

Smart Transportation - Integrated Corridor Management

Integrated corridor management (ICM) is a strategy to maximize supply of underutilized capacity on roadways by managing movement of cyclists, pedestrians, cars, transit, freight and others all together. This marks a stark contrast to the traditional approach of considering each user separately. By integrating and treating all existing structures and systems as one operation,

improvements can be made for all users and balanced appropriately according to need. The result of these massive integration efforts is to have both target corridors and parallel roads resemble living laboratories, in which traffic engineers are constantly monitoring and studying the behaviors of users and adapting the system to meet their needs.

NATIONWIDE EXAMPLES SOLUTIONS:

Curiosity Lab, Peachtree Corners, GA

- **Background:** Some cities are utilizing the pilot approach in testing and developing proof of concepts for smart transportation strategies and technologies. Peachtree Corners identified a test site for transportation technologies so that they could test the technologies' capabilities in a safe and cost-effective manner within a controlled environment. This will help the transformation of these technologies from concept to commercialized and scalable projects.
- **Strategy:** Peachtree Corners city developed Curiosity lab; a living laboratory that is designed to be utilized as the proving ground for transportation technologies. The 500-acre technology park consists of 5G-enabled 1.5 autonomous vehicle test track and smart cities, enabling daily interaction between road users and the test tracks on a daily basis. The lab's intelligent traffic cameras, traffic signals, smart streetlights, and data sensors provide video coverage and collect data that is monitored from a central operations center. It also features technology incubators that provides an innovation space dedicated to early-stage startups and corporate innovators within the industry. Sprint has partnered with the city and provides subject matter experts at no charge to the organization interested in exploring 5G.
- **Key Outcomes:**
 - Safe and controlled environment for emerging technology pilot projects to help identify interoperability, capabilities and potential challenges, therefore enables experience-based and informed decision-making
 - Enhanced collaboration between partner agencies and the private industry
 - Expedites the emerging technology testing and deployment through real-world experiments and fine-tuning



CDOT and Panasonic V2X Roadway Management

- **Background:** Colorado Department of Transportation (CDOT) seeks ways to collect and utilize data to perform efficient, informed and cost-effective roadway management within the state and deployed connected vehicles for a real-world experiment.
- **Strategy:** In collaboration with Panasonic Corporation of North America, CDOT and building on a successful pilot program, the DOT performed real-world deployment of an advanced Vehicle-to-Everything (V2X) on I-70. Along the corridor and during the pilot, road-side nits and connected vehicles collected and shared data and sent information to the CDOT-Panasonic V2X Data Processing Center through cellular network. The center utilized the data and together with weather-related data performed analysis and transmitted information back to the vehicles. The objective was to improve safety, mobility and operations on the roadway, and support local traffic managers with informed-decision making.
- **Key Outcomes:**
 - Largest V2X pilot in North America
 - Enhanced collaboration and partnerships
 - Enabled additional pilot projects for V2X technology
 - Encouraged collaboration with automobile manufacturing companies
 - Up to 80% fewer crashes and 50% shorter travel times, improved air quality, enhanced economic growth



TARGETED SMART CITIES ELEMENTS AREAS

Existing and Emerging Technologies	Investment Criteria	Strategic/Transportation Priorities	Planning Duration	Benefits	Collaboration	Infrastructure	Performance Measurement

TARGETED HILLSBOROUGH CORE INVESTMENT AREAS

Good Repair and Resilience	Vision Zero	Smart Cities	Real Choices When Not Driving	Major Investments for Economic Growth

Sources:
<https://www.curiositylabptc.com/>
<https://www.cinemassive.com/case-studies-list/the-curiosity-lab-at-peachtree-corners/>

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Sources:
<https://www.codot.gov/news/2018/july/cdot-and-panasonic-take-first-steps-to-turn-i-70-into-connected-roadway>

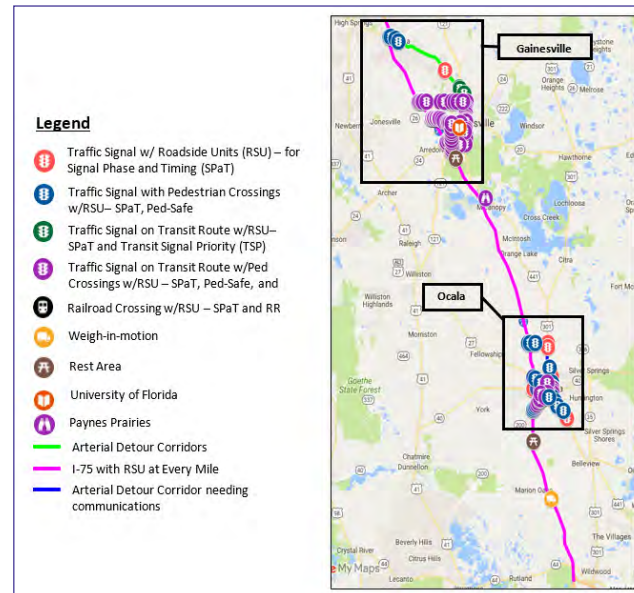
Smart Corridors

Smart corridors are a technology-driven approach to the use of roadways both freeways and arterials. They increase capacity and improve journey time reliability while maintaining safety. The technology is controlled from regional control centers which can, for example, activate and change signs and variable speed limits. This helps keep the traffic flowing more smoothly.

NATIONWIDE EXAMPLE SOLUTIONS:

I-75 Florida's Regional Advanced Mobility Elements (FRAME) project

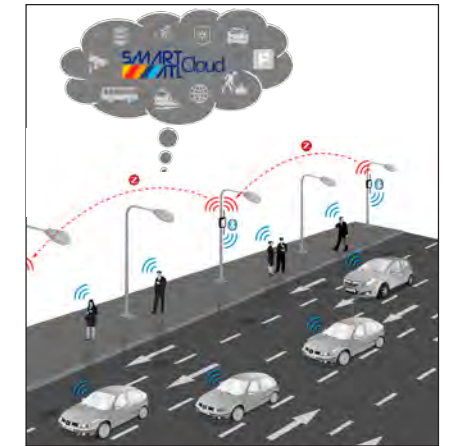
- ▶ **Background:** I-75 Florida's Regional Advanced Mobility Elements (FRAME) project deployed emerging technologies to better manage, operate, and maintain the multi-modal transportation system and create an Integrated Corridor Management solution on I-75 and state highway systems in the Cities of Gainesville and Ocala.
- ▶ **Strategy:** The emerging technologies in this project are Automated Traffic Signal Performance Measures and Connected Vehicle technologies such as Roadside Units and On Board Units for effective traffic operations; Transit Signal Priority and Freight Signal Priority. The goal of the project is to disseminate real-time information to the motorists during freeway incidents
- ▶ **Key Outcomes:**
 - Increased safety for I-75 users
 - Improved reliability for I-75 users
 - Reduced delay for trips using I-75
 - Accommodate population and economic growth and demand for moving people and freight
 - Enhanced regional emergency evacuation and response



On some busier sections of corridors, for example, the hard shoulder is temporarily opened or have converted to a permanent extra lane so that more vehicles can travel, avoiding the expense and disruption of widening the road.

North Avenue, Atlanta, GA

- ▶ **Background:** North Avenue Smart Corridor project used the latest technology to increase safety and improve multimodal traffic operations in this 2.3-mile stretch of roadway. In a partnership with the Georgia Institute of Technology and the Georgia Department of Transportation, data is gathered and analyzed to assist both short- and long-term transportation planning to create a safer and more efficient place to live, work, and play. North Avenue connects some of Atlanta's most important destinations such as Coca-Cola headquarters, AT&T headquarters, GDOT, etc.
- ▶ **Strategy:** A public demonstration and "living lab" for Internet of Things (IoT) deployment, data collection/analytics, autonomous vehicles, and partnerships, the innovative living lab approach delivered a range of technologies including:
 - Installation and use of hundreds of internet of things (IoT) sensors
 - Urban environment adaptive signal timing system
 - Vehicle-to-infrastructure communications
 - Bluetooth travel time and origin destination system
 - Demonstrating connected automated vehicles
 - Reconfiguration of existing roadway through restriping to support crash reduction
- ▶ **Key Outcomes:**
 - Smoother traffic flow, more reliable journey times
 - Improved safety for all road users
 - Collaborative working between the public and private sector
 - Highlights Georgia's and Atlanta's belief in the effectiveness of Smart City technologies



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Sources:
 FDOT, <https://www.fdot.gov/traffic/its/projects-deploy/cv/maplocations/i75-frame.shtm>

