

Capacity Building for Smart Data and Inclusive Cities

Resource Packs



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What's Coming Next for Smart Cities

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» Background

About these Documents:

These three resource packs have been produced by Cityfi for the SDIC project as part of its first-year milestone workshop. They therefore are primarily targeted towards cities and urban actors in the middle of their smart city journey. However, we have made an effort to keep provide a wide variety of general information in these resource packs in order to be useful for a wider range of potential readers.

About the author:

[Cityfi](#) is in the business of urban change management, with an eye toward facilitating and empowering positive, sustainable impacts and economic returns. At our core is dispelling the myth that a necessary evil of good business is often a suboptimal outcome for people and the environment. We believe that true public-private partnerships are built upon clear lines of communication, common goals, aligned incentives and outcomes. Cityfi helps towns, cities, governments, start-ups, and companies understand and navigate the increasingly complex urban landscape, and work together to make positive change, fast. We focus a great deal on technology, but in the context of what is good for cities, citizens, and the long-term health of our environment.

We are global thought leaders in the transportation, technology and finance sectors. Working by inspiring community action, advising organizational leadership, developing strategic roadmaps, and facilitating public-private partnerships and pilots, Cityfi integrates public policy, urban design, economic development,

capacity building, and civic innovation to achieve measurable outcomes to create more livable, sustainable and efficient communities. We leverage a network of subject matter experts with experience across multiple sectors and geographies to provide holistic strategies, action plans, and practical solutions to meet corporate and community priorities.

About the Project

The Capacity Building for Smart Data and Inclusive Cities (SDIC) project is built around a three-year collaboration between the National Institute of Urban Affairs (NIUA), the Institute of Development Studies (IDS) and four partner cities: Bhopal, Jabalpur, Thiruvananthapuram and Kochi. The project aims to address technical and institutional challenges at the local level for realizing the Smart City Mission's objectives by strengthening capacities of four smart cities.

The project will draw a connection between technological and relational solutions; between big data and 'small' or local data; between the ability of urban authorities to deal with cutting edge technologies and their abilities to incorporate information and insights from everyday citizens; and most fundamentally, between a vision of smart cities that emphasizes technocratic 'data driven' governance and a vision of being smart that emphasizes and prioritizes using new technologies to make urban society and urban life more inclusive, safe, resilient, and sustainable.

This project is funded by the European Union.



“MAKE BIG PLANS; AIM HIGH IN HOPE
AND WORK, REMEMBERING THAT
A NOBLE, LOGICAL DIAGRAM ONCE
RECORDED WILL NOT DIE.”

-- DANIEL BURNHAM

» Resource Pack 1: Smart Cities Frameworks and Management Approaches

Smart Cities Values + Elements

Cities, technologists, and urban leaders are each working to create and define the ideal or prototypical smart city. It's likely that none will succeed on its own, and that the smart city will look radically different as one travels from town to town and across the globe. While the outcomes can and should look different, it is useful for cities to consider how a consistent framework might drive decision making. As such, we've provided a series of frameworks or descriptions of smart cities, enabling a customized focus on verticals like public safety or mobility, asset like building or infrastructure system, or function like data or procurement. Ultimately, it is the matrixing of verticals, assets, functions, and values that will lead to the development of a smart city.

While many cities (across the globe) have begun implementing projects and initiatives in the smart cities space, it's useful to consider these within the context of a broader strategy. Also, while it's important to develop a smart city strategy, that doesn't always come first. Oftentimes, projects are created because of a specific opportunity - whether vendor or city driven. In many cases, strategies come after a number of projects have actually been deployed.

Approaching a Smart City Strategy

Suggested reading:

[Smart Cities: An Overview of the Technology Trends Driving Smart Cities](#)

[A New City O/S; Chapter 2](#)

[Digital Master Planning: An Emerging Strategic Practice in Global Cities](#)

[Estonia, The Digital Republic](#)

The Waterfall Approach

[Cityfi](#) works closely with clients to develop human-centered strategies and solutions that work. Starting from the perspective of the end-user, we believe it is important to quickly develop and test assumptions through a collaborative process rooted in design thinking. This research-driven approach is intentionally iterative as we acknowledge uncertainty. It is critical to be sensitive to the potential benefits of new transportation technologies as well as the unintended consequences of new tools and services. At the onset of any project, it is important to engage all critical stakeholders to clearly articulate "North Stars" — the guiding vision and core values that will ground all strategies and objectives of any plan. It is important early on to establish this shared understanding across stakeholders as it will

provide clarity to the project focus and offers a valuable touchstone as key project decisions are made.

Once North Stars have been established, it's useful to move quickly from research and assessment to planning and action, allowing the room for failure and the flexibility to learn and quickly develop a better, more robust strategy, and appreciation of the aversion to risk taking. Consequently, one should approach planning in such a manner that allows cities to build on their strengths in measurable ways but also allows for "graceful failure." With our growing dependence on smart city and other technologies, we need to account for the non-digital in our strategies — this is just as much about being ready for the future as assuming it might not work the way we had anticipated. With that in mind, our team has led efforts to effect transformational change from within government so we plan with our clients — not for them. Our work applied this approach when developing a citywide technology roadmaps; these plans built on existing capacity and resources, complemented policy priorities, and brought new stakeholders to the table to help the public sector realize the desired outcomes. Our inclusive process provides clients with ongoing opportunities for community and stakeholder engagement as a means to build capacity and support for the final plan. Our

process also typically culminates with the first steps of implementation to help our clients move from plan to action more seamlessly. With the City of West Hollywood, for example, in addition to developing their first-ever smart city strategic plan, we worked to help them identify and establish partnerships to facilitate the implementation of identified pilot projects and will be supporting the development of staff training to help them create more internal advocates for a "smart city hall." Over the

course of this entire project, we engaged city staff and management as well as the general public to solicit input and help prioritize the strategies to be recommended in the completed plan.

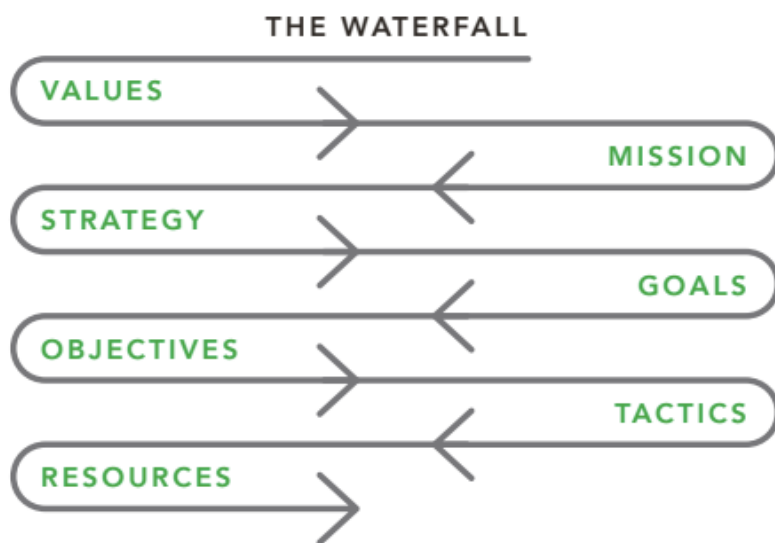
Values:

Identifying

the core values of a city helps serve as the "north star" for smart city decision-making. Sometimes making a problem bigger is a smart way to gain broader buy in - particularly across departments and sectors, where implementation issues may arise. If you can get people to agree on the problem being solved in service of a particular value, it becomes easier to make more tactical decisions and align resources appropriately.

Values examples:

Smart cities initiatives have evolved from opportunistic and idealistic to really focused



on problem solving. As follows are a series of values that have been used to frame smart city / smart data initiatives.

- Move a metric / solve a problem
- Equitable / inclusive
- Entrepreneurial / iterative
- Cross cutting / collaborative
- Transparent
- Human Centered

Transforming the Urban Landscape: The Visual Capitalist Approach

Infographic - [Anatomy of a Smart City \(Visual Capitalist\)](#)

Smart city solutions can be grouped into into at least six broad categories, transforming the urban landscape (more on this in Resource Pack 3) as referenced in the link above:

1. Infrastructure: Smart lighting is one of the most important solutions that will be implemented in citywide infrastructure. While smart lighting sounds trivial at first glance, it's worth noting that lighting alone consumes a whopping 19% of the world's total electricity.
2. Buildings: Heating, energy usage, lighting, and ventilation will be managed and optimized by technology. Solar panels will be integrated into building design, replacing traditional materials. Fire detection and extinguishing is tailored to individual rooms.
3. Utilities: Smart grids (used for energy consumption monitoring and management), water leakage detection, and water potability monitoring are just some smart city aspects on the utilities side.
4. Transport: Intelligent, adaptive fast lanes and slow lanes (cycling, walking) will be

implemented, while charging stations through the city will power EVs.

5. Environment: Air pollution control, renewable energy, and waste management solutions will make for greener cities. Rooftop gardens or side vegetation will be integrated into building designs, to help with insulation, provide oxygen, and absorb CO2.

