Dallas Innovation Alliance

SMART CITIES LIVING LAB CASE STUDY

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City of Dallas

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PHASE 1 PROJECT PARTNERS

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DART

DALLAS BIG THINGS HAPPEN HERE

The County of Dallas, State of Texas

DALLAS REGIONAL CHAMBER

The DEC The Dallas Entrepreneur Center

DOWNTOWN DALLAS INC

25 the REAL ESTATE COUNCIL

Texas Research ALLIANCE


“A smart city is one that lives at the intersection of data, technology, and community to improve quality of life, resource efficiency, and inclusive economic development.”

WELCOME

A coordinated and engaged community is a key element to creating a smart and inclusive city.

This core principle led to the launch of the Dallas Innovation Alliance (DIA) on September 15, 2015 as part of The White House Office of Science and Technology Policy's smart cities program announcement. Created as a 501(c)3 public-private partnership, the DIA's mission is to support the priorities delineated in the City of Dallas' 2014 Smart City Domains framework. To provide this support, DIA serves as an R&D partner to the city by identifying and testing innovative projects that fit Dallas priorities. The DIA's operating definition is that a smart city is one that lives at the intersection of data, technology, and community to improve quality of life, resource efficiency, and inclusive economic development.

Today the DIA, with key leadership support at the City of Dallas, encompasses a network of three dozen partners across the public, private, civic, and academic sectors and over 20 city departments. In short, the DIA has taken a best minds approach in order to align on projects and objectives for its Phase I "Smart Cities Living Lab powered by AT&T" in the West End Historic District in Downtown Dallas.

The Living Lab launched in March 2017 and is the fastest to-market smart cities initiative in the country, moving from ideation to implementation in under 12 months. This work has been done with key input and direction from the City of Dallas, DIA partners, network of experts from dozens of cities around the world, and most importantly, the citizens of Dallas. This accomplishment supports the theory that an independent organization working across sectors

to support the vision of the city would allow for rapid testing to identify high-value projects for consideration of larger deployment.

DIA is generating a growing knowledge base of innovative technologies and approaches used in cities around the world. Through projects like the Living Lab, we are able to match new ideas to the distinct needs of individual Dallas neighborhoods and test these ideas directly in those neighborhoods. Our intention is to deliver pilot results and our learnings to the City and the public. Next steps are to work closely with the city and partners to scale up what is working, translate ideas and learnings from the pilots (including opportunities in finance) into actions and to begin developing our Phase II community initiatives in Southern Dallas.

The DIA has learned a great deal since its inception in 2015 and is generating data with applications across multiple city departments. Over the course of the Smart Cities Living Lab, the West End District has seen increased foot traffic and local business revenue, decreased crime, reduced energy and water consumption and found new ways to engage citizens and visitors with their city. We know this through both quantitative measurement and qualitative surveys of residents and businesses. Smart lighting in particular holds the potential for a 50-70% reduction in (energy and operational) costs, with the added benefit of improved public safety via better lighting quality, and responsiveness to community needs via real-time outage reporting. One of the single greatest benefits of smart cities initiatives is the ability to leverage investments to accomplish objectives across multiple departments; creating more efficient use of budget with a greater return on investment.

We look forward to sharing our more detailed findings in this document. We are still relatively early in the process and recognize that many findings are preliminary, but suggest some exciting opportunities and data driven results to inform future efforts and value to the city. As a learning organization, we actively seek your ideas for improving our approach.

The DIA's success is only achieved through collaboration with our partners. We are extremely grateful to the City of Dallas for its leadership, vision, and partnership. We also want to thank and recognize our Organizational Partners AT&T and Toyota, Lead Community Partner United Way of Metropolitan Dallas, Lead Partner Cisco, Pivotal Partners Current by GE and Foley Gardere, and Partners Granite, IBM, AECOM, and Universal Mind. The leadership of the Dallas Regional Chamber, DART, Downtown Dallas Inc., VisitDallas and the Texas Research Alliance have provided valuable support and insight from the very inception of the organization. Finally, thank you to the citizens of Dallas, who have shown such enthusiasm, interest and support of this journey in creating a Smarter Dallas.

For Our City,

Trey Bowles and Jennifer Sanders
Cofounders, Dallas Innovation Alliance

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"Ultimately, a smart city works to solve city problems, conserve resources, and create an inclusive and prosperous city; the technology itself is not enough without measurable insights provided by data. The work of AT&T and the Dallas Innovation Alliance in building the Living Lab has provided a great platform to test and share results of projects that could broadly impact Dallas for the benefit of our citizens. We look forward to continued progress in creating a truly smart city for all of Dallas."

- Dallas Mayor Mike Rawlings

HISTORY OF THE DALLAS INNOVATION ALLIANCE

From the inception of Dallas Innovation Alliance (DIA) in 2015, the City of Dallas has shown immense support of the vision and goals of the DIA. Without this partnership, including the investment of time, expertise and staff resources, progress and results would not have been possible. The partnership between Dallas and DIA is structured via a Donation Agreement initially adopted by the City Council in December 2016; which allows DIA to work for the public good in the City's right-of-way and all equipment is donated to the City upon the conclusion of The Living Lab. This also allows DIA to work in concert with City of Dallas, while maintaining the flexibility to rapidly respond to emerging needs, concerns, and trends. Throughout the process, the DIA has engaged professionals at all levels of City of Dallas, including more than 20 individual departments. DIA did not request funding from City of Dallas to deploy The Living Lab.

> "The City of Dallas is creating a comprehensive smart cities framework that uses IoT technology to solve the problems that matter most to the community. In collaboration with the city, we've deployed our AT&T Digital Infrastructure nodes and smart street lights to help make the West End neighborhood safer for the people who live and work there."
>
> - Michael Zeto, VP of AT&T IoT Solutions and General Manager of Smart Cities

Organizational Structure

The DIA is structured as a freestanding 501(c)3 nonprofit with a public-private partnership structure. This allows the organization to have cross-sector alignment and take a best minds approach to design, development and execution. Funding was obtained via 70 percent grant and 30 percent private sector support. As an independent organization, the DIA can execute pilot projects without going through formal procurement, with the goal being to test new technologies and execute at a rapid pace. This structure allowed the Living Lab to be the fastest-to-market smart cities project in the country.

In April 2016, initial priorities and use cases were established at a session at the Deloitte University Greenhouse, and the Living Lab was launched less than a year later. Through a combination of grants and private sector support – both financial and in-kind – the DIA has been able to operate at a very lean operational budget leveraging the expertise and resources of our private sector partners.

Commitment to Community Engagement and Education:

Since DIA's founding, it has held a series of community events, reaching several thousand citizens from across organizational and geographic sectors across the DFW region. All were welcomed, including residents, students, businesses, academia, nonprofit organizations, civic and governmental entities. Ideation sessions during early events have led to the establishment of dedicated committees around Data, STEM/Workforce Development and Quality of Life, with others planned for launch. The DIA is actively involved in community organizations impacting local neighborhoods, as well as city-wide nonprofit organizations. In seeking to provide connective tissue between progressive and impactful initiatives across the region, DIA is working to develop a cohesive ecosystem that can drive maximum cumulative impact of these projects. We look forward to continuing to collaborate with entities across the city in the coming years.

Creating educational opportunities related to future careers and workforce development in smart city technologies is core to DIA's mission. Therefore, engaging schools and educators has been a top priority from day one. This falls on several educational levels, including developing experiential learning modules for K-12; working on events and curriculum paths to future career certifications with Dallas County Community College District; and collaborative research grants and capstone projects with local universities. On a broader workforce level, we are working with existing organizations to expand job pipeline opportunities for green and Smart City-oriented careers.

