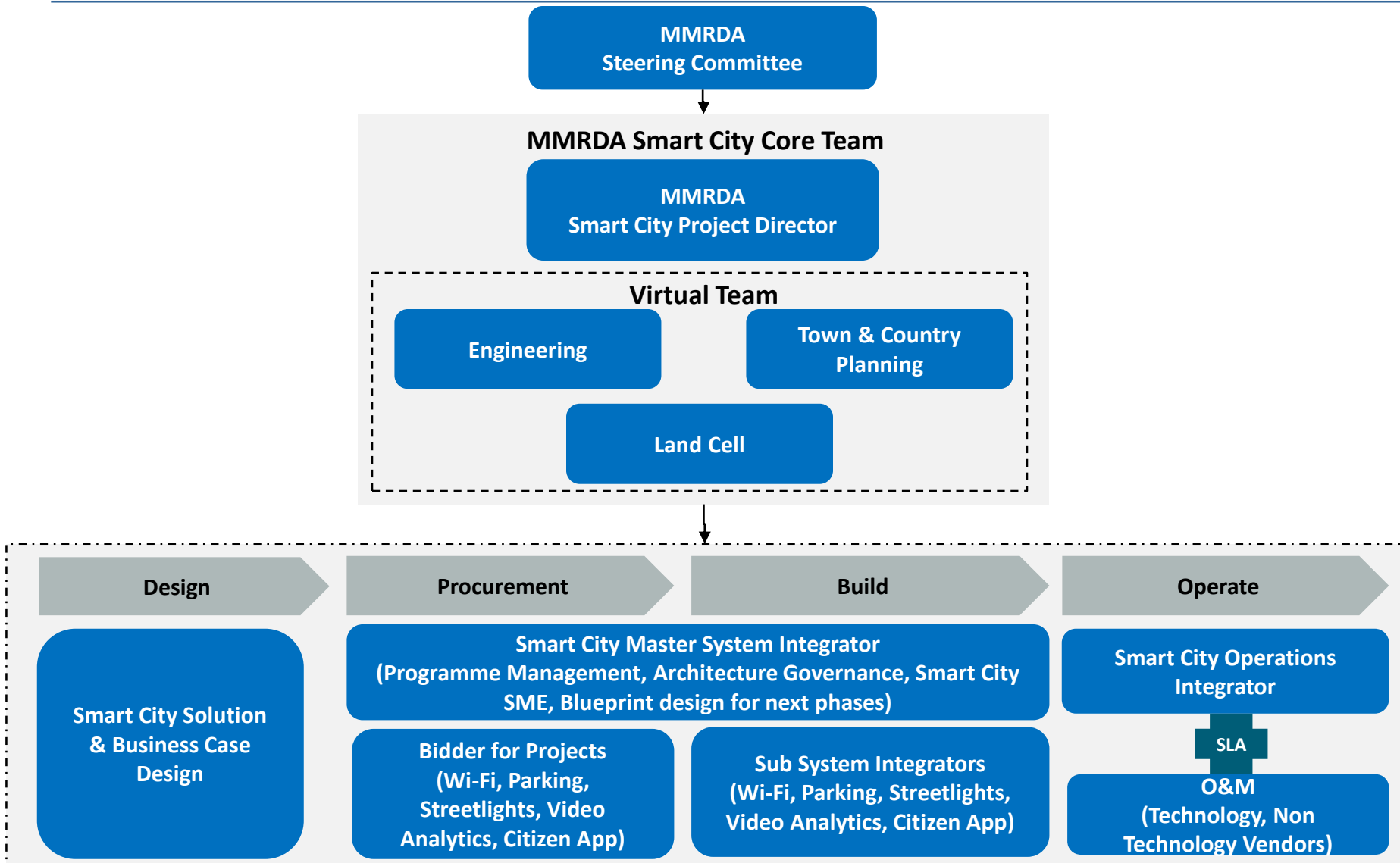
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The timeline for foundational initiatives implementation will span for 36 months with a proposal to begin the blueprint design for advanced and futuristic initiatives as overlapping activities



The governance structure will include senior MMRDA leadership, smart city core team and multiple system integrators to make this project a success



Considering the complex eco-system of partners we propose an Operating Model with MMRDA owning the planning/control and a smart city operations integrator taking ownership of operations/maintenance

	Plan	Control & Monitor	Smart City operations Integrator	Operate	Maintain
Wi-Fi	MMRDA <ul style="list-style-type: none"> Plan for rollout to other MMR regions 	MMRDA <ul style="list-style-type: none"> FMS team will monitor the Wi-Fi network using the wireless management system 		Wi-Fi O&M Team <ul style="list-style-type: none"> Monitor Network availability Monitor Security Revenue Management and Billing 	
Smart Parking	MMRDA <ul style="list-style-type: none"> Plan for additional parking spaces based on demand and trend analysis Plan for Rollout to other MMR regions 	MMRDA <ul style="list-style-type: none"> Land Cell will have visibility to monitor parking availability, usage, revenue etc.. 		Parking Operator <ul style="list-style-type: none"> Manage day to day operations of parking 	Parking Technology O&M <ul style="list-style-type: none"> Manage Application, Infrastructure, Instrumentation, Helpdesk
Intelligent Streetlight	MMRDA <ul style="list-style-type: none"> Plan for rolling out intelligent streetlight in other MMR regions 	MMRDA <ul style="list-style-type: none"> Engineering team will have visibility on saving and generation. 		Streetlight Operator <ul style="list-style-type: none"> Maintain Streetlight and other equipment's on pole 	
Video Surveillance & Analytics	MMRDA <ul style="list-style-type: none"> Plan for surveillance coverage and new analytics use cases Plan for Rollout to other MMR region 	MMRDA Control Center <ul style="list-style-type: none"> Monitor BKC Street furniture thefts Encroachments Incidents & Emergencies Coordinate in Emergency/Incident 		BKC Police <ul style="list-style-type: none"> Monitor Public Safety Traffic Police <ul style="list-style-type: none"> Monitor Traffic 	Video Analytics Technology O&M <ul style="list-style-type: none"> Manage Application, Infrastructure, Instrumentation, Helpdesk
Citizen App	MMRDA <ul style="list-style-type: none"> New Services Rollout to other MMR regions 	MMRDA <ul style="list-style-type: none"> Content Approval 		Citizen App O&M <ul style="list-style-type: none"> Manage Application, Infrastructure, Helpdesk 	

Once phase 1 solutions have been implemented additional initiatives can be build upon the existing capabilities