6. Life: There will be citywide Wi-Fi for public use, while real-time updates will provide citizens information on traffic congestion, parking spaces, and other city amenities.






Managing a Smart Cities Initiative

Governance Models

Differing governance models are being used with different goals and outcomes. One of the biggest challenges that many run into in applying smart city technology is developing an approach to governance and to management. Creating new offices for the sake of communications or economic development may make sense in certain contexts, but needs to be made clear to other departments and officials.

Once a strategy is developed, it is recommended that cities use a consistent framework to analyze opportunities and deploy resources appropriately. The prioritization should be tailored to the values and goals in any city.

As we look to go from framework to operationalizing an approach, we like to think through the various elements that need to be considered for any initiative. As follows is a worksheet developed in partnership with NYU for working with mayors to better develop their particular priorities or smart city initiatives.

Value Proposition  What problem am I trying to solve? Why can't we do this with current approaches? How will we measure impact?	Engagement  How do I ensure my constituents share my enthusiasm?	Operations  How might we enable the city workforce to be champions? How ready is our data and systems infrastructure?	Partnerships  How do we engage businesses, universities, and entrepreneurs?
	Ethics  How might we ensure privacy? How do we build trust and inclusion?	Financing  How might we think creatively about financing and budget? Are there revenue opportunities?	Risks  How do we identify and address political or other challenges?

Framework for smart cities initiatives, developed by NYU Wagner School.

Roles and Models:

One of the biggest challenges that many smart city efforts encounter is how to fit in with existing governance structures, institutional arrangements, and balancing their new mandates with other actor's existing responsibilities. The roles and responsibilities of new offices – for example for communications or economic development – need to be made clear to other departments and officials in order for them to function effectively. Further, this is not simply a challenge at the beginning of a smart city journey, but one that evolves throughout the journey. In this section we present various models encountered through our previous experiences.

CTO: One smart city governance model is a model led by the Chief Technology Officer (CTO) of a city. Although there isn't a standard definition, the CTO is often responsible for

guiding the adoption of new technologies in a city, and overseeing innovation efforts, enterprise architecture and digital transformation efforts. [New York City](#) is a leading city that follows the CTO model. The previous CTO of New York, Miguel A. Gamiño Jr., was appointed by Mayor Bill de Blasio. He was responsible for collaborating with city agencies to develop a Smart City and IoT strategy for the city, as well as overseeing the city's Broadband Program. The CTO of New York reports to the First Deputy Mayor. This model was really externally focused, while in Chicago, their CTO focused more on leveraging data to connect with city operations.

CIO: Another smart city governance model is a model led by the [Chief Innovation Officer](#) (CIO) of a city. The CIO's primary responsibilities often include leading the strategy and implementation of smart city frameworks, exploring and executing innovative strategies in city planning, and creating a vision for the

city's future in relation to technology and innovation. While the CTO's priority can be limited to maintaining existing technology efforts, the CIO must be a trailblazer of civic innovation. Kansas City is one city that follows the CIO model. The city's CIO, Bob Bennett, is in charge of leading and overseeing innovation efforts, collaborating with other cities to bring best practices to Kansas City, and work closely with the city's procurement department to engage companies for new projects.

New Urban Mechanics: Another smart city governance model is the [New Urban Mechanics](#), a model that started in Boston and was deployed in Philadelphia. The New Urban Mechanics can be regarded as an in-house innovation team within the city government that uses human-centered design to prototype solutions for urban issues. In Boston, the team works on a wide variety of issues ranging from affordable housing to public spaces and play. One of its advantages is that it is able to take on risks and test projects that other city agencies may not have the appetite for. It has a diverse and multidisciplinary team that prides itself on being human-centered, nimble, iterative and innovative.

CDO: The City of Chicago hired the first Chief Data Officer, and cities across the world have followed suit. While some of these roles were originally developed to focus on ensuring open data - for accountability purposes and to support the civic tech community, the value of sharing data internally was quickly recognized. With cities looking to develop zero based budgeting approaches and creating opportunities for collaboration, the role of a CDO can be critical. From an operational standpoint, this role can be placed in a variety of locations - from the administrative suite to the budget office to IT. Regardless of where the role ultimately sits, the issues

considered require strong connections across departments, ensuring that data is collected, stored, and shared in ways that support collaboration but ensure privacy.

Smart Cities Czar: Another smart city governance model is a smart cities czar, which is another label for someone leading smart city efforts. Although it is not an official title, the goal of a smart cities czar is to take a more holistic approach to smart cities to ensure that technology is not merely an end, but a means to achieving greater social good. There are often overlaps in the responsibilities between the role of the czar, a CTO, CIO or other smart city leader designations.

Distributed working group: Another smart city governance model is a distributed working group. A working group is often a collaboration between various leaders and stakeholders who aim to achieve a specific goal. It is often the primary governance for cities where there is no clear smart city vision, strategy and leadership. In a working group, the goals include developing an agenda for the city, increasing mutual awareness and collaboration, and stimulating discussions about ideas and potential opportunities among others. One example is in Toronto, where the city formed the [Smart Cities Working Group](#) made up of public-private sector members. The goal is to raise awareness of smart city issues, and collectively develop a vision for a smart Toronto.

Consultant driven: Another smart city governance model is a consultant-driven model. Sometimes, a government does not have the capacity, human capital nor expertise to pursue smart city efforts. In these situations, consultants are helpful in advising and supporting a government on how to become a smarter city. Many

large corporations have advisory services pertaining to smart cities. One example is [Arup](#), an international firm that has expertise in architecture, urban planning and engineering. For smart cities, the company has experience in helping cities like Christchurch and Guadalajara in developing smart city solutions.

Cross cutting issues

Smart cities strategies and programs aren't all about the data or technology. There are key cross cutting functions like procurement, or metrics setting, or privacy that drive these initiatives. Driving change - particularly in areas like procurement, where people inside government may already feel ownership over the process, can be challenging. While sometimes time consuming, it's often best to bring these people to the table early on to get their buy in. Better to have their insights and expertise and understand where road blocks are at the outset of a project than having surprises pop up later on.

Case Studies on Smart City Strategies

The concept of "smart cities" is interpreted differently all over the world, and you will find various cities across the globe that integrate technology in different ways. Several cities that have emerged as leaders in the smart city sphere include Singapore, Barcelona and West Hollywood in California. Although each of them differ in their strategy, governance and implementation, they all reflect a high-level and nuanced understanding of what makes a human-centred "smart city".

Singapore

Singapore is one of the world's leading cities and financial centers. Home to approximately 5.5 million people, it is widely regarded for

its robust market economy, ease of doing business, highly skilled labor pool and overall quality of life. It is also as one of the world's top smart cities due to its extensive applications of Internet of Things (IoT) technology in areas such as mobility, health care and public safety.

Singapore first launched its plans to become a world-class smart city in 2006 when it released its Intelligent Nation Master Plan, which aimed to make Singapore a city powered by information and communications technology. The city is broadening its smart city vision, and pushing to become the world's first "smart nation" through its [Smart Nation Program](#). The program, which was launched in 2014, seeks to use technology to address urban problems related to the aging population, urban density and energy sustainability.

The Program's key pillars include a Digital Economy, Digital Government and Digital Society. It should be noted that, like many initiatives in the smart cities space, this highly regarded endeavor has faced challenges from within existing government bureaucracy. Within the 3 pillars are several domains that the Singaporean government is focusing on: transport, urban living, health, digital government services, and startups and businesses. The Program also identifies important Strategic National Projects that are high-level priorities for unlocking Singapore's smart city capabilities. They include:

Core Operations Development Environment and eXchange (CODEX): It is a digital platform that enables the government to deliver better digital services. It entails a government data architecture for common data standards, transfer of systems and data to the commercial cloud, and a shared suite of software and digital infrastructure

E-Payments: It refers to a national e-payments infrastructure. Under it, some solutions include PayNow (a peer-to-peer money transfer system for bank customers) and NETS (an e-payment solution for coffee shops, hawker centers and industrial canteens)

Moments of Life: It is an initiative to deliver more citizen-centered and personalised government services. Moments of Life (Families) is an app that supports parents with newborns and young children. It digitizes birth registration and medical records, and provides information about local child-related institutions.

National Digital Identity (NDI): It is a digital identity system that allows residents and businesses to engage in digital transactions with the government and private sector. It involves SingPass (an authentication system for residents to access digital government services) and MyInfo (an online service that auto-fill selects personal details for digital forms)

Smart Nation Sensor Platform: It is a nationwide sensor platform to improve city services and operations. It is being applied in areas such as water usage, drowning detection, air quality, rainfall etc.

Smart Urban Mobility: It entails autonomous vehicles, on-demand shuttle buses, contactless e-payments for public transportation, open data & analytics for transportation and research in autonomous vehicle standards.