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Sources:
 Atkins
<https://www.snclavalin.com/en/beyond-engineering/north-avenue-smart-corridor>

Smart Corridors (continued)

NATIONWIDE EXAMPLE SOLUTIONS:

The Ray, Atlanta, GA

► **Background:** In collaboration with amazing partners The Ray brings these big potential technologies and best practices to their stretch of I-85. Located along The Ray, the Georgia Visitor Information Center in West Point is home to the state's very first solar-powered PV4EV (photovoltaic for electric vehicle) charging station. It's one giant step toward creating the infrastructure that's needed to support electric vehicle transportation. First-in-the-world roll-over WheelRight tire safety monitoring system sends drivers a text message with critical information about their individual tire pressure and tread depths. The Ray is the testing ground for Wattway's pilot project in the U.S.: a pavement that uses traditional solar cells, protected in a patented frame, that allows the road surface to generate clean energy under heavy vehicles. The Georgia Department of Transportation (GDOT) and The Ray are jointly partnering with Panasonic to create a vehicle-to-everything (V2X) data ecosystem that will enable Georgia's first connected interstate roadway. In addition to several roadside units along The Ray that will receive connected vehicle information, Panasonic is building their CIRRUS V2X (vehicle-to-everything) platform, or the "brain", enabling Georgia DOT to leverage the real-time, location-specific data to improve roadway safety, ease congestion, identify maintenance needs and roadway interruptions.



► **Strategy:** Georgia is implementing new ideas and technologies to create a regenerative highway ecosystem on The Ray's 18-mile stretch of I-85, and several pilot projects are already underway, including solar-powered vehicle charging, tire safety check station, solar-paved highway, smart planting, bioswales, climate modeling, V2X connected technology, etc.

► **Key Outcomes:**

- USA's first road surface solar panels on autonomous vehicle lane
- Co-locating transportation, energy and information technologies
- Regional collaboration and partnerships with tech companies, stakeholders and research centers

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Sources:
<https://theray.org/>

Truck Highway 55 Connected Corridor, Mn

► **Background:** MnDOT plans to deploy SPaT at approximately 22 traffic signals along corridors between I-494 and I-94. Two deployment locations have been elected, TH-55 and I-394, each offering a different scenario for application of the Snow Plow Signal Priority (SPSP). Along TH-55, signal priority would be given to plows as they approach mainline signals. Deployment on I-394 would occur at interchange signals and ramp meters along the corridor, allowing plows clearing exit and entrance ramps to operate more efficiently.

► **Strategy:** In response to the Connected Vehicle SPaT Deployment Challenge, MnDOT has been working with public and private stakeholders to explore key areas of interest for CV. The highest priority was identified as snow plow and maintenance operations. The SPSP system would provide plows the ability to request extended green or early green phases at traffic signals along snow plow routes via DSRC.

► **Key Outcomes:**

- Increase safety and mobility of roadways
- Improve plowing times and fuel efficiency by reducing time spent waiting at signals
- Improve productivity/efficiency of gang plowing operations
- Establish MN as an active participant in CV technology
- Gain valuable procurement, licensing, installation, and operational experience with CV technology
- Identify priority considerations for AV/CV legislation and rulemaking



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Sources:
<http://www.dot.state.mn.us/its/projects/2016-2020/connectedcorridors.html>

Smart Public Services and Infrastructure

Smart public services and infrastructure address the development of public smart city services and the required infrastructure to enable the solutions' deployment. As technology is transforming lives, enabling automation and seamless connectivity, and unlocking potentials of emerging

technologies to revolutionize public services. Developing the appropriate infrastructure that can support and advance the public service technologies is critical to the success of these efforts.

NATIONWIDE EXAMPLE SOLUTIONS:

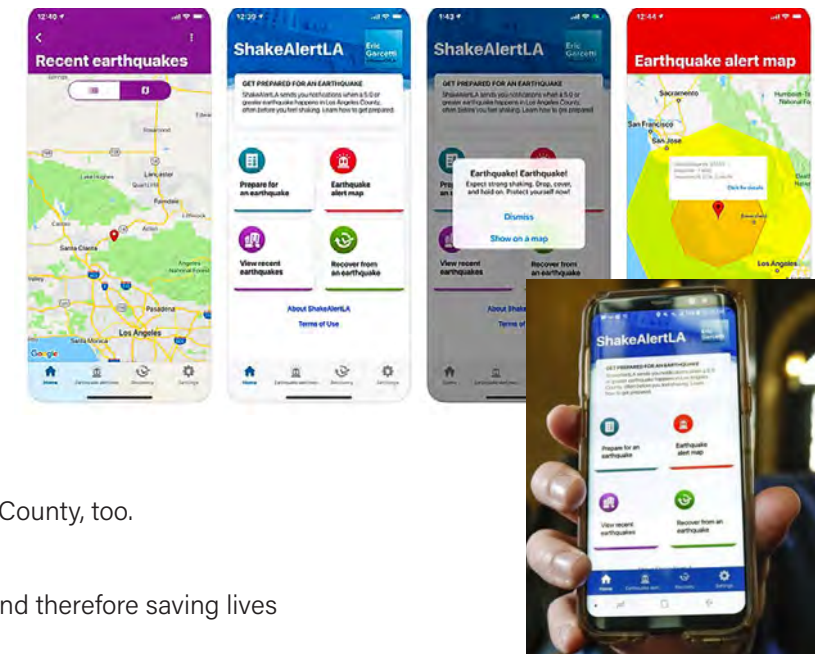
Smart Waste Management, New Orleans, LA

- **Background:** Despite the successful efforts in collecting refuse in residential, commercial and tourism areas, the New Orleans sanitation department faced challenges in collecting trash, especially with illegal disposal.
- **Strategy:** The sanitation department utilized HDTV-resolution cameras integrated with radar sensors and installed at locations identified as chronic illegal dumping sites. As part of the mayor's CleanUpNOLA initiative, the radar system identifies illegal dumping activities, tracks the vehicle or the person automatically, and triggers an alarm to notify the responsible party. In addition, and when the cameras are not actively monitoring sanitation crime, they operate as regular safety cameras.
- **Key Outcomes:**
 - Crime detection and collection of fines from illegal dumping
 - Ability to increase the return on investment by utilizing cameras in a flexible manner



ShakeAlertLA, Los Angeles, CA

- **Background:** The city is facing challenges in day to day urban functionality such as congestion, environmental pollution, and climate change. In addition, the threat of natural disasters such as earthquake adds another layer of complication. Earthquake Early Warning (EEW) systems are effective, however, less effective for those who live closer to the epicenter of the earthquake..
- **Strategy:** The city, in collaboration with US Geological Survey (USGS), Annenberg Foundation and AT&T, developed an earthquake alert app that utilizes hundreds of sensors to collect data and send alerts to users' smartphones when a seismic activity is detected. The app also uses open-source technology and can be used outside the L.A. County, too.
- **Key Outcomes:**
 - Providing users with critical seconds of warning and therefore saving lives
 - Real-time information sharing
 - Regional collaboration and data sharing



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Sources:
CITA
<https://www.axis.com/es-ar/customer-story/5020>

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Sources:
<https://mobility.here.com/learn/smart-city-initiatives/los-angeles-smart-city-data-and-sustainability>
<https://www.latimes.com/california/story/2019-08-14/earthquake-early-warning-app-shakealertla-released>
<https://www.lamayor.org/mayor-garcetti-launches-nation%E2%80%99s-first-publicly-available-earthquake-early-warning-mobile-app>

Smart Lighting Solutions

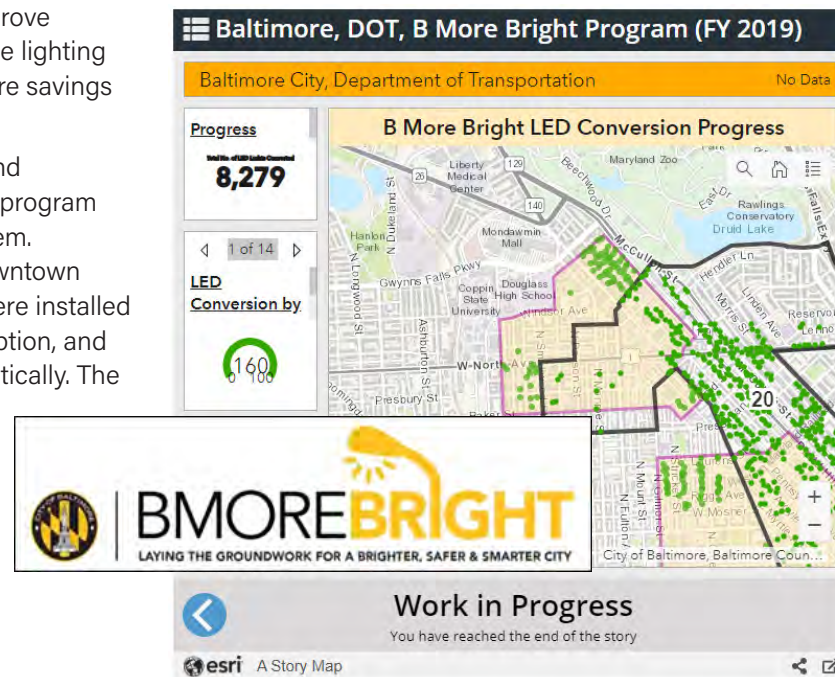
Community buildings, structures, parks and equipment play a critical role in the economic growth and the Quality of Life of a community. Smart lighting solutions can yield significant benefits by providing sense of safety, security and equity in targeted areas, as well as enabling maximized

efficiency from the existing resources. Smart lighting solutions have also proven to reduce energy consumption significantly.

