

A commissioned study by Cisco in partnership with FICCI

Smartest Cities of the Future

Case Study: Vijayawada Golden Mile



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White Paper

Smartest Cities of the Future

Case Study: Vijayawada Golden Mile

A commissioned study by Cisco in partnership with Federation of Indian Chambers of Commerce and Industry (FICCI)

Arjun Vishwanathan
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Executive Summary

Indian cities, today, are facing unprecedented challenges. The pace of urbanization is increasing exponentially. A quick look at facts available in the public domain within central government websites and data repositories points to as much:

- Of India's 1.32 billion population in 2016, it is estimated that the growth rate of the population in urban areas between 2001 and 2011 alone was 31.8%.
- According to the High-Powered Expert Committee appointed by the Ministry of Urban Development, which gave its recommendations to the government in 2011, there is a requirement of investment in urban infrastructure to the tune of INR39 billion (INR39.2 lakh crore at 2009–2010 prices) over the next 20 years. (Source: Ministry of Housing and Urban Affairs, Government of India)

The increased mobility and migration of the rural population to urbanized clusters has led to severe pressures on the current and available urban infrastructure. In addition, climate change and other environmental and energy pressures make it imperative for cities to take remedial action. To promote a thriving, healthy, and sustainable culture, cities must aim to achieve economic, social, and environmental sustainability — which is possible only by improving efficiency and through integration of infrastructure and services — basically become "smart" (i.e., the digital transformation [DX] of cities).

This transformation is just the beginning. Cities of tomorrow must immediately rethink how they operate and deliver services by leveraging digital tools, data, and intelligent connected systems.

The Government of Andhra Pradesh (AP) and Cisco have created India's longest Smart Street — "The Golden Mile" in Vijayawada. The three-kilometer stretch has several smart services integrated to make the citizens' lives easier. With 35 Wi-Fi access points, providing speeds of up to 2Mbps, close to 1,500 people can access internet along the Golden Mile stretch. 240 smart lights ensure an energy-efficient lighting experience.

Clearly, the benefits of such a technology-powered and driven initiative are envisaged to be manifold, among them are the economic, social, and environmental benefits. These can be briefly explained as follows:

- (1) **Economic benefits:** Direct or indirect revenue generation or opportunity to save costs, including, but not limited to, direct revenues and taxes, indirect revenues by way of local economic development, and direct monetary benefits from cost savings, among others.

- (2) **Social benefits:** The direct or indirect positive impact on city infrastructure and citizens, including, but not limited to, enhanced city planning and development, e-government services delivered directly to citizens, improved productivity, and enhanced law and order.
- (3) **Environmental benefits:** The direct or indirect positive impact on finite natural resources available to a city/town/nation, including higher awareness and, thus, reduced pollution levels, reduction in the use of fossil fuel, and use of green energy for a cleaner environment.

Cisco India, with its suite of "smart" Internet of Things (IoT)-based technologies, has embarked on this ambitious journey of turning Vijayawada into a Smart City. Cisco's "Country Digitization Acceleration" program is its flagship project via a long-term partnership with state governments and civic agencies to drive India's digitization agenda, bolster the gross domestic product (GDP), create jobs, and ensure the health and well-being of its citizens.

Smart City Project: The Golden Mile, Vijayawada, India

The Golden Mile in Vijayawada, India, whitepaper will contain the following segments:

- The framework of sustainability
- Technology at the core of Smart City sustainability
- Cisco's Golden Mile framework
- Monitoring of the Golden Mile project in Vijayawada
- IDC monitoring of Cisco's Golden Mile project in Vijayawada
- Analysis of data from Golden Mile Smart City initiatives
- The concept of value capture funding
- Golden Mile Project: IDC Citizen Survey
- Why invest in Smart Cities now?
- Conclusion: creating the Smartest Cities of India

The Framework of Sustainability

The objective of any Smart City mission is to promote sustainable and inclusive cities that provide core infrastructure and give a quality of life to its citizens, a clean and sustainable environment, and an application of "smart" solutions. The focus is on sustainable and inclusive (social, economic, and digital) development, and the idea is to look at compact areas and create a replicable model that will act like a lighthouse to other aspiring cities.

A Smart City initiative is expected to result in benefits that will form the basis for replication within other cities and, subsequently, the nation. These can be broadly classified into three categories:

Economic Benefits

Economic benefits are defined as those that will generate direct or indirect revenue or provide the opportunity to save costs; either of which shall lead to a credible and substantial accrual of monies to local and state government bodies. These could take form (not limited to) as follows:

- The accrual of direct revenues to civic bodies or state government by way of tax collection, fine collection, advertising revenues, and so forth.
- The accrual of indirect revenue by way of local economic development — increase in small and medium-sized enterprises (SMEs), foreign direct investment (FDI), and so forth.
- The accrual of direct monetary benefits by way of cost savings (near term, midterm, or long term), such as reduced expenditures by way of smarter multimodal transportation, fuel cost, and so forth.

- Any other such monetary (direct or indirect) benefit that will be manifested because of Smart City initiatives.

Social Benefits

Social benefits are defined as those that will arise out of Smart City initiatives and could result in a variety of benefits that directly or indirectly affect city infrastructure and citizens, including, but not limited to:

- eGovernment services delivered to citizens, faster and at a lower operating expense
- Improved productivity and service
- Waste management inclusive of recycling and reduction of waste and/or enhanced waste treatment
- Traffic control and its associated benefits that span across all types of benefit domains

Environmental Benefits

Environmental benefits are defined as those that have a direct or an indirect positive impact on the finite natural resources available to a city/town/nation. These could be (but not limited to):

- Reduced pollution levels arising out of smarter control of traffic (peak and off-peak hours), waste management, and so forth.
- Reduced consumption of fossil fuel used to generate energy (e.g., electricity) and increased use of green fuel.
- Any other observed or estimated reduction in environmental burdens using Smart City-centric technologies.

Advanced motion sensors and software application controlled by the Kinetic platform (Cisco's city digital platform) help adjust luminosity and ensure efficiency. Additionally, 10 parking sensors deployed to ease traffic congestion help manage parking by providing visibility into real-time availability of parking spots. The stretch is equipped with four motion sensors to help detect traffic violations and traffic movement as well as number plate recognition.

The Golden Mile is also equipped with an environmental sensor to monitor the air quality of the area, and Cisco has deployed 98 cameras along the stretch, with IP camera application management features to ensure safety and security. This is represented via this on-ground photograph.

Figure 1

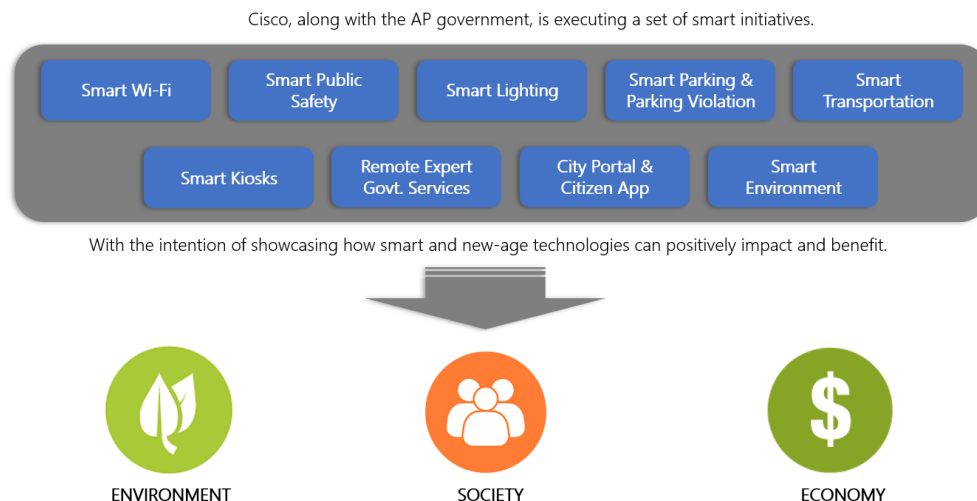


Technology at the Core of Smart City Sustainability

It is observed that Smart City initiatives increasingly rely on cross-department connections and scale to realize their full potential. The idea is not to tackle each challenge in an independent manner but to take advantage of the multiplier effect that city-wide holistic solutions bring to a city.

The Vijayawada Golden Mile project is an example of this, as illustrated below.

Figure 2



In orchestrating this, Cisco India has deployed a wide set of technologies to sustainably translate the inflection of technology into core benefits for the city. This is illustrated in Figure 3.

Figure 3

SmartWi-Fi  <ul style="list-style-type: none"> • Foundational layer • 33 access points to give connectivity and to enable other services. • Includes data center supporting all other solutions. 	Smart public safety  <ul style="list-style-type: none"> • Over 100 video surveillance IP cameras to provide: <ul style="list-style-type: none"> ▪ Location monitoring ▪ Incident detection & management ▪ Analytics & reporting
Smart lighting  <ul style="list-style-type: none"> • Over 400 nodes of WiFi-enabled lighting controls and video sensors to support automated lighting, sensing and motion detection. 	Smart parking  <ul style="list-style-type: none"> • Deployment of sensors and cameras to detect no-parking and loading zone violation events
Smart transportation  <ul style="list-style-type: none"> • Implemented on 2 buses and 8 bus stops. • Monitoring, tracking and scheduling of services, combining voice, data and video. 	Smart kiosks  <ul style="list-style-type: none"> • Two kiosks to give citizens a digital channel to engage with the city. • Potential source of revenue through advertising.
Remote Expert  <ul style="list-style-type: none"> • Deployment of a REGS PODs to enable a portfolio of government services through a high-quality, high-definition video and voice experience. • Access to public services anytime, anywhere. 	City portal & citizen's app  <ul style="list-style-type: none"> • Vijayawada City Portal will be a one place for all Citizen, Business and Visitors for all City Services and information. • Citizen App will deliver Smart services on Mobile APP.