Singapore's Smart Nation Program is considered a smart city best practice for several reasons. Aside from its advanced level of technology resources and human capital, the city performs pilot projects for smart city technology extensively, thus gaining valuable

insight into its effectiveness and reducing risks and costs of failed implementation. Furthermore, because the government has extensive ownership of public housing in Singapore, in which 80% of the population reside, it is more easily able to test smart city technology for residents. Singapore's government plays a major role in driving its Smart Nation Program, and distinguishes it from other cities around the world. All Smart Nation Program initiatives are 100% funded by the government without any funding from the private sector. This structure allows a more cohesive implementation system, and a potential reduction in conflict between the interests of the government and technology companies. Singapore also places emphasis on integration between smart city efforts by various government agencies. Overall, Singapore also defines smart cities in a holistic manner, and prioritizes an ambitious framework defined by resident-centred, personalized and equitable technology. Its advanced progress in smart city technology and extensive reach in all aspects of society compared to other major cities makes Singapore a leading example of what a technology focused smart city can look like.

Barcelona

Barcelona is one of the world's prominent tourist and cultural destinations, and one of the trailblazers in the area of smart cities. Home to around 5 million people, it is widely known for its influence in entertainment, fashion, science and arts. More importantly, it

Barcelona's smart city efforts began after the 2008 recession as a way to transform itself and rejuvenate its economy. Led by the mayor, the city took advantage of its extensive fiber optic cable network to develop a comprehensive Internet of Things (IoT)

system that resulted in citywide WiFi and widespread applications in energy savings, waste collection, parking and water irrigation among others. The use of IoT resulted in at least 47,000 new jobs, \$58 million in water savings and increase in parking revenue by \$50 million annually.

Beyond the city's IoT infrastructure, Barcelona has created a robust smart city ecosystem and forward-thinking vision of a human-centred smart city that is a unique model for others to emulate. Barcelona envisions a future smart city that pursues digital sovereignty for people, and empowers government and citizens to decide their own priorities in how technology is used for the social good. In June 2016, the city created the Digital Innovation Office (DIO), which is responsible for defining Barcelona's technology and innovation policies. The office has since created the [Barcelona Digital Plan](#), a living roadmap for Barcelona to become a smarter city. The three foundational axes of the plan are digital transformation, digital innovation and digital empowerment. Within the axes, the plan has around 122 projects that can be classified into different focus areas including digital economy, digital education and training, technology for a better government, digital inclusion, make in BCN, urban technology, city data commons, democracy and digital rights, and i.lab. Some initiatives include:

- Internet 4all (program aimed at reducing the digital gap between neighborhoods and ensuring access to new technology)
- Open Data Portal (a portal with public data that citizens can use)
- Maker District (a public and collaborative social innovation project that empowers

local community to create solutions)

- Vincles BCN (programs aimed at strengthening elderly people's relationships through technology)
- Digital Identity (program that helps the government provide personalized digital services to each resident)
- Fab Labs (local citizen-participation social innovation labs)
- MediaTIC Incubator (incubator that benefits businesses with high technological impact)

Barcelona is considered a smart city best practice for several reasons. Its smart city strategy addresses all aspects of society, and does not utilize technology for technology's sake. Instead, it focuses on how technology can empower residents and enhance social, economic and urban development. This is seen through its initiatives, specifically the Maker District and Fab Labs, which encourage citizen-participation and co-creation for socially innovative solutions to urban problems. It also recognizes the importance of having different sectors collaborate on projects rather than adopting a siloed approach towards smart cities. Barcelona has adopted a transversal and horizontal approach in making sure its smart city projects are connected. Through the city-owned Telecommunications Network and the Urban Platform, which serves as the city's IT architecture, the city is able to collect, manage and communicate information and data on a common and open platform. Thus, projects can be more easily analysed and managed.

West Hollywood

West Hollywood is a two-square-mile city

in Los Angeles County that houses 34,000 residents. It is one of the county's primary hubs for arts and culture, and is known for its desirable quality of life and walkability. Notably, it is also known for its innovative approaches towards creating affordable housing, reimagining public realm design, and empowering its residents in decision-making. West Hollywood became the first city in Southern California to develop a [Smart City Strategic Plan](#). In an effort led by Cityfi with the support of Skidmore, Owings & Merrill, Iteris, Inc., and Steer, the city now has a roadmap to better integrate smart city technology solutions, improve internal efficiency in City Hall and improve its external resident service experience.

The city approached the plan from the lens of sustainability, mobility, accessibility, resilience and transparency (SMART), and using data to address its struggle with traffic congestion, climate change, homelessness, and ineffective use of civic data. It also wanted to create a guiding vision that united its existing technology and innovation-related initiatives. The plan consists of three foundational strategies: creating a culture of data in city government, collaborating and experimenting across departments to do more with less, and automating processes to improve customer experience. It has a total of 14 initiatives to address the city's SMART goals and various implementation measures within each initiative. The plan was ultimately approved by West Hollywood's City Council in February 2018 and released to the public, and the city is in the process of starting its first pilot project.

West Hollywood's Smart City Strategic Plan is considered a smart city best practice for several reasons. The city's small size, high

density and extensive ecosystem of resources make it easy to test smart city technology that can then be adopted by other cities in the region. The plan defines smart cities in a holistic manner, and prioritizes a framework defined not merely by technology, but creative problem-solving and multi-sector partnerships. Furthermore, the plan's ultimate goal is enhancing interactions that people have with the city, which improves quality of life and economic development. Ultimately, people are at the centre of West Hollywood's smart city strategy.

» Resource Pack 2: Key elements of a data strategy

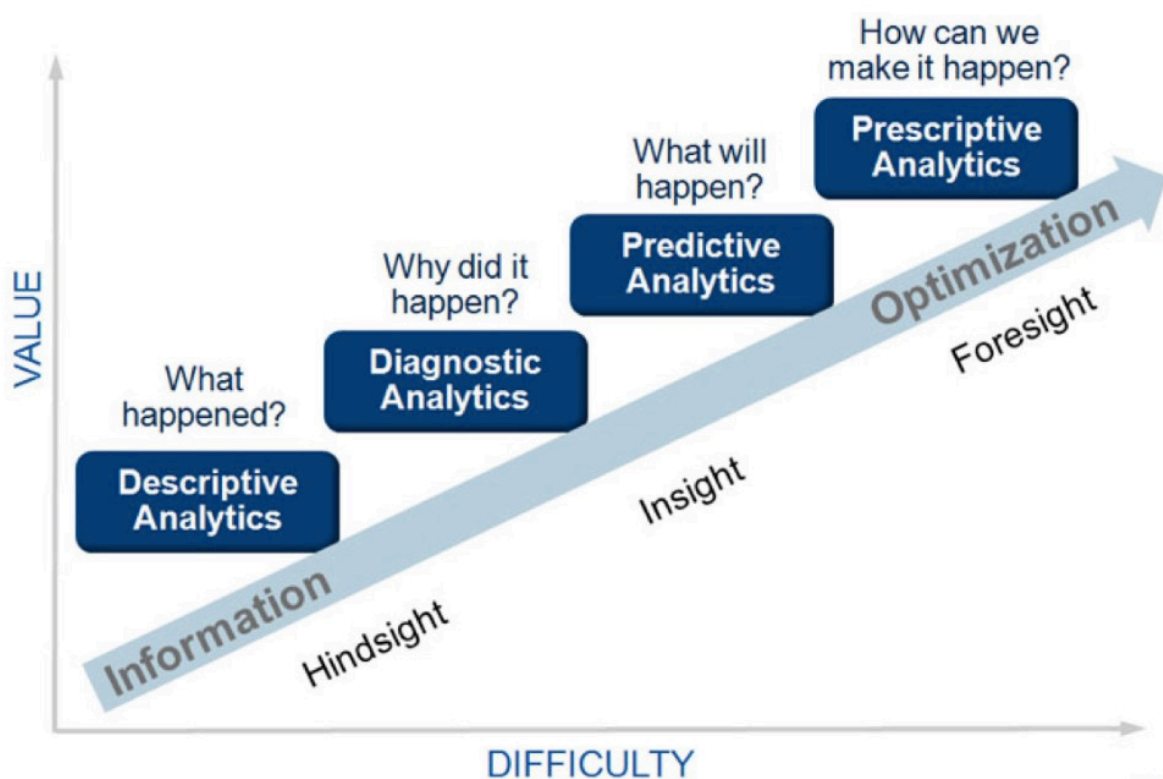
Approaching Data Strategically

Now that you are excited about the value of data, how do you ensure your approach is impactful and sustainable? First, you will need your ingredients: your objective, your stakeholders, your data, and your toolbox.