NATIONWIDE EXAMPLE SOLUTIONS:

Baltimore Bright Program, Baltimore, MD

- **Background:** The city of Baltimore sought to improve nighttime safety in entertainment districts, improve lighting asset management and maintenance, and measure savings of energy and money.
- **Strategy:** In collaboration with Philips Lighting and Baltimore Gas and Electric, Baltimore Bright pilot program was created to develop a connected lighting system. The program focused on 20 streetlights in the downtown entertainment district. Philips CityTouch nodes were installed that can dim or brighten, monitor energy consumption, and report outages and other technical issues automatically. The system also provided streetlight infrastructure data via wireless communications.
- **Key Outcomes:**
 - Cross-reference of 113 data points of light outages, crime, and traffic incidents
 - Improve sense of safety and security
 - Reduce maintenance costs

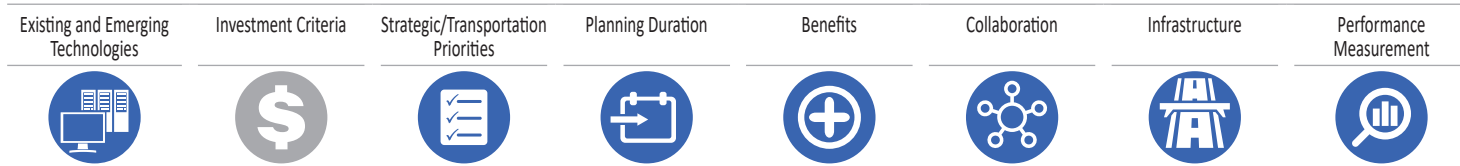


Smart Lighting Retrofit, Birmingham, AL

- **Background:** In an effort to improve safety, modernize infrastructure and engage citizens, Birmingham launched the Brighter Birmingham program. The goal was to upgrade and retrofit seven city parking garages with LED fixtures, upgrade the streetlights and highways lighting, and improve lighting in parks and architectural areas.
- **Strategy:** Through an energy audit, the implementation team identified parking garage retrofits as the fastest return on investment. Philip's Lighting, city council, parking authority and mayor's office collaborated closely and utilized a construction company and engineering team from the local market.
- **Key Outcomes:**
 - Money and energy saving
 - Improved sense of safety and security, and empowered local jobs
 - Reported increase in parking garage utilization within 5 days
 - Eliminated the need for capital expenditure by financing the retrofits through energy savings and public funds



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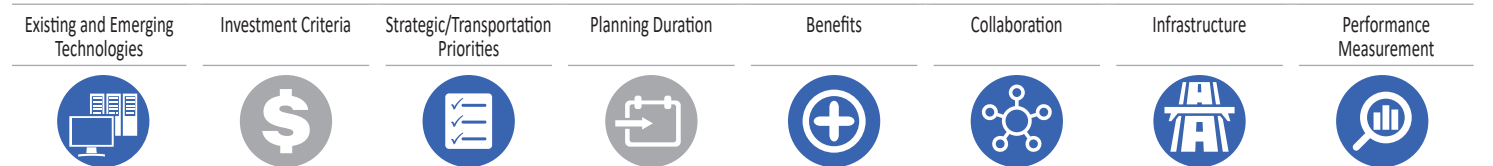


TARGETED HILLSBOROUGH CORE INVESTMENT AREAS



Sources
<https://transportation.baltimorecity.gov/bmorebright>

TARGETED SMART CITIES ELEMENTS AREAS



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Sources:
 CITA
<http://applications.nam.lighting.philips.com/blog/index.php/2016/06/27/philips-lighting-and-city-of-birmingham-revitalize-downtown-parking-garages-with-led-lighting/>

Smart Public Safety

Smart City solutions (such as IoT) connected by wireless networks offer innovative approaches in identifying danger spots and risk management for safety improvements. Video sensors through facial recognition help identify missing persons, gunshot sensors will alert the law enforcement,

and weather sensor technologies alert residents of natural disaster locations, provide updates and recommend safety routes. Utilizing technology for safety projects will empower communities to take proactive actions regarding their safety needs.

NATIONWIDE EXAMPLE SOLUTIONS:

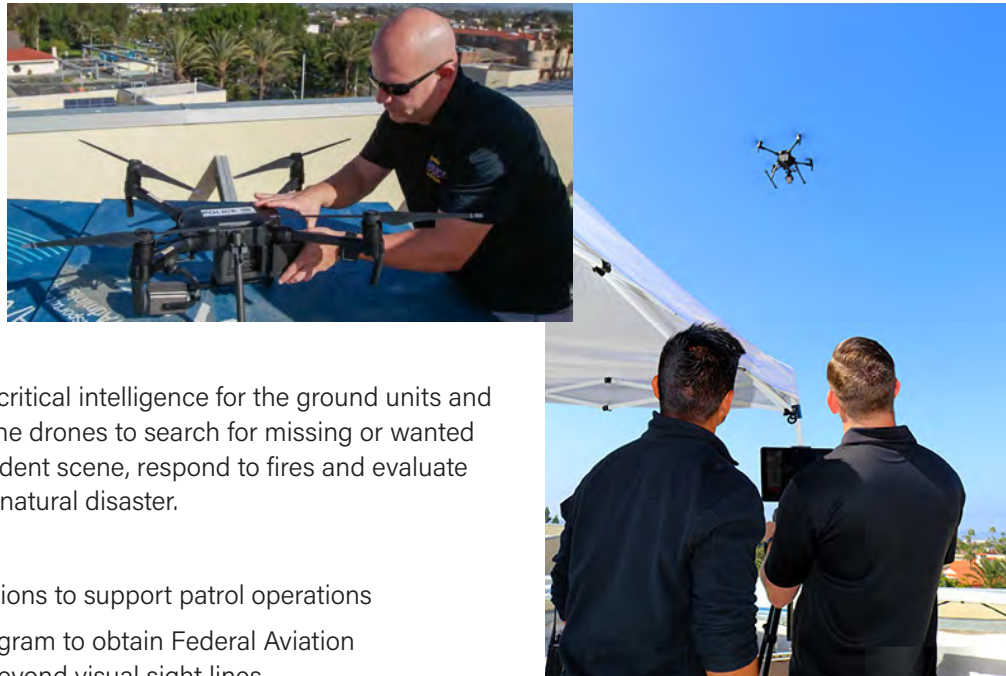
Drones as First Responders, Chula Vista, CA

► **Background:** Chula Vista Police Department (CVPD) was facing a challenge in providing and maintaining safety for residents due to population growth and lack of resources.

► **Strategy:** The CVPD launched the Drone as a First Responder (DFR) program that sends a drone to the site to feed live video when an emergency call is received. The live video collects critical intelligence for the ground units and first responders. CVPD also uses the drones to search for missing or wanted persons, document crime and accident scene, respond to fires and evaluate damage following an incident or a natural disaster.