"Organizations like the Dallas Innovation Alliance are critical to the successful expansion of Civic Innovation. Governments and corporations excel at different pieces of the equation, but only an actor like the DIA can rapidly explore the emerging needs and opportunities of civic import and match those with solutions in a timely fashion. Without these types of people working to improve the state of civic tech, society will not reach its full potential that new technologies make possible."

- Kirk Talbott, Executive Director, Smart City Atlanta

EXECUTIVE SUMMARY

A Focused Neighborhood Approach

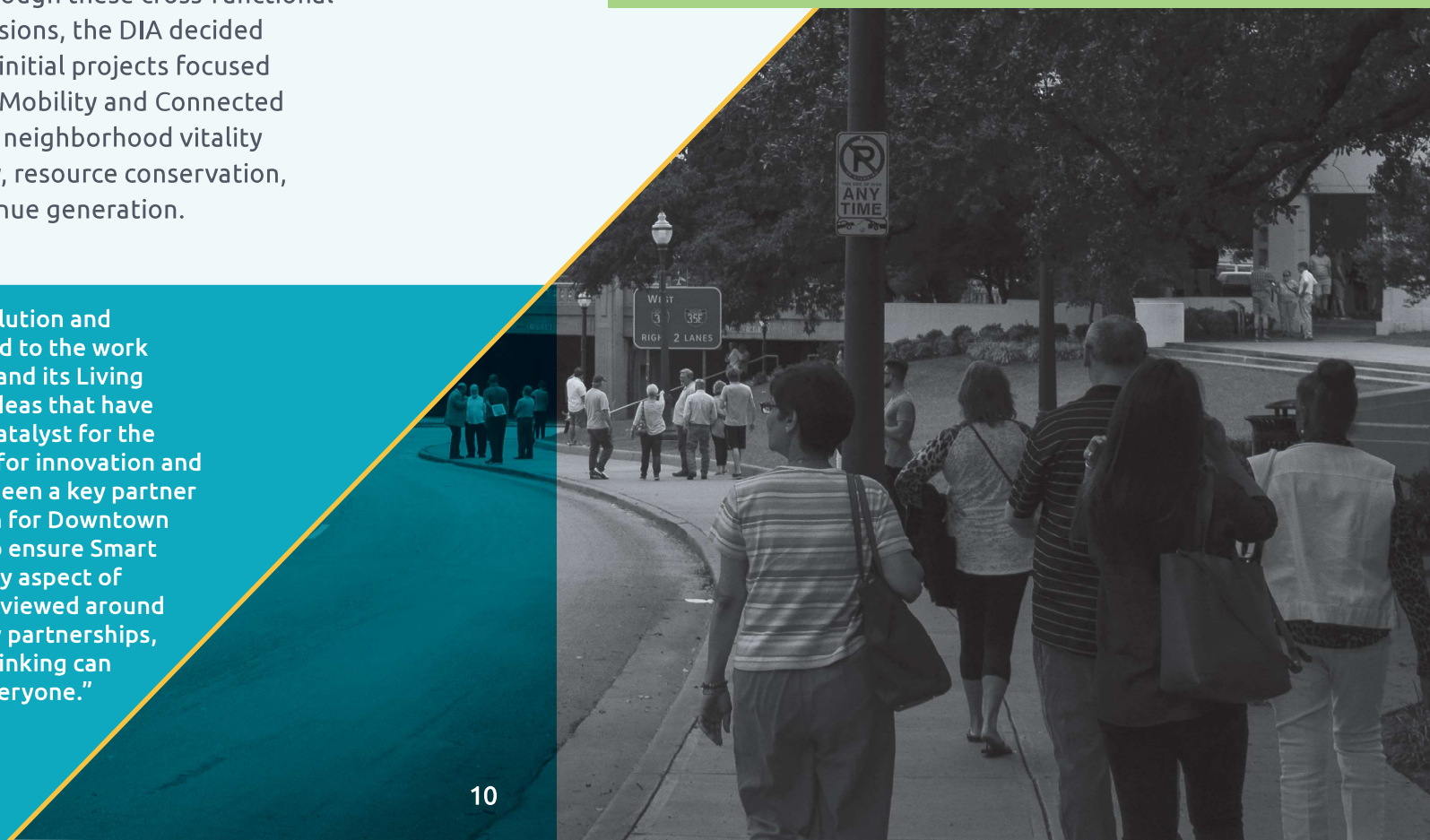
From the outset, it was clear that a multi-phased approach would bring the greatest opportunity of success in designing and testing smart city solutions. Understanding that each neighborhood has different needs, each phase of the DIA will focus on priorities for distinctive areas of the city, as delineated through city priorities, community engagement and partner feedback. The efforts of a large ecosystem of collaborators are critical for achievement of these efforts, not least of which is aligning priorities across multiple departments and data collection and integration – a key component of measuring success and making informed decisions. Through these cross-functional conversations and planning sessions, the DIA decided on a pilot zone "Living Lab" for initial projects focused on Smart Infrastructure, Smart Mobility and Connected Living. Goal outcomes included neighborhood vitality and quality of life, public safety, resource conservation, cost savings and potential revenue generation.

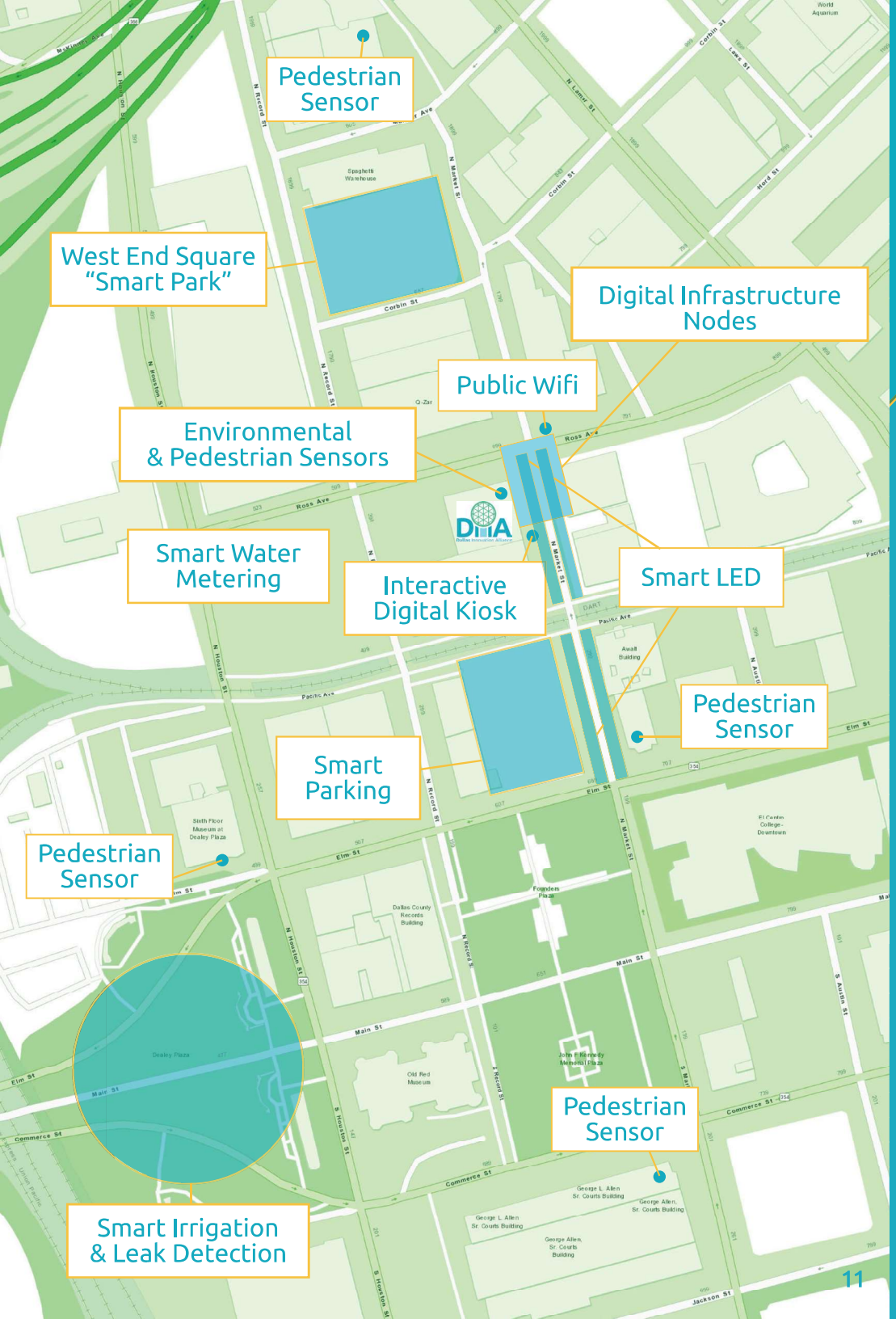
"Public-private partnerships, like the Dallas Innovation Alliance, are a great vehicle to show the direct link between innovation and economic growth by establishing the protocols for how the city and the business community can work together through a living lab to implement innovative solutions to city issues. In turn, this elevates our region's profile and lets companies looking to relocate or expand here know that they will find an innovation-friendly climate that can enable their success."

