US IGNITE SMART CITY ROI

BACKGROUND

Communities often have to take the long view with investments, particularly large capital infrastructure projects, but leaders also want their smart city efforts to deliver some tangible returns early on. To that end, US Ignite hosted a Forum workshop on Smart City ROI focused on projects designed to deliver financial and social returns in the near term.

The day's presentations and discussions highlighted deployments related to energy savings, community engagement, public safety, and transportation. There continue to be unexpected challenges, but also tremendous upside as cities implement connected platforms with room for continued growth.

On the challenge front, it's often difficult to project costs at the outset of a smart city deployment because there are few existing models for reference. The groundbreaking nature of these efforts also means that municipal partnerships may need to evolve, and that leaders have to communicate early and often with the public about goals and expected outcomes.

On the positive side, communities are accruing real benefits, and as pioneers, they're creating examples for other cities to follow. Equally important, these communities at the forefront of the smart city movement are putting platforms in place that will support new applications and services in the future. Today's smart streetlights, kiosks, drone deployments, adaptive traffic signals, and smart parking strategies are just the beginning of a transformative effort that will reshape communities for decades to come.

The US Ignite Forum workshop on Smart City ROI took place on February 6, 2020 in San Diego. Along with representatives from the city locally, the workshop featured community leaders from Atlanta; Boston; Greensboro, North Carolina; Carlsbad, California; and Chula Vista, California – plus additional university, industry, and non-profit partners.

This playbook shares their experiences and conclusions.

SMART STREET LIGHTING – SAN DIEGO

San Diego has what is arguably the largest smart city platform anywhere in the U.S., including 4,100 streetlights with adaptive controls and 3,200 sensor nodes deployed on light fixtures. The city is planning to install another 1,000 nodes before the smart streetlight project is complete.

Because of the scale of the San Diego implementation, which is deployed in partnership with AT&T and GE Current, the city is now a test case for streetlight projects everywhere. On its face, the potential advantages are huge. The conversion to LED lighting alone was modeled to save about $1.5 million in energy costs per year, and there are additional savings to be gained from dimming streetlights when full power isn't needed, and from reductions in operational costs related to lighting maintenance. Beyond the energy savings from LED conversion, there are also new application opportunities created by the attached sensor nodes. Researchers will be able to use data from these nodes to track microclimate changes for urban planning purposes, and to understand pedestrian traffic patterns for public safety efforts and retail business development.

San Diego smart streetlights

The project is revolutionary, but because it's one of a kind, San Diego leaders are also encountering unexpected issues that impact return on investment. The city is now making the necessary adjustments to counter these challenges.

As San Diego pursues the expected long-term financial and sustainability benefits of its smart streetlight deployment, here are the problems it's solving along the way.

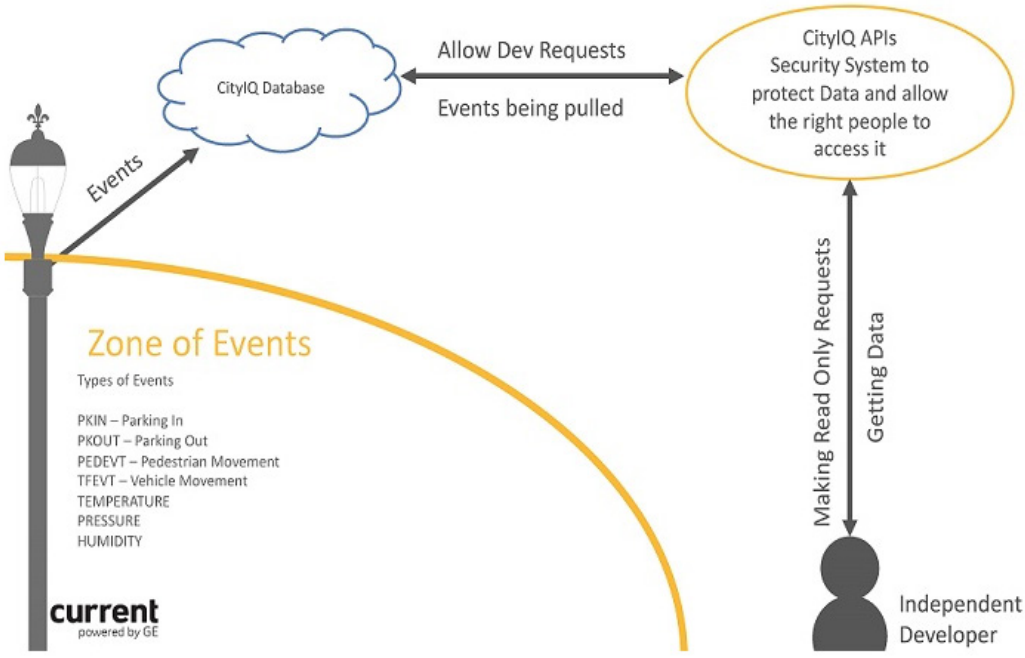
CHALLENGE #1 – OPERATIONS

The conversion to LED lighting alone has driven significant energy and cost savings for San Diego, but the ability to dim those lights as a low-power option promises even more benefits. Unfortunately, under the current agreement with San Diego Gas & Electric, the city gets charged for streetlight power on a bulk-rate model. LEDs get charged one rate, high-pressure sodium lights get charged another rate, and so on. To save money from dimming, each streetlight would need to have its own individual utility account, allowing the city to be charged for actual energy usage.