► **Key Outcomes:**

- Drones flown in over 1,080 missions to support patrol operations
- First urban police response program to obtain Federal Aviation Administration approval to fly beyond visual sight lines



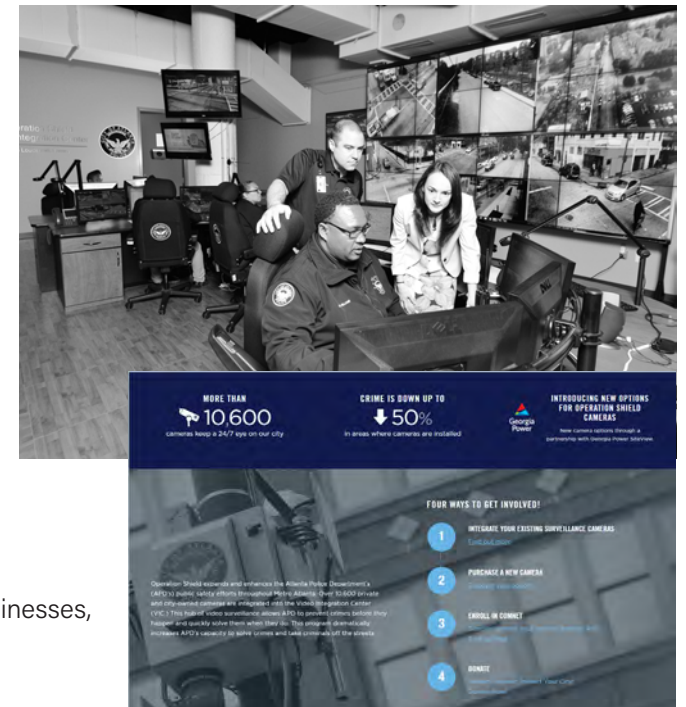
Atlanta Police Foundation Operations Shield, Atlanta, GA

► **Background:** The City needed to expand the city's surveillance efforts in a cost effective manner to improve safety and protection for residents resulting in the Atlanta Police Foundation utilizing technology to address their needs.

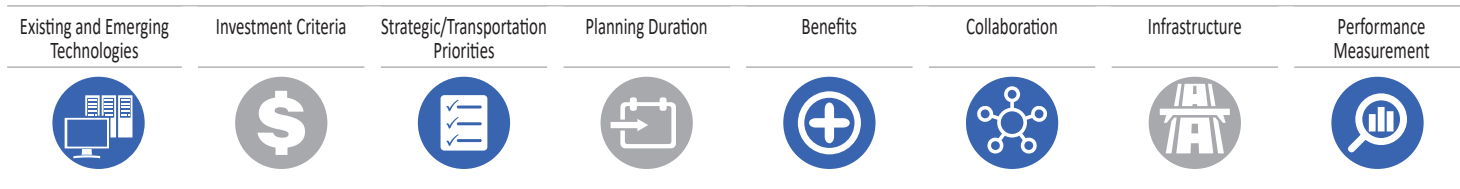
► **Strategy:** In order to increase visibility, the Police Foundation launched the Operation Shield system. this integrated system was designed to access video resources from private and public entities into a single platform. In collaboration with public schools, departments of public works, watershed management and aviation, and the Atlanta Police Foundation, the accessed videos now stream across a mesh network, fiber and 4G connections for cloud storage. Through the security information management system, these videos can be accessed by police officers as needed.

► **Key Outcomes:**

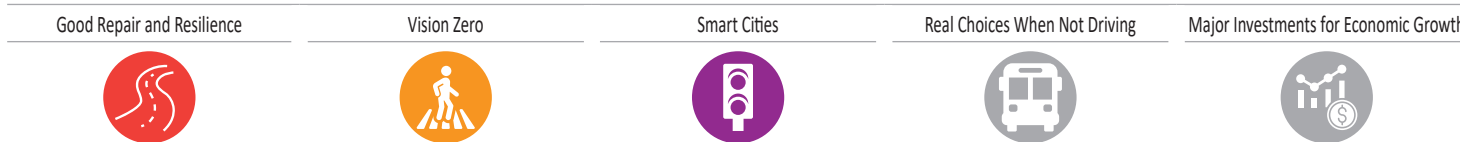
- Leverage security footage without maintenance cost
- Regional collaboration and video sharing between private businesses, shopping malls and housing complexes
- Improved emergency response



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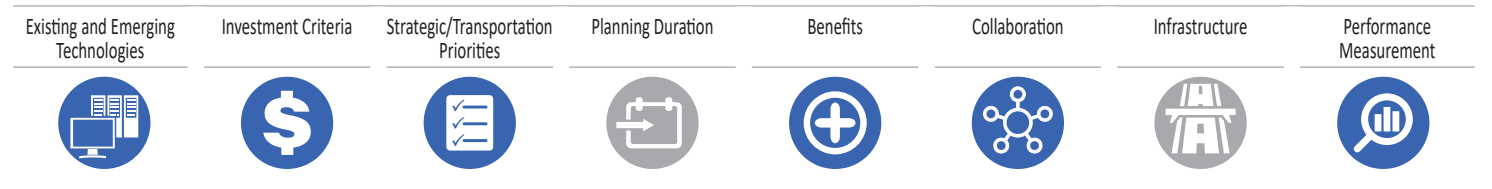


TARGETED HILLSBOROUGH CORE INVESTMENT AREAS



Sources:
<https://www.chulavistaca.gov/departments/police-department/programs/uas-drone-program>
<https://www.chicagotribune.com/sd-me-chula-vista-police-drone-program-california-cpca-award-20190318-story.html>

TARGETED SMART CITIES ELEMENTS AREAS



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Sources:
<https://atlantapolicfoundation.org/operation-shield-6-2/>
<https://atlantapolicfoundation.org/programs/operation-shield/>

Stakeholder Partnership

Stakeholder collaboration and partnership plays a key role in developing strategic goals, regional priorities, coordinating efforts and achieving consensus. Partnerships will encourage

regional data and other resource-sharing to benefit both agencies and residents. Partnerships will encourage regional data and other resource-sharing to benefit both agencies and residents.

NATIONWIDE EXAMPLE SOLUTIONS:

Smart Cities Regional Initiative, San Diego, CA

- **Background:** The initiative was launched by Cleantech San Diego in collaboration with cities of Carlsbad, Chula Vista and San Diego, Port of San Diego, International Airport and SANDAG. The initiative's common goal was to facilitate local government's services in an integrated manner for connected communities, economic development, equity and inclusivity, and Quality of Life improvements.
- **Strategy:** Through this integrated collaboration initiative, San Diego transformed the regional approach in providing government services to stakeholders and residents, and has had a significant impact on the social, economic and environmental development within the region. The cross-jurisdictional collaboration has also enabled the regional stakeholders to make "smarter" and informed decisions, maximizing public funding, improving civic participation and creation of a platform that enables innovation and business growth.
- **Key Outcomes:**
 - Established a connected community through integrated services on a single platform
 - Improved equity and inclusivity, and promoted economic growth
 - Strengthened the relationship between stakeholders, businesses and residents
 - Enabled a cultural shift and therefore further harmonized agency operations

Cross Sectoral Partnerships, Boulder, CO

- **Background:** Boulder recognized the need to develop cross sectoral partnership within the region to develop and set the vision and priorities for Smart City deployments.
- **Strategy:** City of Boulder planned workshops and invited a wide range of institutions to participate, including government agencies, universities, private sector, and federal laboratories. The purpose was to establish a regional consensus for regional Smart Cities priorities and to identify strategies for using data to improve government programs and service-delivery.
- **Key Outcomes:**
 - Working group of diverse partners with diverse interests collaborated to create a shared vision
 - Identified priorities for the deployment of smart city technologies and strategies that the entire region can benefit from
 - Strengthened the relationship between stakeholders, businesses and residents



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Sources:
CITA

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Sources:
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Smart Public Transit