It is pertinent to take a closer look at the technologies that have been implemented to enable citizen convenience.

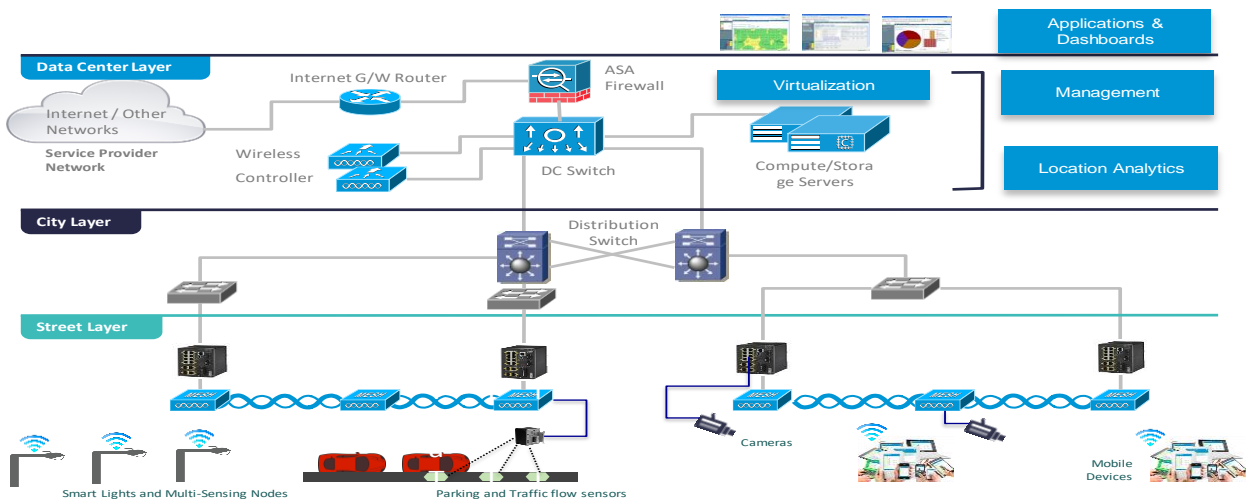
Figure 4



As is evident from the slew of services enabled by Cisco for the Golden Mile project, the availability of smart solutions and the inflection of technology have resulted in the ability of the area (and, tomorrow, the city as a whole) to become smarter. The primary objective is to implement appropriate solutions efficiently, rather than only focusing on new technology development.

To achieve this precisely, Cisco has leveraged its capabilities in the infrastructure and network domains to create a central datacenter (network operations center [NOC]) to support Smart City technology initiatives. This is illustrated below.

Figure 5



What emerges from the above is Cisco's and the AP government's desire and vision to drive sustainable benefits and convenience for Vijayawada's citizens. The NOC promises exciting possibilities — convenience and technology-wise — for a variety of players and stakeholders within the overall ecosystem.

- For **citizens**, it promises a better service experience through real-time access to context-aware infrastructure services, such as traffic, parking, lighting, environment, and so forth.
- For **civic agencies** and **urban service operators**, it offers innumerable opportunities for revenue and/or cost and productivity optimization through real-time intelligence and responses across silo agencies and systems.

So, how does the technology serve to benefit the city of Vijayawada?

Enhanced Data Collection for Operations and Planning

Smart City initiatives enable the collection of data on urban mobility to include vehicle data, traffic volumes by vehicle types, and tracking of a specific vehicle across the city. Other information includes data on pedestrians, bicycles, and transit. Data alone, and in combination with other data sets, allows for robust city, transportation, and transit planning. Origin and destination pairs or patterns can be identified by frequency and time of day, allowing for mass transit routings to be refined and a better understanding of movements within the city; traveler behavior can be identified, including routes taken or not taken, which could provide insight into policies or contemplated policies, such as congestion pricing or tolling of certain streets or routes.

Traffic and Intersection Data Monetization

Data is becoming increasingly valuable, even if the exact value is not yet known today. A network of Smart City technologies with sensors, cameras, data from vehicles, Bluetooth-enabled mobile phones, and other inputs provides for a very rich volume of data, which, in turn, could be monetized. Advertisers, retailers, shipping and logistics companies, insurance companies, and software developers, among others, may pay handsomely for such data in the coming years.

Better Resource Utilization

Smart City technologies allow for better use of city resources. Smart City technologies reduce the need for the police to direct traffic, lessening the risk of harm to officers and freeing them for more tasks better aligned with their skills. In addition, Smart City technologies could move traffic more optimally as the system can "see" the full traffic network and make decisions accordingly. Automatic number plate recognition at city technologies could readily identify the location and heading of a vehicle if a city was looking for it, or if used against an existing database of vehicles being sought. Maintenance of traffic controllers and other traffic infrastructure can be undertaken remotely, allowing for more efficient work of traffic operations personnel and decreased time a signal is out of street service. As buses move through traffic faster, transit agencies may be able to operate additional runs of a bus route as operators will be able to complete their routes faster.

Potential Revenue Generation

A key bulwark to the planning and implementation of Smart City initiatives, and also traditional perceptions of risks around costs (sensors and implementation) and changes to processes, is for stakeholders to be

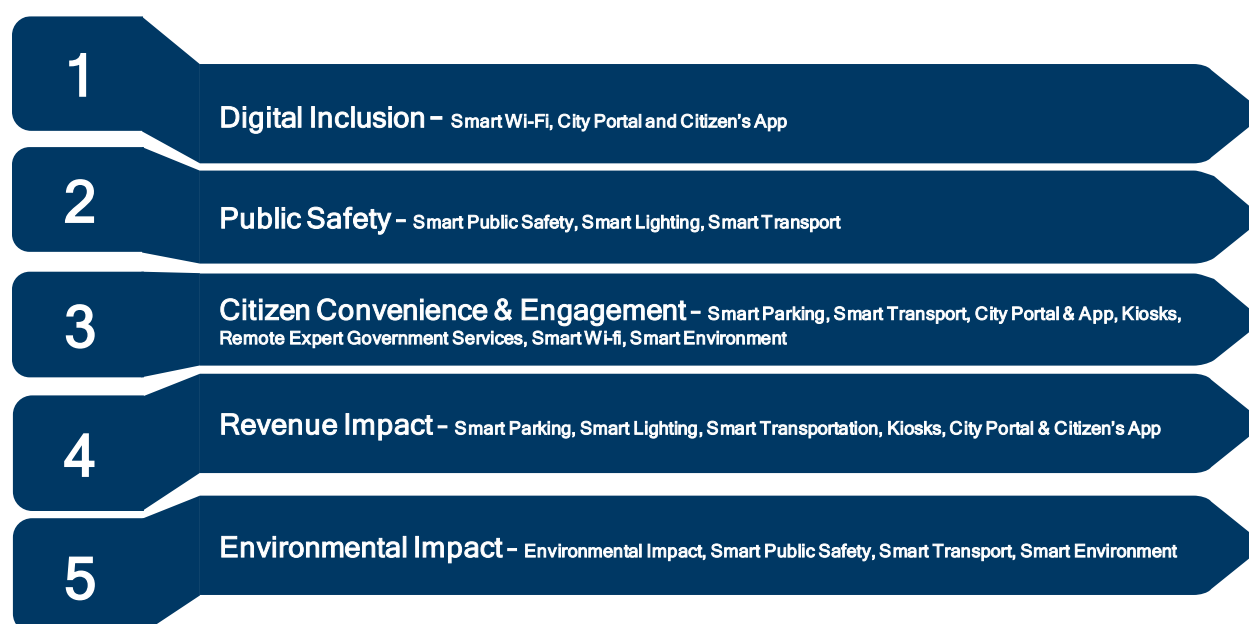
able to justify the expenses by having a measurable and sustainable ROI and a credible vision that promises the ability to generate revenues from these initiatives, rather than just decreasing operating expenses. There are multiple ways to generate revenues from smart initiatives, including, but not limited to, tax collections, parking fines, state and private advertisements, convenience fees, and so forth.

Cisco's Golden Mile Framework

Cisco's Golden Mile framework is the culmination of a seamless inflection of strategic socioeconomic and citizen and city well-being strategy. Leveraging ICT and advances in IoT, Cisco has orchestrated a Smart City in Vijayawada, which has been envisioned to be at the vanguard of intelligent and environmentally sustainable living, which will be linked to make the city a better place to live in.

Within this limited space — long-term impact on the Bandar Road, the Golden Mile project aims to address many potential challenges being faced by any city. These are illustrated below.

Figure 6



Let us look at each of these individually for an estimation of their impacts on the lives of citizens, their convenience to civic agencies and town planners, and for the state government.