San Diego hasn't yet tested the economics of streetlight dimming, but the city is planning a pilot project to move a subsection of the new streetlights to a variable rate. Doing so will significantly increase the number of utility accounts that officials have to track, manage, and review. However, it also has the potential to dramatically further reduce costs.

CHALLENGE #2 – FINANCIAL EXPECTATIONS

While the long-term outlook for saving significant money with smart streetlights is promising, implementation delays are extending the timeline for recouping project costs. There is also the challenge that the streetlight sensors require additional power separate from the LED lights and lighting controls. The cost of electricity required to power the sensors mitigates some of the benefits of energy reduction from the city's conversion to LEDs. San Diego is adjusting its cost models with the recognition that the overall financial savings derived from energy efficiency are not likely to be as high as originally projected.



Data collected by streetlight sensor nodes

CHALLENGE #3 – PUBLIC ENGAGEMENT

As a groundbreaking new project, the San Diego smart streetlight initiative could have benefited from earlier and more comprehensive communication with the public around goals, impacts, and milestones. The city continues to work on better communicating its efforts, both around how the sensors function, and how energy and cost savings are likely to accrue.

SAN DIEGO INTELLIGENT STREETLIGHT BENEFITS:

- Cost savings on deploying sensors & LEDs simultaneously
- Adaptive controls
- The right light level at the right place at the right time
- Proactive maintenance capabilities
- Operational energy & cost savings
- Valuable data for city planning & public use

LESSONS LEARNED

Not everything has gone according to plan for San Diego. Critically, though, the city is working through the gnarly details of deployment in a way that should not only benefit San Diego in the future, but also other communities planning streetlight upgrades. As Deputy Director of Sustainability Heather Werner pointed out, the city has every incentive to make the project a success. Cost savings are a big motivator, but so too are the advantages from applications that have yet to be developed in conjunction with the data collected from the streetlight sensor nodes. These applications have the potential to help the city provide better resident and business services, improve public safety, and meet climate action plan targets.

KEY TAKEAWAYS

- Be prepared to work closely with a utility partner to coordinate any billing changes required to support adaptive lighting.
- Recognize all of the factors that go into cost modeling – including potential operational delays and new resource requirements – particularly as a deployment scales.
- Communicate early and often about project objectives and the impacts on city operations, residents, and businesses.

SMART STREET LIGHTING – ATLANTA

Although Atlanta uses the same AT&T/Current technology platform that San Diego has deployed, the east coast city's approach to smart streetlights has been very different from its counterpart in California. Through a close partnership with Georgia Power, Atlanta officials have focused heavily on the applications enabled by streetlight sensor nodes, and specifically the use cases around public safety and mobility that those sensors support. The partnership is essential to the deployment since the streetlight infrastructure is shared, with about 75% of streetlights owned by Georgia Power and roughly 25% owned by the city of Atlanta. The streetlight upgrades are not tied to a parallel LED conversion effort, and the pilot project has included only 200 streetlights compared to the San Diego deployment of several thousand.

One of the key takeaways the Atlanta team discovered during its sensor implementation is the importance of extending the project beyond the public works department to create a broader, citywide endeavor. By expanding the stakeholder group to include public safety, city planning, sustainability, and transportation departments, the team has found that it can create more value and return on investment through the increase of potential use cases.

On the other hand, city officials have also noted that there are places where technology is not the appropriate solution to a problem, and where technology can create new challenges that need to be addressed.

USE CASE #1 – SMART PARKING

Through a combination of streetlight sensors and an application from CivicSmart, the Atlanta team was able to test the use case of parking enforcement. In one test, the city trained the CivicSmart software to take in sensor data from parking spaces downtown to calculate parking time and identify parking events in areas near stop signs and fire hydrants. Officials then used the application to record infractions and trigger notifications to the city's parking enforcement partners.

The test was successful in communicating potential infractions to parking enforcement, and in proving that driver notifications are effective at changing behaviors. However, because of an effort made by the city to cease predatory parking enforcement, the use case test ended.

Sensor detection: vehicles parked in crosswalks

Instead of focusing on enforcement, city leaders decided to shift gears and use the software to record events that pertained to public safety. Officials began to test and record events of cars parking in crosswalks and bicycle lanes – events that could create dangerous conditions for pedestrians and cyclists. With a more strategic placement of sensor nodes, the city could use that information in the future to prioritize high-impact street safety projects.