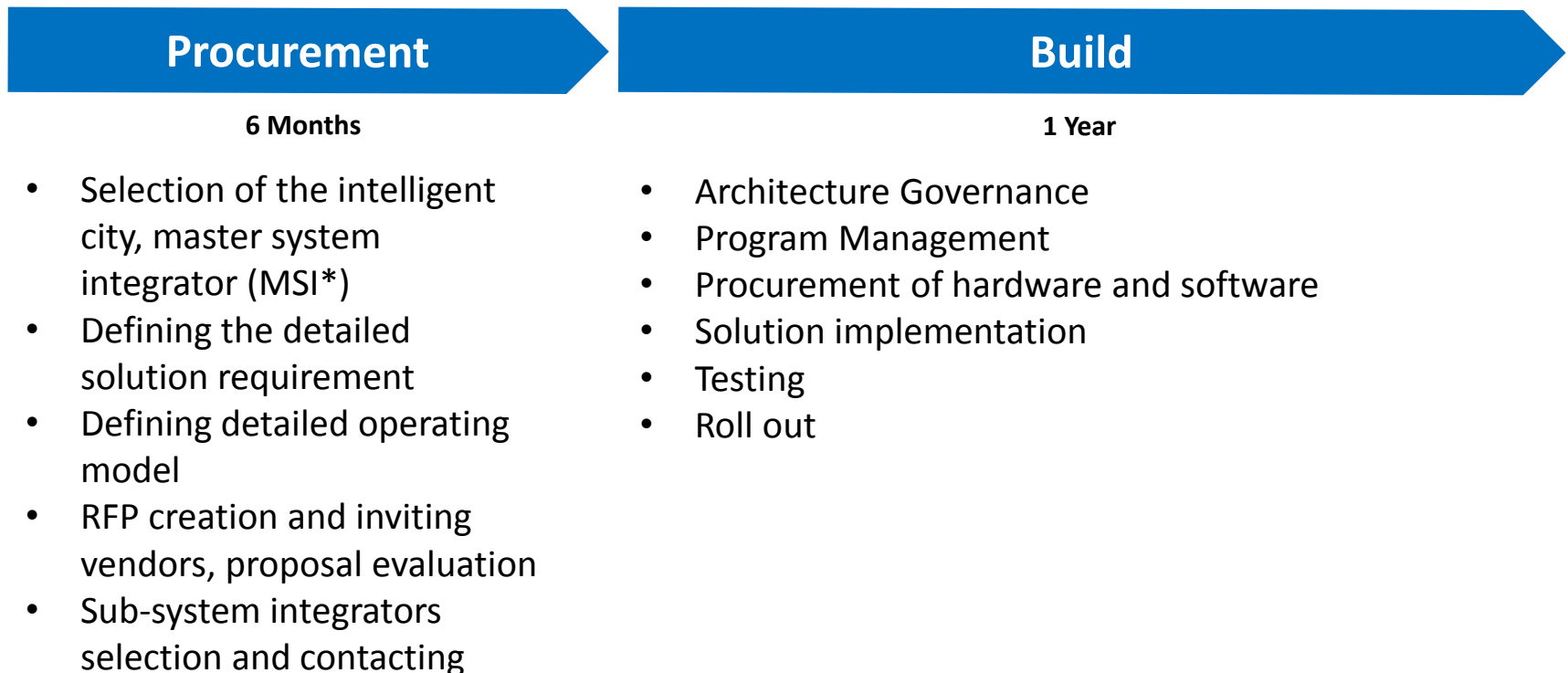
Wi-Fi	Smart Parking	Intelligent Streetlight	Video Analytics	Citizen Mobile Application
<ul style="list-style-type: none"> ▪ BKC Wide Wi-Fi ▪ Communication Backbone for Parking Sensors, CCTVs, Kiosks 	<ul style="list-style-type: none"> ▪ On Street, Open and In Door Parking ▪ Parking Guidance App ▪ Parking Space Management ▪ Parking Reservations 	<p>Lighting</p> <ul style="list-style-type: none"> ▪ Light & Motion Sensor <p>Solar</p> <ul style="list-style-type: none"> ▪ 200 kw Grid Tied Solar PV 	<ul style="list-style-type: none"> ▪ 50 new cameras to cover entire BKC ▪ Integration with Mumbai CCTV ▪ Command Center at MMRDA and BKC Police St. 	<ul style="list-style-type: none"> ▪ BKC Information ▪ Key Contacts ▪ Citizen Involvement Mobile App ▪ Kiosks
<p>Extend for more Smart City Apps</p> <ul style="list-style-type: none"> ▪ Air Pollution Sensors ▪ Smart Meter (Electric/Water/Gas) ▪ Water Quality Meters ▪ Flood Sensors 	<ul style="list-style-type: none"> ▪ EV Charging Stations ▪ EV Charging Station Locator ▪ Differential Parking Charging 	<p>Lighting</p> <ul style="list-style-type: none"> ▪ LED Retrofit Lighting <p>Solar- expand to 1 MW</p> <ul style="list-style-type: none"> ▪ Solar PV on Buildings (Terrace and Façade) ▪ Solar PV on Bus Stops 	<ul style="list-style-type: none"> ▪ Extend Command center at MMRDA to City Command Center ▪ Feed to Transportation Planning 	<ul style="list-style-type: none"> ▪ Citizen Involvement in Planning ▪ Citizen Services -GIS and ERP Integration

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Way Ahead

MMRDA should board intelligent city consultant for RFP preparation, vendors selection and program management. The tentative timelines for procurement and implementation should be approximately 18 Months.



* MSI roles and responsibilities illustrated in the next slide

Way Ahead

Intelligent City Consultant for the BKC program implementation should have following governance structure.

Programme Management

Roles

- Program Manager 1
- Program Manager 2

Architecture Governance

Roles

- Application Architects
- Network Architect
- Datacenter Architect

Smart City SME & Blueprint Development Consultant

Roles

- Smart City Principal Consultant
- Smart City Consultant

Roles & Responsibilities

Programme Management:

- Responsible for Program Management
- Lead the Project Plan design & Review
- RFP creation
- Vendor Evaluation
- Coordinates the reviews, steering committee meetings

Architecture Governance:

- Evaluate vendor design
- Lead Architecture design and review
- Ensure adherence to Architecture & Guiding Principles
- Ensure compliance to Govt. Standards & Security

Smart City SME

- Subject Matter Expertise to the project & Blueprint
- ### Blueprint Development Consultant:
- Identify next set of initiatives and create blueprint for the same

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Key Exclusions

This business case excludes the following points from its analysis

Key Exclusions

- It is assumed that the data center will be operational at MMRDA
- Civil work is not considered in the costing and will be extra
- Windload analysis for the solar panels will be done later and will cost extra
- Any structural changes done to streetlights and their foundations is not included and will cost extra
- Seating space for PMO and Systems Integrator needs to be provided by MMRDA
- MMRDA should provide approval as per project plan that will be prepared in the next phase
- MMRDA to provide all relevant regulatory approvals
- We have considered that infrastructure like streetlights, parking lots, etc., to be permanent. Any change to the existing infrastructure will necessitate an increase in costs to move the equipment

Glossary

Glossary

- AMC - Annual Maintenance Contract
- Capex - Capital expenses
- CBD - Commercial Business District
- CCTV - Closed Circuit Television
- CO2e - Carbon Dioxide Equivalent
- Cr. - Crores (1,00,00,000)
- DoT - Department of Telecommunications
- HPSV - High Power Sodium Vapor
- ICT - Information and Communication Technology
- IP - Internet Protocol
- JNNSM - Jawaharlal Nehru National Solar Mission
- Lakhs - 1,00,000
- LED - Light Emitting Diode
- MC - Municipal Commissioner
- MERC - Maharashtra Electricity Regulatory Commission
- MMR - Mumbai Metropolitan Region
- MMRDA - Mumbai Metropolitan Region Development Authority
- MNRE - Ministry of New & Renewable Energy
- MSI - Master System Integrator
- MW - Mega Watt
- Opex - Operational expenses
- PTZ - Pan, Tilt and Zoom
- PV - Photovoltaic
- RFP - Request for Proposal
- VMS - Video Management System

Summary

Summary

	Wi-Fi (Buying Bandwidth)	Smart Parking (with Electric Cart)	Intelligent Streetlights (with Solar Panel)	Video Analytics	Citizen App	Consolidated
Capital Expenses (INR in lakhs)	523	330	676	342	69	1,941
Operating Expenses (INR in lakhs for year 1)	132	189	25	186	20	552
Revenue (INR in lakhs in year 1)	273	279	71	88	80	791
NPV (INR in lakhs)	469	1,464	(321)	(1,183)	395	823
IRR	25%	49%	NA	NA	89%	16%
Simple Payback (in years)	3.42	2.98	NA	NA	1.19	5.98
Discounted Payback (in years)	5.65	3.35	NA	NA	1.32	7.38

Recommendation is to implement all 5 foundation initiatives considering the consolidation financial feasibility and stakeholder benefits.

