

# Chapter 1

## Smart Cities: Vision on-the-Ground

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### Introduction

“Smart City” is a puzzling expression. Every day, cities around the world are hearing and reading about ideas and projects that are titled and initiated under the word “smart.” Many of these ideas and projects are technology-laden. Mention of green energy, artificial intelligence, Internet-of-things (or otherwise connected “things”), self-driving vehicles and more is common. All of them or nearly all of them have voracious data demands.

So is a Smart City one that deploys cool technology to produce, ingest, and analyze data, then connects the parts and replaces infrastructure and services that do not do that? Is a Smart City a city that only uses twenty-first-century technologies? No. Rather, a Smart City explores, experiments with and uses these technologies to improve its community. The resulting improvements produce better governance, services, economic and education opportunities, and social equity for community members. It is almost certain that a city is not yet “smart” even after it has deployed and connected all the new technologies if it has neglected to include new, innovative policies that “understand” the nuances of privacy concerns and other issues in a world of ubiquitous data, social media, and high-performance computation and analytics.

As a data architect for the City of Austin, Texas (a photograph of its downtown is shown in Fig. 1.1), I am most familiar with this fast-growing metropolitan city’s efforts in understanding, defining, and creating smartness. In 2016, Austin was a finalist in a US Department of Transportation (USDOT) competition called “The Smart City Challenge.” Although Columbus, Ohio eventually won the USDOT

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**Fig. 1.1** Austin, Texas (Ed Schipel—Flickr)

competition, the leading investment made by the City of Austin in engaging the surrounding community, its universities, and its industry partners brought together an understanding of what Austin thinks smartness is.

## Vision

Austin's Mayor Steve Adler described Austin's vision for a Smart City [1]

We could focus on what I call the shiny pennies, such as the futuristic transit stations, the automated cars, and the traffic lights that automatically adjust to weather and congestion. They're even talking about apps that can tell you where open parking spaces are so you don't have to drive around looking for them. We're talking about really cool stuff here, but that's not how our final application is going to read.

[Instead], we will talk about how our top priority is making sure people can access work, school, and healthcare. Our proposal will begin with communities living on the formerly segregated east side of town called the Eastern Crescent. We will talk about people who were recently pushed out of Austin because it has become unaffordable, and how we will reintegrate them back into the flow of the city with more mobility options. The test for our success ... will not be whether we can design the most sparkling technological toys. The test will be whether a senior citizen of the Eastern Crescent can get to her doctor without having to take a bus two hours in each direction.

It is only by providing equal access that we will ever get on equal footing. We don't have a shot at racial equality without everyone equally and equitably benefiting from the services the city offers. The Smart City Challenge is not about turning Austin into an

ever-more-perfect utopia. It's about becoming an ever-more-equal city by creating opportunities and greater mobility for the people who are often last in line for the next big thing. This is less about transportation than it is about transformation.

So in essence, a Smart City is a city that uses technology and policies to improve its community. How that improvement manifests itself in the deployment and management of technology (assets) or local policy (process) is a topic of intense local interest, which may be influenced by standards, best-practices, and socio-economic value judgments.

## **The Role of the Private Sector, Universities, and Nonprofits**

One stereotype of government in action might be that long procurement processes, caution, risk aversion, inefficiency, slow, low or sloppy technology pervade its operations. Aside from how comically disagreeable such a stereotype might be, it also belies and insufficiently respects the systemic complexity of a city's social, environmental, and fiduciary responsibilities. These responsibilities include the impact of the necessity of public oversight of the city's operations, the justifiable exclusion of most business models that generate profits in the private sector, and the abiding, natural constraint that cities do not have the option of picking their customer demographics and laser-focusing their "products" on a targeted set of customers to maximize revenue.

How does a city get "smart" under these constraints? Extending the constituency of a Smart City beyond its government entities to include public-private sector partnerships, nonprofits, universities and the community's open government enthusiasts will enable useful outcomes. By including this larger constituency, we can simultaneously innovate faster, leverage more advanced and nimble risk management processes, benefit from private sector and university expertise, and build a community of "smart" collaboration.