For any city to cater to and meet the growing demands of an urban population and the consumption of natural and man-made resources, it must leverage technology and the resultant smart solutions to drive a holistic benefit for the entire ecosystem. The business value is spread across the current Smart City value chain, leaving the most opportunity for consolidation. The need for Smart Cities and smart initiatives is therefore:

1. **Digital inclusion:** Digital inclusion is one of the foundational programs of the current state and the central government. With the rise in the number of affordable smartphones, and India alone pegged at about 370 million smartphone users, this enables a huge potential to drive digital inclusion. In equal measure is the spread of smartphones and mobile phones with internet capabilities in the rural segment. Accordingly, the Golden Mile project in Vijayawada enables digital inclusion via:

- a. **Smart Wi-Fi:** As explained in this document earlier, Cisco's Smart Wi-Fi enables 33 access points to give connectivity and enable other services. Conveniently spread across key access points in the Golden Mile stretch, Smart Wi-Fi allows citizens to easily log on to the Wi-Fi port and access internet free of charge. The estimation is that enabling free internet connectivity will drive greater awareness of civic services which are digital-enabled today.
 - b. **City portal and citizen's app:** The Vijayawada civic agencies have also since digitized many of their services via online and app integration. The portal and app give citizens and visitors digital access to city services and information and enable citizens to transact for delivery and fulfillment of civic services. The availability of services such as basic city information, tourist spots, and designated parking areas — notwithstanding the ability for citizens to make civic agency payments, such as property tax and water tax — is a huge step forward in digitizing services and enabling convenience and digital inclusion to citizens and businesses alike.
2. **Public safety:** For any city, the convenience and safety of its citizens is of paramount importance. This is inclusive of various community partnership programs as well as core infrastructural initiatives that are established to ensure the well-being of citizens, particularly women and children. To this extent, Cisco's Golden Mile project has established a slew of technology initiatives to drive enhanced public and citizen safety, such as:
 - a. **Smart lighting:** Cisco has deployed over 400 nodes of Wi-Fi-enabled lighting controls and video sensors to support automated lighting, sensing, and motion detection. Deployed over a particularly important stretch on the M.G. Road, these smart lights are "motion detect-enabled" and allow for remote and dynamic controlling of lighting. These smart lights not only ensure public safety by illuminating particular stretches of the road when motion is detected but also lead to significant power savings vis-à-vis normal LED lights.
 - b. **Smart transport:** Cisco has also implemented, on two buses and eight bus stops, monitoring, tracking, and scheduling of services, combining voice, data, and video. These video camera-enabled buses help relevant authorities track the movements of buses and timeliness in arrival and departure and, more importantly, ensure the safety of passengers by monitoring the inside of the bus for any disturbances, anti-social elements, and potential accidents.
3. **Citizen convenience and engagement:** Critical to a city's endeavor to provide relief and convenience is its ability to digitize services and enable a level of ease of services that does not inconvenience citizens of various ages. To this effect, Cisco, along with the state government and civic agencies, has launched a myriad of digital initiatives aimed at enabling enhanced citizen convenience and engagement.
 - a. **City portal and citizen's app:** The city portal and citizen's app enable digital inclusion and transformation for citizens, businesses, and visitors for city services and information. The app aims to deliver smart services on smartphones. The app and portal allow consumers to undertake multiple transactions, including:
 - i. Parking space identification via Cisco's smart parking initiative
 - ii. Seek and procure information on various tourist spots in and around the city
 - iii. Make payments across a wide variety of civic services, including property tax, water tax, sewage tax, water meter tax, sports fee, and so forth
 - iv. In addition, citizens can also monitor critical environmental metrics, such as the temperature, humidity, SO₂ (µg/m³), PM_{2.5} (µg/m³), PM₁₀ (µg/m³), and O₃ (µg/m³).

- b. **Smart parking:** Cisco has deployed a set of eight sensors at a designated area to enable citizens to easily identify available parking spots via the app and accordingly park their vehicles. This is expected to lead to a more systematic flow of traffic and result in lesser congestion on the roads.
 - c. **Smart kiosks:** Other smart initiatives that Cisco has deployed in the Golden Mile project are two kiosks to give citizens a digital channel to engage with others and with the potential of a source of revenue through advertising. Conveniently placed at strategic locations, these kiosks are engagement-friendly and help citizens and tourists with relevant information on the city services and popular tourist spots, among others.
 - d. **Remote Expert for Government Services (REGS):** Cisco has deployed one REGS POD to enable a portfolio of government services through a high-quality, high-definition video and voice experience with access to public services anytime, anywhere. Citizens can walk in to the REGS POD and interact with relevant government officials to address their queries, make clarifications, and transact on a variety of civic services, including payment of taxes, fines, and even lodge police First Information Report.
 - e. **Smart Wi-Fi:** Free provision of Wi-Fi along the M.G. Road with 33 access points to enable citizens to log in and browse the internet as well as AP government services, portal, and app.
4. **Revenue impact:** One of the core elements of any Smart City project is its ability to generate viable and sustainable revenue from such initiatives. The propensity to produce revenues lies in a smart initiative's ability to leverage technological deployments and drive citizen engagement to generate monies, whether these are in the form of advertisements (private, public, and governmental) or in the form of direct intake of monies from citizens for enhanced services provided.

Figure 7

Smart WiFi	Citizen's Portal and App	Smart Lighting	Smart Parking	Smart Transportation
Potential WiFi package revenue	Potential advertising revenue	Cost Savings from power	Advance booking of parking slots	Sale of smart transportation tickets
Potential advertising revenue	Civic Payments and fines	Cost savings from carbon emissions	Savings from traffic congestion and land use	Digital advertisements within buses and at bus stands
Civic Payments and fines	Mobile based payments for civic resources	Savings from public safety and law and order issues		Fuel savings
Mobile based payments for civic resources	Potential Smart Transport Card recharges			

Let us take a closer look at how these can be achieved:

- a. **Smart parking:** As discussed earlier in this document, smart parking can be monetized by leveraging the available parking and enabling citizens to block/book a specific parking spot for a fixed charge. Currently, the Golden Mile radius has eight parking spots and is not monetized, given that convenience and decongestion of traffic flow are the core propositions. However, from the perspective of the entire city, and as and when Vijayawada is a truly comprehensive Smart City, the possibilities for convenience and monetization are immense, considering that Vijayawada already boasts a population density of 16,939 people/square kilometer. (Source: Vijayawada City Census 2011 Data)
 - b. **Smart lighting:** Smart lighting is another potent monetizable initiative, as this technology enables civic agencies and the State Government of AP to save on significant costs of lighting up roads. As will be explained further in this document, the potential exists to save up to 70% from the cost of powering street lights alone. This is notwithstanding the savings on labor costs, efficiencies, and productivity that will add to these potential savings.
 - c. **Smart transportation:** Another initiative that could lead to the state government being able to generate revenues is the smart bus/transport. Civic agencies, private and public players, and enterprises in the Americas and Asia/Pacific have been known to monetize the display panel (television) in a bus to capture the attention of the passengers. With advertisement and public welfare announcements, messaging, and program proliferation, civic agencies would be well placed to charge a premium for such interventions and engagements.
 - d. **Smart kiosks:** A significant potential exists to leverage smart kiosks (with display) for private and public enterprise advertisements and also for public welfare messages. Another opportunity is for the kiosks to be leveraged to encourage citizens toward digital inclusion and make payments and civic remittances digitally, thus promising timely and incremental payments.
 - e. **City portal and citizen's app:** Both the city portal and citizen's app offer a robust and sustainable mechanism to drive incremental revenues. Digitization offers citizens the convenience of being able to remit necessary taxes and other civic fees from the comfort of their homes/offices without necessarily having to step out physically. Such interventions will inevitably lead today's digitally transformed population to leverage this convenience to remit fees, thus upping the potential to drive larger inclusion of payers and, accordingly, remittances.
5. **Environmental impact:** Air pollution has been a matter of environmental and health concerns, particularly in urban areas. The Central Pollution Control Board, along with the State Pollution Control Boards, has been operating the National Air Quality Monitoring Program (NAMP), which covers 240 cities in the country. In addition, continuous monitoring systems that provide data on near real-time basis are also installed in a few cities. Accordingly, Cisco has deployed an environmental sensor across the Golden Mile radius to track, in accordance with national metrics, indices and parameters, necessary air quality, and temperature metrics for the convenience, safety, health, and well-being of the citizens of Vijayawada. Separately, Cisco's smart lighting and transport initiatives have the potential to lead to significantly better environmental indices for the city.
 - a. **Smart lighting:** Power generation in India is primarily through the use of coal as the catalyst agent, while significant steps are being undertaken to promote the use of alternative sources of cleaner and greener energy. With the ability of Cisco's smart lights to consume up to 70% lesser power, this leads to a situation where the use of coal and resultant

emissions can be significantly controlled, leading to better air quality and resource utilization.

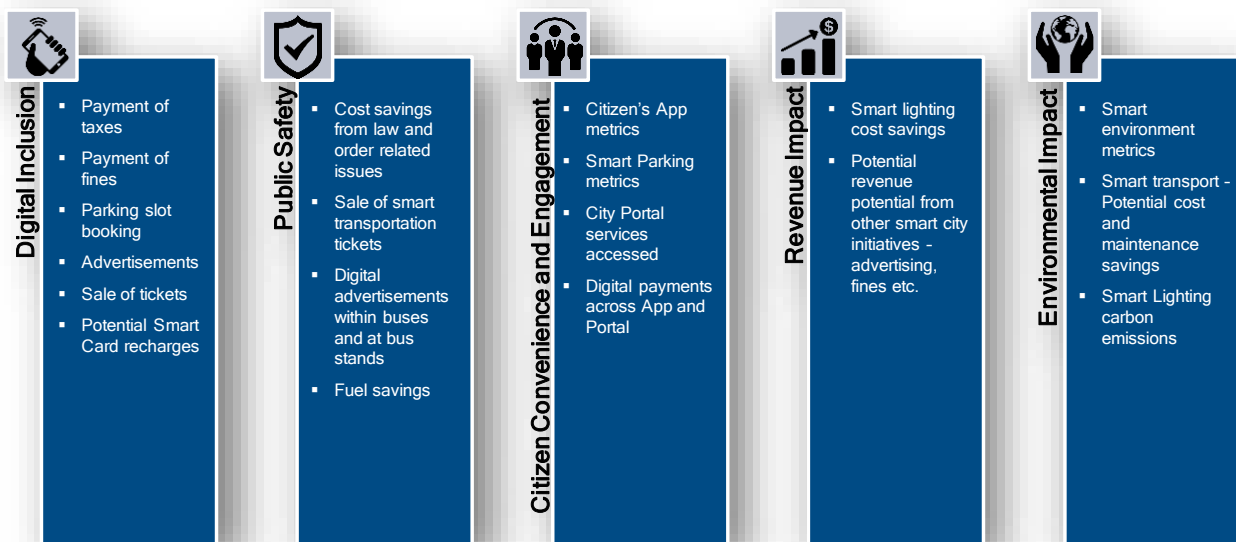
- b. **Smart transport:** While currently at a nascent stage, the use of sensors and other such technology within the smart bus can lead to lesser traffic congestion and better utilization of fuel, thus leading to an enhanced air quality index.
- c. **Smart environment:** As highlighted earlier in this document, one environment sensor is strategically deployed to constantly monitor the air quality index and other relevant parameters around the Golden Mile radius and relay such information back to the network operations center, which, in turn, integrates the information within the city portal and citizen's app. The metrics monitored are the temperature, humidity, SO₂ (µg/m³), PM2.5 (µg/m³), PM10 (µg/m³), and O₃ (µg/m³).

