US Ignite Public Safety Playbook:

Today, there are smart city public safety projects rolling out across the country, but beyond the pilot stage, these efforts have proven difficult to scale. Too often they're independent from other local initiatives, and any lessons learned are isolated within the projects themselves. To expand early public safety pilots into sustainable programs, cities and their partners need to collaborate, sharing best practices around the development of public safety data collection processes, data analytics, and information visualization methods.

On May 30, 2018, US Ignite hosted a workshop with the city of Las Vegas and other municipal, university, industry, and nonprofit partners. The workshop highlighted multiple community case studies and illustrated how smart city infrastructure can enable and improve public safety.

This Public Safety Playbook showcases many of the lessons learned in these early smart city deployments. It also provides recommendations for other municipalities seeking their own solutions to public safety challenges, including the need for better real-time decision-making, increased reliability of services, and reduced emergency response times and costs.

BACKGROUND

Communities are looking to quickly identify current gaps in their public safety initiatives and to understand how newly available data can improve operations. Data sources fall into three categories: real-time, historical, and crowd-sourced. From a municipal perspective, the first will increasingly come from sensors and cameras deployed throughout communities. The second comes from local documentation and other forms of institutional knowledge. And the third comes from information shared by people in the region, like news of upcoming events.

Often, information is siloed in different municipal departments or outside the government altogether. When that happens, communities may find themselves overspending on critical technology tools and overlooking indicators of potential disaster. This can result in communities underestimating necessary functionality, following lowest-bid procurement rules, or buying duplicate systems.

However, as Las Vegas CIO Michael Sherwood attests, that's a solvable problem. Departments and citizens can work together to pool data and other resources as long as there is a will to do so.

The larger challenge comes not in gathering the necessary information but in making disparate data sets work together in order to gain insight and value.

For example, public safety at a traffic intersection depends on multiple variables, from vehicle performance and driver behavior to weather and general visibility. How can communities quickly analyze all of those variables and respond in a way that makes citizens safer?

Below is a short outline of the stages smart city public safety efforts have undergone as they increase in size, scope, and complexity. Many cities today have a number of smart intersections they monitor to test systems for improving pedestrian safety. Several cities, including Las Vegas, have created dashboards for a wide range of public safety data with real-time alerts for both residents and first responders. Finally, we are starting to see cities, like Nashville, test out real-time decision-making for positioning of police, EMT, and other resources.

	Example Project	Benefits	Infrastructure Challenges	Policy Challenges	Size
Stage 1: Data Collection and Processing	Pedestrian sensors	Improved intersection safety as part of Vision Zero goals to reduce accidents and fatalities	Sensor deployments require access to vertical real estate while video feeds will require intensive data processing	Cities must decide who is able to share data, how they will protect against cybersecurity threats, and whether to delete video records to maintain privacy	Intersection
Stage 2: Data Visualization	Public safety dashboard for city and residents	Integration of several data sets and sensors into easy-to-read interfaces	Cities must integrate real-time data from sensors to impact safety, parking, and transit decisions	Can be tough to link dashboard to decision-making process for first responder assets	Neighborhood
Stage 3: Real-Time Decision-Making	Pre-position police and EMT	Reduce traffic fatalities through quicker response times	Large challenges with data integration from weather, traffic, video, dash cam, crime reports, and other sources	City leadership must decide whether first responders will adjust policy on positioning and on the impact of placement of first responder facilities	Citywide

This playbook examines specific case studies where cities are tackling both data collection and analysis challenges as they relate to public safety. Focusing on traffic programs, police and fire department initiatives, and some of the newest technology tools available, this guide offers practical information for the development of smart city, public safety strategies based on real-world knowledge and insights.

TRAFFIC SAFETY

Traffic and pedestrian safety are critical priorities for the city of Las Vegas, which has now implemented a data-driven system for monitoring and analyzing activity on local roads that is also designed to scale as new technologies, policies, and processes develop. Officials in Las Vegas began their efforts by identifying specific goals, and by deciding on the guiding principle of making both civic data and key performance indicators from their initiative open to the public.

Once these strategic parameters were set, municipal leaders contracted for the development of a technology platform called ResultsVegas. The platform serves as a clearinghouse for real-time data, but it can also interface with tools and services developed by third parties. Las Vegas officials acknowledge that they can't hire data scientists fast enough to keep up with the flood of input the platform currently collects, but at the same time, they point out that their open data approach means the city can continue to build, and solicit others to build, new applications for data analysis as a way to synthesize more of the available information over time.