- The total **Capex** requirement for implementing all initiatives is **INR 19.41 cr.**
- The total **Opex** requirement is **INR 5.52 cr.**
- The **Revenue** generated from the foundational initiatives is **INR 7.91 cr.** which is sufficient to fund the Opex requirement and make the initiatives **self sustainable** in the longer term
- Implementing all initiative swill give an **IRR of 16%** and **payback period of 5.98 years**
- Total carbon footprint reduction per year is **845 tons of CO2e equivalent to planting 845 trees**
- BKC wide Wi-Fi will provide **high speed seamless connectivity** and will serve as a **backbone for intelligent city applications and sensors.**
- Reduction in time to find parking is from 20mins to 5 mins.; **man days saved** due to smart parking is **7813 per year**
- Intelligent street lighting will reduce energy consumption for street lighting by **40%** and solar panel will **generate clean energy** sufficient to cover approx. 25% of current street light energy requirement
- Video Analytics will provide **proactive threat detection** and will also help in reducing the street furniture theft
- Citizen App will provide a **single window information channel** for all BKC requirements

Sensitivity Analysis



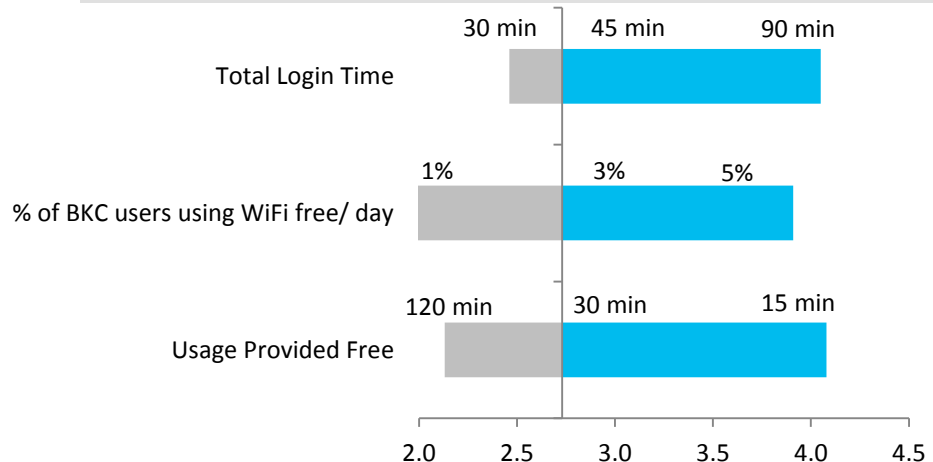
Variations in IRR, revenue and payback period are primarily caused by changes in percentage of BKC users utilizing free Wi-Fi per day

Levers Identified For Sensitivity Analysis of Important financial Parameters

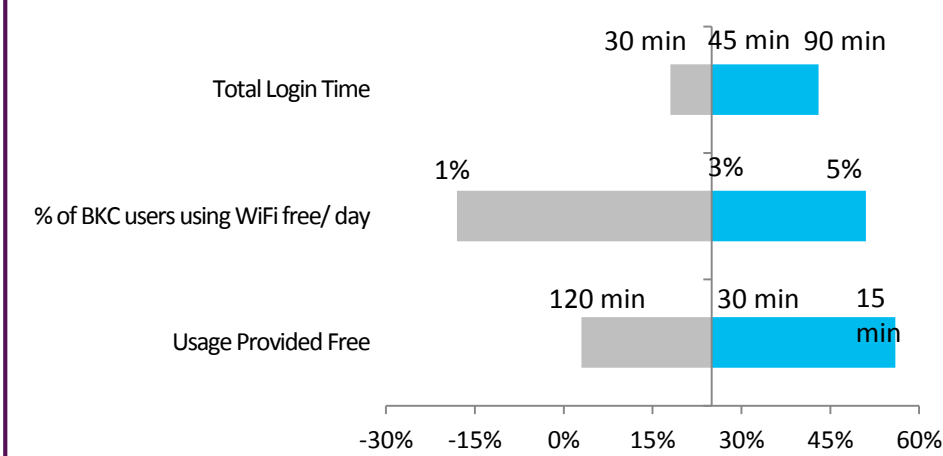
Lever	Figures proposed	Lower Limit	Upper Limit
Total login time	45 min	30 min	90 min
% of BKC users^ using WiFi free/ day	3%	1%	5%
Usage Provided Free	30 min	15 min	120 min

^ No of employees and visitors in BKC using Wi-Fi

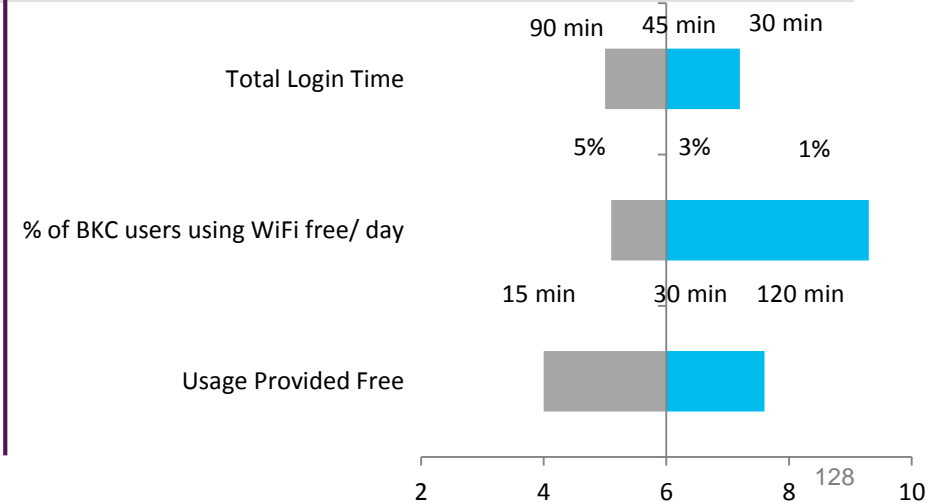
Variation in Revenue for BKC-Wide Wi-Fi (in INR Cr.) by changing following levers:



IRR Variation in BKC-Wide Wi-Fi due to changes in following levers:



Changes in Simple Payback Period (in years) due to changes in select levers:



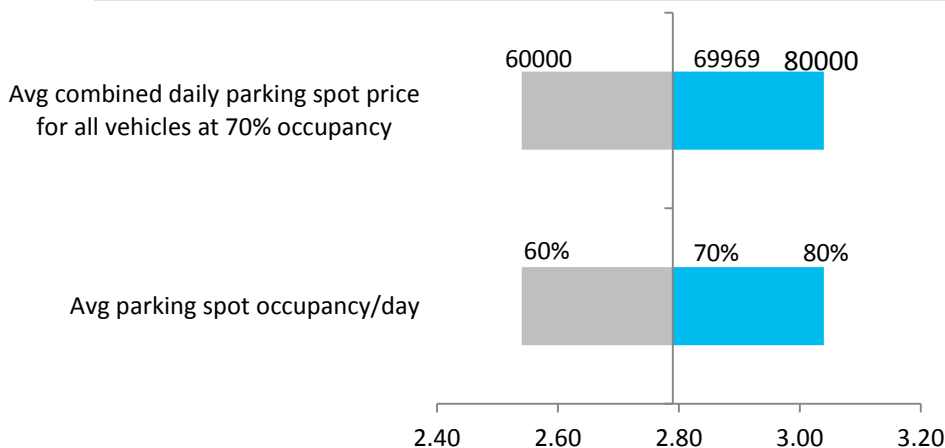


Average parking spot occupancy is a critical variable in determining the returns from the initiative.