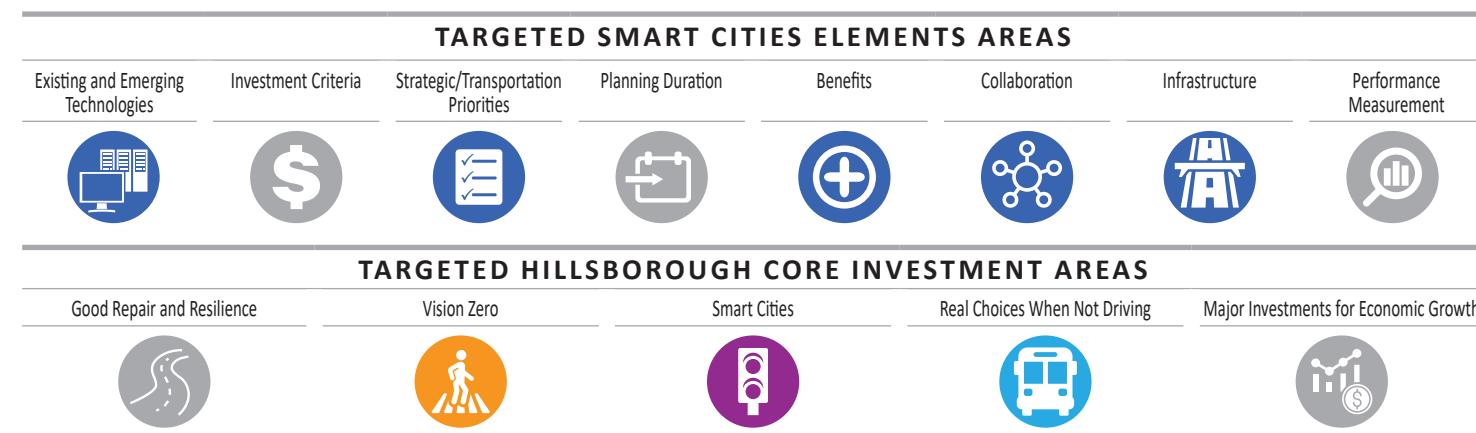
Maintaining and navigating a transit system provides many opportunities to enhance the experience with innovative technologies. Providing smart transit options is critical to improving equity and inclusivity for those who rely on transit for their mobility needs. A successful smart transit program can be measured by performance metrics like reliability, ability to access travel

information, accessibility, convenience, infrastructure quality, and quality of the rider experience. Mobile ticketing, smart screens and digital displays, and applications allowing real-time information are just a few examples of smart public transit enablers.

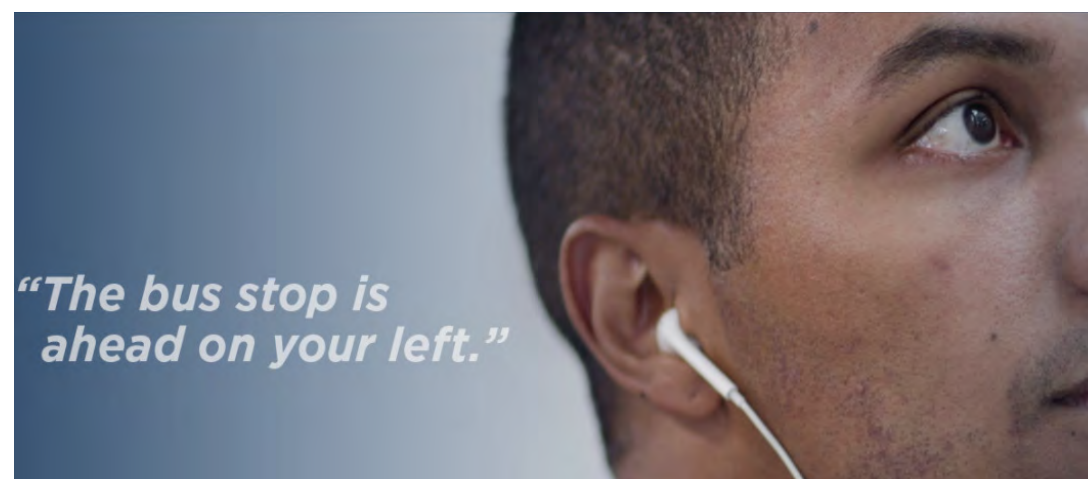
NATIONWIDE EXAMPLE SOLUTIONS:

Wayfinding for the Blind, Long Island, NY

- **Background:** 26% of adults in the United States have some type of disability with 4.6% having a vision disability with blindness or serious difficulty seeing. Long island's NICE provides transit services to thousands of riders every day. This also includes riders with visual impairments. Despite the funding challenges and the growing costs of operation and maintenance, NICE recognized the importance of providing convenient service to visually impaired riders. The sensors are integrated into an audible wayfinding app to use real-time data and connect users and mobile devices to transit center facilities to help them navigate their way through the Rosa Parks Hempstead Transit Center which one of the most visited transfer points.
- **Strategy:** Through partnership with Sensible Innovations, Nassau Inter-County Express (NICE) installed a smart wayfinding system to serve riders with special needs. The sensors are integrated into an audible wayfinding app to use real-time data and connect users and mobile devices to transit center facilities. They installed iBeacon low-energy electronic sensors throughout the transit center as well as the bus bays, entrances and information/ticket counters.
- **Key Outcomes:**
 - Improved equity, inclusivity, access to real-time information and convenience to riders with special needs
 - Improved transit services by connecting users and their mobile devices to transit center facilities
 - Enhance collaboration and partnership



Sources:
<https://www.nicebus.com/Able-Ride/Aware-App>
<https://www.sensible-innovations.com/single-post/2017/05/05/New-NICE-bus-app-helps-blind-riders-navigate-transit-center>
<https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html#:~:text=61%20million%20adults%20in%20the,is%20highest%20in%20the%20South.>



Smart Utilities

With growing population in cities and urban areas, local agencies and city managers recognize the need to identify smart and innovative approaches to save money, optimize resources and making smart utilities projects a priority in improving efficiency and quality of life. Smart utilities technologies and strategies provide real-time data and monitoring of consumption, improve

visibility and awareness on the utilities usage and enable performance measurement. Connected systems improve utilities' reliability, enhance connectivity, and promote economic growth. Together with innovations such as solar power, microgrids and electric vehicles charging stations, smart utilities result in improve level of service to the community.

NATIONWIDE EXAMPLE SOLUTIONS:

Smart Grid, Montgomery, AL

- **Background:** In a collaborative effort, Alabama Power, the City of Montgomery, Montgomery County and Montgomery Area Chamber of Commerce focused on improving the alignment and collaboration on smart community projects within the region.
- **Strategy:** The organization created the Montgomery Smart Community Alliance and identified electric grid reliability as a priority. To address this, Alabama Power deployed the Montgomery Area fiber and reliability project and sectionalized segments of the power lines for fault isolation. This helped improve the crew deployments and troubleshooting activities. The organization used the same approach in providing dark fiber connectivity for Montgomery Chamber of Commerce.
- **Key Outcomes:**
 - Increased overall reliability and Quality of Life by reducing power outages
 - Used the same fiber to improve City's public Wi-Fi network, enhanced connectivity and reduced connectivity costs
 - Improve troubleshooting activities through fault isolation
 - Enhanced economic growth
 - Expansion to smart neighborhoods



Building Energy Benchmarking and Reporting Program, Seattle, WS

- **Background:** The city recognized that clear and accessible data can encourage energy efficiency and improvements.
- **Strategy:** Seattle's data visualization dashboard was developed with the goal of providing access to data such as addresses, floor areas, age and building-use characteristics, energy use intensity, Energy Star score and greenhouse gas emissions. The data posted in 2015 shows an overall increase in efficiency with drop in energy consumption for the 3,300 properties listed on the dashboard. The city also increase the number of Energy Star certification-eligible buildings by 13 percent between 2015 and 2016 with a 99 percent compliance rate over three years.
- **Key outcomes:**
 - Accessible dashboard for property owners, tenants, building operators, policy makers, contractors, and utilities managers to filter, download and sort data
 - Performance measurement, increased compliance rate, energy efficiency and consumption reduction
 - Building rating transparency and GHG emissions



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Good Repair and Resilience	Vision Zero	Smart Cities	Real Choices When Not Driving	Major Investments for Economic Growth

Sources:
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TARGETED SMART CITIES ELEMENTS AREAS

Existing and Emerging Technologies	Investment Criteria	Strategic/Transportation Priorities	Planning Duration	Benefits	Collaboration	Infrastructure	Performance Measurement

TARGETED HILLSBOROUGH CORE INVESTMENT AREAS

Good Repair and Resilience	Vision Zero	Smart Cities	Real Choices When Not Driving	Major Investments for Economic Growth

Sources:
 Smart Cities Plan, Bellevue
<https://www.seattle.gov/environment/climate-change/buildings-and-energy/energy-benchmarking/how-to-comply>
<https://www.seattle.gov/Documents/Departments/OSE/Seattle%20Energy%20Benchmarking%20Analysis%202016%20for%20web.pdf>
<https://www.aceee.org/sites/default/files/pdf/topic-benchmarking.pdf>

Smart Energy and Sustainability

Smart energy and sustainability strategies and technologies help cities save money, improve energy efficiency and delivery, and contribute to regional economic growth. Strategies and technologies may include EV charging stations, LED lighting retrofits, solar panel systems, and more. These tools help cities meet and advance their sustainability goals and reduce impact on natural and environmental resources. Sustainability is one of the core elements of smart cities and

is also an emerging field. While urbanization continues to grow and contribute to the increased carbon emissions globally, critical actions must be undertaken to prioritize a low carbon future. Governments, cities, and stakeholders must work collaboratively to address the climate change impacts.