IDC Monitoring of Cisco's Golden Mile Project in Vijayawada

International Data Corporation (IDC), in partnership with the state government of Andhra Pradesh, undertook a rigorous effort to monitor the efficacy and efficiency of the smart initiatives deployed by Cisco in Vijayawada. In this endeavor, IDC adopted a two-pronged approach:

- **IDC — Cisco Smart City Scorecard:** A statistically developed scorecard to monitor data and information directly received from the NOC situated in Vijayawada. This voluminous data was monitored over a period of 160 days, and the parameters under which they were analyzed are illustrated below.

Figure 8



This rigorous monitoring exercise is symbolic of how the Golden Mile project, as and when a city-wide scale-up of smart initiative is established, can lead to significant societal, economic, and environmental benefits to Vijayawada in the establishment of the city as a viable and sustainable Smart City. It also addresses, via statistical extrapolation, the economic and societal impacts that smart initiatives can bring to a city as large

as Vijayawada and shall serve as a blueprint of success for future Smart Cities planned in the state of Andhra Pradesh and beyond, in sync with the National Smart City Mission of the Union Government of India.

- **On-ground citizen's survey:** IDC established a strong ground presence to seek and solicit information about the levels of awareness of citizens at the Golden Mile stretch and to promote immediate awareness and benefits arising from the smart initiatives. A total of 3,314 respondents on the ground participated in the survey over a period of 160 days.

Analysis of Data from Golden Mile Smart City Initiatives

As discussed earlier in this whitepaper, "digital inclusion," "citizen convenience and engagement," "public safety," "revenue impact," and "environmental impact" are all important metrics to determine the impacts of smart initiatives to drive societal change in line with technological change.

Segment 1: Digital Inclusion

IDC accordingly monitored digital inclusion via a combination of how citizens are engaging in the digital world, predominantly with their smartphones.

As a starting point, it is important to note that IDC's City-Level Smartphone Tracker estimates that the total smartphone sell-through in 2017 stood at 456,588, highlighting the burgeoning smartphone market and, therefore, the digitally connected citizen of tomorrow. A quick look at IDC-monitored data is illustrated below.

Figure 9: Key Metrics Measured

Digital Inclusion	iOS App Downloads
	Android App Downloads
	iOS - #of Page Visits
	Android - #of Page Visits
	iOS - App Usage by Service Type Accessed
	Android - App Usage by Service Type Accessed
Citizen Convenience	Digital Payments via App, Portal and Kiosk
	PT = Property Tax
	WT = Water Tax
	SW = Sewage Tax
	WM = Water Meter Tax
	SP = Sports Fee

- (1) **App downloads:** On monitoring, it is observed that in a short period of time, the mobile app was downloaded a total of 401 times. It is interesting to note that while altogether this may seem a small figure compared with the total number of potential smartphone users (Android and iOS) in Vijayawada, this is reflective of the number of aware users within the Golden Mile stretch alone. Of these downloads, leading to potential future increase in digital inclusion, 28% were by iOS users, and the balance of 72% were from Android users.

It is estimated that about 57,000 vehicles cross Benz Circle at the Golden Mile stretch daily (Source: Rajulapudi Srinivas. "57,000 vehicles cross Benz Circle daily". The Hindu). Separately, it is estimated that at any given point of time during normal day and evening times (9AM–9PM), the number of people who would potentially spend at least 10–15 minutes around the area — a sufficient time to be aware and

accordingly download the app and others — is expected to reach about 100,000 approximately over a period of 4–6 months.

Within this view, the number of app downloads seems moderate, given that the smart initiatives are at a nascent stage of their life cycles. **When, however, extrapolated to the entire city of Vijayawada and given the adequate time and awareness building, it is expected that the vision of "digital inclusion" shall certainly be met, and a vibrant Vijayawada should be able to claim a substantial number of citizens, with smartphones as being digitally included and enabled.**

- (2) **Parking page visits:** Today, core to commuters in any large commercial area is their ability to find convenient and adequate parking for their vehicles. Indeed, in a burgeoning city such as Vijayawada with over 1.5 million inhabitants, the current number of vehicles (two-wheelers and four-wheelers and not including public transportation) and their future growth are expected to be substantial.

The automobile industry in India alone produced a total of 25,316,044 vehicles, including passenger vehicles, commercial vehicles, three-wheelers, two-wheelers, and quadricycle, in March–April 2017, registering a 5.41% increase over the same period in the previous year. If these were to be taken as a surrogate placeholder indicating the number of vehicles in India, its representation within Vijayawada can be surmised.

It is therefore interesting to observe that within the Golden Mile stretch, IDC witnessed a total of 597 parking page visits during the monitoring period of 167 days. Given that there are only eight smart parking spaces currently deployed, the page visits showing interest by itself is symbolic of the fact that citizens are increasingly looking at technology to alleviate parking woes when stepping out.

- (3) **Digital payments:** Critical to the digitization of any society is the ability of civic agencies to digitize their services, thereby inducing and enabling a high level of convenience and engagement to its citizens. The city administration of Vijayawada has since digitized many of its services, and these are available via Cisco's city portal and citizen's app.

IDC's monitoring of the digital payments resulted in the observation that given the right incentive (digitization), citizens today are more than willing to embrace technology and perform their duties as responsible citizens. This is illustrated below for the 160-day monitoring period.

Figure 10

Digital payments (via portal, app, and kiosk)	Transaction Types	Nos.	%
	PT - Property Tax	3,763	48
	WT - Water Tax	1,717	22
	SW - Sewage Tax	1,368	17
	WM - Water Meter Tax	638	8
	SP - Sports Fee	375	5
	Total	7,861	

Driven by the flexibility and convenience provided by Cisco's technology deployments, the citizens of Vijayawada made a total of 7,861 transactions of varying nature and types — services and transactions that

would have hitherto required them to physically visit the designated civic offices and spend time and effort. What we see on the other hand today is that citizens have willingly embraced the technology option provided and driven by digital inclusion, responsibly carrying out the transactions required. Of the digital transactions made, 48% is for property tax alone, followed by water tax at 22% — proof of the fact that digital inclusion is indeed the way forward.

On a simple mathematical extrapolation of these current figures, given time and awareness building, the approximate 1.5 million population of Vijayawada will soon move the digital way, thus saving the state innumerable amounts of resources and monies in the form of physical offices and collection centers.

Segment 2: Public Safety

Public safety is a critical element of any sustainable relationship between the state and its citizens. In any society today, the safety, security, and well-being of citizens are matters much discussed and invested in from the perspectives of resources, time, money, and technology.

In a state with a GDP of US\$10 billion in 2010 and expected to touch US\$17 billion by 2025, public safety has to be one of the most important pillars of progressing toward a stable and safe society and industrial workforce. Accordingly, IDC and Cisco monitored "environmental metrics" and "public lighting" as two very important metrics that define the citizen perception and need for the feeling of a safe society.

(1) Smart lighting: In most cities, street lights are installed and maintained by civic agencies with an overdependence on human resources for the management and maintenance of street lights. Most urban and semi-urban cities and towns are still using a combination of fluorescent, CFL, high-pressure sodium lamps, or metal halide bulbs, which are not designed to meet area-wise lighting needs. It is adequately understood today that the illuminance required in different areas of streets and roads varies significantly depending on vehicular versus pedestrian traffic. Additionally, the street lighting of important public crossing areas will also vary depending on the time of day and the flow of vehicular and pedestrian traffic.

Smart street lighting is being recognized by many city leaders as a first step toward the development of a Smart City. In addition to increasing the energy efficiency of the city and reducing energy costs, carbon emissions, and maintenance costs, smart lighting can also provide a backbone for a range of other city applications, including public safety and traffic management.

It requires a simple glance across every town and city in India today to observe that late evenings and night hours are the ones that are most prone to anti-social and criminal activity, especially endangering the lives of common citizens and women, in particular. In view of this fact, public safety is agreeably the primary concern for the government and with the help of smart lighting, networked lights across the city could quickly become a keystone to help civic and law enforcement agencies in enabling a significantly higher level of safety and wellbeing. In the near future, by deploying smart street lighting systems, public safety can be enhanced with a smarter and more widespread surveillance.

Cisco, in view of the above and in partnership with the Vijayawada Municipal Corporation, floated and implemented the concept of smart lighting. Starting with the Golden Mile stretch, Cisco installed 100 "Smart LED Lights," which, apart from them being low maintenance, also enable remote switch-on and switch-off and maintenance. Added to this is the fact that these Smart LED bulbs have sensors for motion detection, thus being able to detect the necessary levels of illumination depending on the flow of pedestrian traffic.