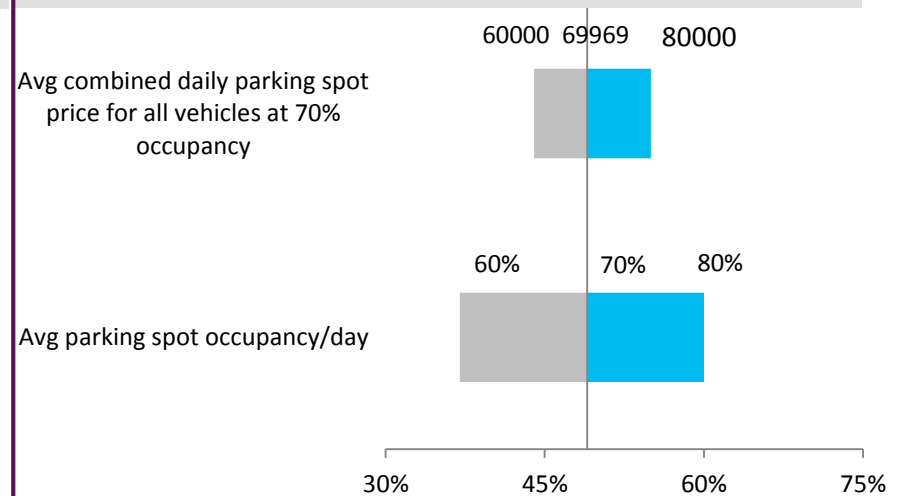
Levers Identified For Sensitivity Analysis of Important financial Parameters

Lever	Figures proposed	Lower Limit	Upper Limit
Average combined daily parking spot price for all vehicles at 70% occupancy	69969	60000	80000
Average parking spot occupancy during a day	70%	60%	80%

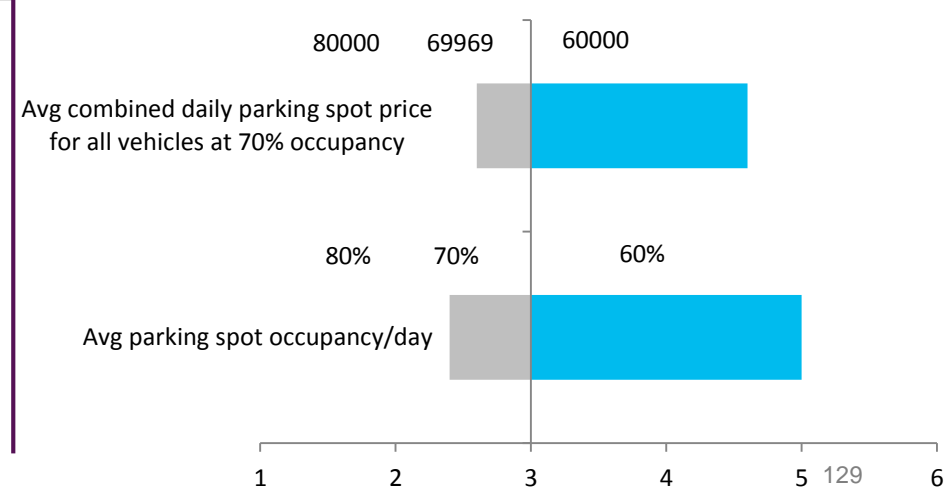
Variation in Revenue for Smart Parking (in INR Cr.) by changing following levers



IRR Variation in Smart Parking due to changes in following levers:



Changes in Simple Payback Period (in years) due to changes in select levers:



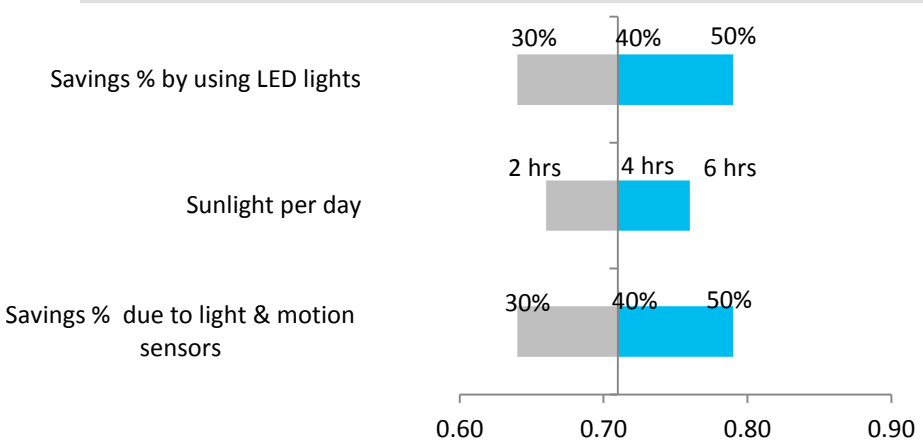


The efficacy of LED lights in saving power is an important determinant of the financial performance of smart lighting.

Levers Identified For Sensitivity Analysis of Important Financial Parameters

Lever	Figures proposed	Lower Limit	Upper Limit
Savings % by using LED lights	40%	30%	50%
No. of hours of sunlight per day	4 hours	2 hours	6 hours
Savings % due to light & motion sensors use	40%	30%	50%

Variation in Revenue for Smart Lighting (in INR Cr.) by changing identified levers:



- Pure financial Net Present Value of the initiative is expected to be Negative (-3.21 Cr.) for a period of 10 years
- Thus, expected payback period is in **excess of 10 years**
- IRR Calculations are, thus, **not applicable**, for pure financial projections.
- The over-all **Positive Socio- Environmental Impact** , makes this a desirable initiative

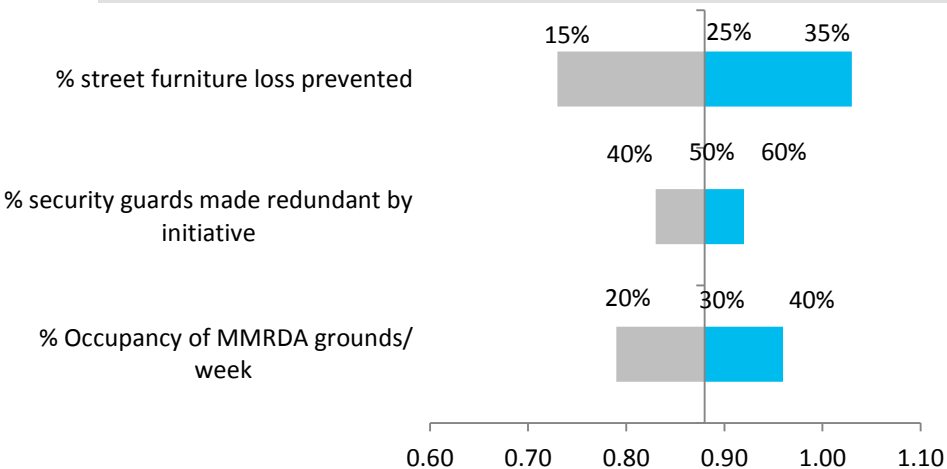


Prevention of street furniture loss can make the video analytics initiative more financially viable

Levers Identified For Sensitivity Analysis of Important Financial Parameters

Lever	Figures proposed	Lower Limit	Upper Limit
% of street furniture loss prevented by video analytics	30%	20%	40%
% of security guards made redundant by video analytics initiative	50%	40%	60%
Occupancy % of MMRDA grounds per week	25%	15%	35%

Variation in Revenue for Smart Lighting (in INR Cr.) by changing identified levers:



- Net Present Value of the Video Analytics initiative, in purely financial terms, is projected to be Negative (- 11.83 Cr.) for a period of 10 years
- Thus, the expected financial payback period is in **excess of 10 years**
- IRR Calculations are, thus, **not applicable**, for pure financial projections
- The project however promises a **Overall Economic Value Addition of 4.75 Cr (NPV)**, which makes this a socio-economically viable initiative