CITY OF LAS VEGAS VEHICLE AND TRAFFIC ALERTS

The information Las Vegas is collecting and feeding into its new platform comes from a wide variety of sources. First, the city is using Dedicated Short Range Communications (DSRC) to send data from signal lights to vehicles. Second, the city is leveraging in-vehicle systems installed by certain car makers as a means of gathering information on major car collisions through emergency broadcast messages (TCS). Third, the city is collecting data from anti-lock braking systems as an additional set of information to help predict and analyze traffic flow.
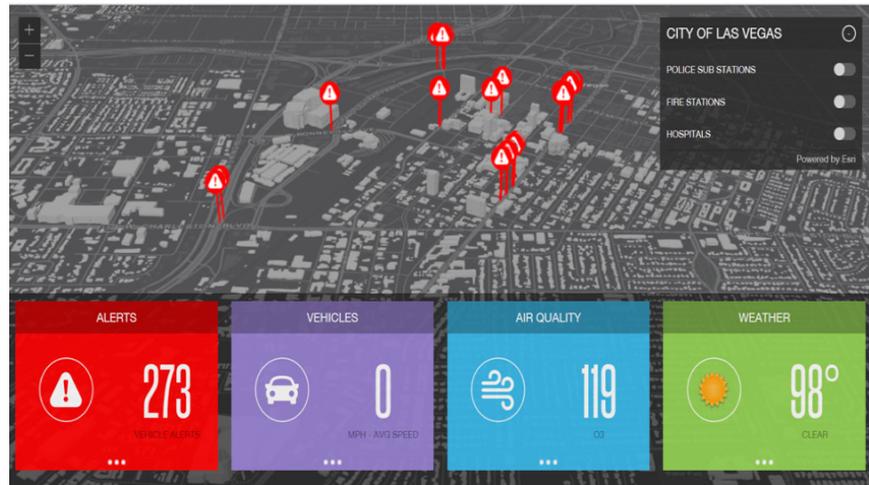
Outside of vehicle communications, officials in Las Vegas have also installed focus camera systems in 25 intersections downtown. Importantly, these cameras do not store sensitive data. Instead, they make assessments based on patterns of activity and then send alerts when anomalies are detected.

Las Vegas also hosts a number of sensors in public spaces to count cars, bikes, and pedestrians. This information can be used to generate a heat map of population movements, which is useful not only for public safety but also for driving local business investment.

Leaders in Las Vegas know they have only begun to scratch the surface of data collection for traffic management, and they've outlined several possible scenarios for the future.

Other camera use cases include:

•   Dwell detection: Analyze how long pedestrians stay put and characteristics of that dwell time.

•   Lidar deployment: Use this relatively inexpensive technology to monitor near-misses between pedestrians and vehicles, and to inform traffic signals of the need for a light change when a jaywalker is detected.

While early use cases are only a sampling of the services Las Vegas may yet develop, the important piece of the puzzle for the city is that it has a platform ready to scale as new needs and opportunities are identified.

Key Takeaways:

•   Adopting an open data approach can be critical not just for transparency but also for the scalability of smart city public safety initiatives.

•   When implementing a platform for public safety data management, a key evaluation criterion should be the ability of the platform to ingest new types of data and support new tools and applications for analysis over time.

POLICE AND FIRE

Traffic management is one major tenet of public safety. Emergency response is another. Cities have been working on pilot programs to both streamline first responder response times and provide analysis for the placement of public safety resources. This can help with strained city public safety budgets while increasing safety for first responders.

Efforts to apply new smart city technologies to emergency response are still in their infancy, but three case studies from Lincoln, Nashville, and Albuquerque illustrate how communities are beginning to look at evolving their response systems to improve safety outcomes.

Lincoln, Nebraska

Lincoln is presently deploying an automated vehicle location (AVL) application, MACH, in police and fire vehicles. Initially, MACH is providing a collection of data that can be used to assess how effectively emergency vehicles have been allocated and deployed after the fact. However, in the future, AVL is expected to become a dynamic, mission-critical application that can inform personnel about resource availability during an actual emergency event.

The next generation of AVL for Lincoln requires real-time connectivity with a computer-aided dispatch system in order to enable closest unit dispatch. Ultimately, the dispatch software will recognize the coordinates and status of field units and recommend assignment to incoming calls for service accordingly.