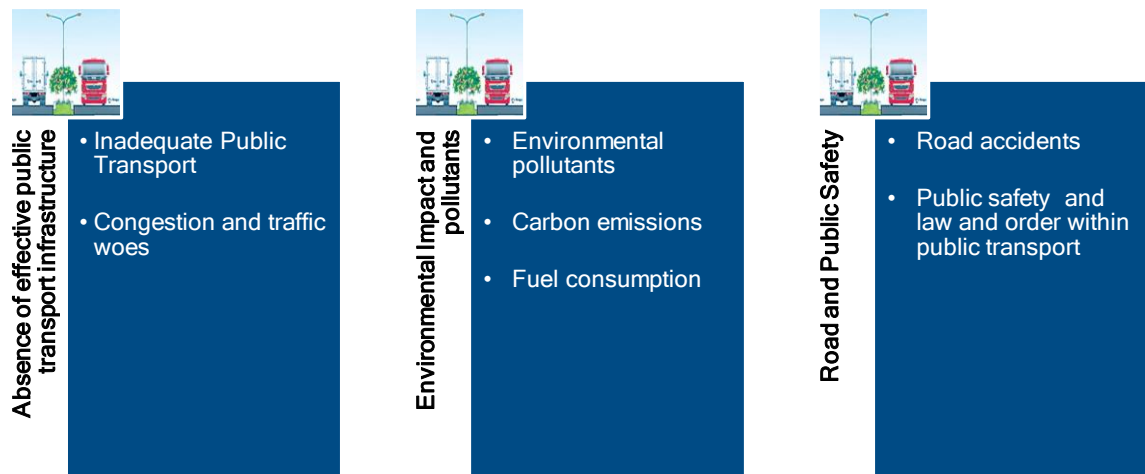
All in all, smart lighting will go a long way in driving viable and sustainable governmental, public, and citizen benefits such as to effect change within cities and the lives of citizens. With street lights creating

a network canopy, those networks of data can be used by more than just lighting departments, empowering even schools and businesses via a lighting infrastructure that brightens the future of the digital city.

(2) Smart Transport

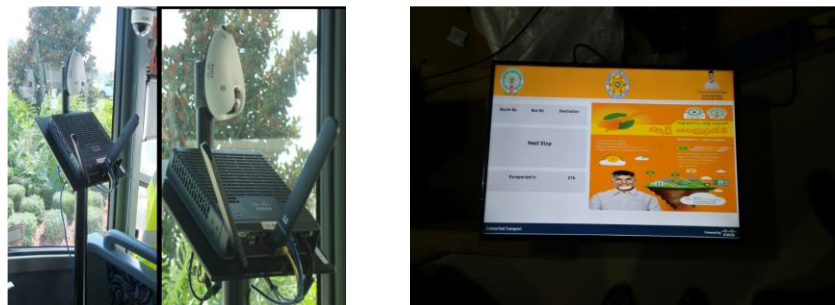
The challenges of urbanization have led to huge pressures on the infrastructure and public transportation of cities. Broadly put, these can be categorized as below.

Figure 11



Cisco has deployed one television, camera, and sensor each within two buses in the Golden Mile radius with the view to alleviate such challenges in the near future. This is illustrated below.

Figure 12



The vision of such smart initiative is that over the course of time, smart public transport will become the norm and assist with:

- (1) **Passenger information system:** Real-time information for passengers using a public transport system with expected wait time and expected time of arrival via connected electronic display boards at bus stops.
- (2) **Parking assistance:** Information on available parking slots for ease of entry and exit.

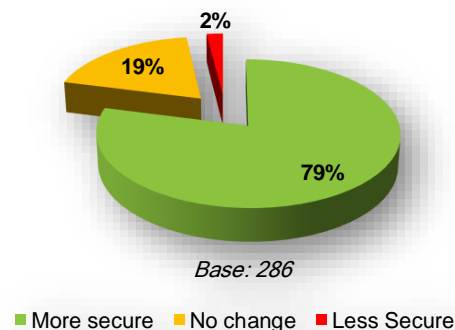
- (3) **Public safety:** The presence of camera/s within buses will go a long way in addressing the law and order challenges within public transport, particularly beneficial for women and children. When coupled with **automated speed enforcement**, the buses automatically render a high degree of safety by negating possible road and traffic mishaps by way of overspeeding.
- (4) **Smart card:** Potentially, smart cards could come into use in the future to enable citizens the ease of entry and exit being monitored through smart cards, as is prevalent in many countries globally. This could also be a source of revenue and digital money and taken in conjunction with the popularity of mobile wallets, it will go a long way in digital inclusion too.
- (5) **Revenue generation:** Televisions within buses and other mass public transport have proven to be a credible source of revenue and general awareness. The state could monetize these by playing advertisements of private players for a cost as well as use the televisions to play out public awareness and health-related programs of the state and union governments.

Within IDC's Citizen Survey, citizens were queried on their perception of safety and security in view of the smart initiatives in the Golden Mile corridor. This is illustrated below.

Figure 13

MEASURE OF SECURITY WITH SMART CITIZEN SAFETY

79% feel more secure, whereas, 19% users feel no change in the level of security after implementation of these services



Q. After the implementation of these Smart Public / citizen safety services in MG road (Bandar Road), how safe do you feel?

Segment 3: Citizen Convenience and Engagement

Key to the success of any Smart City initiative or the city itself is the ability to enable enhanced convenience while engaging citizens toward a greater good in their lives. An enhancement to the daily lives of the citizens will have to be met with a multitude of initiatives and perseverance.

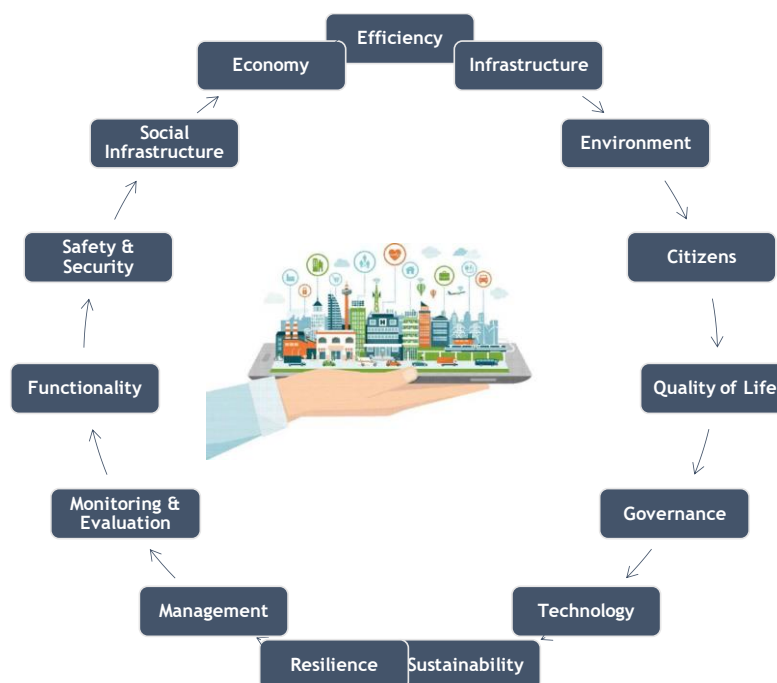
To this effect, we have already studied the impacts that smart parking, smart transportation, citizen's portal and app, kiosks and REGS, smart Wi-Fi, and smart environment can bring. Put together, these technologies form the bulwark of a society and a city that finds resilience in the new-age digital economy — an economy in which services, initiatives, citizens, and the government come together to build a cohesive sustainable society. As has been observed, smart initiatives to drive citizen convenience and engagement will lead to the society and government being able to produce and consume more and have better, healthier, and safer

lives — better health facilities, better education by leveraging digital technologies, enhanced quality of life — and all this while treading lightly on the infrastructure and natural resources at disposal.

This will, by considerable measure, also lead to enhanced trust. For Vijayawada to truly be a Smart City, it must address a multitude of variables and facets of technology and citizen hopes — all together. To cater to this increasing urban population in the future, cities need to plan and provide a suitable environment for future investments, create new jobs and livelihoods, build reliable public infrastructure, provide social services with ample access to affordable housing, and, most importantly, support efficient use of resources for a sustainable quality of life.

When viewed in a broader concept and in conjunction with the Smart Cities Mission of the Government of India (Source: Niti Ayog: 2017), it becomes clear that any journey toward a Smart City and subsequently citizen convenience and engagement must involve the below variables.

Figure 14



Segment 4: Revenue Impact

It is reasonable, at best, to assume that smart initiatives must lead to the potential for state governments and municipal corporations to drive revenue enhancement. Cisco's Golden Mile project establishes exactly that.

Smart lighting: IDC monitored the smart lighting initiative in much depth via power consumption of 40 smart lights versus 100 non-smart lights (plain LEDs) to ascertain the impact of the smart initiative, and the salient takeaways are:

- (1) It was observed that non-smart lights on average consumed 320.2kWh per day against an average of 93.8kWh by smart lights. In terms of power savings, smart lights are observed to be about 70% more efficient, leading to the hypothesis that, given the scale of an entire city, the savings on coal and other similar natural resources would be immense.

- (2) Such non-smart light consumption, when observed weekly, was seen to be about 2,236.1kWh versus smart lights at about 654.1kWh, leading to an average weekly savings of 1,581.5kWh, enough to power many homes, especially in rural areas — rural electrification, channeling excess power for intra-state economics, and others.
- (3) IDC also analyzed, based on publicly available information on power tariffs, the impact of such savings, as highlighted above. These are illustrated for the entirety of the 160-day analysis period, as shown below.