Data analysis objectives range in value and difficulty. Some investigative questions you may consider for the purpose of your analysis are:

- Descriptive: Describe the data, common for census data
- Exploratory: Find relationships that were not clear beforehand, useful for defining future studies, remember correlation does not imply causation
- Inferential: Use a small dataset to learn about a larger population, most common goal of statistical analysis, sample must be representative of the population
- Predictive: Use data from observations to predict values for a future scenario, important to measure the right values and use as much data as possible
- Causal: Understand how a change in one variable would affect another, usually requires a randomized study, this is the gold standard of data analysis

Data Analytics: *Organizational Value vs. Difficulty*



Source: Drake University

Data Analytics: Organizational Value vs. Difficulty

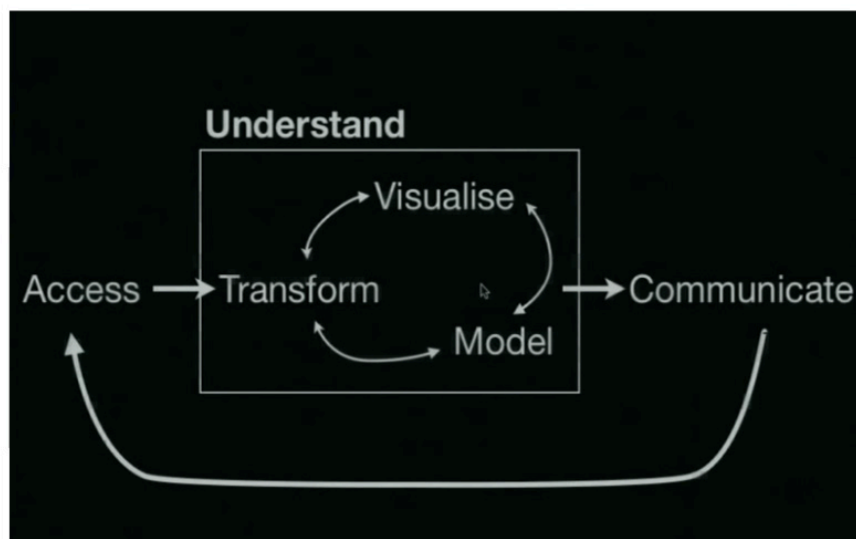
When it comes to data, the city has put significant effort in recent years into increasing data sharing across departments and making the data easily accessible. Including data from different parts of the city, county, and beyond can enrich your analysis and help you find new relationships and insights.

Open data portals can also contribute to your toolbox to complete your analysis. However, before diving in to a particular platform, you may want to consider 'storyboarding' using a whiteboard or paper to save yourself time later on.

Once you have decided on an analytics path, useful tools include Excel or programming languages like R or Python, which can help with data cleaning, or business intelligence tools like Tableau or PowerBI for quick visualizations. For presenting the final analysis, you may consider using one of Esri's Story Map templates or PowerPoint. There are a seemingly infinite number of tools out there to support your analysis, with new tools becoming available every day, so it is helpful to do some research and talk to people about what you are looking for to get direction.

Of course, your job is not finished when your analysis is complete. From there, you'll want to communicate your findings as effectively as possible, ask more questions, and start the

Data Analysis Cycle



Source: [Hadley Wickham, creator of the R Tidyverse](#)

process over again!

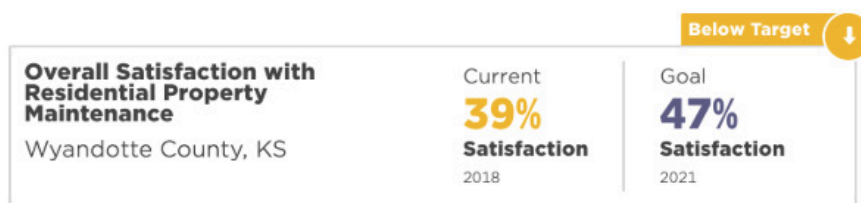
Key Performance Indicators and Goal Setting

As the saying goes, what gets measured gets done. When you aim to use data to drive performance in a particular initiative, the first step is to determine what measurements, or metrics, would reflect success. For example, Kansas City's SOAR initiative seeks to improve safety and quality of life in its neighborhoods. Residential Satisfaction, as measured by an annual survey, therefore represents a meaningful indicator.

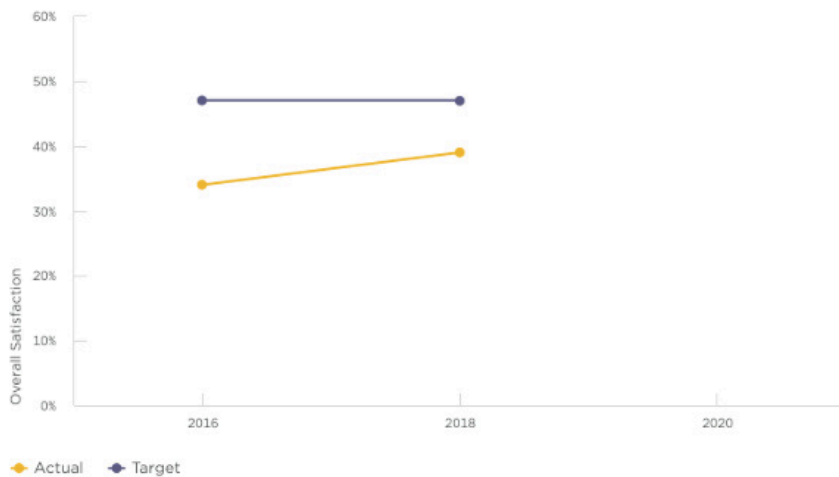
Associating a goal with your key performance indicator, or KPI, helps to motivate both the government and community towards achieving success by providing accountability.

Example: [Kansas City's SOAR Initiative Dashboard](#): Resident Satisfaction

While such accountability may seem scary at first, you will likely find that staff appreciate the opportunity to be recognized for their



Overall Satisfaction with Residential Property Maintenance



Source: Unified Government of Wyandotte County and Kansas City, KS, 2018

progress. The only caveat is to measure the performance of programs over people (initiatives over departments), in order to create the conditions for collaborative effort towards shared goals. When people feel personally evaluated, they may be motivated to focus on the appearance of progress rather than diagnosing issues or recognizing when an initiative is not working.

KPI (Key Performance Indicator): The main metric or metrics you use to define success.

Data Analysis Cycle

Effective data analysis includes everything from accessing or collecting data to communicating your findings. Once you finish the analysis process, you'll want to ask more questions and start over again!

Collection

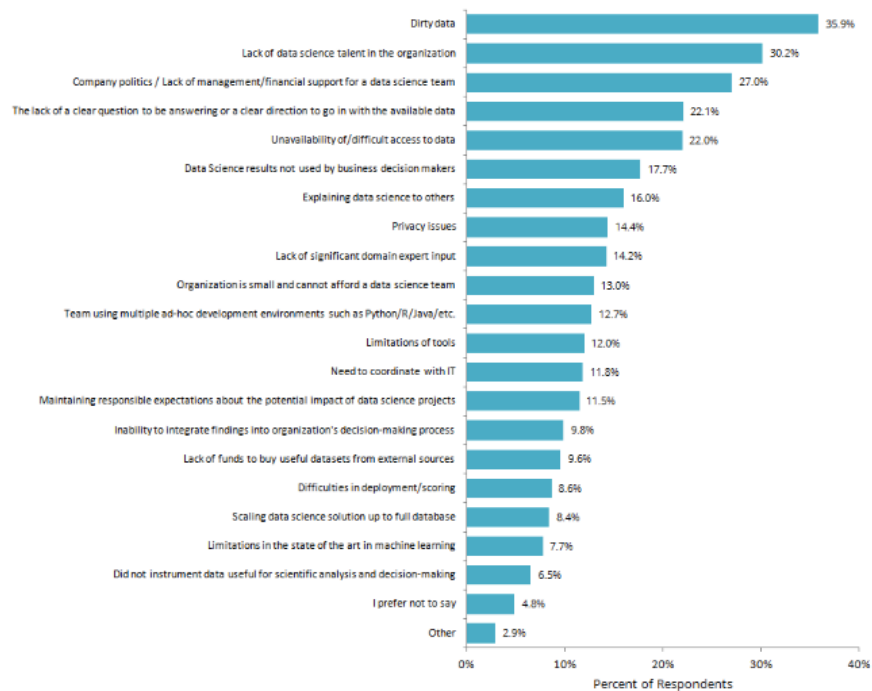
Data is perhaps the most important asset a smart city has, as it improves internal communication, transparency and citizen engagement, and operational efficiency. To collect this valuable data, first look at what you already have. To make this gathering process easier, the smart city makes any non-sensitive data open to the public and establishes clear and open communication channels between departments. (See Case Study: The LA City Geohub).

If the data you want to measure does not exist, there are a plethora of collection tools and approaches.

We can roughly think of data collection in two categories. Passive, or automated data collection includes sensors, GPS devices, and websites or apps that track data about how users interact. Active, or manual data collection includes methods like surveys, interviews, and simply counting. Both methods have their advantages and disadvantages in terms of effort, expense and gaining meaningful metrics. You will ultimately need a mix of the two.

For example, if, like Kansas City, you are looking to measure quality of life, you may want to pursue a combination of something like Soofa's Smart Bench which measures pedestrian traffic (in addition to providing solar-powered charging for people's

Challenges that Data Professionals have Faced in the Past Year



Data are from the Kaggle 2017 The State of Data Science and Machine Learning study. You can learn more about the study and download the data here: <https://www.kaggle.com/surveys/2017>. Respondents were asked, "At work, which barriers or challenges have you faced this past year? (Select all that apply)." A total of 10153 respondents were asked this questions.