Beyond collecting location information, the Lincoln police department is also using other types of data to run predictive analytics and optimize resource deployment. This includes data about historical patterns in crime, and also information about the relative crime risk in the built environment. Environmental factors that contribute to risk include variables like population density, where transportation nodes exist, the presence of local retail businesses, and whether there are liquor stores nearby. Lincoln police use this information to establish risk profiles in 250-meter cells. The process then ranks the highest-risk cells for upcoming 8-hour time blocks in order to target those areas for enhanced police presence by officers during their duty shifts.

Nashville, Tennessee

Like Lincoln, Nashville is currently working to reduce the average emergency response time for EMS and fire suppression units by optimizing resource allocation. Officials are primarily using historical incident response data—including the location of incidents, emergency type, and units dispatched—rather than real-time information. However, the city is also experimenting with machine learning techniques to gain more insight into how this data can be used to predict future needs.

Nashville's technical approach, developed in collaboration with researchers at Vanderbilt University, applies unsupervised learning methods to characterize incidents, and then uses stochastic survivability algorithms and Bayesian spatio-temporal models to predict the time of occurrence for different types of incidents.

This model will be further refined using historical traffic and delay information, as well as weather and road conditions, thus resulting in a more accurate prediction of when and where future incidents are most likely to occur.

A major goal of the Vanderbilt and the Metro Nashville research team is to develop a decision support system with accompanying tools and visualization schemes that aids operators in placing emergency response equipment in optimal locations to improve overall dispatch processes. An optimized routing tool will also be developed and used at the dispatching station for emergency response vehicles to decrease overall response times and vehicle maintenance costs while improving effectiveness and overall safety.

The Nashville fire department even plans to use the new data and analysis tools to support funding requests for additional response vehicles and fire stations. It is expected that the department will also be able to save money over time through more efficient use of equipment and fewer vehicle miles traveled.

Photo of Nashville Emergency Response Viewing Engine (NERVE)

Albuquerque, New Mexico

Albuquerque is the number one city in the nation for auto theft, making crime the top issue facing the community. The local government currently does not have enough police officers, so reducing crime through data and analytics and providing officers in the field with the latest technologies is paramount.
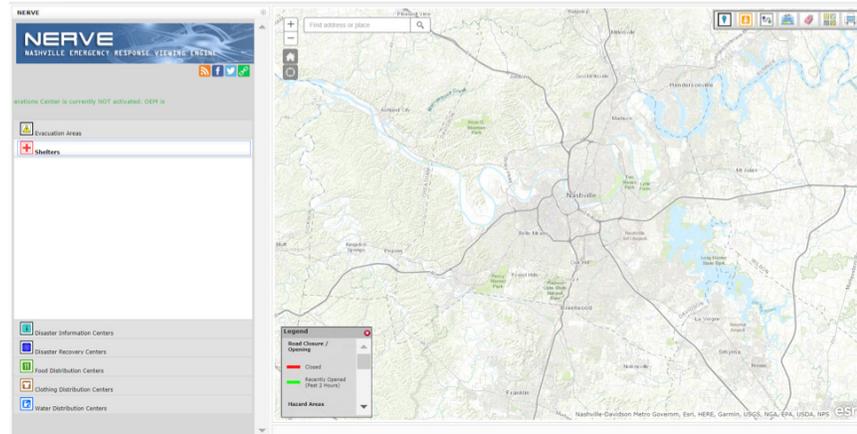
The focus of Albuquerque's smart city public safety program is live operation crime analysis. The police department is working to provide information in real time to officers from data sources that include social media and video feeds from cameras situated on video trailer units and at 274 traffic intersections. Going forward, cameras will be deployed on buses and used in collaboration with the city's department of transportation.

In addition, Albuquerque has implemented modular sensor units around the city for gunshot detection and last-return Lidar range data. Used in connection with "hot list" information from the National Crime Information Center (NCIC), Albuquerque officials say the deployment of the sensor units coincides with a leap in the criminal conviction rate of 28%.

In the future, Albuquerque plans to add new cameras around town, create permanent sites for gunshot detection sensors, and deploy automated license plate readers at both fixed and mobile locations.

Key Takeaways

- Cities are using a combination of location data, video feeds, audio sensors, and more to improve emergency response.

- Public safety data is valuable for both real-time incident response and event modeling with predictive analytics.

- Smart city emergency response initiatives are largely still in the pilot stage, but now is the time to monitor these programs and learn lessons for future at-scale deployments.

INNOVATIVE MULTIMEDIA STRATEGIES

Cities are still discovering the potential for network-connected sensors to provide real-time data for public safety purposes. Recent innovative projects involve making sensors mobile, combining multiple sensors at fixed locations throughout a community, and applying new analytics to raw video footage collected from local municipal cameras.