NATIONAL EXAMPLE SOLUTIONS:

Electric Vehicle (EV) Charging Infrastructure, San Francisco, CA

- **Background:** To provide sufficient infrastructure for EVs, the city needed a network of charging stations to meet the growing demand, as well as encouraging the EV ownership through improving access to the charging stations.
- **Strategy:** In partnership with Black & Veatch and San Francisco-based Volta Charging, the city achieved a significant expansion of Volta's network of free public charging stations. Organizations worked collaboratively to obtain the required permits and perform engineering and design activities. They also worked with businesses where stations were located to address their needs.



- **Key Outcomes:**
 - Improved access to charging stations and accelerated EV adoption
 - Clean-energy vehicle infrastructure and free charging
 - Alleviate range anxiety by rapidly scaling its portfolio of free public electric car charging stations

Net Zero Microgrid, Denver, CO

- **Background:** Due to the rapid population growth, the city identified congestion and environmental impacts as two of the top priorities. The City and County of Denver and Excel Energy came together to find a solution that not only addresses congestion and environmental issues, but also evaluates emerging technologies and provides economic benefits.
- **Strategy:** In collaboration with Panasonic CityNOW, Xcel Energy deployed a net zero microgrid as a living lab to test smart innovations. The lab, Peña Station NEXT, is a 382-acre transit oriented public-private development located near Denver International Airport. Other key players in this effort include Denver International Airport, RTD, Colorado DOT, Fulewider and U.S. Department of Energy's National Renewable Energy Laboratory (NREL). This is a great example that demonstrates the importance of stakeholder alignment for success of smart city projects. The award-winning microgrid project includes a 1.6 MWdc carport solar photovoltaic (PV) system, a 259 kWdc rooftop solar PV system, a 1 MW/2 MWh battery energy storage system, and Panasonic's Technology & Business Solutions Center, which serves as the anchor electricity load.



- **Key Outcomes:**
 - The solar carport produced approximately 5 MWh per day, making the development carbon neutral
 - Solar PV at one of the locations recharges the battery and can maintain operations depending on the availability of sunshine
 - A smart streets network that integrates connected LED streetlights, environmental sensing, community WiFi, public safety, and smart parking; and an on-street deployment of V2X technology.

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TARGETED HILLSBOROUGH CORE INVESTMENT AREAS

Good Repair and Resilience	Vision Zero	Smart Cities	Real Choices When Not Driving	Major Investments for Economic Growth

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Sources:
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Data Management

As a critical practice in development and management of smart cities, managing data is a valuable resource to unlock improvement potentials based on the performed analysis. It provides opportunities to perform accurate performance measurement and make data-driven performance-based decisions. Data management targets stakeholder collaboration and partnerships, advances

utilization of existing and emerging technologies, and improves regional efforts in sharing data and resources, ensuring the different efforts support each other and help achieve overall goals and objectives. Effective data management requires development of a data strategy and reliable methods to govern, access, secure, integrate, aggregate, store for data analytics.

NATIONWIDE EXAMPLE SOLUTIONS:

Digital Equity Strategic Plan, Kansas City, KS

- **Background:** The purpose of the Digital Equity Strategic Plan is to address the issue of Digital Divide and data access for locals including the Mayor, City Council, City staff, corporate citizens and the community at large. It is developed to promote a shared understanding of the need for taking actions to ensure locals are able to access and participate in an increasingly digital society.
- **Strategy:** The Strategic Plan outlines strategies that will help create opportunities for all local residents to gain equitable access to and utilization of the digital resources. It was built upon and leveraged current and future strategic priorities, such as the City's Digital Roadmap, Smart City initiative, Community Health Improvement Plan (CHIP), Neighborhood & Housing Services Departments' Five Year Consolidate Plan and partnerships with others to engage in Digital Inclusion locally and nationally.
- **Key Outcomes:**
 - Improved Digital Equity, including but not limited to access to internet/Wi-Fi and data
 - Developed a strategic direction with six (6) Digital Equity Policy Priorities and associated action items
 - Involved community outreach and engagement to develop a regional consensus
 - Benchmarked the current activities and identified gaps



Data Privacy Policy Protection, Boulder, CO

- **Background:** To establish privacy protection procedures and publicize privacy policies, the IT department in Boulder collaborated with the city managers and agencies for a detailed review of data schema and record refresh plans before publishing their open data website.
- **Strategy:** [Opencolorado.org](https://opencolorado.org) is a platform that holds public data available and accessible to the residents. The city's IT department developed licensing terms, including terms of use, attribution and a disclaimer, and collaborated with local governments to share public information and transparency strategies.
- **Key Outcomes:**
 - Accessible data for local residents
 - Improved data sharing, protection and policy, access and transparency
 - Enhanced collaboration with stakeholders



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Sources:
 Kansas City Digital Equity Strategic Plan
<https://cityfi.co/portfolio/kc-digital-roadmap/>

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Sources:
 Getting Smart About Smart Cities
<https://opencolorado.org/>

Information Communication Technology (ICT)

From smart cities initiatives, to IoT, Big Data and data management, ICT plays a key role in development and success of the success of strategies. ICT has transformed our lives within the past decades, and continues to do so as the technology advances. “Smart cities use information and communication technologies (ICT) together with other means to improve Quality of Life and

efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generation with respect to economic, social and environmental aspects” (Smart Sustainable Cities: An Analysis of Definitions). IT provides the means to maintain the existing and develop future digital infrastructure required to deliver services to the community.

NATIONWIDE EXAMPLE SOLUTIONS

Establishing Working Relationships with IBM, City of Houston, TX

- ▶ **Background:** The City of Houston was one of the many cities that recognized the importance of developing working relationships with Tech companies to bridge the gap between government and the public sector. Local governments often do not have the resources and capacity to provide and operate smart city solutions, the participation and partnership with private industry was identified as an essential element to the success of deployed solutions.
- ▶ **Strategy:** The City of Houston identified smart recycling and waste management as a priority. Recognizing the value of collaboration and partnership, the City sought to develop working relationships with IT organizations to help reimagine recycling and waste initiatives. As one of the IBM Smarter Cities grant recipient, the City of Houston established working relationships with IBM to perform analysis and lessons learned from initial testing and pilot projects. The City performed follow-up meetings and engagements to establish a better understanding of the city’s needs and ultimately develop flexible solutions.
- ▶ **Key Outcomes:**
 - Enhanced working relationships and collaboration with Tech sector
 - Tech sector became a partner in developing and exploring new solutions rather than just selling, therefore established mutual wins



Creating Leadership Roles for IT, San Francisco, CA, City of Chicago, IL, and Boston, MA

- ▶ **Background:** With the increasing advancement in Information Technology (IT)/ICT, and the rise of big data and analytics, lack of IT skillsets and expertise is becoming problematic. Many from the private industry approach local agencies and governments with a range of new technology solutions. Many city leaders consider IT positions as service providers to other divisions and department, and not as subject matter experts that can help develop and drive strategic priorities in smart cities. As local agencies unlock technology and data potentials, decision makers are recognizing the role of IT and the organizational changes required to accommodate IT expertise, knowledge and skillset.
- ▶ **Strategy:** Cities such as San Francisco, Chicago and Boston are embracing new roles and position for IT. San Francisco and Chicago have hired Chief Data officers to assist and oversee their open data activities and initiatives, as well as the increasing data and IT related projects. Boston took a similar approach and hired Sustainability Data Managers who oversee and are responsible for centralizing sustainability data in the city and keep the IT community connected.
- ▶ **Key outcomes:**
 - Dedicated staff for IT and data management
 - Development of formalized roles and responsibilities for ICT/IT
 - Cultural shift in the organizational structure



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Sources:
 Getting Smart About Smart Cities
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<https://www.houstonpublicmedia.org/articles/news/2012/08/07/37188/ibm-to-provide-free-help-for-houston/>
<https://www.dallasweekly.com/articles/ibm-smarter-cities-challenge/>

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Sources:
 Getting Smart About Smart Cities
<https://www.seedinfotech.com/importance-organization-culture/>

Citizens Engagement

In order to keep a consistent pace in identifying and addressing residents' needs within communities and promote economic growth, local agencies and city managers strive to utilize not only smart, but also innovative strategies and solutions to keep the community engaged. Some

NATIONWIDE EXAMPLE SOLUTIONS:

Open Source/Open Data Initiatives, San Francisco, CA, City of Chicago, IL, and Boston, MA

► **Background:** To enhance residents' engagement, smart cities are utilizing crowdsourcing applications and are publishing open data sets to provide platforms for information sharing and data access. These applications and initiatives have represented a significant transformation in the way local agencies interact with their residents and communities. However, in some cases, civic hackers and the unintended consequences have caused challenges in data security and privacy.