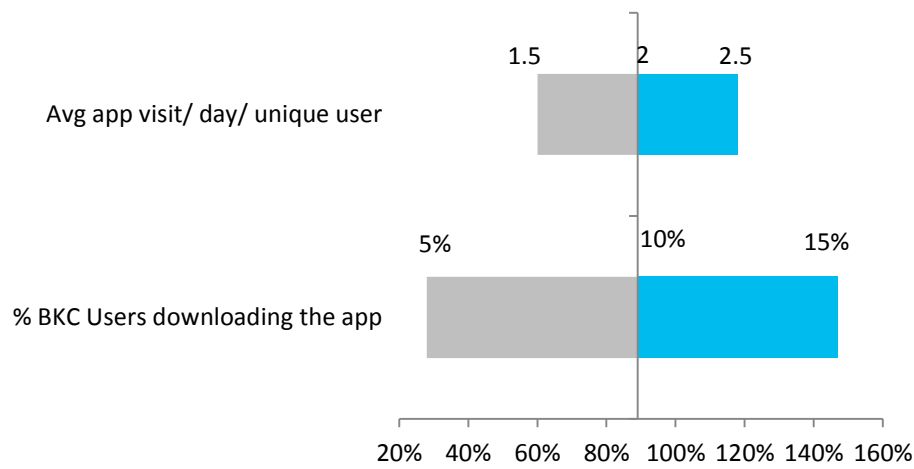


Percentage of people downloading the app has a tremendous impact on the financial viability of the initiative

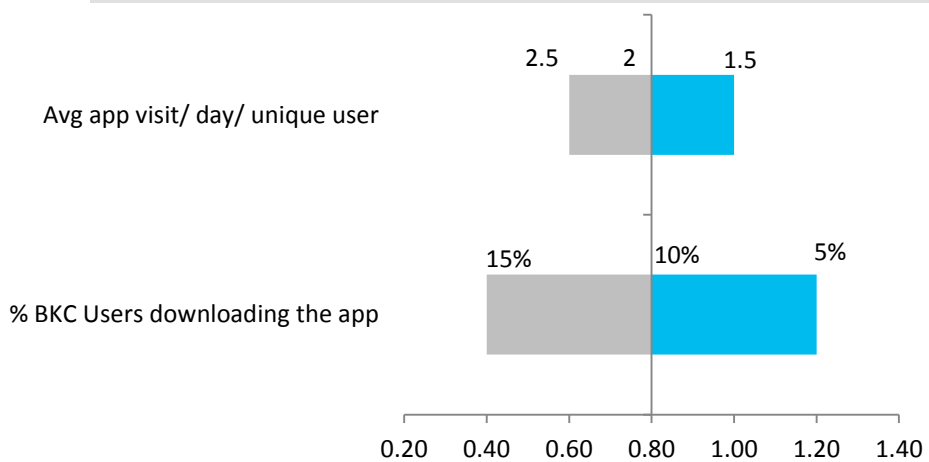
Levers Identified For Sensitivity Analysis of Important financial Parameters

Lever	Figures proposed	NPV (Cr)	IRR	Lower Limit	Upper Limit
% of people downloading the app	10%	3.94	89%	5%	15%
Average number of times app is visited per day per unique user	2	3.94	89%	1.5	2.5

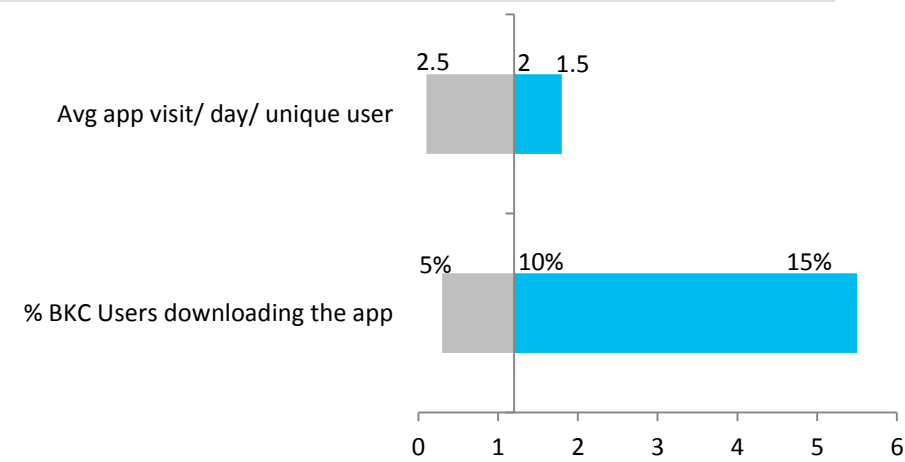
IRR Variation in Citizen's App due to changes in the identified levers:



Variation in Revenue for Citizen's App (in INR Cr.) by changing following levers

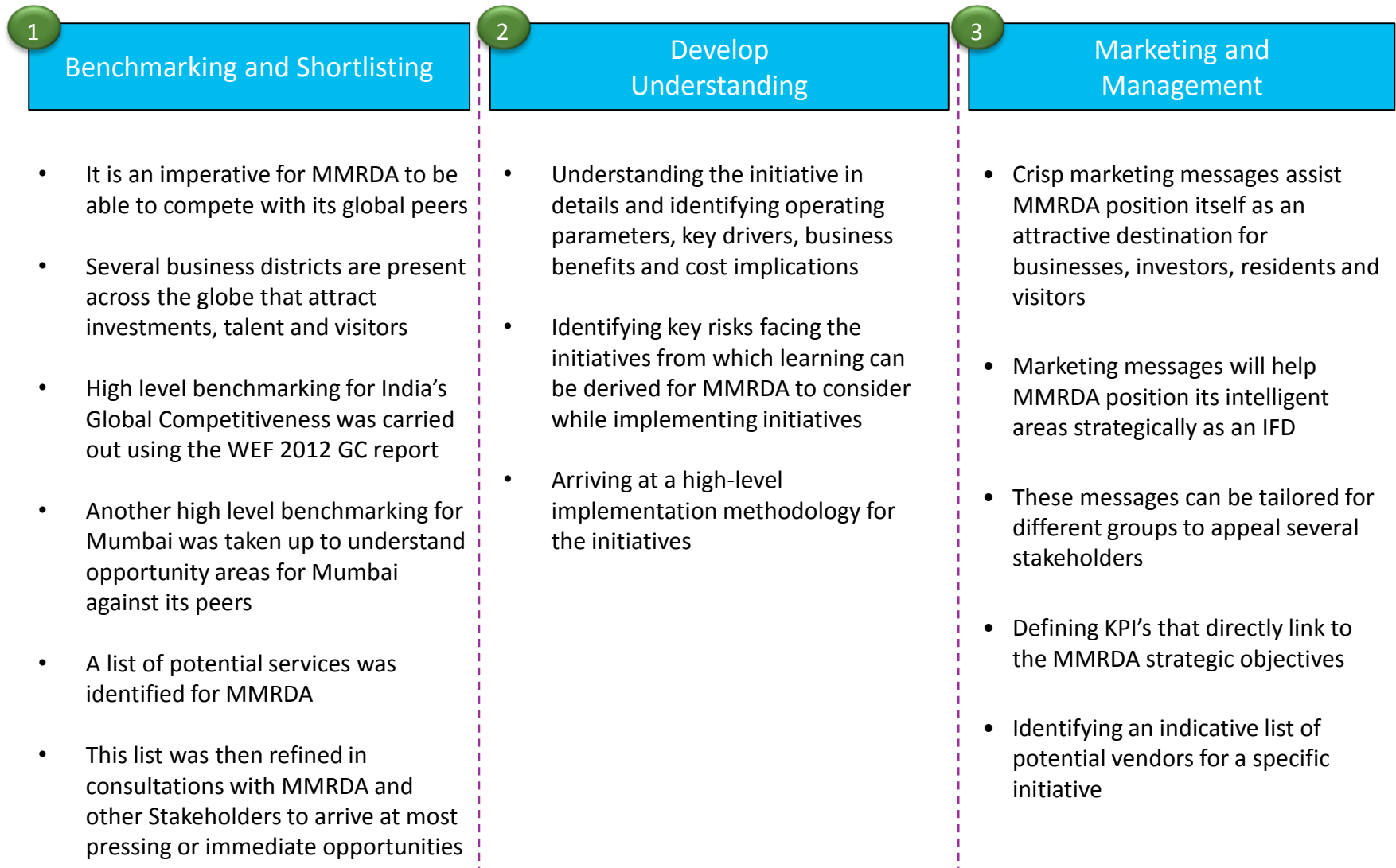


Changes in Simple Payback Period (in years) due to changes in select levers:



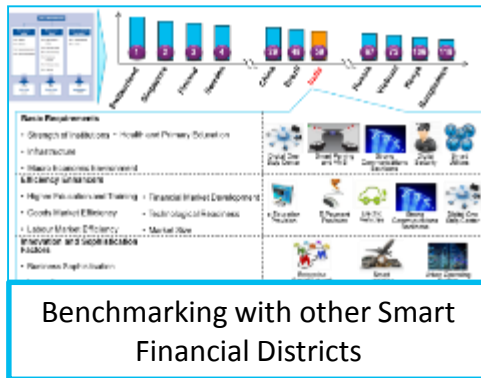
Initial study approach

Project approach enlisted benchmarking of services, developing service definitions and creating marketing messages



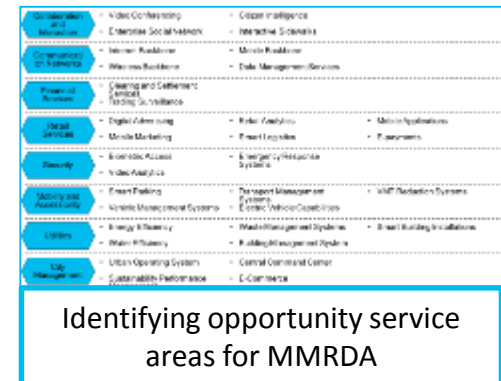
When compared to global peers, Mumbai ranks less favorably and there are several areas of improvement

A Benchmarking and Opportunity Areas



Benchmarking with other Smart Financial Districts

- Benchmarking Mumbai and India against their global competitors to gauge the size of opportunity to improve
- Identifying broad categories that help IFC's become competitive
- Generating a list of services that form a part of the identified categories



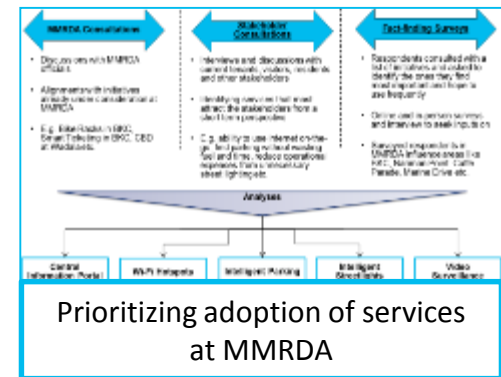
Identifying opportunity service areas for MMRDA

B Shortlist and Prioritize



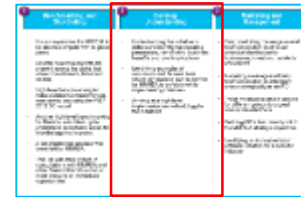
Shortlisting opportunity areas for MMRDA

- While the list of services could be longer, a short list of services that are immediately important to MMRDA is considered
- This shortlisting is done based on consultation held with MMRDA officials, BKC tenant stakeholders and fact finding surveys

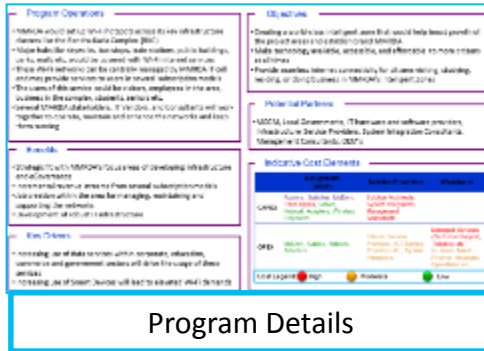


Prioritizing adoption of services at MMRDA

It is important for MMRDA to understand initiatives in detail, validate the benefits, and record key learning

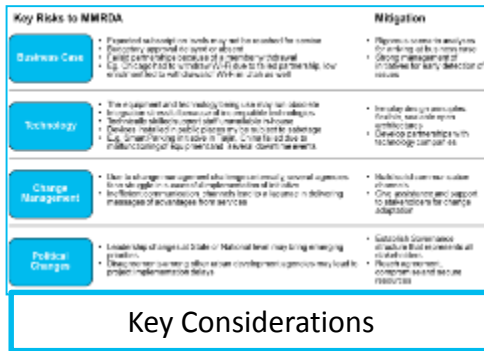


A Understand Initiative Details



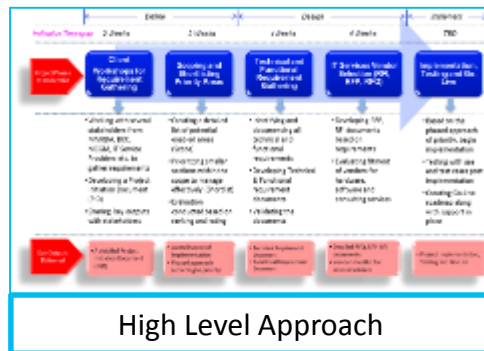
- Detailing out the program operations, key drivers, benefits, and objectives of the initiative
- Identifying potential partners and associated cost elements

B Identifying Risks



- Defining the control frameworks for MMRDA and partner agencies
- Conducting stakeholder consultations
- Assessing potential cost and revenue implications of services

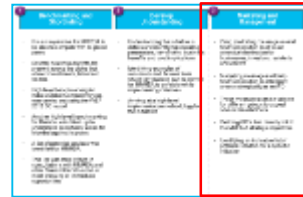
C Develop a high-level approach



- Evaluation of existing hardware, software and physical infrastructure
- Identifying infrastructure that needs to be procured
- Feasibility analyses

Detailed Project Report (DPR)

Each initiative must be marketed, measured and managed well for realizing desired outcomes



A Marketing Messages and Indicative Business Case

Tourists	A Premier Global Business Address	<ul style="list-style-type: none"> Future ready digital infrastructure Business friendly Resilient and secure
Residents	Experiencing The Digital Life	<ul style="list-style-type: none"> Connectivity, e.g. one stop centre Safe and secure Personalised services
Visitors	Experiencing The Digital Difference	<ul style="list-style-type: none"> Connectivity Safe and secure Personalised services
Partners	Differentiated Investment Opportunity	<ul style="list-style-type: none"> Commercial services Business friendly Focus on brand attraction
Staff	Processing New Residents	<ul style="list-style-type: none"> First services Increase responsiveness
Public	Transformation in The Digital Age	<ul style="list-style-type: none"> First services Develop differentiated employment opportunities

Tailored Marketing Message

- Developing overall marketing messages for MMRDA Intelligent Areas
- Marketing messages will help MMRDA position its intelligent areas strategically as an IFD
- Further an indicative business case is showcased

Estimated Business Case - Indicative

The business case of the Indicative Initiative for MMRDA can create a net present value (NPV) of INR X Crores over 5 years and an initial investment of INR 3.2 Lakh crore spread over five years.

Total Investment (INR Lakh)	-3.2
Total Benefits (INR Lakh)	3.8
Net Cash Flow	+0.6
Net Present Value (INR Lakh)	X
Payback On Investment	3.8 %
Internal Rate of Return	3.8 %
Payback Period (years)	X
Maximum Yearly Reduction in Total Spend (INR Lakh)	X

Business Case

B KPI Definition

KPIs at Organization Level

Whether the Intelligent MMRDA Initiatives are making MMRDA a preferred destination for businesses, residents and visitors. E.g. increased investments, higher residential occupancy etc.