Community leaders in Wilson, North Carolina and San Diego, California are among the avant-garde of the public safety sensor movement. Their case studies below point to new ways of both deploying sensors and taking advantage of the multimedia data those sensors can provide.

Wilson, North Carolina

The city of Wilson, a rural community in North Carolina, and Wilson Greenlight, the publicly owned, high-speed fiber-optic network, already support the maintenance of more than 100 public safety cameras. However, officials are taking that effort a step further by launching a novel drone-system infrastructure combined with a remote video streaming pilot application for on-site emergency incident monitoring.

The video application is designed to provide a first-person point of view of an incident to response workers not on-site. Using a secure connection powered by Wilson's high-bandwidth communication network, the camera-equipped drones will feed information back to the community's emergency operations center (EOC) or to other authorized personnel elsewhere.

The team is looking to expand this effort into a new project on developing transmission and processing architecture for 3-D mapping to aid mission-critical analytics, reduce response times, and aid in search and rescue. This new effort set a goal of being less expensive than comparable commercially available technologies such as LiDAR, and has the potential to obviate routine and costly public expenditures in personnel and equipment to perform similar functions.

San Diego, California

The city of San Diego is working on a smart city initiative in collaboration with industry partners to develop the world's largest smart city Internet of Things (IoT) sensor platform. The $30 million city-led project will install 14,000 Adaptive Control LED light fixtures around the city, including 3,200 with an enhanced sensor package.

Over 3,200 smart street lights will be deployed to monitor traffic, pedestrian safety, and environmental conditions.

In the enhanced sensor package, optical, auditory, and environmental sensors will create a multi-use platform to enhance sustainability, improve mobility, and help assist public safety. The city has already piloted a small network of these sensor arrays for traffic, parking, and pedestrian safety. The addition of built-in gunshot detection, domain awareness, and accident alert features will extend the city's ability to protect citizens even further.

Key Takeaways

• Robust network connectivity is critical for advanced sensor applications.

• Cities are only just beginning to tap the potential of video for improving public safety.

• Multifunction sensor platforms are emerging as a natural evolution to single-sensor deployments.

THE ROLE OF COMMUNITY ENGAGEMENT

Beyond the practicalities of new smart city public safety initiatives are the education and outreach efforts that must accompany them.

Municipal outreach on public safety issues tends to get incorporated into broader community engagement by city officials as they set their smart city or economic revitalization strategies. Public safety becomes an important part of that discussion—as it should. As a result, there

are a number of community engagement efforts to ensure public input into these public safety initiatives. These are vital to ensure that stakeholders agree with the goals of the smart public safety project and its component parts, including the collection, privacy, security, and use of public safety data.

Below are example efforts.

Henderson, Nevada

The of city Henderson brought together all of its municipal departments to create a multi-stakeholder strategy, which became the Henderson Strong plan. The Henderson Strong Comprehensive Plan (Henderson Strong), a citywide planning document that communicates Henderson's vision, long-term goals, and objectives that guide the physical development and orderly management of growth for Henderson for the next 20 years, was adopted in July 2017. This plan was built on a strong foundation of research and community engagement.

In the fall of 2017, under Mayor Debra March, Henderson formed a smart city working group comprised of city managers and staff to draft a citywide smart city strategy and roadmap. Henderson Strong was used as a guide in the development of these smart city documents. The end result is a smart city strategy that serves as a "living document"—one that will evolve with the rapid pace of technology and changing citizen expectations. This is a starting point for an engaged and collaborative partnership among citizens, businesses, academia, and government.

While Henderson Strong serves as the city's citizen-built vision of Henderson's future, its smart city strategy has a shorter-term outlook and a technology-centric focus. It is designed to guide an incremental, iterative deployment of digital, connected technologies over a one to three year horizon. This strategy is peppered with opportunities to leverage technology to improve government services and citizen experiences.

There are already 29 smart city projects within Henderson, including one fire department pilot program that will use drones to create more visibility during fire emergency incidents. Both the fire and police departments are also implementing new data analytics tools to assess their efforts across the large Henderson geographic territory. And the city is investigating new video use cases, including bodycams for emergency response workers that will be deployed in the summer of 2018. City officials are bringing together stakeholders through workshops and other venues to collaborate with businesses and residents in the region to determine best practices for video usage and management that take personal privacy into account.