Figure 15

In kWh	Month 1	Month 2	Month 3	Month 4	Month 5	Cumulative for Monitoring Period
Non-smart lights (kWh)	72,059	76,579	80,321	81,714	89,377	400,050
Smart lights (kWh)	21,924	23,301	23,817	24,408	23,872	117,322
Savings (kWh)	50,135	53,279	56,503	57,307	65,505	282,729
Savings %	70	70	70	70	73	71

Publicly available data on power tariffs in Vijayawada are **approximately INR 6.37** (Source: Andhra Pradesh Central Power Distribution Company Limited - Tariffs, <http://www.apcpdcl.org.in/tariffs.php>)

At these rates, let us take a closer look at the potential cost savings that the move to smart lights would offer the Municipal Corporation of Vijayawada for public welfare and convenience, notwithstanding safety.

- (1) Daily, the use of non-smart lights costs the city of Vijayawada (Golden Mile stretch alone analyzed) about **INR2,024/-** vis-à-vis smart lights at about **INR594/-**; a daily saving in outright costs of about 70%. When extrapolated to the entire city of Vijayawada, this warrants serious consideration — Vijayawada, based on publicly available information, has a total of **26,968 street lights** of varying sizes, form, and illuminance (tube lights, SV lamps of varying wattage, and so forth) (Source: Vijayawada Municipal Corporation)
- (2) The power savings from a basic hypothesis of a city-wide smart initiative, such as smart lighting, are tremendous to say the least.
 - i. Vijayawada Municipal Corporation would save a total of approximately **150,819kWh** daily, enough to power many other industrial or agrarian initiatives that the state government may want to achieve. It is to be considered that these savings stated above are for a day alone — extrapolated over a year of sustained deployment, this would roughly translate to power savings of 55,048,767kWh per year.
 - ii. Translated economically, this would mean a saving of approximately **INR35 crores per year (approximately US\$ 5.22 million)**, other things remaining constant.
 - iii. There is another variable that must be taken into consideration — manpower and labor. The maintenance of lights has been predominantly a labor-intensive activity because of the employment of multiple government resources (manpower) to manage this. If taken holistically, the savings will be even more economically, notwithstanding the potential of reskilling and leveraging the existent workforce into other more productive functions of the municipal corporation.

Smart parking: The ability of the city infrastructure to orchestrate a smooth flow of traffic and, more importantly, smooth parking saves fuel, time, and effort. It is a known fact that in industrial towns, vehicular

traffic can impose a severe burden on the existing infrastructure (i.e., parking). Long traffic jams caused by commuters looking for a parking space are a given lately. In this kind of a scenario, smart parking could go a long way in easing the pressure off road traffic, and it also simultaneously adds to revenues.

- 1) Imagine if commuters could conveniently locate available parking spots on their apps, book it online via an OTP method, and be returned with a code, then drive to the specified area and upon being asked to input the received code into a deployed smart screen, park their vehicles — all for a certain price, of course.
- 2) Per the Municipal Corporation of Vijayawada (source: Vijayawada Master Plan), the average vehicular flow around the Golden Mile stretch is roughly about 185,140 per day. An extrapolation would suffice to highlight the fact that when smart parking would be made available, for at least 10% of the vehicular inflow (at very conservative estimates), the impact on revenue (per prescribed governmental rates) and easing of traffic will be immense.

Smart transportation: Technology plays an important role by predicting the demand and supply data to feed into transportation planning. Technology can also help in improving the reliability of the public transportation network by providing visibility on arrivals/departures/route information for travelers for a hassle-free journey.

- a. As the public transit population grows, it becomes increasingly important to launch surveillance systems on the public transport (e.g., buses, mass transit railway, underground, and trains) to secure public transportation. The administrators can monitor the public transport remotely and act against any accidents/incidents. The video footage can also be used as legal evidence against damage or criminal action on the public transport.
- b. Multimodal fare integration can help citizens to use multiple modal options without the hassle of purchasing different tickets. Intelligent traffic management can aid in efficient traffic flow. Additionally, leveraging the smart display within the bus can benefit the state government and civic agencies in driving advertisements from private and public players, thus leading to revenues.

Citizen's portal, app, and kiosk: The objectives of smart cities are to improve the quality of life of city dwellers, enhance the efficiency and competitiveness of the economy, and move toward the sustainability of cities through better resource efficiency. As cities evolve, they increasingly connect to their residents through technology. The state government and civic agencies could evaluate, based on the Golden Mile pilot, fast and effective installation at the range of field locations under a variety of conditions. Smart kiosks can be leveraged for a multitude of services, including (but not limited to) civic remittances, payments, parking fees, parking fines, and other similar remittances, which would lead to an addition of revenues for the state government and municipal corporations.

Segment 5: Smart Environment

A Smart City is one where capital, resources, and knowledge are managed in a wise manner, with a focus on innovation, sustainability, efficiency, and quality of life. A Smart City needs to forge the way toward socially inclusive communities with a low ecological footprint. People within smart cities will enjoy a quality of life in a clean, green living environment where public and open spaces are pristine and waterways and water features, including natural/artificial lakes, wetlands, ponds, and rivers, are lifestyle attractions for all.

The benefits of smart environment are numerous, including quality health conditions, individual safety, and accessibility to good quality areas (tourist, residential, and commercial). To ensure a low carbon, low water, and low ecological footprint with infrastructure designed to adapt to the present and future impacts of climate change, smart cities need to consider and leverage technology at the very design and planning stage of the project. This is detailed below.

Environmental metrics: The concept of and awareness about environmental metrics and its impact on lifestyle, health, and wellbeing are slowly gaining ground among citizens in India. Given that the air quality index is being widely reported by publications almost daily, the interest being taken by citizens is expected. This is also in sync with the growing environment and air quality-related ailments and diseases being reported across a wide swathe of the country.

Cisco's smart environment sensors have established and deployed a mechanism to monitor critical environmental metrics almost around the clock, and manifesting it in a convenient manner via the citizen's app and city portal. This allows citizens to monitor critical environmental metrics prior to stepping out toward the Golden Mile stretch, and this is particularly beneficial for the elderly or young children or people suffering from bronchial ailments.

Under the Swachh Bharat mission, the Ministry of Environment, Forest, and Climate Change released the prescribed National Air Quality Index (AQI). The AQI is illustrated below.

Figure 16

AQI Category, Pollutants and Health Breakpoints								
AQI Category (Range)	PM10	PM2.5	NO2	O ₃	CO (mg/m ³)	SO ₂	NH ₃	PB
Good (0 - 50)	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory (51 - 100)	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately Polluted (101 - 200)	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor (201 - 300)	251 - 300	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very Poor (301 - 400)	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe (401 - 500)	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

(Source: National Air Quality Index launched by the Environment Minister. AQI is a huge initiative under Swachh Bharat — AQI to act as "One Number-One Color-One Description" to judge the Air Quality for Common Man: Shri Prakash Javadekar)

Upon monitoring the data made available by Cisco's environmental sensors deployed within the Golden Mile stretch, IDC made the following observations.

Figure 17

Environmental Metrics	30-Day Average	60-Day Average	90-Day Average	120-Day Average	160-Day Average
Temperature in C	26.5	26.1	25.9	25.4	25.7
Humidity	69.7	68.3	66.3	64.1	63.3
SO ₂ (µg/m ³)	21.2	20.7	18.1	16.9	16.6
PM2.5 (µg/m ³)	54.5	48.7	51.6	49.8	52.6
PM10 (µg/m ³)	73.6	79.8	85.2	84.2	88.8
O ₃ (µg/m ³)	5.7	5.5	5.1	5.4	7.3

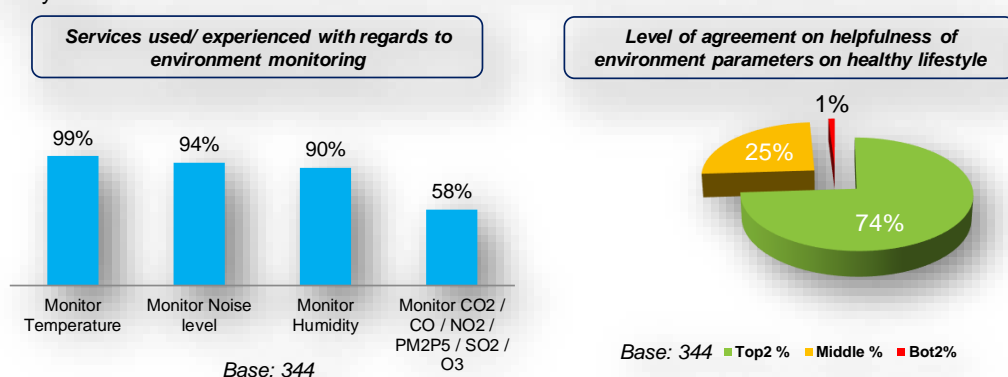
Upon closer inspection, it shows that while the PM10 (µg/m³) figures were at "satisfactory levels" per the AQI index, the PM2.5 (µg/m³) levels on average fell under the "moderately polluted" category, symbolic of advisory related to "may cause breathing discomfort to people with lung disease, such as asthma, and discomfort to people with heart disease, children, and older adults."

The broad takeaways from the above environmental metrics point to a city that will increasingly be pressured on its air quality index and the resultant ailments and related medical problems. The Cisco Smart Environment initiative will go a long way in alleviating this issue by providing proactive and historical information at the click of a tab on the Cisco Smart App.

This is equally represented in IDC's Citizen Survey in which citizens were asked to highlight their experiences with Cisco's Smart Environment initiative. This is illustrated below.