Copyright 2018 Business Over Broadway

electronics), and an annual survey to ask about satisfaction directly.

[Article - 'Smart Benches' Help Cities Work Better](#)

Management, Access, Security

Data management is critical if you are to get the most value out of it. According to a 2018 survey of over 16,000 data professionals, the most common challenge faced is "dirty data."

Source: [Business Over Broadway](#)

Access and security (setting user permissions) are also important. As discussed above, the smart city errs on the side of making data open.

[Article: Why Smart Cities Need Open Data](#)

Analysis

Data can be analyzed for many different purposes, some of which were highlighted at the beginning of this resource pack. Keep in mind that pursuing a more difficult question or using more advanced tools does not mean that you will gain deeper insights. Start any analysis by identifying your objective, and then find the simplest path to answer the question and communicate your methodology to others.

Visualization

As another apt saying goes, pictures tell 1,000 words. Visualized data is much more engaging and easy for people to understand. Some common visual techniques include a large statistic, as typical in infographics, bar charts for comparison, and line charts for showing trends over time, as often seen in dashboards.

[Data Visualization Tools](#) - datavisualization.ch

An operational dashboard is a reporting tool that is used to monitor business processes

that frequently change and to track current performance of key metrics and KPIs. Compared to other types of dashboards, the data updates very frequently, sometimes even on a minute-by-minute basis.

Training modules

Ultimately, the value of data can best be seen in the real world. Data training should be customized to the needs of a particular community - focusing on real examples, meeting people where they are, and building a shared culture. [Linked here](#) is an overview of a six part training approach that Cityfi built for a large transportation department in the US.

Data tools / dictionary

API (Application Programming Interfaces): Similar to a User Interface, except intended for consumption by software rather than humans. APIs are often described as a technology that allows applications to talk to one another. APIs can help a developer handle a “commodity task” rather than writing their own code to do the same function. Web APIs are APIs with endpoints that are addressable over the Web. APIs can be used to query or update a database, initiate a process, add functionality to an application (e.g. Google Maps API). Depending on the volume of API calls, an API provider may charge the application developer a fee for using the API.

Cloud: A server that is hosted by a provider such as Amazon, Google, or Microsoft, rather than on-premise.

Confounder, or Confounding Variable: A variable that is correlated with both the outcome and other variables in the model. For example, let’s say you are studying whether

walking increases happiness. The weather may be a confounding variable, as it impacts whether people walk and how happy they feel.

ETL (Extract, Transform, Load): Data automation tasks are often called ‘ETL jobs,’ to cover the three most common stages of data processing from a source system: extracting the data, transforming the data, or making it fit the formatting you want, and loading the data to another platform. For example, you may extract data from a traffic counting sensor, transform the data to show the total number of vehicles per day, and upload the new dataset to a dashboard or open data portal.

Function: A block of organized, reusable code that is used to perform a single, related action. See Programming Language.

Forking: Within Github, A fork is a copy of a repository. Forking a repository allows you to freely experiment with changes without affecting the original project.

GIS: Geographic Information Science, System, or Software, depending on who you ask. When it comes to software, Esri is not the only GIS, but it is the biggest. Others include Mapbox, Tableau, and QGIS.

Git: An open source version control system to help teams (or, often times, distributed individuals) stay in sync.

Github: Facebook for nerds, Wikipedia for programmers, or Twitter for code, depending on whom you ask. (Mozaed, 2016). A hosting site to share and review code using the Git version control system.

GUI (Graphical User Interface): Sometimes

referred to as GUI (pronounced 'gooey'), Graphical User Interfaces enable you to perform analysis without using a programming language, such as through dragging-and-dropping.

- Kettle Pentaho (free) and Safe FME are examples of data automation/ETL tools that have a GUI
- JMP and RapidMiner are examples of statistical analysis tools that use a GUI

HTML (Hyper Text Markup Language): The standard programming language used to create websites. HTML Often used in combination with CSS, a styling language.

IDE (Integrated Development Environment): IDEs are more user-friendly environments to use programming languages, such as RStudio for (mostly) R, Jupyter notebooks for (mostly) Python, or Github for git.

Javascript: A computer programming language commonly used to create interactive effects within web browsers.

Library: See Package.

MATLAB: Programming language and desktop environment (proprietary/paid service) for numerical computation and visualization. Geared towards engineers and scientists.

Open Source: Software in which the original source code is made freely available and may be redistributed and modified. However, plugins or packages added on to the software may be proprietary.

Outlier: A data point that falls outside the range or pattern of the rest of the data.

Overfitting: When a model explains the specific dataset you've looked at, but is not generalizable. Always be cautious of whether your findings overfit your dataset!

Package: Pre-compiled code in a well-defined format that can perform certain functions and comes with help documentation. Also known as a library. For example, the twitterR package in R contains functions to read from the Twitter API, so that you do not need to set up the integration from scratch.

PII (Personally-Identifiable Information): Data that can be used to identify, contact, or locate an individual, such as name or phone number. Various techniques exist to anonymize data that includes PII, but there is always a risk that someone could re-identify the individuals.

Programming language: A written means of instructing a computer or application to do something such as read data, perform calculations, or create a visualization. Some advantages of programming languages:

- They are collaborative - you can easily explain to someone what your code is doing through comments
- They are reproducible - you can run your code/instructions over and over again with updated data
- They are fast and support big data - programming languages can quickly read or analyze datasets with millions of rows
- They are modular - you can easily 'plug in' existing code by copying and pasting or through formalized "packages" or "libraries."

Python: Open source general programming

language. Python contains a library called pandas that is designed for data analysis and visualization. Python users typically use an integrated development environment (see IDE) such as Jupyter notebooks (web based) or Spyder (desktop). Esri integrates with Python through ArcPy.

R: Open source statistical programming language designed for data cleaning, analysis, and visualization. R users typically use the integrated development environment (see IDE) RStudio to work with R, which contains helpful integrations to Github and R's help resources.

Relational database: A collection of data items organized as a set of formally-described tables from which data can be accessed or reassembled in different ways without having to reorganize the tables. The relational database was invented by E. F. Codd at IBM in 1970. See SQL.

SAS: Statistical software (proprietary/paid service) for analysis and visualization that contains both a point-and-click interface and a command syntax.

Script: A document written in a programming language (also known as 'code'). A script often represents a complete set of instructions for cleaning and analyzing data.

SQL (Structured Query Language): A programming language used to communicate with databases. According to ANSI (American National Standards Institute), it is the standard language for relational database management systems. SQL statements are used to perform tasks such as retrieving certain data from a database.

SPSS: Statistical software (proprietary/paid service, owned by IBM) for analysis and

visualization that contains both a point-and-click interface and a command syntax.

Stata: Statistical software (proprietary/paid service) for analysis and visualization that contains both a point-and-click interface and a command syntax.

Statistical analysis: Exploring a data sample to draw inferences about the underlying population, often using software such as R, SPSS, Stata. Be careful of confounders or non-representative samples!

Storyboard: An outline of a presentation, often used when presenting data findings. Can be used as a noun or verb. Storyboarding helps you to assemble your analysis into independent pieces to then choose the most interesting findings and arrange them in the most compelling order.

User Interface (UI): The part of a computer system or application that the user interacts with, such as the display screen, keyboard, or mouse.

Virtual Machine: A desktop that is hosted on a cloud server.

Wireframe: A sketch or prototype for a data visualization or website. Can be used as a noun or verb. Wireframes can be as simple as paper drawings or may use dedicated software such as Invision. The purpose of a wireframe is to get feedback from stakeholders and be able to make changes easily before you start with the software you'll ultimately use. Also see Storyboard.

Using data to shape an organization

Though there is no one-size-fits-all organizational structure, a common theme among the most successful organizations is

that they integrate data and their analytics team(s) into day-to-day operations.

Airbnb has long been on the cutting edge of getting value from data. In a [recent article](#), their head of data science shared the history that shaped their three data science “tracks,” which serves as a helpful example for public and private organizations alike.

Source: Airbnb

Case Studies

Management and Access: LA City Geohub, LADOT Mobility Data Standard

In January, 2016, Los Angeles launched a new kind of open data portal called the “Geohub.” An open data portal is a website that anyone can visit to access city data either to download or analyze directly using the site. These portals started to become popular among US cities starting in 2008, after then- President Barack Obama launched an open data initiative out of the federal government.

The Geohub is different from other portals in that it is all spatial, or map-based, and in that it offers the city much more control and customization of permission levels than is typical.