- Duane Dankesreiter, SVP, Research & Innovation, Dallas Regional Chamber

"A big part of the West End's evolution and recent successes can be attributed to the work of the Dallas Innovation Alliance and its Living Lab initiative. The cutting-edge ideas that have sprung from it have been a true catalyst for the West End's new identity as a hub for innovation and technology. In addition, DIA has been a key partner in the 360 Plan, our strategic plan for Downtown and connected neighborhoods, to ensure Smart City principles are applied in every aspect of urban redevelopment. The DIA is viewed around the country as an example of how partnerships, motivation and out-of-the-box thinking can build Smart Cities that benefit everyone."

- Kourtny Garrett,
President, Downtown Dallas Inc.





PHASE I: The Smart Cities Living Lab in the West End

The DIA's Phase I effort, the Smart Cities Living Lab, a four-block corridor down Market Street in the West End Historic District, has installed nine integrated projects over the course of a 12 month pilot period. The DIA engaged a mix of global companies and early to mid-stage startups to provide an environment of innovation, learning and growth.

Dense, urban environments provide the best test-case for initial projects as data validity/extrapolations are stronger when testing in a small geographic area that has high levels of activity. The West End was chosen as the location of the Living Lab, as it represents a microcosm of the urban environment, it is a concentration point for startup and entrepreneurial activity via the Dallas Entrepreneur Center and innovative companies like Blue Cross Blue Shield's C1 Innovation Lab. The planned West End Square will bring vital greenspace to the community and is being designed to be a "Smart Park". Moving forward, continuing to take a neighborhood-approach to project development allows for the community to help drive the solutions most needed in their unique area of Dallas.

SMART CITIES LIVING LAB - OBJECTIVES AND EXPECTATIONS:

The objectives for the DIA Living Lab program are to provide an environment where technologies and strategies can be tested to inform broader deployment decisions under the premise that cities should have "R&D labs" they can utilize - much as universities and corporations. The aims of the Living Lab are threefold:

1. Differentiate Dallas as a leader in innovation.
2. Execute a fully integrated pilot, with the ability to measure results specific to each project, and also the cumulative value via cross-project data insights.
3. Create a case study providing results, recommendations and examples of new sustainable financial models that allow for scaled deployment at near-zero or lowest possible capital expenditures; with a large component being the identification of new revenue streams for the city.

Simply put - how can Smart Cities' technology and data analytics improve operations and quality of life while conserving natural and financial resources, and generate additional revenue for the city?

Project Evaluation Process and the Value of Data:

There are a number of methods by which we have measured the results of Living Lab projects and their impact on the community.

- Results have been reported quarterly to establish progress and areas of expansion or improvement.
- Results have been measured from DIA project data, as well as publicly available data, and private data provided by local businesses.
- Through interoperable data across departments, greater insights can be gained and, as a result, better decisions made.
- The collaboration horizontally across the city is where the highest value lies, maximizing investments and minimizing individual project costs that could be combined, a struggle most cities find themselves tackling in the rearview mirror when inefficiencies are later identified.

LIVING LAB: PHASE 1

Dallas Innovation Alliance

SMART CITIES LIVING LAB

How can technology help conserve critical resources, reduce consumption and operational costs?

35% Energy decrease due to intelligent LED lighting

At scale, intelligent controls can add 20-30% operational savings, across city this could equate 10's of millions of dollars over LED bulb life

Water: Smart water meters and irrigation systems enable remote metering, lower water consumption and leak detection via sensors.

16% The National annual average of water consumption lost by leakage and theft

How can initiatives drive increased pedestrian activity, economic development, and public safety?

13% Pedestrian traffic flow increase year over year.

12% Economic Development: Small business revenue increase year over year

6% Crime decrease year over year

Public Safety: Improved lighting and pedestrian traffic has been shown to reduce crime 10 - 15%

Testing new methods to deliver information and services to the public

Interactive Digital Kiosk: Provides access to transit information, awareness campaigns, local points of interest and public facilities.

440 Average monthly users **& 53%** Using multiple functions

Public Facing Dashboard: Living Lab data will be made available to the public via interactive online visual dashboards.

Public Wi-Fi: The City has implemented a public Wi-Fi network in the Living Lab, providing access to internet for residents and visitors.

How can environmental monitoring and green space improve public health?

Green Space: The planned "smart park" West End Plaza will improve quality of life and heat island impacts in the neighborhood and incorporate into the Living Lab.

Solar Environmental Sensors: data on air quality indicators including allergens and contaminants can inform decisions impacting public health interventions, like childhood asthma.

JULY 4 Air quality deteriorated substantially following fireworks

How can smart parking improve operations, congestion, and citizen experience?

Smart Parking: Sensors identify lot/street capacity, utilization and in the future, inform citizens of availability prior to arrival.

7-10% National average of CO_2 emissions attributed to cars circling to locate parking

LIVING LAB: OVERARCHING RESULTS AND RECOMMENDATIONS

The purpose of the Living Lab was to provide:

- A testing ground for emerging Smart City technologies that save money
- Efficient use of internal and external resources
- Improved quality of life

In addition, the integration of the data from these different projects show the cumulative benefits of these investments. For example, combining data from lighting quality, pedestrian traffic, public safety and business revenue can show the correlation of improvements resulting from these initiatives. The overall vision in creating the larger Dallas Innovation District in the West End is to show the economic and social benefits of bringing creative talent, entrepreneurs, corporations, students and citizens together to show the revitalization possible for a neighborhood through these groups.

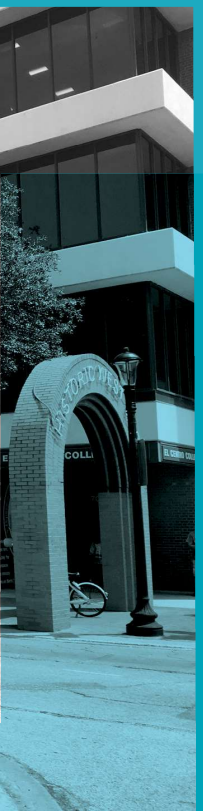
Living Lab results have shown substantial value that could be applied across the city, while others are most appropriate for expansion within dense urban areas. Understanding that there is not a 'one size fits all' solution, neighborhood specific approaches should be taken to ensure the unique needs of varying areas of Dallas are addressed through infrastructural and technological initiatives.