Figure 18

Nearly 3/4th of users give their agreement on environment parameters tracking help them lead a healthy life



Q. What are all the services you have used/ experienced with regards to environment monitoring services
 Q. Please tell me your level of agreement on a scale of 1 to 5 where 1 means strongly disagree and 5 means strongly agree

Across the globe, governments and civic agencies are taking credible measures to bring about a positive impact around sustainable environment and well-being. Let us look at what other countries in the world are doing for a smarter and healthier environment:

1. In Europe, the adaptation policy has been developed across all levels of the government, with some adaptation planning integrated into coastal and water management, into environmental protection and land planning, and into disaster risk management.
2. In Asia, adaptation is being facilitated through mainstreaming climate adaptation action into subnational development planning, early warning systems (such as for cyclones and coastal flooding), integrated water resources management, agro-forestry, and coastal reforestation of mangroves.
3. In Africa, most governments are initiating governance systems for adaptation. Disaster risk management, adjustments in technologies and infrastructure, ecosystem-based approaches, basic public health measures, and livelihood diversification are reducing vulnerability, though efforts tend to be isolated. (Source: The Pioneer, March 12, 2018)

Cisco's Golden Mile project does exactly that by visualizing public health as a key pillar of a Smart City. Environmental metrics, monitored and displayed via the citizen's portal and app, facilitate greater awareness and proactive control measures for the citizens and help civic agencies plan better.

Golden Mile Project: IDC Citizen Survey

IDC established a strong ground presence to seek and solicit information about the levels of awareness of citizens at the Golden Mile stretch and to promote immediate awareness and benefits arising from the smart initiatives. A total of 3,314 respondents on the ground were surveyed over a period of 160 days.

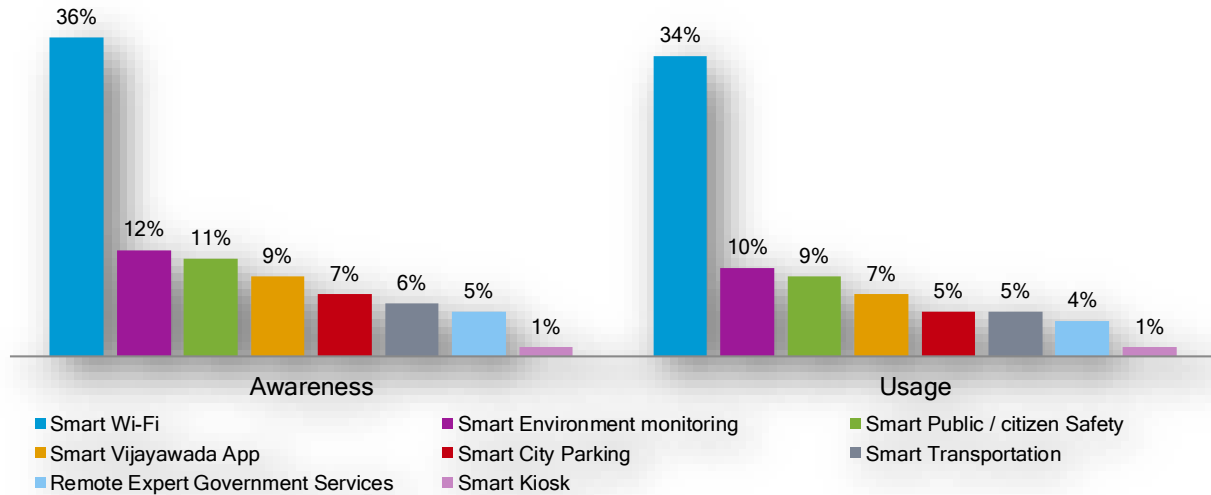
Given that the Golden Mile project was not officially announced to citizens, the survey still threw up interesting results, symbolic of how smart initiatives and technology can impact citizen lives and add to the perception of enhanced benefits and wellbeing. IDC's survey showed that 46% of citizens have, in one way or the other, used these services and were, by and large, either awed or were happy about the technology positively impacting their lives.

Figure 19



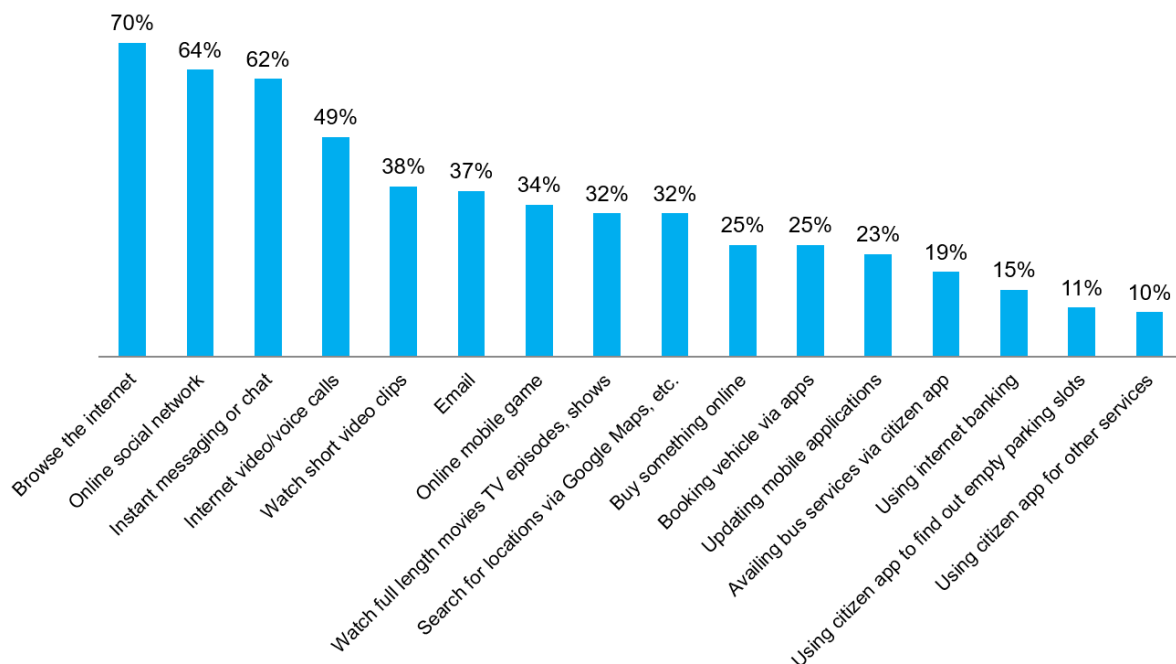
IDC observed that the usage of services among those who were aware of the smart initiatives was equally high, as represented below.

Figure 20



Smart Wi-Fi with the highest awareness also highlighted the use cases that citizens leveraged Wi-Fi for, thus furthering the case for digital inclusion. This is illustrated below.

Figure 21



The citizen survey is highly symbolic of how citizens are increasingly willing to adopt and use technology to enrich their daily lives, with the concept of convenience being paramount for all.

The on-ground survey conducted highlights the fact that citizens, in the digital era, are aware and ready to adopt processes and systems aimed at enhancing the convenience and quality of life. Given the variable of time and as and when Vijayawada becomes a completely IoT-enabled Smart City, it is expected that a

large-scale transformation can be orchestrated, such that it would lead to invaluable benefits for citizens and the city together.

The Concept of Value Capture Funding

With rapid urbanization, we have observed how state and civic bodies are challenged to address the demands of a growing population and balance the existing resources with the need to enable enhanced quality of life, safety, wellbeing, and convenience of citizens. Within this broad ambit, urban and local bodies are continually looking for funds to meet the requirements of creating and upgrading infrastructure. The Union Government of India has accordingly floated the concept of Value Capture Funding (VCF), which essentially aims at capturing a part of the incremental value of investments to secure and offset the costs of provision. Simply put, it is a mechanism/framework to better distribute the costs and benefits in funded infrastructure to facilitate a project that may perhaps otherwise not be taken up at all.

It is to be observed that within initiatives such as the Golden Mile project in Vijayawada, appropriate frameworks could be deployed to capture a part of the incremental value generated from smart initiatives, which, in turn, can be used for funding projects, thus setting in motion a cyclical process of value creation, realization, capturing, and subsequent re-investment into smart initiatives. Such a framework enables civic agencies the ability to launch new projects despite a small resource base. For players such as Cisco, the VCF framework is significant, in that it enables them to participate and run projects that are sufficiently planned and backed by governmental agencies through value and risk sharing.

Globally prevalent, this is highlighted by the following examples:

Hong Kong: Transit value capture is used in Hong Kong and Japan to fund railway lines and new town development. This is a project-based approach that packages investment in railway and housing development together. Commercial holdings along the railway line deliver an ongoing revenue stream as does long-term investment in residential development. In Hong Kong, a significant program of public rental and subsidized home ownership has also been delivered as part of this model.

USA: Tax increment financing (TIF) is used widely in the United States to finance new transit and urban renewal projects. The model draws on anticipated increases in business revenue or rents in areas where incremental value uplift will occur. A portion of the increase is captured via a special property tax, which is then allocated to repay the debt.

India: Recently, the Government of Karnataka decided to create a dedicated fund for investment in mass transit systems by using VCF methods, such as premium floor space index, levying fees for change of land use in the vicinity of a project, and so forth. Specifically, provisions have been made for levying a betterment tax equal to one-third of the increase in value of the land.

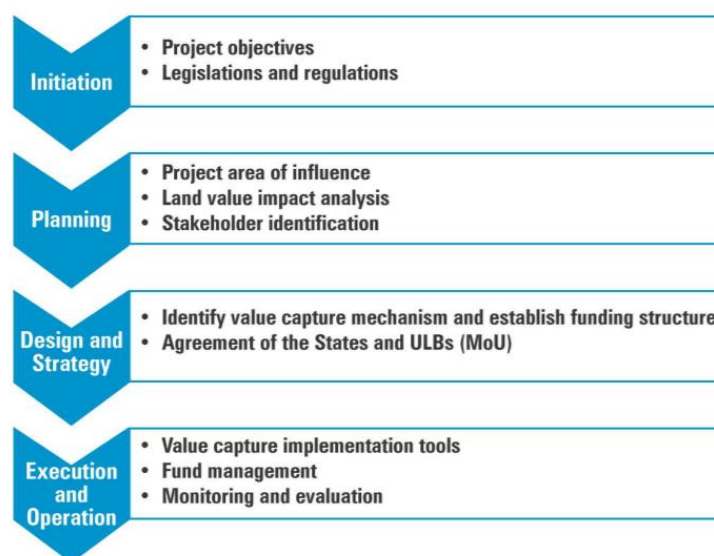
Why is Value Capture Funding an imperative? First, cities are limiting the financial possibility of fully monetizing the benefits of their Smart City investments, thereby relying entirely on the mission grants and convergence. Secondly, the demand for raising additional capital through monetizing assets and infrastructure spending is high and sometimes prohibitive.