[Article: Los Angeles Launches the Geohub](#)

The Geohub is powered by [Esri](#), the world-leading software vendor for mapping tools. Before it launched, individual departments

such as the Bureau of Sanitation, the Bureau of Engineering, the Police and Fire Departments, and the Department of Building and Safety each had Esri licenses in order to manage land use and development, truck routes, etc. The problem was that many city challenges require cross-departmental collaboration. For example, if the Bureau of Engineering needs to repair a sewer line, they want to know what other

The **Analytics track** is ideal for those who are skilled at asking a great question, exploring cuts of the data in a revealing way, automating analysis through dashboards and visualizations, and driving changes in the business as a result of recommendations. The **Algorithms track** would be the home for those with expertise in machine learning, passionate about creating business value by infusing data in our product and processes. And the **Inference track** would be perfect for our statisticians, economists, and social scientists using statistics to improve our decision making and measure the impact of our work.

Data Scientist – Analytics

Defines and monitors metrics, creates data narratives, builds tools

Data Scientist – Algorithms

Builds and interprets algorithms that power data products

Data Scientist – Inference

Establishes causal relationships with statistics

construction may be occurring on that street and when. Or the Mayor’s Office may want to know crime statistics to carry out a platform of improving public safety.

Now, all of the city data lives in one place. However, departments may specify certain datasets or maps to only be available to their department, to still maintain privacy. For

example, Department of Finance users are the only ones who can see tax information for specific businesses, though other city employees can see aggregate numbers. A data publisher may also set the permissions so that only a certain group of people can access it. These users can be from any department, further assisting with cross-departmental collaboration. Aside from access and security, such groups also help with data management as they can be named to describe a particular project or initiative, such as for the 2028 Olympics or Vision Zero.

While the Geohub was originally custom-built for Los Angeles through a partnership with Esri, is now available as an out-of-the-box product called [ArcGIS Hub](#).

More recently, the Los Angeles Department of Transportation again set the precedent for smart data management and access through their Mobility Data Specification (MDS). MDS is documentation that instructs private mobility providers such as [Uber's electric bike share program](#) how to share data with the city in a standardized way, in order to create a more coordinated traffic management system. The key lesson from this project is that private providers are very willing to participate in discussion with the public sector and share data, as long as whatever is requested of them is clear and reasonable.

Combining MDS with the infrastructure (from a technical and culture/staffing standpoint) that LA has been building for the past few years also means that the city can easily decide which data should be made open to the public versus which is more appropriately used internally.

[Mobility Data Specification on Github](#)

Driving Performance: Brooklyn Public Library

At Brooklyn Public Library, our challenge was looking at re-orienting the work and focus on the library from a transactions-based business to a relations-based business. As such, we had to think about the metrics that were being used throughout the organization to measure performance. In recent years, we started a program called [BKLYNStat](#), which provided access to the baseline performance data of the library. It was great for capturing information, but it wasn't really changing the way that the business worked. So we realized that we needed to take a different approach. Not only did we need to collect different data, but we needed to figure out how to get people to use data - not just as a reporting tool - but for decision-making.

As an effort to get people to use the data portal more, we decided to begin providing more data that might be useful to staff in library branches, rather than just showing them data that they had reported (not that this isn't useful, because the analytical tools and visualizations are quite insightful). One of the first tools that was added / developed was [BranchStat](#), which combined branch specific data with insights about the community in which the branch was located. This connected directly to one of the organization's strategic objectives of tailoring services to meet the needs of specific communities. In addition, data is shown that connects branches to each other based on shared performance and community characteristics. This connected to another new strategic objective: increasing collaboration among staff.

Defining new metrics. We've said here that what gets measured is what matters. It's true. In a library, what's historically been measured is the number of books checked out. We've added other things metrics like wifi and computer sessions and door count, but none of these really got at the core business shift we were hoping to see.

Key lessons learned include:

- Focus on training / culture
- Meeting people where they are (in the library, that meant being visually oriented, providing staff with the ability to customize analysis)
- Work with the most excited group of people first to build a coalition of users AND great case studies of how using data changed a behavior (for example, the time when a program was held, or potential outreach targets based on communities being represented in programming or circulation stats)
- Don't start a data initiative with a punitive lens
- Don't expect to see success overnight. The library invested in Tableau a couple of years before staff uptake was really seen. Change, particularly cultural change, takes time, even in our fast paced world.

In addition to driving data utilization among staff in branches, the data team (part of the strategy department, often staffed by interns) worked with various departments to get them to open up and share data to be able to make better decisions about facilities, real estate, HR+Staffing, etc. As with front line staff,

getting buy-in that sharing data would make people's lives easier took time. The job is still not complete. Convincing people that they would not be punished for poor data or poor performance was a challenge. The goal of the organization was the shift culture towards a more data driven, collaborative ethos, so with those priorities in mind, people had to refrain from pointing fingers or laying blame when the data uncovered new or unexpected problems in organizational performance. If people were punished initially, there would have been a reticence to share data.

» Resource Pack 3: What's Coming Next for Smart Cities

Technology Opportunities

New technologies allow us to monitor or listen to the built environment in ways previously unimaginable. These tools, particularly in the smart city space, are evolving rapidly, coming to market more quickly than ever, and providing new opportunities to manage and predict the operations of the built environment.

The number of new tools and technology opportunities is seemingly endless. It is important for cities to understand the landscape of possibilities, but also to recognize that it's going to be unlikely to be a leader across the board, so it's important to pick the areas that best align with key priorities.

As follows is a series of potential opportunities that Cityfi has identified or explored with various clients.

URBAN PLANNING AND DESIGN

Data-Driven Urban/Suburban Planning and Modeling Tools

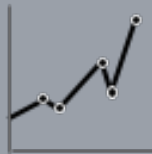
Integrate data visualizations with 3-D parametric models to allow users of all skill and knowledge bases to participate in the community planning process.



- See impacts on environment, transportation, revenue, etc. pre-build
- Civic Engagement
- Create alternate scenarios to reach goals

Machine Learning Urban Models

Machines receiving sensor and other data use algorithms to find outliers and analyze user behavior to draw conclusions, which can then be used to trigger responses such as alerts or automatically change system settings.



- Quickly identify irregularities
- Automatic data collection for all connected systems

Electronic Citizen Participation

Allow citizens to interact with the government over digital platforms at any time of day; for example, online voting, online community meeting portals, etc.

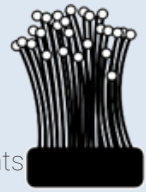


- Increases opportunities for citizens to give feedback to the government on their own time

CONNECTIVITY

"Piggybacked" Fiber Optic Networks

Internet Service Providers (ISPs) receive fiber optic lines or right-of-way from governments or companies to provide services.



- Allows smaller players to compete with larger ISPs
- Establishes baseline of services for all who are connected
- Eliminates the need to install multiple lines
- Cost savings from laying fiber optic infrastructure along with other utility lines

Small Cells and Distributed Antenna Systems

Cells and distributed antenna systems are installed in large gathering spaces – such as campuses, subways, and plazas – to increase wireless access.



- Expand coverage in rural regions and other problem areas
- Improve coverage in densely populated areas
- Revenue opportunities

Spectrum Sharing Technologies

Policy changes that permit technical innovation for sharing otherwise prohibited bands of spectrum for everyday use. Also, technologies of collision avoidance within shared spectrum.



- More efficient, higher-throughput use of spectrum
- Opens spectrum market to smaller players

MOBILITY

Mobility as a service

Rental cars, taxis, bikeshare, commuter rails, and other shared transportation with data collection, whether through sensors or app-based GPS tracking, are an existing example of a shared economy.



- Eliminate need for car ownership while creating independent fleets
- More efficient use of cars

Dynamically-Routed, Demand- Driven Mass Transit

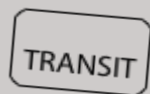
Mass transit utilizing smartphone applications to measure commuter demand and calculating the most efficient route in real-time.



- Cheaper
- Demand-specific service

Open Payment Systems

A region utilizes a single-standard payment system for use across public and private vendors.



- Mobile integration combines payment and user trip planning
- Data analysis will reveal rider habits
- Bundle modes for more transit options

Data-driven Decision Making

Cities and counties leverage technologies including intelligent traffic systems (ITS) to generate user data to define the most impactful interventions or investments.

- Resource efficiency
- Improved program effectiveness and outcomes

CITIZEN EMPOWERMENT

Crowd-Sourced Information

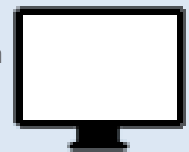
Utilize smart phones as sensors that report conditions – traffic, roads, Wi-Fi and cellular coverage, etc. – to a cloud-based database.



- Does not require additional sensor hardware
- Use could be more widespread than traditional sensor allows
- Application goes beyond machine-recognized inputs

Civic Data Warehouses

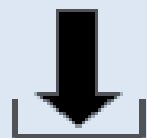
A central hub for data displays from multiple sources to be utilized by policy makers, analysts and others when making reports and models.



- Offers space to analyze real-time and historical data
- Aggregate data allows for cross-dataset querying

"Open Data"/Third-Party Developer Ecosystem

Making data accessible to the public increases citizen engagement as developers not associated with the city create public services using the released data.



- Increase civic engagement
- Proposed solutions come directly from the public

GOVERNMENT EFFICIENCY AND RESILIENCE

E-Government Service Delivery

Automating government services using mobile and websites to digitize existing processes; for example, permitting, inspections, and voting registration.