"Understanding that there is not a 'one size fits all' solution, neighborhood specific approaches should be taken to ensure the unique needs of varying areas of Dallas are addressed through infrastructural and technological initiatives."

Below are ***key learnings*** from the Living Lab focused on resource savings; neighborhood revitalization, public safety and quality of life; data and finance.

Resource Efficiency

Energy	LED lighting can achieve overall savings of 50-70 percent via energy savings of 30-40 percent, with industry standards indicating an additional 20-30 percent operational savings with intelligent controls. Future benefits of smart street lights via sensors, cameras and encasement of small cell, Wi-Fi and 5G suggest this project could generate the most substantial return on investment of projects tested.
Water	Water conservation via smart metering and controls for city water infrastructure and irrigation in city parks also bring substantial resource, cost and operational savings via proactive maintenance and identification of repair needs in real-time. Smart water metering offers citizens the opportunity to track water usage throughout the billing cycle, allowing informed behavioral changes to minimize consumption and their water bill. Leak detection can identify repairs far earlier than they could be identified otherwise, saving both water loss and financial investment. Per the EPA, water loss via breakages and theft on average equates to 16 percent of water consumption annually. Sensor technology alongside water audits can recover 75 percent of these losses.



Equity via Smart Lighting

Some communities feel disenfranchised, and one example we have heard through community engagement is around lighting quality, quantity and response time to power outages. As a result, many do not know how to report, or alternatively, have stopped reporting 311 related items like light outages, illegal dumping and code violations; as well as public safety incidents. Through automated real-time outage reporting, lighting repairs can occur quickly, improving trust and safety within these communities.

Thirteen additional intelligent control nodes were added to light poles in the southern sector to extend the pilot into other parts of the city. One of the nodes reported an outage. Through the diagnostics run remotely, it was determined the issue was a power source outage, vs. a bulb malfunction. It was quickly identified as a source issue and able to be addressed more quickly than traditional method of report and response.

Neighborhood Revitalization + Public Safety

Economic Development	Local businesses sharing revenue and customer traffic data have shown a 12 percent revenue increase year-over-year. Since the launch of the Dallas Entrepreneur Center in 2014, more than $100 million in private investment has been made in the West End.
Pedestrian Activity	A 13 percent increase in pedestrian flow has been seen year-over-year, and spikes in traffic at non-intuitive times of day have been identified, providing local businesses with insight to capture extra foot traffic.
Public Safety	Across the country, cities have credited increased foot traffic and improved LED lighting with a 15 percent decrease in violent crime. In the West End, there was a 6 percent decrease in crime year-over-year [2016 vs. 2017].

Public Health

Green Space	The future addition of the West End Square "Smart Park" will provide an additional proving ground in the Dallas Innovation District for park operations and visitor experience; in addition to the quality of life and public health impacts of proximity to green space; and reducing heat island via removal of asphalt. The DIA is working with Parks for Downtown Dallas, Dallas Parks & Recreation and the architecture firm James Corner Field Operations to develop technology elements in the smart park.
Public Health	In the Living Lab, we focused on certain environmental and public health impacts resulting from air quality measurements and anomalies in Downtown Dallas. Learnings from the solar-powered sensors deployed in the Living Lab are helping inform the design of future projects. The integration of environmental data with data concerning traffic congestion, flow and idling, and the presence of large-scale development projects can show air quality impacts on surrounding neighborhoods. *Learning:* air quality significantly deteriorated in the hours following fireworks shows on July 3rd and 4th, offering an opportunity to educate citizens on how to protect themselves at and following large events to prevent asthma and related incidents.
Waste Management	An additional recommended project is smart waste management that can improve quality of life via enclosed waste receptacles that eliminate the ability to tamper/rummage through trash. It also uses sensors to alert sanitation when trash cans are full, which can lead to route efficiencies. The system supports clean streets objectives, can minimize smell during hot Texas summers and decreases the risk of waste-related health issues. The DIA has received frequent requests from downtown residents and businesses for waste management improvements to address quality of life issues they are facing in their neighborhoods.

FUTURE RECOMMENDATION

The addition of noise and crowd detection sensing could alert police and first responders to potential vehicle accidents or criminal activity, shortening response time and informing officer allocation needs.

"There is no doubt that having a living, breathing innovation and technology driver in the West End is a huge win for businesses and citizens. Tutta's has seen substantial revenue increases year-over-year during the innovation initiatives in the Living Lab. I feel like we're on the cusp of something really great and if it weren't for the folks creating this driver; it wouldn't be possible."

- Jeremy Scott, owner of Tutta's Pizza

Citizen Engagement and Service Delivery	The digital interactive kiosk showed that services including wayfinding, local points of interest, public facilities [parks, libraries, government facilities] and a 'selfie' function were used by the public on a sustained basis, averaging over 440 users/month, with the majority of users visiting multiple services. Education was provided around voter registration, DART programs, and Downtown Dallas Inc. events and services. **Future Recommendations:** Look to add software features matching city delivery priorities, such as purchasing transit or event tickets, two-way communication with city staff, safety reporting, or others. Inclusion of communications equipment like Wi-Fi, small cells and sensors can provide additional value to citizens and additional revenue to the city. The addition of advertising provides sustainable revenue to pay for both the upfront and ongoing costs for a kiosk system, with net positive revenue to the city. DART is currently deploying a full kiosk system across its network using a similar model.
Mobility & Parking	The goal from this initial installation in surface lots and garages is to gain a better understanding of parking capacity and utilization of these facilities, including overall demand, length of stay, and times of highest demand. Future goal outcomes include pushing real-time parking availability onto consumer-facing applications, and layering occupancy data with parking revenue/enforcement, weather data, special events and environmental data to measure how these factors impact vehicle travel downtown. Smart parking can decrease CO2 levels via less circling to locate parking, which is estimated to contribute between 7 to 10 percent of carbon emissions in cities; San Francisco saw a 30 percent reduction from its parking initiative.
Data & Analytics	A coordinated data strategy benefits both citizens and decision makers in several ways. By making it easier for stakeholders to combine and compare data from multiple departments, city leaders jumpstart innovative data usage and more easily share resources and expertise. The city has made progress with its big data and analytics platform, and substantial savings can be achieved through these initiatives, such as a "dig once" policy, where all relevant projects in the same geographic area are coordinated to complete commercial development, water repairs, laying of fiber and other projects concurrently. This insight and coordination requires data integration and analytics. The transition to predictive/integrated decision making can save money and improve citizen service delivery. This is a transition that is underway in the city and will take time and resources, but the benefits are limitless and an essential foundation for the future.

Emerging Sustainable Financial Models and Digital Inclusion:

Cities are creating new models to pay for large-scale infrastructure and technology upgrades, many involving a combination of elements detailed below. Upfront capital costs are also being increasingly covered via public-private partnerships, where private capital is leveraged in financing, leading to no out-of-pocket upfront costs to citizens. While more data around these collaborations is needed to determine best fits for Dallas, some additional ideas learned from colleagues in the City of Dallas and others around the country include:

- Identify additional (or increased) revenue sources that are possible in conjunction with project deployments.
- Projects of interest to the city can be incorporated into the smart cities roadmap strategy, integrating multiple related projects into a portfolio/circular approach where cost savings and additional revenue streams pay for projects over time.
- Set as a condition of P3 agreements that service providers contribute to a digital inclusion fund. San Jose recently set terms for a $25 million dollar fund in conjunction with recently announced P3s with AT&T, Verizon and Mobilite.
- An additional financial component used in other cities has been the use of Community Block Grants and other federal funds to complete advanced infrastructure projects.