USE CASE #2 – TRANSPORTATION STUDIES

Currently, the city commissions transportation studies to help inform the planning and design of infrastructure projects. These studies are finite, conducted over the course of six to 12 hours, one or two days out of an entire year. The CityIQ nodes on streetlights presented a unique opportunity for the city to collect and own transportation study data continuously throughout the year.

The CityIQ mobility data can inform decisions on: when and where to adjust speed limits by tracking speed over time, how to manage commuters in congested areas by tracking queue lengths, and when to change how lanes are managed to make the right-of-way safe for all modes of transportation by tracking lane utilization. The data collected provides the support for transportation policy decisions that might otherwise be based on optics or perception rather than hard data.

The city of Atlanta uses the streetlight sensor platform to provide more insight as it studies mobility. In one case, the city worked with technology partner GE to turn vehicle speed data into visualizations that clearly showed most vehicles traveling at only 10-15 miles per hour along a stretch of road in the downtown corridor. The visualizations contributed to a study that explored a decision to reduce the local speed limit. In another case, Atlanta officials used the sensors' lane utilization data to provide insight into a potential conversion of a four-lane, one-way road to a two-way road.

Critically for Atlanta, the city had to pay for much of its traffic data before installing streetlight sensors. Now it owns the data it needs, and has easy and comprehensive access. Data ownership has proven to be critical in managing infrastructure partners from other agencies. For example, earlier data had indicated a rush hour duration from 5:00 pm to 7:00 pm, but new sensor data indicates an earlier start time of 3:00 pm.

Lane utilization and speed studies

USE CASE #3 – GUNSHOT DETECTION

Gunshot detection is one of the flashier apps supported by Atlanta's smart streetlight platform, but it's also one where the costs have proven hard to justify. When officials tested the app, the data showed that four areas of the CityIQ footprint are responsible for more than 50% of gunfire incidents. However, police officers already knew this information from their own patrols, and it didn't improve their ability to protect the public. As a result, the city decided it would rather spend more money on law enforcement personnel than on the gunshot detection application.

Interestingly, the gunshot detection software was initially the only application for the smart streetlight platform that offered not just numeric data in its dashboard, but also visualization tools. According to Smart Cities Program Manager Christine Primmer of Georgia Power, visualization capabilities are proving critical for making effective use of the platform.

DATA VISUALIZATION IN ATLANTA

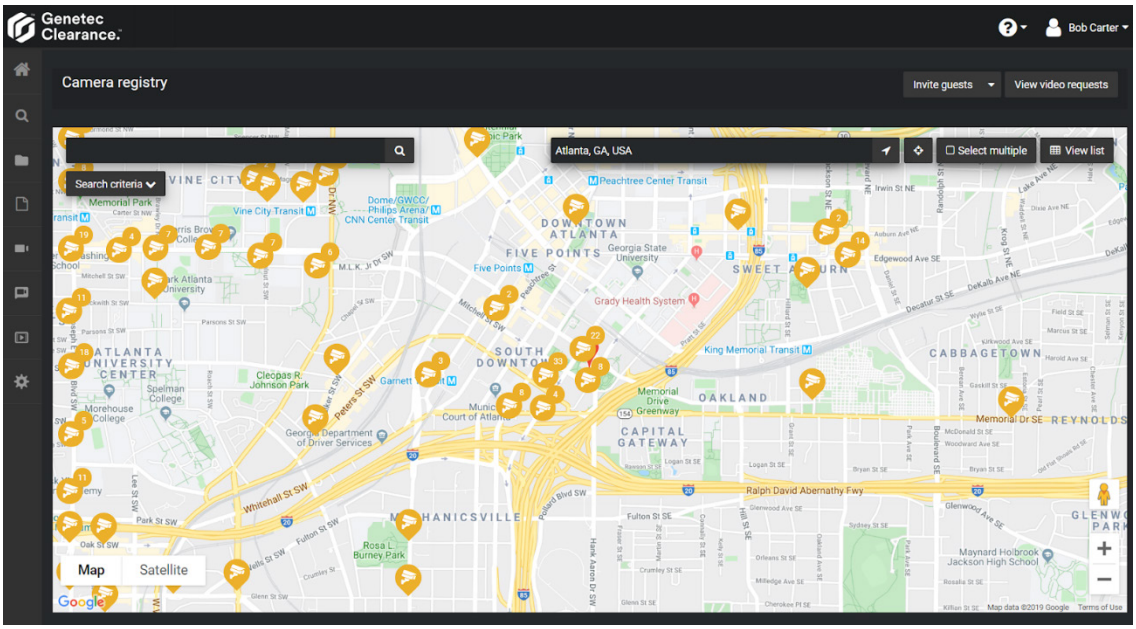
The architecture of the Atlanta node platform was built to be a data-generation engine, not necessarily a user interface. Despite the fact that the nodes were producing ~8.5M data points/day/node, these data points required a purpose-built application to consume the data and allow a business user to understand and analyze it.