Las Vegas, Nevada

The city of Las Vegas has established an Innovation District as a proving ground for a number of technology focus areas including economic development, public safety, education, medical, retail, and others. The district provides a live testing capability for the city government and industry partners to assess the scalability and costs for any smart city project before it is deployed citywide. The freedom of a testing ground also means project leaders can determine how citizens, visitors, and businesses react to new technology implementations, and make adjustments before they're unveiled to a larger population.

For smart city funding, Las Vegas has spent $250,000 so far on pilot programs. These pilots are designed to entice residents and city departments to commit to more investments down the road as the value of new projects is proven out. Community engagement has focused on sharing best practices through the ResultsVegas playbook, and on telling stories of project successes

to residents. The goal of this outreach is to explain the potential return on investment (ROI) with these smart city efforts, and to demonstrate the value of data and real-time decision-making tools.

Among the outreach tactics used by the city of Las Vegas is information sharing through social media. The city currently has more than 300,000 followers on Twitter, which it uses as a vehicle for delivering news and information and correcting misinformation. More than 90,000 engagements on Twitter in 2017 included real-time responses to follower queries.

Key Takeaways

- Involve stakeholders early in the process of developing a smart city roadmap.

- Create a testing ground where possible to prove the value of smart city pilot projects and make necessary adjustments before scaling up to citywide deployments.

- Communicate with fellow city leaders and citizens on an ongoing basis to address any concerns and head off conflict before minor issues become major ones.

CHALLENGES

For as much as the cities referenced in this playbook have accomplished, there are still two major issues that need more attention and dedicated effort. One is the issue of personal privacy—determining what new technologies including video surveillance are truly in the public's best interest, how to mitigate individual privacy concerns, and how to prevent both official and unofficial abuse of new data collection systems.

The second is cybersecurity, which is an ever-evolving concern as attackers develop new methods for compromising the integrity of municipal data systems. The fallout from a recent cyber attack in Atlanta is reportedly costing the city millions as it attempts to restore crucial software and services.

In both the case of privacy and cybersecurity, city officials are highly aware of the potential pitfalls ahead and the sensitivity required to ensure smart city efforts meet privacy and security goals. However, that does not mean leaders have found all the answers they need, only that they have begun to ask the right questions.

As smart city public safety efforts move from the pilot stage to sustainable programs, officials will need to steadily apply what they learn about privacy and security threats, codify best practices, and communicate with their citizens about how concerns are being addressed. Only by regularly assessing smart city challenges around privacy and security, dedicating resources to solving associated problems and mitigating threats, and sharing information on lessons learned can cities protect their communities while also making them smarter, more equitable, and more prosperous.

FURTHER RESOURCES

Benefits and Best Practices of Safe City Innovation, Center for Technology Innovation at Brookings.
https://www.brookings.edu/wp-content/uploads/2017/10/safe-city-innovation_final.pdf

Blueprint for Smart Public Safety in Connected Communities, An Initiative of the Global City Teams Challenge.
https://pages.nist.gov/GCTC/uploads/blueprints/20170824-PSSC_Blueprint
20170823_FINAL.pdf

Can Algorithms Predict House Fires? Data-Smart City Solutions, Ash Center for Democratic Governance and Innovation at Harvard Kennedy School.
https://datasmart.ash.harvard.edu/news/article/can-algorithms-predict-house-fires-990

Digital Transformation: Wiring the Responsive City, Center for State and Local Leadership at the Manhattan Center.
https://datasmart.ash.harvard.edu/sites/default/files/2017-11/cr_87.pdf

Predictive Tools for Public Safety, Data-Smart City Solutions, Ash Center for Democratic Governance and Innovation at Harvard Kennedy School.
https://datasmart.ash.harvard.edu/news/article/predictive-tools-for-public-safety-506

Project Greenlight Detroit, is the first public-private-community partnership of its kind, blending a mix of real-time crime-fighting and community policing aimed at improving neighborhood safety, promoting the revitalization and growth of local businesses, and strengthening DPD's efforts to deter, identify, and solve crime.
http://www.greenlightdetroit.org/

RAVEN911 Gives Emergency Responders a Bird's Eye View, Data-Smart City Solutions, Ash Center for Democratic Governance and Innovation at Harvard Kennedy School.
https://datasmart.ash.harvard.edu/news/article/raven911-gives-emergency-responders-a-birds-eye-view-758

Smart Cities: Digital Solutions for a More Livable Future, McKinsey Global Institute
https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/smart-cities-digital-solutions-for-a-more-livable-future

Trends in Smart City Development, Center for City Solutions and Applied Research, National League of Cities.
https://www.nlc.org/sites/default/files/2017-01/Trends%20in%20Smart%20City%20
Development.pdf