Additional Revenue Streams Possible via Living Lab Technologies:

- Advertising: Digital advertising is established to provide higher revenue than print/static advertising. Cities are also piloting beacon-based public notifications and advertising via embedded sensors in sidewalks and roadways.
- Telecom Leases: “Street furniture” provides additional locations for placement of equipment including small cells, 5G, Wi-Fi hotspots, etc., via light pole, kiosk and waste management. This encasement provides improved connectivity, as well as additional revenue opportunities.
- Operational Efficiencies: From reduced need for maintenance, more evidenced-based staff allocation models and integrated work order processes, there are significant cost savings available via these projects.
- Increased parking revenue has also been seen via smart parking initiatives.


Wi Fi
3:26pm
Friday, August 31
Welcome
TO THE
DIIA
Dallas Innovation Alliance
SMART CITIES LIVING LAB
POWERED BY
AT&T
TRANSIT SERVICES
EN
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KEY LEARNINGS:

As we developed and implemented the Living Lab and compared notes with leaders in other cities, certain overarching themes emerged from initiatives across the country:

Data Integration	A deep respect for the complexity of data integration and visualization. Developing a cohesive and integrated data platform across many systems is a highly complex and labor-intensive goal that takes significant time. The City's Big Data platform initiative is critical to success of all external projects and internal processes.
Establishing Baseline Metrics to Drive Results	Ensure that you have the ability to establish key KPIs at the outset, which was a challenge in some cases given a lack of available baseline data and industry standards for some projects. For example, currently street lights are not individually metered, so precise baseline usage was not possible. A foundational step will be to solve for existing data gaps to establish these baselines for KPI tracking prior to embarking on projects at scale.
New Ways to Pay	As part of our collaboration with other Smart City programs around the country and the world, there are financial models that could be interesting to test after being adapted to infrastructure needs of Dallas neighborhoods. San Diego, San Jose and other cities have engaged in these new models; Kansas City and Atlanta are currently pursuing RFP responses to expand their initial testing grounds to other parts of their cities.
Cohesive View Across the Ecosystem/ Departments	It became clear, in our coordinated activities related to the West End, that working with multiple public organizations and departments was critical and not always simple. We gained an appreciation for the challenges faced by the city. There are so many initiatives underway at any given time that it is nearly impossible to have our eyes on everything in motion across the city [and beyond, amongst community organizations and nonprofits working in the space]. Ongoing, regular communication across organizations is key.
Setting Expectations for Data Standards	Level setting and establishing expectations for data structure, formating and standardizing from the outset with the private sector; both for internal data integration and direct data delivery to the Dallas Open Data portal. This minimizes the current need for significant internal staff resources, and allows for maximum value adds from the data generated.
Value and Challenges of Data Sharing	The challenges associated with establishing data sharing agreements between internal and external entities must be addressed in a way that provides security and value to both parties. The integration of public and private data in areas including security/safety, camera footage, parking occupancy, and others provide valuable, comprehensive insights to the public and private sectors.

NEXT STEPS

The experience gained through the establishment of the Dallas Innovation Alliance and the Smart Cities Living Lab in the West End has shown the value of an independent, cross-sector partnership in supporting Smart City objectives that improve quality of life, resource and operational efficiencies, and economic development. The ability to move quickly in deployment, work collaboratively and gain insights into the relative value and potential of larger Smart City investments is a vital step in moving towards a smart and inclusive city - but it is just a beginning.

Our recommendations have emerged from evaluation of our pilot results and from direct city, citizen, and partner input.

For the DIA, next steps will include:

1. We will continue to measure results of Living Lab projects and support the design of the West End Square "Smart Park". Key to that effort is focusing on smart operations and interactive experiences; with a foundation on the infrastructure needed to support technology as it evolves and changes.

2. We will continue to formalize our next phase focused on Southern Dallas. These Phase II efforts will look at solutions to challenges not directly addressed in the West End and uniquely critical to our fellow citizens in Southern Dallas, focused on mobility, the digital divide and public safety, with others on the horizon. Phase II projects will launch in 2019.

3. We will continue to support the city, communities, and other cities throughout the region as we move towards our common goal to create communities that provide high quality of life, efficiency, and access to opportunity.

4. We will continue to build our community partnerships and committee engagement projects with exciting programs planned for Fall 2018, including a civic data hackathon pairing citizens with data experts to develop solutions for issues they identify in their communities; and a planned research project that will include K-12, DCCCD, and University institutions.

For the City of Dallas, our near-term recommendations include:

1. Expansion of select Living Lab projects through the West End Historic District, to enhance impacts to the full district, its residents and businesses. We look forward to working with City officials to determine which components are most promising for expansion.

2. This expansion offers two-fold benefits:

    a. First, a larger sample size with which to extrapolate fully-scaled deployments focused on lighting, pedestrians, traffic, parking and noise sensor detection, and the addition of waste management improvements.

    b. Second, and equally if not more importantly, this expansion responds to prominent feedback and desire from residents, businesses and visitors to the West End that these projects would provide enhanced safety, clean streets, business impact and quality of life. Responding to data insights gathered and citizen engagement is the methodology we will continue to utilize as we expand.

3. The systematic review of all pilot projects is highlighting service areas that could be attractive to the city and which could attract funding from private investors. To know which of these would be most valuable, a first step is to ensure that private providers of infrastructure and services still meet levels of service and regulatory compliance required by the City.

    As one example, “smart poles” delivering lighting improvement and other benefits could be a very attractive target for funding by private capital. They deliver a strong and financially measurable benefits package, starting with the value directly delivered to the city with smart lighting including better lighting quality and public safety outcomes, while conserving energy and allowing the streets department to improve processes through automatic outage reporting. They also provide additional revenue opportunities through leasing the interior of the poles to embed equipment such as small cells, 5G and Wi-Fi hotspots.

4. Making these smaller investments also provides an opportunity to stress-test new financial modeling and contract structures prior to setting city-wide projects in motion. Ideally, the short/mid-term expansion could reach across downtown to create a showcase of a smart urban core. Ultimately these expansions will lead to cost savings and additional revenue streams for the City.

ONGOING RECOMMENDATIONS

In August 2018, the City of Dallas released its Smart Cities Roadmap, an expansion of its 2014 Smart Domain Strategy, and building off of 2016's Technology + Plan.

As the city moves forward with planned initiatives and investments via the operating budget, and the critical bond program, our recommendations would include the following:

- Fully leverage existing city-owned assets in the right-of-way for Smart City element incorporation, immediately focused on street lights, streets, traffic signals, city camera networks, water, stormwater and wastewater infrastructure. Improvements to core city infrastructure leads to economic gains, resiliency and cross-functional performance efficiency.
- Utilize existing, planned capital projects as opportunities to incorporate smart infrastructure, including bond program projects focused on streets, bike lanes, traffic signals, lighting, parks, city-owned facilities and others. This substantial investment ratified by citizens has the potential to take these investments further and creatively design these projects to create future infrastructure that will set the foundation of new standards and policies as our city continues to grow and expand.
- Concurrent with the development of these projects, ensure a look to the future and incorporate larger strategic vision for 10-20 year advances in mobility, infrastructure, parking and citizen service delivery demands. For example, how do current investments support the eventual move toward autonomous vehicles for both people and goods, how does a decrease in parking demand speak to changes in parking minimums, city development codes and land use planning, and how can existing economic development strategies support the emergence of future industry clusters and entrepreneurs that will drive the future careers and businesses that can define Dallas as a force in the global economy?
- Investment in the continued expansion of data analytics platforms and Dallas Open Data to reap the full internal and external benefits of big data and citizen transparency via open data. The functionality of data collected from all city projects should have this compatibility with existing systems top of mind. Integrating data sources breaks down information silos and maximizes resources within and between departments.
- Continued exploration of public-private partnership models and closed-loop portfolio approaches for financially sustainable Smart Cities deployments.
- Engage citizens directly to establish a data deployment policy and best practices. This begins by educating, listening and including public input on the process and reasoning for data collection, protection and use. Establishing and communicating the public benefits driving the use and analysis of this data is critical for success of data-driven Internet of Things programs.
- Look to projects at a neighborhood scale that allow for a community's direct input into the design process to address the challenges that are most directly impacting quality of life and access to opportunity.
- Develop a standard operating procedure across city departments that outlines requirements around data ownership, privacy, security, data format and ingestion standards and monetization. This comprehensive set of requirements can provide best practices that lead other cities toward similar objectives.