- Reduce resources needed to perform city services
- Increases conveniences as processes become self-services

Distributed Power Generation and Storage

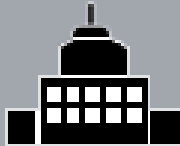
Governments can anticipate natural and man-made disasters by leveraging distributed power generation (solar, wind, geothermal, etc.) in combination with advanced energy storage and distribution (microgrids.)



- Service continuity
- Improved resident comfort, satisfaction

Data-Driven Contractor and Vendor Management

City governments partner with and supervise private companies offering public services.



- Vendor performances is measured by sensors and data is reported in real-time

Demand Management

When user behaviour and usage exceeds the available public assets, incentives such as pricing or alternatives are delivered digitally to help reduce current demand.



- Improve resource allocation
- Cost savings from waiting for demand to decrease

Fleet Management

Create efficiencies in municipal fleet management by employing IoT-driven solutions for fleet management and applications to communicate fleet locations to city staff and residents.



- Improve resource allocation
- Improved resident satisfaction

Fleet Electrification, and EV Charging Infrastructure

Transition city and county government fleets to electric vehicle platforms and build out necessary EV charging infrastructure for government – and potentially public – use.



- Resource efficiency
- Environmental benefits
- Pilot new public revenue generation opportunities

BUILDINGS AND INFRASTRUCTURE

Building Management Systems

Sensors track energy consumption and building performance data that is then updated to a cloud-based, real-time dashboard for building managers and occupants to make data-informed decisions.

- Cost savings
- Tailor to occupant - specific behaviour
- Foundation for predictive analytics and computation at a building level



Smart Thermostats/ Edge-Controlled Energy

Thermostats connect to the Internet and are adjustable from any location using a web platform; in addition, have the ability to learn user behaviour and set a schedule automatically.

- Cost savings
- Energy Savings



Instrumented Public Way Infrastructure

On-street infrastructure – including trash cans, lighting, and parking spaces – that utilize sensors to collect real-time data

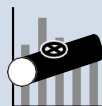
- Increase resource efficiency
- Track and manage demand more effectively



Infrastructure Analytics

Collect data from industrial machines via Internet connection that can be delivered to systems that automatically adjust operation to optimize performance.

- Increase efficiency with adjustments
- Monitor machinery more easily
- Bridge the gap between vendors and customers to reach optimal performance levels
- Create alternative scenarios to reach goals



Computer Vision Analytics

Cameras transmit data to computers than use algorithms to sense data – traffic, pedestrian counts, speed, etc. – And display it on a web-based dashboard.

- Useful for tracking pedestrians, especially in high traffic areas
- Analyse foot traffic for program use and marketing decisions
- Gather identity information without requiring effort from the user
- Automate congestion pricing, parking enforcement, tolling, etc.



What's coming next: New Businesses, New Models, New Standards

Cities should also be aware of the new businesses, business models, and standards that are being developed. Cities across the world were completely off guard when Uber came in and disrupted transit systems - likewise other new technology solutions are entering cities at a pace that policy has a hard time keeping up with. So it behooves cities to consider how best to develop regulatory approaches that are flexible or that are outcomes driven rather than incredibly prescriptive in order to be well positioned to ultimately leverage the new products and services being offered.

It's also beneficial to think about what's coming to market. The number of venture backed startups working in the urban space is increasing, with many using public data to provide insights to government or tools and services to residents and businesses.

Working with innovators:

- Explore flexible regulatory frameworks and policies that prioritize high level city goals, rather than prescribing solutions to problems
- Consider new approaches to procurement
- Ensure that small or new companies have the opportunity to compete
- Contract based on outcomes, rather than outputs
- Keep abreast of new companies
- Look at who is participating in accelerators
- Research what venture capital firms are investing in
- Talk to the companies / innovators / service providers in your city
- Bring them together to connect

- Share your purchasing roadmaps and goals

Urban VCs / Accelerators

[Y Combinator](#): Startup accelerator that provides seed funding for early-stage startups. Located in Silicon Valley. Launched many successful companies like Airbnb, Dropbox and Reddit.

[UrbanX](#): Startup accelerator that supports urban-tech startups. Helps companies in design, manufacturing, engineering, marketing, community building and branding. Located in New York City.

[Fontinalis](#): Venture capital fund that invests in new-mobility technology companies. Interests in autonomous vehicles, intelligent infrastructure, new mobility models etc.

[STIR](#): Program that connects startups to government agencies to co-create solutions for urban issues

[Urban Innovation Fund](#): Venture capital fund that provides seed capital to entrepreneurs working on urban issues

Startups

[Hello Lamppost](#): Engagement

Description: Playful and quirky approach to engagement. Activates inanimate objects via SMS conversations. Has been used globally. Could be event driven or ongoing.

[Remix](#): Street / Transit Design

Description: Platform for holistic approach to designing transportation and mobility systems, from intersection to city scales.

[Stae](#): Data Platform

Description: Real time big data, IOT SAS platform for mid-size cities and municipalities, supports AV's, drones etc.

[My Sidewalk](#): Data / Engagement Platform

Description: Data sharing / aggregation / analytics tool that tracks and communicates progress towards goals. Has worked regionally, so ideally situated to develop dashboards that track progress.

[Ideas42](#): Professional Services - Behavioral Economics

Description: as expanding and introducing new services delivers potential capacity, thinking about how lessons from the field of behavioral economics can enhance and incentivize adoption is critical. Ideas42 works across the globe to use behavioral economics strategies to understand what works best to change decision making.

[Numina](#)

Description: High quality, low cost video sensors for car, bike, ped movements, parking detection etc.

[Iteris](#): Data / Transportation Platform

Description: Traditional hardware and software ITS company, but innovative and a leader in intersection and corridor ITS

[Via](#): Transportation

Description: Software to power microtransit

[Lyft](#) + [Uber](#): Transportation

Description: Expanding to pooled rides, bikes,

scooters, electric, transit aggregation in-app

[Miles](#): Transportation

Description: Mobile app that rewards people's daily commutes with redeemable deals

[Citymart](#): Procurement

Description: Provides different innovative approaches to government procurement

[Neighborly](#): Economic Development

Description: Facilitating individual investments in public projects

[SeeClickFix](#): Civic Engagement

Description: Empowers residents to identify and report community issues to government

[ClearRoad](#): Transportation

Description: Helps governments collect data to inform road usage pricing programs

[Rentlogic](#): Housing

Description: Providing renters with the opportunity to get data on buildings they are considering (combines open data sources, because people don't try new buildings as frequently as they might restaurants or services for which review based platforms Yelp or Tripadvisor may work)

Potential new standard:

[IoT Trust Mark](#) for public sector projects?

Description: IoT Trust Mark is a non-profit effort to evaluate the trustworthiness of a connected device. It was launched by

ThingsCon, a German organization in Berlin. The criteria include: privacy & data practices, transparency, security, stability and openness.

Collaborative platforms

[City Tech Collaborative](#): A consortium in Chicago that helps cities adopt technology solutions to strengthen urban infrastructure, and provides business development opportunities to participating businesses. It is located in UI Labs, a technology organization that is interested in the future of manufacturing in cities. The collaborative provides services such as city solutions, civic design & user testing, and convening & facilitation of global leaders.

[Colorado Smart Cities Alliance](#): A multi-sectoral collaboration of public, private, academic sector leaders to accelerate adoption of smart city projects in Colorado through citizen-centered design and public policy. It provides a vibrant laboratory for smart city technology testing, “civic labs” for people to co-create and design solutions, shared resources and intelligence in smart cities, and an ecosystem for public-private partnerships and collaboration.

Implementation Tools and approaches

Procurement tools

The UK has been the global leader in local government procurement innovation over the past twenty years. Many cities across the globe are working to catch up. In recent years, a number of cities have implemented a variety of new practices

Unsolicited Bid: An unsolicited bid is usually a proposal made at the initiative of an organization that is not in response to a request from the government. Usually, the

bid is made to undertake a public-private partnership project with the government. Many government agencies around the world have different policies surrounding unsolicited bids. It is often difficult to respond to unsolicited bids in a way that maintains transparency in the procurement process.

An example of an organization supporting unsolicited bids is Los Angeles Metro. Its Office of Extraordinary Innovation has an [Unsolicited Proposal Policy](#), which creates space for new ideas and innovations that do not fit in typical parameters of other RFPs. It opens up possibilities for new partnerships between Metro and different organizations.

Reverse RFP: A reverse RFP occurs when a single buyer, usually the government, offers a contract for bidding. The bidding for a project, also known as reverse auctioning, begins at a certain number, and decreases as sellers try to beat the competition. The process continues until the bidding period expires, and the company with the best offer wins the contract. This process is often seen in e-procurement, in which bidding is performed in a digital, real-time process in a more dynamic and competitive process compared to traditional paper-based processes.