► **Strategy:** Some cities, including San Francisco, Chicago and Boston, have developed programs and policies that encourage agencies to track and publish existing and non-sensitive data to the public. The community, including residents, private vendors and entrepreneurs utilize the data to develop useful applications and perform analysis for their own purposes. For example, San Francisco released 600 data sets and as a result, dozens of smart apps have been created that help residents and communities on a daily basis. Even though the open data initiatives has helped local agencies with transparency and improved collaboration, the actions undertaken under these initiatives are time consuming and requires additional resources. To address this, cities are looking into ways to better manage and aggregate crowdsourced data and are being more strategic regarding what data sets they make available to the public.

► **Key Outcomes:**

- Improved access to data
- Facilitated transparency and crowdsourcing
- Enhanced collaboration
- Improved data management



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Sources:
 Getting Smart About Smart Cities
<https://www.dataversity.net/intelligent-crowdsourcing-big-data-solution/>

cities have identified enabling residents to provide feedback as well as participating in decision making process as a priority. This will also result in developing solutions that promote equity.

MyColumbus App, Columbus, OH

► **Background:** As stated within the city's Smart City Plan, Columbus is committed to transparency and partnership, and is comfortable and confident in sharing and using data, information and visualization to engage residents and inspire innovation. "Columbus has an active and engaged citizenry with whom the City routinely communicates through established institutional structures such as our Mobile City Hall, Neighborhood Pride, and Area Commissioners" (Smart City, The City of Columbus, p.10).

► **Strategy:** The city developed the MyColumbus app that maintains ICT data from across the city and is available to public and a fingertip. The app provides enhanced access to the community resources including transit schedules, capital project information, 311 service requests, and more. The app also promotes environmental and personal health through providing information about local sporting events, parks, and tips for environmentally sustainable behavior. In addition, users can push and pull information through an interactive feedback loop housed within the app.

► **Key Outcomes:**

- Robust data visualization accessible to public
- Interactive feedback that allows data sharing (through both pulling and pushing information)
- Winner of the 2014 Consumerization of IT in the Enterprise (CITE) Award for Best Customer App
- Publicly available online data center, with access to zoning, aeriels, traffic counts, GIS layers, and population estimates
- Allowing users to create maps, charts and other visualizations free of charge using a variety of data and geographic areas from the Columbus region



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Sources:
 Columbus Smart City Plan
<https://www.thecolumbusteam.com/2016/05/have-you-discovered-the-mycolumbus-app/>

Smart City Maturity Model Framework/ Performance Management

Understanding and benchmarking progress prior to deployment of strategies and technologies plays a critical role to ensure activities are performance-based, are in alignment with goals and objective, and resources are allocated efficiently to address areas of opportunity and strength. To establish a better understanding of current activities, plan future activities, address areas of

NATIONWIDE EXAMPLE SOLUTIONS:

Smart City Maturity Model Framework, Bellevue, WS

► **Background:** To establish a better understanding of the current state of the practice and development of a more tailored approach in identifying the next steps in smart city planning, Bellevue Smart utilized the framework to utilize the assessments' analysis in defining strategies. The framework utilizes five (5) levels of maturity including Level 1) Ad-Hoc, Level 2) Opportunistic, Level 3) Purposeful & Repeatable, Level 4) Operationalize/Managed, and Level 5) Optimized.

Maturity Index	1	2	3	4	5
Standard Scale	Ad-hoc	Opportunistic	Repeatable	Managed	Optimized
CONNECTIVITY					
TRANSPORTATION					
PUBLIC SAFETY					
WATER					
BUILDINGS					
ENERGY					



► **Strategy:** The plan utilized the framework to benchmark activities, measure smart city maturity, perform gaps analysis, and identify the desired level of maturity for each element within a specific timeframe. The intent was to programmatically progress towards a higher level of maturity to achieve increasing capabilities and develop strategies for resource allocation.

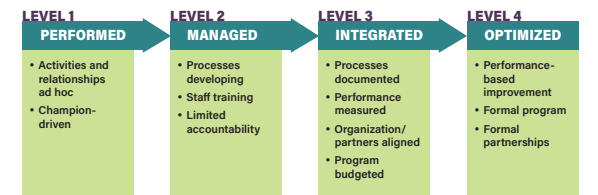
► **Key Outcomes:**

- Assessed and benchmarked current state of the practice
- Levels and gaps guided the development of strategies, including budget proposals and other funding opportunities and plans
- Smart city elements were broken down to sub-elements for further analysis of action items required to mode towards the desired level

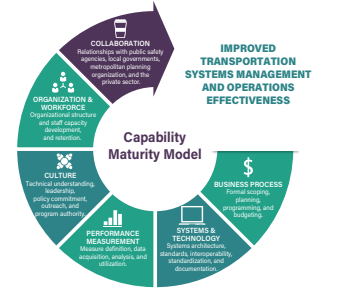
strength and opportunity, and measure progress in desired outcomes, and identify the next steps, cities and agencies are developing performance measures and measures definitions. Some cities also utilize the Smart City Maturity Model Framework, a self-assessment approach to identify the level of maturity for each smart city elements.

Transportation Systems Management and Operations (TSMO) CMM Workshop, Nevada Department of Transportation (NDOT)

► **Background:** The first step for NDOT to develop a TSMO program was the 2014 Capability Maturity Model self-assessment workshop. Under the supervision of the Federal Highway Administration (FHWA) and the American Association of State Highway and Transportation Officials (AASHTO), and through research conducted by the Second Strategic Highway Research Program (SHRP 2), NDOT was one of the first DOTs selected to undertake a self-assessment workshop to evaluate the effectiveness of Nevada's transportation systems management and operations



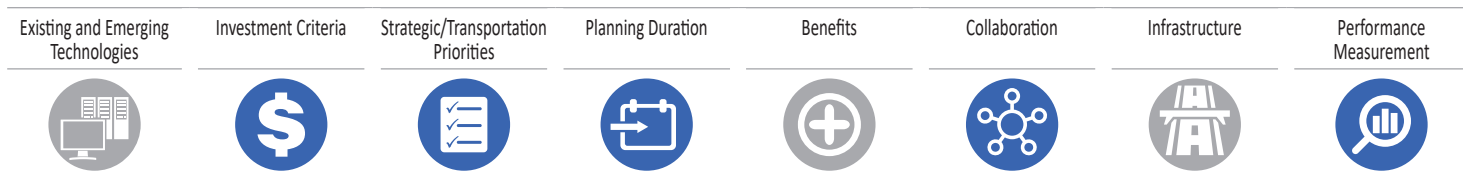
► **Strategy:** The assessment used the CMM as a tool and estimated the extent and maturity of TSMO activities under the six key dimensions of Business Processes, Systems and Technology, Performance Measurement, Collaboration, Culture, and Organization and Staffing. These CMM dimensions are interrelated and the success of one depends on the performance of another. These six CMM dimensions are integrated formally throughout NDOT existing processes to carry out the mobility objectives.



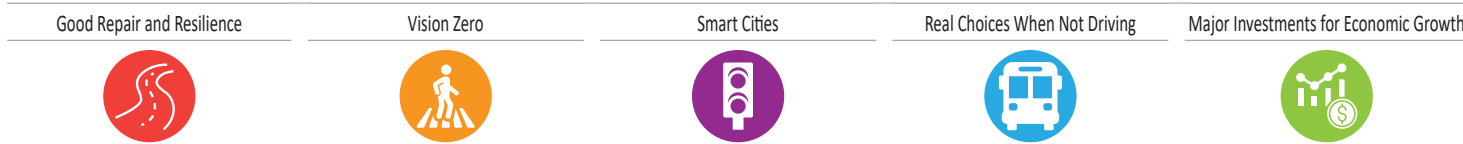
► **Key Outcomes:**

- Used the CMM dimensions as its framework for the statewide TSMO Program Plan to ensure the undertaking of targeted action items that will address all six dimensions.
- Developed a formalized schedule of recurring CMM self-assessments for the TSMO Program.
- Performed the agency's second CMM workshop in 2020 at the early stages of TSMO implementation to ensure action items are up to date considering the TSMO advancements since 2014 and are inclusive of targeting both internal and external stakeholders at a statewide level.