We are grateful to the city for their vision and partnership throughout this journey, and to our partners across the DIA organization. The shared mission and gift of expertise, resources and insights have made this possible. We look forward to next steps on building Smart Cities for the whole of Dallas, and shaping neighborhood strategies to create inclusive communities and a high quality of life in our city. Our organization will continue to support short- and long-term efforts in whatever capacity is needed to work toward this dream for Dallas.


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TOPICS FOR CONSIDERATION IN SMART CITY DEPLOYMENTS

In our learnings, several topics have risen to the top as important areas of discussion for cities as they build out these programs. Brief summaries of each of these topics can be found below.

Civic Data Ownership & Monetization

Civic data is an asset with a tremendous (and growing) potential for value, but cities often operate under an assumption that the data they collect and publish should always be available at no cost. Certainly, taxpayers have a right to access the data that they are funding, and there is a solid case that public data should be unconditionally free to nonprofits, the press, or academic researchers. However, for businesses that use this data for profit, it is not unreasonable for cities to charge for access. An early mover in this field is the city of Copenhagen, Denmark, which, since 2015, has partnered with Hitachi to operate the City Data Exchange. Initial results from this project suggest that, although there are still kinks to work out, a monetization platform can successfully overcome regulatory and privacy concerns. City leaders can design access controls including access charges based on the volume of data consumed, time-limited levels of free access, fee waivers for NGOs, press, and citizens, "quid pro quo" arrangements with private-sector partners, and the incorporation of data access into contractual negotiations as a method to defray project costs.

Data Privacy Policies

Throughout much of the developed world, the right to privacy is protected by law, yet people's behavior is now being recorded more often, and in a wider variety of ways than ever before. As increasing numbers of cities adopt open data policies, city leaders are becoming increasingly aware that access to bulk information can produce concerns regarding privacy, security and liability. In developing a data privacy policy, city leaders must consider that adopting law-based frameworks may open potential privacy risks, as the process for creating and amending laws necessarily lags behind technological advancement and innovation, and terms and definitions are constantly evolving. Risk-mitigating balance tests provide city leaders with a standardized decision-making toolkit to document the decision-making process behind whether data are made public. While there is some subjectivity in weighing the public good versus the private right to privacy, language can be carefully crafted to weigh specific elements, and to bring rationale into the decision of whether to release, redact, or withhold civic data. Such balance tests are currently used in dozens of cities. Those employed in San Francisco and Seattle have won awards and praise from open data and privacy champions alike and are publicly available for other cities to mimic.

IoT and Smart Cities Infrastructure

For many years, the Internet of Things (IoT) has captured headlines, with various media outlets describing its potential to transform lives by enabling "smart," sensor-enabled devices to communicate with each other, and with end users. By combining physical and digital infrastructure, city leaders can more efficiently use data to provide their constituents with an enhanced quality of life, including insights into infrastructure needing repair, allowing for predictive maintenance, or monitoring of water levels to alert

and divert drivers in the case of flooding. However, by increasing interconnectivity among infrastructure, organizations, and individuals, city leaders also expose new vulnerabilities that criminals can exploit in order to cause damage to essential infrastructure, disrupt the flow of sensitive data, and steal personal or sensitive information. In considering IoT security and implementation, there is tremendous buzz around the use of blockchain technology to make communication among devices safer and faster, but limitations surrounding storage space and network capacity make it currently infeasible for citywide IoT deployment. Even without blockchain technology, by implementing robust cybersecurity practices, city leaders ensure the privacy, integrity, and security of citizen- and enterprise data.

Costs, Financials, and the P3 Model

If cities are to address the yawning gap between infrastructure needs and resources, public- and private-sector institutions must collaborate to innovate and fund creative solutions that allow cities to effectively deliver citizen services in the digital age. One option is for cities to enter into public-private partnerships (P3s) to leverage the resources and expertise of the private sector at a reduced upfront cost to taxpayers. P3s are common tools for financing physical infrastructure in cities, but with respect to digital infrastructure, buy-in from city leaders and private-sector partners is often hindered by the difficulty of measuring the return on investment. Citizens, too, are concerned about privacy and distrust the collection and use of personal data. Evidence from successful initiatives nationwide suggests that P3s led by independent nonprofit organizations can effectively manage concerns regarding transparency, accountability, and equity. Across the United States, nonprofit-led P3s are kickstarting development and implementation of Smart Cities technologies, ensuring public engagement and support, and objectively evaluating solutions from a variety of providers and vendors. They also help city leaders manage risk associated with projects by establishing guiding principles, like considering which party has the greatest incentives to undertake preventative risk management and to minimize the financial consequences of a risk.

Smart Cities and Legacy Zoning Codes

Municipal zoning codes tend to lag behind technological development, and an unfortunate result is that code officers and courts generally have to use tools designed for earlier stages of development to deal with new challenges. Across the country, city leaders are making changes to their zoning codes, in order to allow the built environment to catch up to the changing technological landscape, and to encourage adaptive reuse of existing space. One option is for city leaders to relax zoning and permitting requirements in well-defined districts, while also installing low-cost sensors to monitor noise levels, air quality, structural integrity, and crowd sizes, thus allowing city leaders to hold developers accountable by automatically triggering warnings or summon code compliance officers to their location to issue fines based on verified, recorded data. An additional alternative is the use of form-based zoning, which underscores the physical design of a place, rather than its use. Finally, web-based mapping software can be used to assist developers in identifying structures that may meet their needs, while also being aware of applicable city codes and zoning policies.

Procurement & RFPs

As city leaders continue to implement Smart Cities technologies, they increasingly find that traditional procurement processes face a number of challenges, including new technical features and infrastructure needs, complex ownership models, potential for new financial flows and revenue generation, and risks associated with the reliability, performance, and eventual obsolescence of ever-evolving technologies. Rising to the challenge, city leaders are finding innovative ways to procure public resources and engage with the vendors offering applicable technologies to urban systems, including public working groups, Requests for Information (RFIs), and the use of pilot programs and platform partnerships. To increase transparency within the traditional RFP process, a growing number of cities are using smart city working groups and technical standards committees to map out smart city opportunities and engage citizens regarding what criteria should be included in the request, while allowing cities to require that proposals include proprietary information or solutions with the protection of non-disclosure agreements. As an addition to the traditional RFP, more cities are experimenting with using an RFI that precedes the RFP, and that functions as a kind of market analysis. RFIs are especially prevalent in the rapidly changing Smart Cities space, because they allow a city to conduct its own analysis and engage in internal learning regarding new advances in technologies. Finally, establishing pilot programs and platform partnerships for new technologies can offer city leaders the opportunity to familiarize themselves with different potential technology solutions, explore a given technology's value to city operations, and gather input from the community prior to committing to a larger investment.