A reverse RFP is beneficial for several reasons. It results in the reduction of price for the government agency issuing the reverse RFP. Furthermore, because it is done digitally, it is usually more efficient than traditional auctioning. It is also seen as a way to increase competition between bidders and thus, increase the potential for innovative solutions. In a report conducted by the Office of Federal Procurement Policy (OFPP), research found that the use of reverse auctioning created net price savings of over 10% in projects for US federal agencies. Similarly, a 2011 IBM report

found that reverse auctioning could help the US federal government to save \$8.9 billion with the Department of Defense specifically able to save almost \$6.1 billion.

Several US cities are using reverse auctioning in their procurement process. Los Angeles has used reverse auctioning since January 2011, and saved between \$15-20 million for approximately 15 projects. Philadelphia began using reverse auctioning in 2016, as it saw positive results from a 2014 pilot program that yielded up to 6% of savings on pilot projects.

Streamlined Pilot RFPs: Streamlined pilot RFPs refer to RFPs for pilot projects that are streamlined to reduce inefficiencies. Streamlining the RFP process is extremely important for saving time and effort in order to focus on more essential parts of the process.

Philadelphia is a good example of a city that streamlined its RFP process to gain results. The former mayor Michael Nutter started [FastFWD](#), a new procurement model that connected entrepreneurs with city departments to initiate pilot projects. To streamline the RFP process, the city significantly reduced the amount of paperwork from 47 pages to 18 pages. It also used grant funding instead of city funding for the pilot projects so that the city was able to accept a larger risk profile for innovative projects. The city also conducted broad outreach to reach a variety of companies who would have the potential to innovate.

Startup in Residence (STIR): The [Startup in Residence](#) concept is a partnership between startups and government agencies that facilitate the co-creation of technological solutions for civic problems. The STIR concept exists around the world and different countries

and cities pursue it in unique ways. In the US, the STIR program was first launched in 2014 in San Francisco by the late Mayor Ed Lee, in which startups compete to be placed in a 16-week program. The winning companies then partner with city departments to use technology to address civic challenges. The STIR program now covers 31 government agencies around the country in cities including Los Angeles, Houston, Washington D.C. and Miami-Dade County. Some of the program's original startups from San Francisco include Conversation.One, RideAlong and ZenCity.

STIR benefits many stakeholders involved. For the government, STIR helps city departments and agencies gain access to the knowledge and innovation in the startup world and private sector. Oftentimes, such know-how is not widely developed nor disseminated in the government sector due to bureaucracy or lack of competition. On the startup side, technology entrepreneurs are now able to gain access to the government tech market, which is relatively less developed and thus has a larger growth potential. The STIR program also has a positive impact on procurement, as it breaks down barriers between startups and government, thus making procurement easier and more efficient.

Retrofitting Contracts: Retrofitting contracts for smart cities are agreements between governments and private companies to retrofit existing infrastructure with digital technology to create a more connected city. Due to the rise of Internet of Things (IoT) technology, cities now have the potential to use infrastructure to generate valuable, data-driven insights about the environment and human behaviour in cities.

One major city that has a citywide retrofitting contract is Mexico City, whose Ministry of Economic Development recently signed an agreement with AT&T to create an IoT pilot project. The pilot program will retrofit public markets in Mexico City, and equip them with WiFi connectivity, video surveillance system and an IoT control center to manage its sensor devices. The program aims to increase connectivity and business possibilities, as well as improve the overall experience for business owners and buyers.

Collective purchasing agreements: Collective purchasing agreements occur when multiple organizations unite as a group to make purchases so that they can gain greater buying power and lower prices than they would have if they purchased individually. The goal of such agreements is to save time and money in producing a contract. Collective purchasing agreements also provide higher quality products and services for governments and residents. In the public sector context, multiple governments will share procurement contracts. There are a variety of types of collective purchasing:

- True cooperatives (Two or more organizations combine requirements and solicit bids for goods or services)
- Piggyback options (One or more organizations represent the requirements of multiple groups and allow other organizations to “piggyback” on the contract)
- Third party aggregators (An organization unites multiple organizations to represent their requirements to manage the contract)

An example of collective purchasing agreements is currently being spearheaded by

Boston. The city’s [Metropolitan Area Planning Council \(MAPC\)](#) has a history of using such agreements to bring down the price of fire and emergency medical service equipment, public works equipment, highway maintenance services and more. In June 2018, the Mayor announced his plans to partner with other major cities like Chicago, Los Angeles and Houston to create collective purchasing agreements for renewable energy. The purpose is to help cities get renewable energy at a lower cost and expand the customer base for renewable energy.

Partnership approaches

Valuing city assets: In a smart city, city assets and infrastructure can be used to generate revenue and create economic value beyond their original function and purpose. With the rise of Internet of Things (IoT) technology, cities are adding sensor technology to physical assets such as public transit, parking meters, streetlights and more to generate data streams and create “connected infrastructure”. In a world where data is the new currency, city assets can be valued and monetized.

Streetlights are a good example of how city assets can become exceptionally more valuable through technology and partnerships. Given how common streetlights are, they represent a major opportunity to apply IoT technology and create more connectivity and digital inclusion built on the foundation of 5G networks. IoT streetlights have many applications including monitoring pedestrian traffic, rerouting cars, detecting gunshots, public safety surveillance, energy usage and more.

Many cities have learned from the 2008 long term lease deal of Chicago’s parking meters, which is often viewed as a worst practice in

asset valuation (by the public sector). This was a 75 year, \$1.16 Billion deal to lease more than 36,000 of the city's parking spots. It is estimated that the investors will fully recoup their investment with more than 60 years left in the deal and the city's pensions underfunded. As cities consider privatization, many are looking at revenue share models to ensure that the upside doesn't solely reside with investors.

PPP: PPP refers to public private partnerships, which are essential towards developing public projects for smart cities. PPPs are a collaboration between government agencies and private sector companies to finance, build and operate major public projects, oftentimes economic and social infrastructure.

There are many benefits that arise from pursuing PPPs. Such partnerships allow for each sector to specialize and build on their comparative advantages. The private sector is often more efficient and productive than the public sector. Thus, PPP projects are often completed faster with fewer or reduced delays, and the return on investment for a PPP is often higher than a project that is purely public or private. Costs and risks are managed more effectively, and government funds are subsequently put to better use.

PPPs are being used to support smart city projects around the world. One example is the conversion of aging payphones into smart kiosks in New York City. Due to the popularity of smartphones, public payphones in New York became less popular and their profits were decreasing. In 2014, the New York City Department of Information Technology and Telecommunications (DoITT) began a PPP with the CityBridge Consortium made up of Qualcomm, Control Group and Titan, which are

all telecommunications companies. Through the partnership, the city replaced many of its obsolete payphones with smart kiosks equipped with free WiFi, digital maps, video calls, device charging ports and more. The project, [LinkNYC](#), is fully funded by CityBridge and gains revenue through advertising. The city receives 50% of gross advertising revenue annually and the project has created at least 750 jobs.

City-supported incubators / accelerators: City-supported incubators and accelerators are often good ways for the government and the private sector to collaborate and innovate together. Incubators and accelerators help entrepreneurs to develop their companies by providing resources, training, office space, funding, legal advice, networking opportunities and more. In general, incubators focus more on innovation, while accelerators focus more on growth. City-supported incubators and accelerators often receive significant financial and organizational backing from local government and focus on priority issues of the city.

Philadelphia started an incubator with its 2013 [FastFWD](#) initiative, however, it failed to create a long enough runway to effectively align incentives for individuals from the public sector to participate. What it did, however, prove is that there was a huge desire for programs to better connect cities with startup solution providers, which led to the development of STIR and other market backed incubators.

An example of a successful city-supported incubator/accelerator is the [Los Angeles Cleantech Incubator](#) (LACI), which was created as an economic development initiative by the

City of Los Angeles Department of Water and Power. Its focus areas include zero emissions transportation, 100% clean energy and smart/sustainable cities. In the past six years since its founding, LACI has supported 73 startups, earned more than \$200 million in revenue, created 1,700 jobs and created almost \$400 million in long term economic value.

Academic partners: In the smart city ecosystem, universities and academic institutions can serve as effective partners in creating more smart city technology. Universities are hubs for knowledge, cutting-edge research, innovation and human capital in every city around the world. They can often help cities overcome challenges that they wouldn't normally be able to address. Thus, they are valuable partners to city governments.

An example of academic institutions addressing smart city problems is Portland State University in Oregon. The university recently opened two research centers, the

Digital City Testbed Center (DCTC) and the Homelessness Research & Action Collaborative (HRAC). The DCTC specifically will focus on how technology can help cities operate more efficiently and figure out how to develop new technologies that address concerns of security, equity, ethics and monopolization. The center will be made available to the city, startups, non-profits and the public.

Resources

[Encouraging Innovation in Local Government Procurement - UK Report](#)

[Case Study: Manchester, England](#)

[Landscape on Innovation in Procurement](#)



National Institute of Urban Affairs

Debjani Ghosh

dghosh@niua.org



Jaideep Gupte

j.gupte@ids.ac.uk



Story Bellows

story@cityfi.co