The original scope of the project only included two applications with sophisticated interfaces: ShotSpotter with detection and analysis of gunshot/audio data, and Genetec Clearance with analysis of video data. In contrast, the applications for collecting traffic, pedestrian, and environmental data only provided high level, single-point-in-time information snapshots.

The project team discovered this limitation in March of 2018 and found it severely inhibiting of the ability to derive value and insights. The team began performing an evaluation of data visualization tools to add to the project. In October 2019, the team brought Xaqt – a data visualization company from Evanston, IL – on board to the scope of the project. The new Xaqt dashboard tools dramatically improved the city's ability to evaluate the data.

USE CASE #4 – VIDEO CAMERA MANAGEMENT

Video cameras for surveillance were already in widespread use in Atlanta before the city moved forward with its smart streetlight project. However, the availability of cameras on the streetlight platform gave the city the reason it needed to reevaluate its hardware budget and look for ways to save money. According to Atlanta Smart City Program Director Lillie Madali, the public-private partnership between the city and Georgia Power offered a more cost-effective video surveillance operation. Utilizing the partnership model allows the city to benefit from the mobility of the Georgia Power crews to maintain streetlight nodes. Including the cost of connectivity in a subscription model also drives overall cost down.



Camera registry for video evidence management

LESSONS LEARNED

For Atlanta government to realize a return on the smart streetlight investment, officials had to coordinate across multiple departments. By getting departments to work together and renegotiate contracts in bulk through the process of deploying new technology, Madali estimates that the city has the potential to save close to a million dollars from connectivity costs, transportation studies, and replacing existing sensors. At the same time, officials have also learned where new technology investments aren't productive. Some jobs are still better managed by humans, and data by itself has limited use without the right tools for analysis. Deploying technology unnecessarily only adds to technology fatigue and general disengagement by city employees and the public.

One other critical lesson learned in Atlanta has been the importance of having an overall manager of smart city strategy. Madali is still relatively new in her role with the city, but according to Georgia Power's Primmer, her presence has helped the team accomplish more in the last six to nine months than it was able to do in the two years previous.

Finally, Atlanta officials learned the importance of appropriately scoping new smart city projects up front. That includes the need to perform a full evaluation of all the data to be generated, as well as the analytics tools available. It also includes creating flexible ways to add new partners to a project as new needs are discovered.

KEY TAKEAWAYS

- Coordinate smart city and other technology projects across departments to take advantage of bulk contract pricing.
- Employ visualization tools to make the most of new sensor data.
- Be aware of bandwidth costs as camera deployments scale.
- Don't deploy new technology just for new technology's sake.
- Ensure flexibility of project scope to accommodate unexpected discoveries.

SMART KIOSKS – GREENSBORO, NC

Greensboro, North Carolina doesn't have the financial resources of a city the size of San Diego or Atlanta, but officials still look for innovative ways to improve civic services and drive local economic growth.

CIO Jane Nickles created the Envision Gate City project with the goal of turning Gate City Boulevard, a main thoroughfare in the city, into a smart corridor. Downtown Greensboro has a host of downtown attractions, but according to Nickles, people typically show up in the area for one purpose or event, and then leave again before exploring other opportunities. With Envision Gate City, she proposed to deploy kiosks throughout the area, encouraging visitors to discover something new in town with the help of kiosk services including wayfinding, public transportation information, free WiFi, and more.

Greensboro partnered with Smart City Media (SCM) to install about a dozen smart kiosks, signing a ten-year agreement that requires no capital investment from the city. In addition to providing information and connectivity, each touchscreen kiosk also: serves as a two-way emergency calling station, supports multiple languages, is ADA approved, and sports a camera for visitors who want to take selfies.

The kiosks are designed to pay for themselves with revenue generated from advertisements.

In the Greensboro arrangement, SCM manages content and communications for the kiosks, Verizon provides the WiFi connectivity, Duke Energy installs and maintains the hardware, and Street Level Media sells the ad space. When kiosks are idle, an ad plays for ten seconds, broadcasting every two minutes across all of the 55-inch kiosk screens in the area. The city can also post its own announcements free of charge, with inventory split between paid ads and public notices. When a kiosk is in use, the ad or notice covers half the screen and continues to play on a loop. Ad revenue initially goes toward recouping capital expenditures, but once the kiosks are paid off, which Nickles estimates will happen in about two years, the city will get 25% of ad funds minus operating and maintenance costs.

BENEFITS AND RESULTS

Early results from the Greensboro kiosks have been positive. People are engaging with the installations, ad inventory is 60% sold out after only five months, and the city is already experimenting with features like changing the LED lights on kiosks to reflect local university colors during homecoming, and adding banners to the selfie application to customize visitor photos.

The city is also posting valuable civic information like details on the local Vision Zero program and collection times for trash and recycling pickup. And Greensboro officials are already looking ahead to potentially integrating new features into the kiosks including E-911 access and ride hailing.