It is interesting to note that within the domain of VCF in India, a recent Economic Times article highlights that 163 cities across 19 states and union territories have opted for Value Capture Financing for urban infrastructure projects and have also appointed consultants to frame VCF policies and identify zones for infrastructure projects. Uttar Pradesh leads the states with 61 cities, including mofussil towns identified to leverage VCF, with Andhra Pradesh with 33 cities and Gujarat with 32 cities. The article highlights this welcome development in response to the Ministry of Finance laying the guidelines for all central ministries.

(Source: <https://economictimes.indiatimes.com/news/politics-and-nation/yogi-adityanath-no-akhilesh-up-takes-shine-to-infra-schemes/articleshow/59100180.cms>)

In February 2017, the Ministry of Urban Development noted that there is a logical process that must be followed for sustainable and beneficial VCF. This is illustrated below.

Figure 22



(Source: Value Capture Finance Policy Framework, Ministry of Urban Development, Government of India, February 2017)

Cisco and similar technology players could be well placed to aid governments and civic agencies in this value chain, thereby rendering unparalleled value for citizens and infrastructure. However, a few areas must be addressed for the VCF framework to work seamlessly:

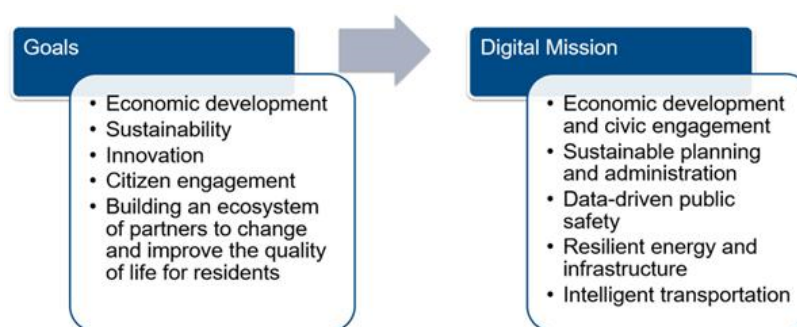
- (1) Calculating value uplift is complex, and, often, asset prices rise well in anticipation of investment or a planning change. Hence, a robust framework for value capture should be in place well before such speculation might occur.
- (2) Value capture should avoid discouraging development efforts or make asset acquisition expensive, which, in turn, will require a close attention to and monitoring of project viability when setting the framework and requirement detailing.
- (3) Robust mechanisms must be created in conjunction for collection of such value — either through the planning process itself or via ongoing and existing value frameworks.

With the growing need for smarter cities in India and the Smart City Mission's vision for a smarter India, there is recognition that public investment and policy changes in urban and regional areas generate enormous value, which can and should be shared more widely.

Why Invest in Smart Cities Now?

In the last four years, the definition of a Smart City has not changed dramatically, but the concept of digital transformation has rapidly developed, which has impacted how cities define their digital missions. In 2017, for the first time, IDC published a taxonomy of digital transformation specific to cities, called IDC's Worldwide Digital Transformation Use Case Taxonomy, 2017: Smart Cities. The figure below shows the main aspects that summarize cities' strategic objectives and their digital missions.

Figure 23



A digital mission is critical to fulfill the strategic objectives of any Smart City. The use of emerging technologies is the focus of smart cities. It allows them to create a technological ecosystem producing concrete outcomes. The 3rd Platform — a combination of existing and emerging technologies — enables innovation accelerators, which include the Internet of Things, cognitive computing and artificial intelligence, next-generation security, virtual and augmented reality, 3D printing, and robotics.

Most importantly, though, the narrative for smart cities and for technology pioneers, such as Cisco, to develop technologies and platforms to create them lies in the fact that digitization is key to unlocking the inherent potential within cities and its citizens, whose lives have been enriched by technology-enabled solutions that help address a wide range of operational challenges across all functional areas of city living and wellbeing. Cisco has been one of the leading solution providers to leverage technology to drive smarter cities — in India as well as across the globe. Let us look at a few of their Smart City projects to understand the need and value orientation;

Barcelona, Spain: Connected City Improves Quality of Life, Stimulates Economy

With 1.6 million citizens, the city planners of Barcelona were facing challenges around stimulating their local economy, thus enhancing the quality of life. Simultaneously, there existed a strong need to improve communications among city departments all the while minimizing government cost outlays yet improving service delivery.

Cisco partnered Barcelona's town planners and deployed a strong mobility foundation via the Cisco Wireless Network. The platform also captured the location of people and assets spread across the city to determine ways to improve planning and enable new and enhanced services. With sensors deployed across key places within the city, Cisco could connect a myriad of assets, including, but not limited to, parking spaces, environmental monitoring, garbage disposal bins, and more — thus leading to the concept of a connected and Smart City.

The end results were astounding considering the technology intervention and smart initiatives did not only revitalize the city to attract investments and events, it also had a positive impact on citizens by giving them more access to information about the city. The connected assets resulted in cost reductions, optimization, and higher efficiencies by way of parking, waste collection, street lighting, and other processes. The city of Barcelona estimates that the economic development by smart buses alone will add about US\$28 million over 10 years via advertisements and ridership, while smart parking is estimated to generate US\$53 million from better enforcement of parking limits and variable pricing.

Copenhagen, Denmark: Carbon Footprint Reduction and Enriched Citizen Experiences via Digital Solutions

Copenhagen envisioned itself as the first European city to go green and become carbon-neutral. Additionally, the city wanted to enable solutions that would enhance urban mobility while creating environmentally sustainable city operations, such as intelligent solutions in waste disposal, lighting, and air quality.

Cisco partnered with Tele Danmark Communications to establish the **Danish Outdoor Lighting Lab (DOLL)** to create "Street Lab" at the center of Copenhagen, involving over 40 competing outdoor light solutions as well as multiple parking, waste, and environmental sensing solutions converged on 7 miles (over 10km) of road. Leveraging Cisco's **"Smart+Connected Digital Platform,"** the initiative aims to connect the city infrastructure over a common network and data layer, thus considerably improving operational efficacy via the model of **"monitor-control-optimize"** each solution. In the domain of reducing carbon footprint, Cisco assisted city planners in enhancing the monitoring efficacy of carbon emissions and their sources. With **DOLL**, Copenhagen can now leverage data to identify and target pollution/emission sources.

Jaipur, India: Enable a Smart and Safer City for Citizens and Tourists

Jaipur in Rajasthan, India, is a major tourist hub with a rich heritage and apart from its 3.5 million residents, it attracts about 40 million tourists each year. This influx of tourists resulted in significant pressures on the quality of services provided to tourists, as well as to citizens, notwithstanding safety issues. The Jaipur Development Authority (JDA) urgently needed to improve the quality of public services and increase information access available to residents as well as offer a stellar tourism experience to visitors. A further need was to focus on safety of visitors and residents alike.

Cisco partnered with the JDA to realize the need for a smart and secure Wi-Fi city through smart technologies and solutions toward a "Digital Rajasthan." Cisco orchestrated a unified platform that aggregates data from a wide variety of sensors to combine data analytics to support a wide range of urban services. Toward the "Digital Rajasthan" vision, Cisco created smart Wi-Fi hotspots for the benefit of citizens and tourists. Advanced IP-based solutions installed at key locations provided for enhanced monitoring and, therefore, an increased level of safety and law and order around the city.

Overall, Cisco enabled a set of solutions to usher in the realities of and the potential for new revenue streams, improved access to public services, better community experiences, and new operating models that drive efficiency and lower cost.

Conclusion: Creating the Smartest Cities of India

Given India's vast diversity, the geographical spread of the urban and rural population and subsequent migration, and the finite resources available to cater to the demands of the people, smart cities are the need of the hour.

Smart cities are currently taking shape and delivering results gradually, as we have observed with the Vijayawada Golden Mile project. This pilot project alone has displayed innovation via technology in delivering enhanced citizen convenience, public safety and digital inclusion, notwithstanding the immense revenue potential in the future.

The IDC Smart City monitoring framework has essentially revealed that for such initiatives, which are oriented toward addressing the needs of a diverse population, it requires:

- (1) Continued innovative thinking and the empowerment of Smart City decision makers to understand the balance between risk and value.
- (2) The need to transform the traditional government — private partnership mindsets.
- (3) "Matchmake" the government demand with a sustained supply of technology innovation, such as the Vijayawada Golden Mile project of Cisco.
- (4) Smart City planners will need to invest in the concept of Value Capture Funding and the immense benefits it brings.
- (5) Smart City solution providers will need to craft go-to-market strategies that consider the customers' and citizens' desires for end-to-end solutions

This commissioned study by Cisco in partnership with FICCI and powered by IDC, aims to introduce the Vijayawada Golden Mile pilot project and the value that it promises to citizens and city planners.

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IDC India (Delhi)

304 Solitaire Plaza
MG Road, Near Guru
Drona Metro Station
Gurgaon 122002
Delhi, India
91.124.476.2300
Twitter: @IDC
idc-community.com
www.idc.com

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