<p>KPI's for Importance</p> <ul style="list-style-type: none"> Whether the number of users for the service are increasing? E.g. increasing subscription rates. 	<p>KPI's for Frequency</p> <ul style="list-style-type: none"> Whether the frequency of usage is increasing? E.g. Number of time parking spots are pre-booked. 	<p>KPI's for Effectiveness</p> <ul style="list-style-type: none"> Whether the services are able to drive value and deliver outcome? E.g. Increased use of data services, reduced errors of crime etc.
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KPI's at Service Level

WiFi Hotspot	General Portal	Intelligent Parking	Intelligent Streetlights	Video Surveillance and Analytics
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Setting KPIs

- Defining KPI's that directly link to the MMRDA strategic objectives
- Key Performance Indicator (KPI's) that are focused on outcome
- Generating templates for reporting progress

Service Domain	KPI	Type	Reporting Frequency	Collection Mode
General Information Portal	Retention Rate	Quantitative (0-100%)	Quarterly	Quarterly Summary and Report (Share with Stake)
	Time taken for user requests	Quantitative (0-100% per request)	Monthly	Portal access dashboard
Intelligent Parking	Occupancy	Quantitative (% of parking spots containing intelligent services)	Weekly	Manual or Automated logs for each parking
	Self parking experience	Qualitative (User's ease of parking)	Annually	Annual survey for the users

Defining KPIs

C Vendor Analyses

Service Domain	Strengths and Weaknesses
Video Analytics	<ul style="list-style-type: none"> Capable to make operators and maintenance teams and provides with built-in video analytics Product portfolio includes integrated AI/ML services for Object/Video Regular updates to provide 24x7 AI/ML capabilities for real-time analysis
Video Analytics	<ul style="list-style-type: none"> Integration between Object/Video and other video products like Object-based Analytics, etc. Regular updates to provide 24x7 AI/ML capabilities for real-time analysis Used primarily for high security areas and experienced in airports, government and public facilities
Smart Parking	<ul style="list-style-type: none"> Analytics processing occurs on edge devices, granting a more effective method of processing video analytics for the vehicles Wide types of data (video, audio, etc.) can be collected and stored locally and can be used for real-time analysis Scalability in function of image processing (on edge devices) vs. cloud
Smart Parking	<ul style="list-style-type: none"> Proven vendor with success in Washington D.C. and San Francisco Innovative first of its kind integrated parking and self management system that can be used for smart mobility services

Vendor Universe

- Vendor analyses based on Industry reports, desk-based research and Accenture's in house industry experts
- This assessment helps identify key partners and vendors which can offer applicable services to MMRDA

Wi-Fi details

DoT Guidelines on Wi-Fi Security

Summary: DoT Regulation for Public Wi-Fi

- Licensee shall create bulk Login IDs at each Wi-Fi hotspot location for controlled distribution. The authentication shall be done at centralized server only which could be a POP location of the service provider.
- Licensee or its Franchisee shall register the Subscriber for providing temporary Login ID and password for the use of public Wi-Fi spot through either of the following methods:
 - Retaining a copy of Photo identity of the Subscriber with licensee which shall be preserved by Licensee for a period of one year
 - Provisioning of Login ID and password through SMS on subscribers mobile phone through automated process and keeping mobile number of subscriber as the identity of the internet subscriber with reference to Login ID provided for a period of one year. In such cases, photo identity may not be necessary.

DOT Guidelines



DOT Guidelines

Intelligent Street lights details

Regulatory Framework and Driver for DESCOM

National Solar Mission

- **Jawaharlal Nehru National Solar Mission (JNNSM)** has objective to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible.
- The mission has set a **target of 20,000 MW** and stipulates implementation in 3 phases (1st phase from 2012-13, 2nd phase 2013-17 and 3rd phase from 2017-22) for various components including grid connected solar power. JNNSM targets **1000 MW Grid connected solar power** in phase 1 (2012-13)

MERC Order

- MERC has issued the Maharashtra Electricity Regulatory Commission Regulations, 2010 for **Renewable Purchase Obligation, Its compliance and Renewable Energy Certificate framework**.
- The said regulations stipulate separate **Renewable Purchase Obligation** (RPO) for non-solar and **solar sources** for the period from **2010-11 to 2015-16** at a **tariff fixed** by the MERC.
- All DISCOMS has to comply with MERC regulation.

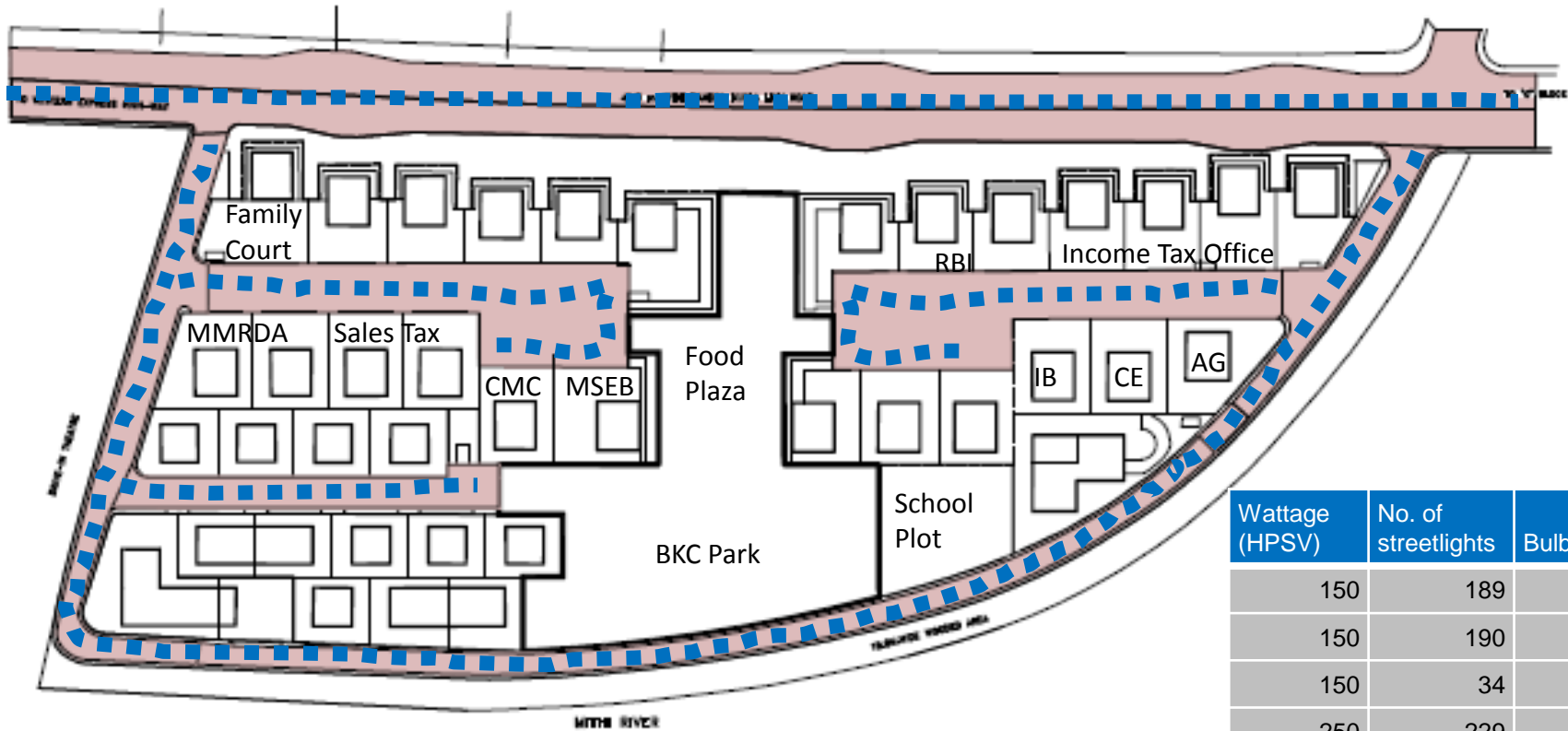
Ministry of New & Renewable Energy

- **MNRE** has issued notices to all state electricity regulatory commissions (SERC) & electricity department to mandate **Solar Power Purchase obligation** to be met with **distribution license**
- MNRE has ordered SERC to fix minimum % to be fixed for purchase of solar energy
- For 2013, Solar RPO was fixed at 0.25% and in 2022 it will go up-to 3%.