Analytics show 8,741 clicks on the Greensboro kiosks since installation, including:

- **20%** selfie photos
- **13%** clicks for restaurant information
- **8.5%** clicks for family activities
- **7%** clicks for attractions including arts and cultural events, and shops and services
- **6.5%** clicks for wayfinding

CHALLENGES AND CONSIDERATIONS

While kiosk engagement is high, Greensboro hasn't yet proven that the installations are improving the flow of foot traffic in the area and encouraging visitors to move from one attraction to another rather than leaving the city after a single activity. That level of insight is going to take both more time and more sophisticated analysis.

It also wasn't a quick process to implement the kiosks initially. Permitting and inspections took time, and the city had to evaluate kiosk sites based on connectivity, local sign ordinances, ADA compliance, sidewalk clearance, lines of sight, and more. The project began in March of 2017, and the first kiosk was installed in September of 2019.

From a data sharing and privacy perspective, Nickles is careful to note that Smart City Media shares 100% of its data with the city, and that SCM retains no personal data through the kiosks. However, the software platform does not provide an open API, meaning there's no control over exactly what analytics are collected, or how and when data might be integrated with other applications.

Importantly, Greensboro considered adding video recording capabilities to the kiosks for public safety purposes, but given perceived sensitivity around surveillance, it has held off on that decision so far.

Finally, there is always a certain amount of risk in partnering with a company like Smart City Media given that these interactive kiosks are still relatively new. However, Greensboro selected SCM because of its success in other cities including Kansas City, Missouri and Louisville, Kentucky.

KEY TAKEAWAYS:

- Interactive kiosks with popular features can be installed in a downtown corridor with little to no financial risk to a city.
- Community engagement is high in Greensboro, but it's too early to tell if the kiosks are encouraging visitors to stay downtown longer, improving the city's vitality and increasing economic activity.
- There are open questions about how cities can use kiosk data effectively, and whether the data will help in future planning decisions and efforts to drive the local economy.

DRONES AS FIRST RESPONDERS – CHULA VISTA, CA

The commercial drone industry is growing globally, with the Federal Aviation Administration projecting the market could triple by 2023. Public safety is one use case for these aerial vehicles, and Chula Vista in California is part of an early wave of governments deploying drones to supplement the local police force.

As a San Diego suburb with 270,000 residents and 254 police officers, Chula Vista has been running its Drone as a First Responder program since 2018. Faced with low officer-per-capita numbers and unsatisfactory 911 response times, the city deployed its drones with the goal of improving citizen safety. Unlike other police departments, which have largely used drones in the aftermath of an event, the Chula Vista police use drones during emergency incidents to monitor conditions and relay information to officers en route. This model boosts situational awareness and helps officers determine the appropriate level of caution with which to approach a situation. It also improves emergency response times by ensuring there are eyes on the scene even before a police officer arrives.

The city of Chula Vista, is one of ten participants in the FAA's UAS Integration Pilot Program (IPP) focused on supporting the integration of drones with public sector initiatives. Participants in this program benefit from advantages like accelerated approval of drone operations that require special authorization.

Importantly, drones in Chula Vista are always operated by a sworn police officer with training certification per FAA Part 107 rules. A second pilot also maintains visual line of site with any drone in the air, and stands ready to intervene in the event of an inbound threat that the first pilot cannot see.

Chula Vista police use two DJI Matrice V2 drones in their program. The hardware includes automated flight controls, cameras with visibility up to five blocks, geofencing capabilities, flight tracking, and telemetry.

RESULTS

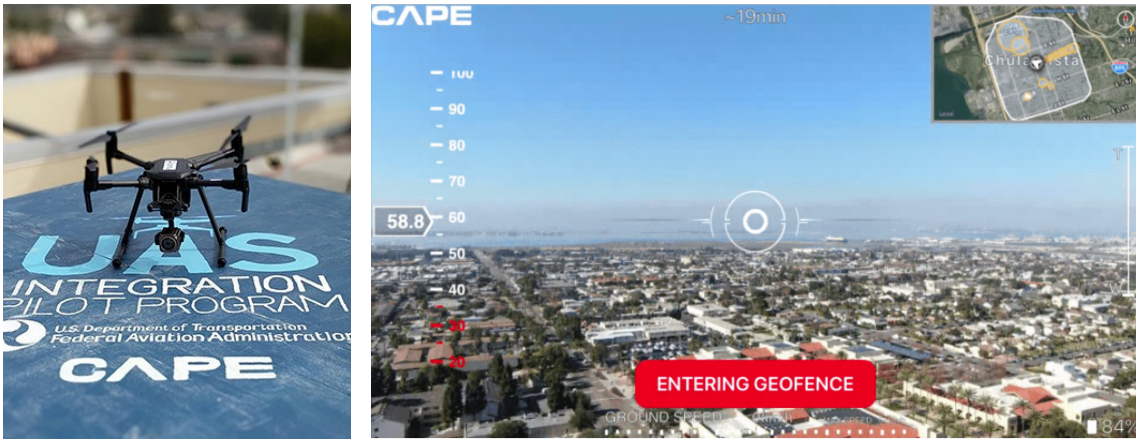
So far, the drone program has produced dramatic results for Chula Vista. Figures shared by Eric Wood, the city's CIO, show that drones have responded to 1,485 calls to date, and have cleared 313 calls without the need for police to send ground units. In addition, the drones have been first on the scene in 45% of 911 calls, with an average response time of 181 seconds, a vast improvement over the average response time of five to seven minutes recorded by officer patrols.