Data Management, Standardization, Analytics

Cities are now presented with ever-increasing ways to capture data, but often fall short of their digital potential because they focus on collecting and using data in narrow, traditional ways. Producing and managing standardized data published to an open portal is essential, and a coordinated data management strategy allows a variety of stakeholders to probe deeply into civic data to help solve for the problems of both citizens and businesses, increase efficiency, and assess city priorities while problems are at sub-critical levels, rather than constantly finding themselves stuck reacting to citizen complaints. The transition from reactive to proactive/predictive is the key to improving internal operations and citizen service delivery. In order to develop these insights, cities must invest in dedicated staff members who possess a deep understanding of the technical, structural, and semantic aspects of data, as well as dedicated data analysts who can generate, test, and operationalize a variety of data analysis methods. In cities with limited resources and strict hiring restrictions, startups and public-private partnerships can help fill these personnel gaps. In addition, participation in university-driven city consortiums, such as the Harvard Ash School, allow for peer-to-peer insights that can expedite progress and minimize missteps.

STRATEGIC PILLARS, CITY ALIGNMENT, AND CITIZEN BENEFIT

DIA Pillar	Topic Area	Upcoming & Existing Projects in West End Living Lab	Value to Citizen	City Priority Supported	Dallas 365	Smart Dallas Priority Supported	Benefit for City of Dallas	City & External Partners Engaged
Resource Efficiency	Energy	LED & Connected Street Lighting	• Improved lighting quality and safety [both perceptual and actual] • Quicker repair of light outages • Funds Saved can be allocated to other citizen-centric areas and services	• Sustainability • Government Efficiency • Innovation/Smart Cities • Safe Neighborhoods	• Resource Conservation/ Sustainability • Improved Infrastructure • Intelligent Emergency Response • Thoroughfare street lights functioning • Quality of Life: 311 Report Response Time • Government Performance & Financial Management	• Smart Energy + Environment • Smart Public Health + Safety	• Energy efficiency toward sustainability metrics • Cost savings in energy and operational efficiencies • Improved public safety via improved lighting • Upgrading infrastructure to allow for additional functions for poles [crowd, noise, gunshot detection sensors; small cell and Wi-Fi encasement; cameras]	• **City:** Communication & Information Services, Mobility & Street Services, Sustainable Building & Construction /Real Estate, Historic Preservation, Landmark Commission • **External:** Oncor, Downtown Dallas Inc., West End Association, DART, Philips and GE
	Water	• Automated Metering Infrastructure (AMI) • Smart Irrigation Systems	• Greater insight into water usage and cost; opportunity for behavior change to impact both of these elements. • Minimizing repair scope and construction that impacts roads and commute times.	• Sustainability • Government Efficiency • Improved Service Delivery	• Resource Conservation/ Sustainability • Water Meter Reading Accuracy • Quality of Life: 311 Report Response Time • Government Performance & Financial Management	Smart Energy + Environment	• Water conservation contributes toward sustainability metrics • Cost savings in water [conservation, leak detection] and operational efficiencies eliminating manual meter reading and late notification of repair needs. • Service delivery/ consumer transparency around advanced metering/usage visibility	• **City:** Communication & Information Services, Dallas Water Utilities, Parks & Recreation, Cultural Facilities, Office of Environmental Quality • **External:** Itron and HydroPoint Data Systems
Public Health	Public Health & Environment	Environmental sensor kit measuring six different factors: Temp, humidity, CO2, NO2, Ozone and Particulate Matter/Allergens	Information on areas of air quality that impact and exascerbate conditions include asthma and allergies	• Public Health • Sustainability	• Localized Environmental Quality Visibility • Data-Driven Governance • Intelligent Insights & Congestion Reduction	• Smart Energy + Environment • Smart Public Health + Safety	• Enhanced air and environmental data, especially around particulate matter & public health impacts. • Provide public awareness around "hot spot" days for asthma, allergies and overall air quality. • Awareness and treatment lead to less school and job absences and improved performance. • Leverage in related OEQ & resiliency efforts.	• **City:** Communicatio & Information Services, Office of Environmental Quality, Resiliency • **External:** Downtown Dallas Inc., DCCCD, DISD, University STEM programs regionally, Ericsson.
	Green Space	Providing insight into the design and development of West End Square, one of the four priority downtown parks being built by the City of Dallas Parks & Recreation Department and Parks for Downtown Dallas	• Mental and Physical Health benefits of outdoor activity • Reduced heat island impacts • Enhanced public space for rest, play and interaction	• Public Health • Sustainability	• Quality of Life • Human and Social Needs • Economic and Neighborhood Vitality • Resource Conservation/ Sustainability	• Smart Energy + Environment • Smart Public Health + Safety	Contributions to public health, sustainability and quality of life priorities. Green space brings associated economic impact and attraction. "Smart" elements to the park design improves operational and cost efficiencies in park management.	• **City:** Parks & Recreation, Communication & Information Services • **External:** Parks for Downtown Dallas, West End Association, Downtown Dallas Inc.

DIA Pillar	Topic Area	Upcoming & Existing Projects in West End Living Lab	Value to Citizen	City Priority Supported	Dallas 365	Smart Dallas Priority Supported	Benefit for City of Dallas	City & External Partners Engaged
Citizen Engagement & Service Delivery	Citizen Engagement & Service Delivery	Digital interactive kiosk with USB charging ports and customized software including wayfinding, public buildings & services, points of interest, public education campaigns, etc.	• Localized access to information guiding transit and travel, city facilities and services, and local amenities. • Added potential to have direct interaction with City staff via webcasts, 311 reporting; potential to pay water bills and other transact-ions; Wi-Fi hotspots/ access & others.	• Citizen Engagement • Service and Information Delivery	• On-Demand Access • Multimodal Transit • Government Performance and Financial Management • Human and Social Needs • Community Engagementent	Smart Governance + Community	• Revenue streams via digital advertising and small cell/5G leasing is possible • Additional functions for public safety, connectivity, etc. • Create an offering for citizens as a gateway to introduce smart cities technology that will allow the city to offer connectivity between citizens and the city. • Test new methods for installing, housing and scaling connectivity across Dallas. • Additional revenue streams via licensing or advertising.	• **City:** CIS, Mobility & Street Services, Sustainable Building & Construction/Real Estate, Historic Preservation, Landmark Commission • **External:** Oncor, Downtown Dallas Inc., VisitDallas, West End Association, DART, CIVIQ Smartscapes
	Connectivity	• Public Wi-Fi [City of Dallas initiative] • Small Cell/Wi-Fi/5G encasement [Potential future project] • Digital Divide: Underserved community broadband/ Wi-Fi access [Project in development for Phase II in Southern Dallas neighborhoods]	Access to internet and cellular connectivity for residents and visitors to Dallas	• Innovation/Smart Cities • Technology/ Infrastructure • Talent Attraction • Economic Development • Equity • Poverty	• On-Demand Access • Improved Infrastructure • Community Engagements	Smart Public Health + Safety	Providing connectivity in key areas in downtown to further engage our citizens in their need for constant connectivity	• **City:** CIS, Mobility & Street Services, Sustainable Building & Construction/Real Estate • **External:** Oncor, Downtown Dallas Inc., West End Association, DART, AT&T
	Data Analytics & Transparency	Interactive Data Dashboard and Visualization: Providing data captured from the Living Lab in an interactive online dashboard allowing for easy exploration of data, and ability to export raw data.	• Researchers, Teachers and Students: access to project data for use in research and STEM curriculum. • Entrepreneurs: Access to project data for use in building, developing and testing new products/services. • Public: Easy to understand visualization of impacts of projects and data; expands data literact. • Data transparency	• Innovation/Smart Cities • Technology/ Infrastructure • Talent Attraction • Economic Development	• Data-Driven Governance • Intelligent Insights • Government Performance and Financial Management • Community Engagements	Smart Governance + Community	Data analytics bring insights and efficiencies not possible with manual processes; these insights allow city management to be proactive rather than reactive in maintenance, operations, public safety and data-driven decisionmaking.	• **City:** Communication & Information Services • **External:** Amazech
Mobility	Mobility	• Smart Parking pilot • First mile/Last mile project in develop-ment for Phase II • Emergency service delivery project in development for Phase II	• Ease of locating available parking • Improved air quality/ CO2 related to decreased circling/ idling finding parking • Land use/planning changes could result from parking usage data, creating increasingly pedestrian-friendly environments.	Technology/ Infrastructure	• Data-Driven Governance • Intelligent Insights & Congestion Reduction • Commuter Safety • Improved Infrastructure	• Smart Transportation + Mobility • Smart Public Health + Safety	• Better visibility of parking lot/on street spot utilization and capacity; make more informed land use decisions • Potential to increase parking revenue via demand pricing or enforcement automation • Improved multi-modal service and options for all Dallasites	• **City:** CIS, DPD-Parking, MSS • **External:** DART, Downtown Dallas Inc., West End Association, Real Estate Owners, Residents, ParkHub, AT&T Digital Infrastructure
Neighborhood Revitalization/ Economic Development	Neighborhood Revitalization/ Economic Development	• Pedestrian Counting Beacon Technology • Improved LED Streetlghting • Small business revenue reporting	• Increased amenities in neighborhood via business mix, attraction • Job creation • Increased pedestrian traffic • Improved public safety • Small business success and longevity	• Talent Attraction • Economic Development	• Data-Driven Governance • Commuter Safety • Resource Conservation • Improved Infrastructure • Intelligent Emergency Response • Intelligent Insights & Congestion Reduction • Multimodal Transit	• Smart Governance + Community • Smart Transportation + Mobility	• Improved occupancy rates, tax base, business and job creation • Increased community 'ownership' and invest-ment in neighborhood • Improved public safety	• **City:** CIS, Real Estate, Economic Develop-ment, Landmark Commission, Streets Public Works • **External:** Downtown Dallas Inc., DART, West End Association, Dallas Regional Chamber, EBSystems, Current by GE, Philips