TARGETED SMART CITIES ELEMENTS AREAS

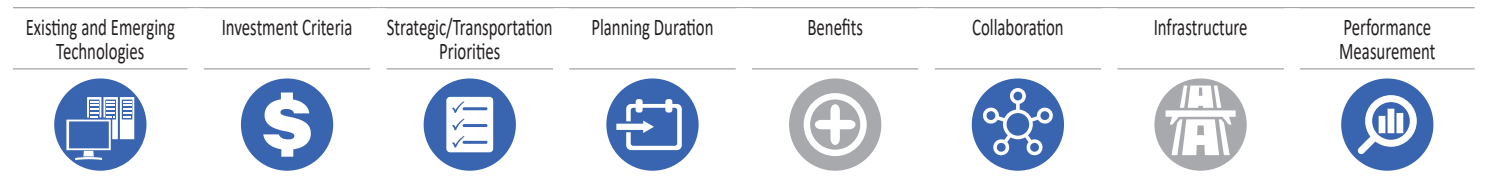


TARGETED HILLSBOROUGH CORE INVESTMENT AREAS



Sources:
 Bellevue Smart City Plan
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TARGETED SMART CITIES ELEMENTS AREAS



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Sources:
 NDOT Statewide TSMO Program Plan, January 2020
<https://ops.fhwa.dot.gov/publications/fhwahop17017/ch3.htm>
 Creating an Effective Program to Advance Transportation Systems Management and Operations, FHWA, Jan 2012

Enforcement Systems

Automated enforcement systems are typically defined as using cameras to monitor and/or enforce traffic control laws. Automated speed enforcement systems include fixed cameras that can continually monitor traffic speeds without a human operator, and/or mobile camera operations, usually deployed in vehicles by law enforcement agents; and “speed-overdistance” systems

that photograph vehicles and measure speeds at both starting and ending points on roadways. Photographs of the speeding vehicle and license plate number are reviewed by jurisdictions, and the owner of the vehicle may receive a citation. This technology has been widely deployed, most extensively in Australia, Canada, Europe, and the United States.

Red light cameras are set up to photograph vehicles entering intersections after signals have turned red. Detection of an offense is made by sensors buried in the pavement and tied to a timing system integrating the traffic signal and pole-mounted camera. Photographs of a vehicle entering an intersection illegally and the license plate number are taken and then reviewed by the jurisdiction

EXAMPLE SOLUTIONS:

Transport for New South Wales

- **Background:** Average speed enforcement works by measuring the amount of time it takes a heavy vehicle to drive between two points and then calculates the average speed of the vehicle. If the vehicle’s average speed is higher than the speed limit for the length of road, the driver will receive a penalty for speeding.

All average speed enforcement lengths are certified by a registered land surveyor to ensure the accuracy of average speed calculations. The distance used when calculating a vehicle’s average speed across an average speed enforcement length will be the shortest practicable distance, which ensures that there is no possibility that a driver’s speed can be overestimated.

- **Strategy:** As part of the Road Safety Plan 2021, average speed cameras are being expanded into metropolitan areas to address risks associated with greater truck movements. Average speed cameras are being installed on motorways and in tunnels across the Sydney Metropolitan region.

These locations include the Cross City tunnel, Eastern Distributor, Lane Cove Tunnel, M2 Motorway, M5 Motorway, M5 East Tunnel, M7 Motorway, Northconnex, Sydney Harbour Tunnel, WestConnex M4, WestConnex M4 – M5 Link and WestConnex M8.

Average speed enforcement lengths are signposted. In regional locations there’s one advance warning sign on each approach that displays a camera image and the text “AVERAGE SPEED SAFETY CAMERA.”

- **Key Outcomes:**
 - decrease the number of crashes
 - prevent injuries, and
 - save lives - In the 25 regional locations where average speed cameras are currently operating there has been a 44 per cent reduction in deaths from crashes involving heavy vehicles.



Washington District Department of Transportation

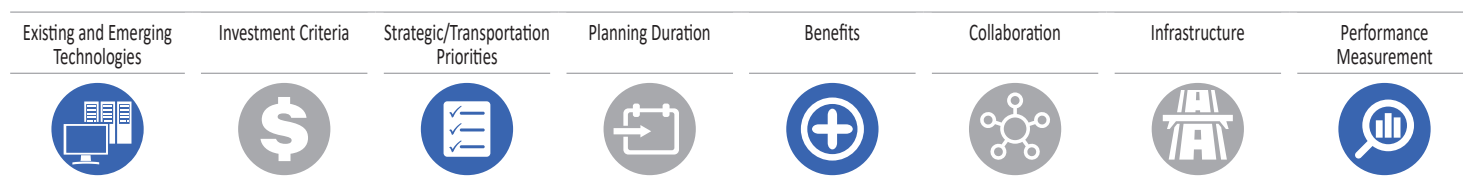
- **Background:** In 1999 citywide survey, District of Columbia residents identified unsafe driving—including running red lights and stop signs—as their number one public safety concern. Sixty-two percent said unsafe driving was a serious problem in their communities. (See the results of drivers who take chances and run red lights.)

- **Strategy:** Cameras capture violations on film and record all of the relevant data for the violation. For example, when a red-light violation occurs, the camera records the date, time, vehicle’s speed, and time elapsed since the beginning of the red signal. The images are then analyzed, possible extenuating circumstances are considered, and the registered owner of the vehicle is verified. A citation showing a photo of the violation is then mailed to the vehicle owner. Individuals may now view their violation images online (requires ticket number and unique personal identification number provided on the mailed citation). As of November 2020 there are 79 cameras and the location of these cameras are public available in addition, the public can make recommendations of future camera locations.

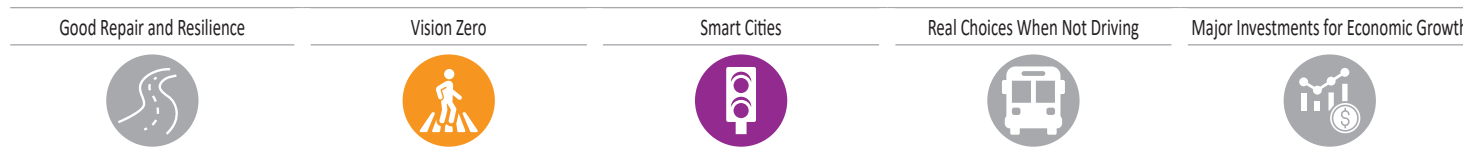


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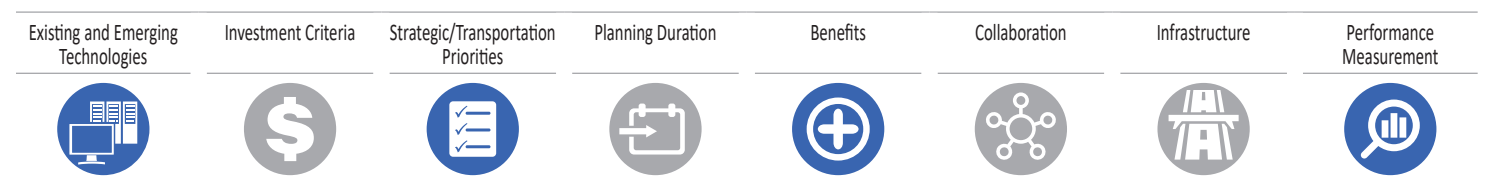


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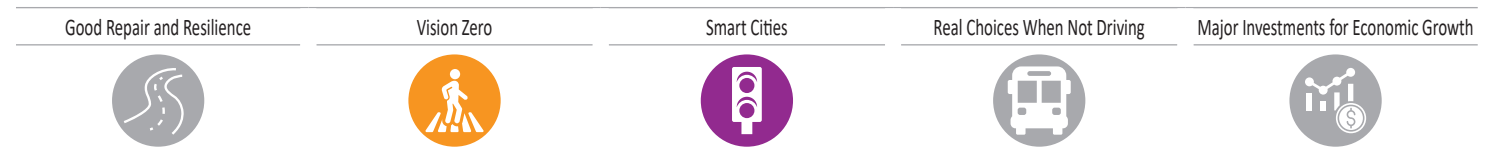


Sources:
 Automated Enforcement: A Compendium of Worldwide Evaluations of Results - DOT HS 810 763
<https://roadsafety.transport.nsw.gov.au/speeding/speedcameras/average-speed-cameras.html>

TARGETED SMART CITIES ELEMENTS AREAS



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Sources:
<https://ddot.dc.gov/page/red-light-enforcement>