In dramatic footage shown at the Forum workshop, Wood demonstrated the value of drone response. Two videos of actual events in the city showed firsthand how quickly a drone can reach an emergency incident, and how much information can be shared with officers still on their way. In one of the videos, footage provided details on a suspect's movements during a foot chase, giving officers the directions they needed to locate the individual in person.

Public response to the drone program in Chula Vista has also been positive. Wood attributes this to a thorough and upfront public engagement effort where the team proactively discussed the program objectives with members of the ACLU as well as citizens during city council forums. These discussions allowed the team to create a number of conditions for managing data privacy and defining acceptable drone use. Among the conditions implemented, the police can only launch a drone in response to a 911 call, and data collected by drones has to be made available to the public via the department website. Video footage can also be shared with other agencies and neighboring authorities allowing them to make use of data during investigations.

FURTHER CONSIDERATIONS AND OPPORTUNITIES

Chula Vista benefits from several environmental conditions with its drone program that not all communities enjoy. The average building height in the area is low, topography is conducive to drone flight, and year-round mild weather makes outdoor operations sustainable.



Drones in Chula Vista are able to cover an area of three nautical miles

Even with ideal surroundings, there is still room for improvement in the program. On the technology side, Wood is hoping for increased automation that would allow drones to self-dock, and improved battery charge that would allow for longer flight times. The Chula Vista police department is also looking toward Electronic Beyond Visual Line of Sight (BVLOS) capabilities that would provide better visual coverage of local air space. This would potentially remove the need for keeping a second drone pilot on standby.

From a regulatory perspective, Wood is exploring legal waivers that would allow operators to fly drones around buildings and much closer to the ground for increasingly tactical operations. His team is also investigating the possibility of a "One to Many" waiver that would allow a lone operator to handle multiple drones safely within a geofenced system.

KEY TAKEAWAYS:

- Drones can be an effective way to supplement local police efforts and improve public safety.
- Community engagement is critical before local governments implement drones.
- Environmental conditions contribute greatly to the potential effectiveness of drone response.
- Federal agencies like the FAA are still developing the regulations that control drone usage.

SMART TRAFFIC MANAGEMENT – CARLSBAD, CA

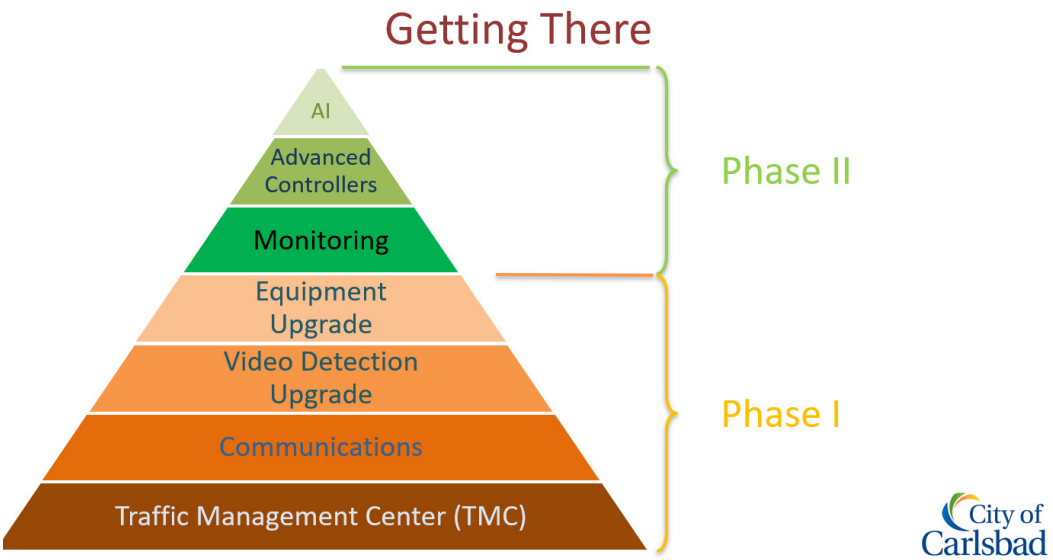
The city of Carlsbad, California invested $4.2 million beginning in 2011 to create a centralized Traffic Management Center (TMC) and to outfit local traffic lights with video cameras and other sensors. The goal was to make it easier to control the flow of traffic in key corridors, decreasing overall congestion and improving mobility for emergency response vehicles.