PEER CITY PROJECT SYNOPSES

Chicago, IL
Array of Things and Lane of Things

Launched in 2016, the Array of Things uses hundreds of interactive, modular sensor nodes installed on streetlights throughout the city, which collect data that is being made available online to researchers, city leaders, and the general public. The project is led by Chicago's Department of Innovation and Technology, which manages the city's open data portal, the University of Chicago, Argonne Labs, and supported by a network of nonprofits, private sector partners, and university-affiliated researchers. An outgrowth of this project, the Lane of Things, was a program that brought together K-12 and University students to develop sensors similar to the streetlight-mounted models, and then conduct a variety of experiments using them. Students presented their findings to school officials, prompting these leaders to consider the use of technology to improve the school's overall environment. These projects have been supported by over $4.1 million in federal research funding and NSF grants.

Kansas City, MO
Open Data Dashboard & Public Data Policy;
and Smart Cities Pilot & RFP

Kansas City's KCStat open data dashboard began in 2011, and offers citizens and city staff visualizations that include including available parking, traffic flow, pedestrian hotspots and the location of streetcars. These data are provided by city staff, and their availability and timely release are governed by a 2014 city council resolution, which directs city departments make data open and available to the public whenever feasible, and with respect to a variety of privacy and confidentiality needs. Additionally, the city's open data practices are governed by a committee of city staff and citizens; committee members see what data the city collects, and then collaboratively set priorities around which data to review, clean, and publicly release.

In 2016, city leaders cut the ribbon on a Smart City pilot program, which includes intelligent streetlights, informational kiosks, and free, public Wi-Fi. Based on the pilot's success, city leaders recently released an RFP that calls for private-sector partners to design and build a fully-integrated suite of sensors, networks, and data analytics platforms, including approximately 800 Wi-Fi access points, 300 traffic sensors, and 30 digital information kiosks. The pilot program is supported by over $20 million in private-sector grants and matching funds, and generates an estimated $4 million annually in operational- and energy savings.

New York City, NY
NYCx and LinkNYC

NYCx: Launched in October 2017, NYCx is a municipal program designed to convert urban spaces into hubs for tech collaboration, research, testing and development in real-world environments. NYCx Co-Labs are designed to be hubs for experimentation and education located in high-need, high-opportunity neighborhoods, wherein local residents, city staff, and academic researchers can collaboratively identify and test new solutions to neighborhood-specific concerns. The spaces host public programs and workshops that allow New Yorkers to test and give feedback on technologies that aim to improve both quality of life and City services, as well as programs that highlight STEM careers. Support is provided by multiple city departments, local - and national nonprofits, and the NYC Economic Development Corporation.

LinkNYC: Millions of people in New York City don't have access to high-speed Internet. To solve this problem, city leaders entered into a multi-year contract with CityBridge to replace 7,500 payphone stands with digital kiosks that will provide free Wi-Fi access, nationwide phone calls, access to 911 and 311, interactive wayfinding and transit updates, and the ability for users to anonymously search for nonprofit- and social services. Initial funding for the project was provided by a consortium of technology- and telecom companies, as well as regional EDCs, and a revenue-sharing agreement with the kiosk vendor. Importantly, the program has struggled to generate more than this minimum payment, and the original agreement has since been modified to allow CityBridge to delay paying the city its share of the revenues above the annual minimum payments.

Pittsburgh, PA
University Partnerships

In 2009, the City of Pittsburgh, in partnership with local universities, launched the Traffic21 program, which identified and implemented technological advancements within the regional transportation system. A spinoff of Traffic21, Metro21 is an initiative that aims to combine technology and policy to allow city leaders to take the pulse of infrastructure, services, and civic engagement throughout Pittsburgh, through the integration of extant systems (e.g. roads, buses, sidewalks) and technology. The successes of Traffic21 and Metro21, in turn, resulted in the 2017 creation of Mobility21, a federally-funded transportation research with over two dozen active research projects and pilot programs focused on creating deliverable solutions to real-world mobility concerns. These partnerships were initially funded through a local foundation, and they maintain funding through aggressive pursuit of research grants.

San Diego,CA
IoT Platform & Large-Scale Intelligent LED Retrofit

Across San Diego, thousands of streetlights throughout the city are being upgraded, making the city one of the largest city-based IoT platforms in the world. Within San Diego's urban core, 3,200 luminaires are being replaced with models that also contain connected sensor arrays supporting a variety of connectivity-, environmental-, traffic-, and public safety initiatives, and that provide city leaders with real-time sensors for decision-making. An additional 14,000 luminaires citywide are being refitted to house connected, fully adjustable LEDs. Phase 1 of this $30 million project is funded through a local technology consortium and CDBG funds, and Phase 2 will be funded through state grants and accumulated savings through reduced energy usage and decreased operational expenditures.

San Jose, CA
Smart Cities [SIC] RFP & P3 Model

In 2017, San Jose's city leaders issued an RFP for the development and implementation of a citywide digital inclusion strategy; this resulted in a public-private partnership that now oversees the installation of approximately 5,000 small cell sites and 800 miles of new fiber outlay. These infrastructure improvements combine to expand Internet access throughout the city, improve the resiliency and reliability of the FirstNet emergency responder communications network, serve as the foundation for future 5G service, and will facilitate a number of smart cities pilot programs, including smart LED lighting grids, public Wi-Fi, and digital monitoring of civic infrastructure and buildings. Per the RFP, these developments are being funded by over $500 million in private-sector financial investments, nearly $4 million in in-kind investments, and $1 million in private-sector grants. Partners have also invested $24 million to support the city's broader digital inclusion strategy, alongside a $500,000 grant from the Knight Foundation. Finally, the project generates San Jose annual leasing revenues of $1,500 per small cell site over the next 15 years.

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