Driver for Reliance Energy

- Reliance Energy has to **comply** with **solar RPO** by MERC.
- Reliance Energy is exploring all possible options to procure renewable energy for meeting its RPO obligation.
- **Shortfall** in meeting RPO is being met by **procurement of Renewable Energy Certificates (RECs)**.

Location Analysis – E Block



Wattage (HPSV)	No. of streetlights	Bulbs	Total
150	189	1	189
150	190	2	380
150	34	3	102
250	229	1	229
250	168	2	336
250	21	3	63
250	3	4	12
70	7	2	14
	841		1325

Location Analysis – G Block



Wattage (HPSV)	No. of streetlights	Bulbs	Total
150	189	1	189
150	190	2	380
150	34	3	102
250	229	1	229
250	168	2	336
250	21	3	63
250	3	4	12
70	7	2	14
	841		1325

Aesthetics of Solar Panels for Streetlights

Conventional Designs



Modern Designs



Video Analytics details

Analysis of Mumbai CCTV initiative

- **6000+ cameras** will be installed all across Mumbai as a part of Mumbai CCTV project
- **200 cameras** will support **ANPR** and **500 cameras** will support **video analytics**
- Scope of Video analytics would include the following
 - Unidentified object detection
 - Motion / intrusion detection
 - Noise level detection (gunshot, explosion, shattering of glass etc..)
 - Camera Vandalism and tamper detection
 - Virtual Fence / Tress Passing / Tripwire
 - People / Mass movement
 - Car Traffic Events (Start/Stop/Illegal parking/wrong direction/Speed)
- **Central Command center** will be setup at **CP office**, 5 regional command center at additional CP offices and a traffic command center will be setup.
- **Viewing center** at **MCGM office, Mantralaya** and one more location (TBD)
- **Dual Display PCs** in 100 Police stations

Cameras Planned in Mumbai CCTV Project

	PTZ	Fixed
M.M.R.D.A. Building	1	3
Family Court Junction & P.A.O.		4
City Park Independent Pole		3
R.B.I .Bank Building	1	4
Library Junction	1	5
I.D.B.I. Bank	1	5
M.C.A. Gate	1	7
American Consulate	1	8
M.T.N.L. Building	1	0
M.T.N.L. Junction		4
American School		3
Nabard Junction		7
Muhmad Estate Junction		2
University Main Gate		2
University Bank Gate		2
N.S.E. Building		4
Ambedkar Chowk		4
	7	67

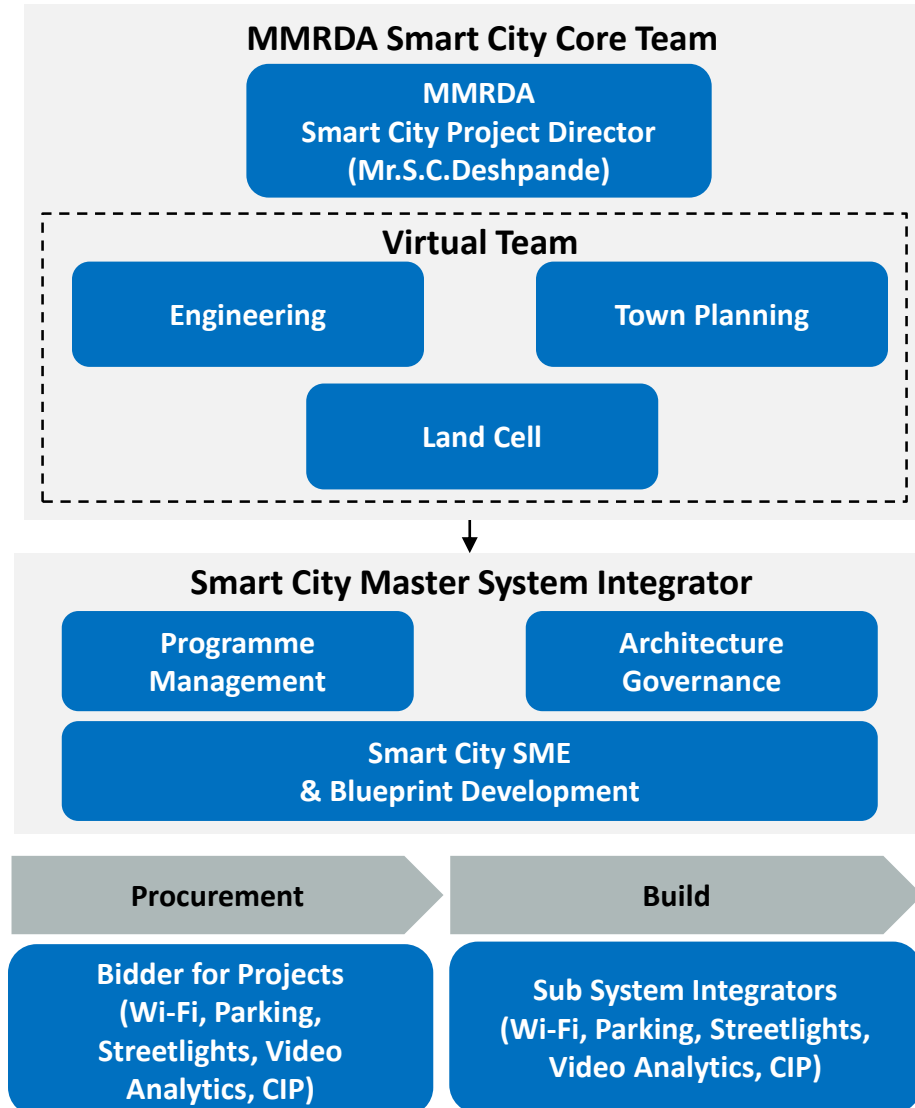
Overall – other details

Financial Analysis Sheet



Microsoft Excel
Worksheet

Project Structure for Procurement & Build Phases



Smart City Core Team:

- Approves the Project and Deliverables
- Delegates authority for day-to-day decisions to the Smart City Master System Integrator

Smart City MSI

Programme Management:

- Responsible for Program Management
- RFP creation
- Vendor Evaluation
- Coordinates the reviews, steering committee meetings

Architecture Governance:

- Lead Project plan design and review
- Ensure adherence to Architecture & Guiding Principles
- Ensure compliance to Govt. Standards & Security

Blueprint Development:

- Identify next set of initiatives and create blueprint for the same

Smart City SME

- Subject Matter Expertise to the project & Blueprint

Bidders

- Technical & Commercial Proposal

Sub System Integrators

- Sub System Design
- Test
- Development
- Rollout

Governance Structure

Roles & Responsibilities

- **Steering Committee:**
 - Members: MC, AMC, Smart City Project Director, Key Dept. Heads
 - Program Oversight
 - Delegates authority for day-to-day decisions to the Smart City Core Team
- **Smart City Core Team:**
 - Members: Smart City Project Director, Representative from T&CP, Land Cell, Engineering
 - Approves the Project Plan and Deliverables
 - Provide Regulator Approvals
- **Smart City Master System Integrator**
 - **Programme Management:**
 - Responsible for Program Management
 - RFP creation
 - Vendor Evaluation
 - Coordinates the Smart Core Team reviews, steering committee meetings
 - **Architecture Governance:**
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