The investment paid off. Thanks to the traffic management project, the city was able to reduce traffic during peak hours up to 40% in select travel corridors, and speed up emergency response times by having operators control traffic signals and give emergency vehicles a clear path to incident areas. There is also now better bike detection at traffic intersections, and vehicle collision rates have decreased overall.

The initial infrastructure upgrade was only the first phase of the city's traffic improvement efforts, however. Following the success of the original project, city leaders began the transition to a more automated and adaptive management system beginning in 2018. That process is ongoing, but Carlsbad CIO David Graham is already reporting some early investment returns from the use of automation and machine learning. These include:

- Reduced traffic signal cycle lengths – This allows more cars to proceed through an intersection and has a direct impact on traffic flow along side streets.
- More cars arriving at intersections during green lights – This means cars idle less, which decreases vehicle emissions.
- Decreased travel time in both directions – Improved traffic flow decreases overall travel time.

Phase two of the Carlsbad traffic management upgrades will continue through the end of 2020.



Carlsbad connected infrastructure implementation phases

TAKING THE LONG VIEW

The effort by city leaders to improve the local roadway system has delivered tangible results for Carlsbad over the last decade. However, Graham says he believes the city made a mistake in its original approach to the project by building out a dedicated and proprietary communications network to support the new traffic management features. That network did not hold up to system demand, and the city ultimately had to upgrade connectivity to enable enhanced automation capabilities.

According to Graham, the connectivity investment is critical not just for the city's current transportation needs, but also for future services and applications. Now that a more robust infrastructure is place, Carlsbad will be ready for new technology developments that require more communication between smart vehicles and the surrounding environment, and for innovations that make use of all the data collected from sensors throughout the region.

The city is already looking into partnerships with the University of California San Diego for data analysis help. New data insights from sensors and connected roadways could inform future projects like autonomous vehicle pilots, electric vehicle charging deployments, and the development of data sharing platforms for regional collaboration.

KEY TAKEAWAYS

- Adaptive traffic management investments deliver tangible ROI through reduced traffic congestion and improved public safety.
- Communications infrastructure to support traffic management should be robust and application-agnostic to ensure it meets both present and future needs.
- Without reliable connected infrastructure, the long-term vision for smart transportation is not viable.

SMART PARKING – BOSTON

Boston has had its fair share of notorious disputes over parking, especially in the winter, and the situation is only growing more difficult as the city tries to cope with limited curb space and commuters using a variety of transit modes including buses, bikes, and scooters.

To combat parking frustration, Kris Carter from the Boston Mayor's Office of New Urban Mechanics and his team have tried out experiments to make it easier for people to find and pay for parking. The city manages about 32 lots (all of which are free in neighborhood main street districts), 8,000 on-street meters, and an estimated 300,000 other spaces around residential areas and schools that are mostly free. The problem is that available spots, particularly in high-traffic areas, are difficult to come by during peak hours. Drivers often circle the streets repeatedly looking for spaces, and in some cases overstay their time in a metered spot because paying the fine is still cheaper than parking in a private garage.

Using best practices from a study by Dr Shoup & SF Park, Carter and his team ran two pilot projects aimed at maintaining parking space occupancy rates at about 85%. At that rate, cars looking for a spot should be able to find one without needing to drive around the block.

PILOT 1: PARKING RATE INCREASE IN THE BACK BAY

Even with 1,650 spaces, parking spots are still in high demand in the Back Bay. This is true throughout the day, and even despite the fact that there are other transit options available besides driving. As a test, the city raised parking fees across the area to $3.75 to see if it would impact occupancy rates. Carter's team then used data from several different sources to analyze the results, including reports from manual surveys, meter transactions, double parking alerts from Waze, and parking enforcement logs.

The test was successful. Parking occupancy dropped from 104% to a range between 85% and 91%, creating an 11% increase in the availability of metered spaces. The pilot also showed a positive impact on parking behavior. Ticket data revealed a 12% decline in illegal parking in residential spots.

PILOT 2: DYNAMIC PRICING IN THE SEAPORT AREA

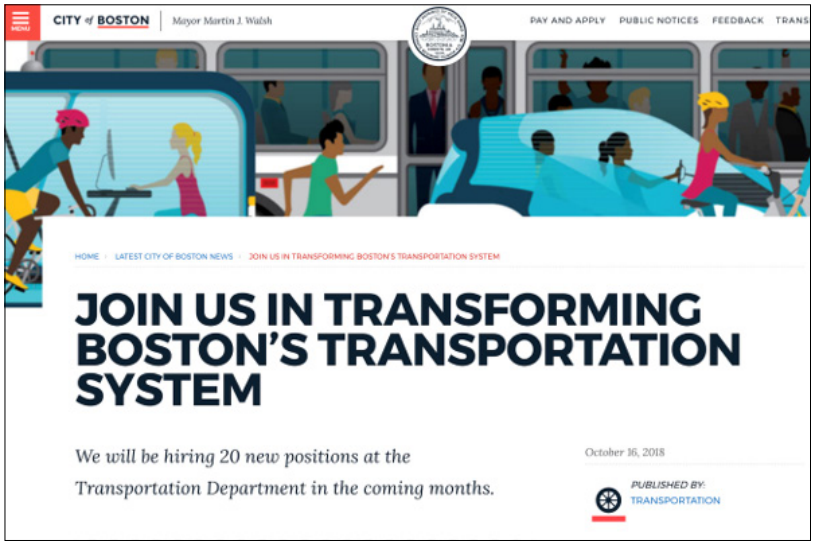
Carter's team used a more dynamic approach to parking adjustment for streets in the Seaport area due to several variables: a higher variation in parking demand throughout the day, the availability of individual sensor-enabled spaces, and the presence of cultural institutions that draw specific activity during weekends or holiday periods. As in the first pilot, the goal was to reduce overall occupancy rates. However, instead of imposing a flat fee increase, the city raised fees anywhere between $1 and $5 depending on demand.

To analyze outcomes, city officials used transaction data from meters, ticket reports, and alerts from Waze on double parking and traffic jams. Officials also considered the use of video analytics, but this proved costly and not terribly effective.

The test was again successful, but not to the same degree as the first pilot project. The primary positive outcomes were improvements in driver behavior rather than lower occupancy rates. Data showed a 24% decrease in double parking and a 44% decrease in Illegal parking at loading zones.

LESSONS LEARNED AND ROI

From a return-on-investment perspective, the Boston parking tests were spectacularly successful. In addition to learning more about parking behaviors, the city was able to collect $5 million in new meter revenue in just one year across two neighborhoods, and $9 million in revenue from fines through a related restructuring of violations citywide. Officials immediately reinvested $1.4 million from that total back into expanding Boston's transportation department, and they announced in July of 2019 a new plan to extend fee changes across the city. The base rate for parking everywhere is set at $2 per hour. The rate in growth areas is $2.50. And the rate in congested areas is now $3.75 per hour.



One thing the Boston team has learned is that a high-tech approach isn't always the right strategy. Dynamic parking, for example, is difficult to communicate to drivers, whereas a flat rate increase can have a significant impact on whether people choose to drive or take another form of transport, particularly when that rate and any associated fines are better correlated to the cost of parking in a private garage.

Even data collection can be more efficient with a low-tech solution. Boston officials found that the cost of hardware and data fees from collecting parking data with sensors currently exceeds the cost of hiring a single new employee to walk the streets and record occupancy rates and parking behavior. The latter method has also allowed the city to collect information on vehicle types and resident parking stickers, and more nuanced data on travel behaviors. That information proved valuable for the community process that led to the expansion of the performance parking program.

Perhaps most importantly, Carter says that the city is making sure to communicate the benefit of parking changes with citizens. It's not just about collecting new revenue. With new funds in fiscal year 2020, Boston plans to invest $8 million in road, bridge, and sidewalk repair; $4 million in sidewalk reconstruction; and $2 million in bicycle infrastructure.

KEY TAKEAWAYS

- There are huge gains possible from studying parking behaviors and adjusting parking rates accordingly. The benefits come from both new revenue and behavior changes that lead people to consider alternate forms of transport.
- It's important to communicate the benefits of any increases to fees and fines. The goal is not to collect revenue just for the sake of collecting revenue, but to use it to improve transportation services and safety throughout the city.
- New technology isn't always the best solution. Low-tech options are sometimes both cheaper and more effective.

FURTHER RESOURCES

New Orleans Case Study on Public Safety Improvements with Axis cameras
https://www.axis.com/customer-story/4962

AT&T, GE Current Smart Cities Digital Infrastructure
https://products.gecurrent.com/sites/products.currentbyge.com/files/at-t-smart-cities-digital-infrastructure.pdf?src=hub-att-smart-cities-digital-infrastructure

Duke Energy Greensboro Smart Kiosk Case Study
https://www.greensboro-nc.gov/home/showdocument?id=45008

Federal Aviation Authority Unmanned Aircraft System Integration Pilot Program
https://www.faa.gov/uas/programs_partnerships/integration_pilot_program

Carlsbad Traffic Signals Resources
https://www.carlsbadca.gov/services/depts/pw/traffic/traffic/signals.asp

Atlanta Case Study on Improved Traffic Management with Axis Cameras
https://www.axis.com/customer-story/4992

SF Park study on Parking Demand
http://sfpark.org/wp-content/uploads/2014/06/SFpark_Pilot_Summary.pdf

Smart City Primer with Resources from Ingram Micro
https://www.us-ignite.org/wp-content/uploads/2020/03/Ingram-Micro-IoT-Smart-City-Primer.pdf