A Smart City engages this expanded constituency to explore innovative business and financing models for projects and programs, to explore advanced data analytics, such as sharing, mining, and integration technologies that will fund and jump start the use of data in business and city services, and to develop new data technologies that are sustainable, scalable, and valuable.

### ***Private Sector***

The private sector, including multinational corporations and local businesses, is usually more nimble in responding to change and more proactive in investigating and adopting new technologies. Additionally, a for-profit entity brings an ROI focus to its operations that the market place demands. Smart City governments need

to explore innovative ways to engage the private sector to leverage these strengths. Through careful adoption of certain private sector characteristics, smart cities may be able to improve their communities and the services cities provide to the citizens.

### ***Universities***

Universities are sources of high-quality research. In most cases, these research problems and solutions are outside the pressing business interests of the private sector. Communities should work with universities to construct research projects and programs

- To understand complex systems, including the data that feeds into and are generated out of those systems;
- To understand what needs to be measured in order to *understand* those systems;
- To understand what needs to be measured to *improve* those systems, and avoid unintended consequences; and
- To provide a basis for new city policies and solution service models.

Universities also have extensive experience applying for and attracting grant funding. Many cities would benefit from their assistance in a coordinated approach to pursue business venture funding or research funding for projects that benefit both scholarship and community.

### ***Nonprofits***

A city's nonprofit entities are often "close to the pulse" of most of a community's activities. Including nonprofits in the definition and implementation of smartness helps ensure that important, inclusive policies and priorities are part of the discussion. Nonprofits are also sources of useful and even provocative data sets.

## **Smart Technologies: Generating and Consuming Data**

Whatever technologies a city chooses in its drive toward "smartness," the technologies will have at least one characteristic in common: they will consume and generate large amounts of data. The rest of this chapter will discuss the challenges facing cities in choosing technologies, business models, and priorities for smart systems. The role of data will infuse and impact that discussion.

The role of data will also be one of the themes for the rest of this book. The reader will note that no system claimed as smart will be a laggard in the generation and consumption of data.

### *Austin, Texas: A Smart City*

Before discussing some smart Austin challenges in detail, it will be helpful to describe the environment in which they are being considered.

Austin, Texas is one of the fastest growing major cities in the United States, and it is surrounded by communities which are among the fastest growing in their population categories [2–4]. The population of the city of Austin has been growing in excess of 100 residents per day since 2010. It has twice as many residents as it did 30 years ago, and its urban metropolis includes parts of five counties with approximately 2 million residents. Commensurate with the growing population is a robust economy, one that actually gained jobs during the recession that began in 2008. Much of that economic growth is driven by technology innovation, a vibrant startup scene, and creative industries that have established Austin as a destination for art, music, film, food, media, and culture. A commercial, housing, and revitalization boom has accompanied the population growth, and has added complexity to the city's composition.

The prosperity represented and derived from the ongoing population growth is not being shared equally by everyone. In 2015, Austin was designated as the most economically segregated major metro area in America [5]. Traditional, long-standing communities of color in working-class neighborhoods are being dislodged and dispersed by gentrifying pressures and high housing costs. In their place, new boutiques and trendy hot spots abound. Lower priced Austin suburbs, meanwhile, are absorbing and re-creating concentrations of poverty in areas where there are few services to meet the needs of the underserved. Working families at all income levels are pressured to live farther away from their jobs in the urban core. Austin has a famously highly educated workforce [6, 7]. Even this generally affluent segment finds itself impacted by the scarcity of reasonably priced family housing near its increasingly urbanized workplaces.

### *Smart City Imperatives*

The medusa-like headwinds of rapid growth, economic segregation, and widespread affordability challenges, conspire to plague Austin with some of the worst mobility challenges in America. They conspire to diminish the quality of life,

culture, and community that Austin has known for decades. Augmenting the city with “Smart” technologies that do not deliberately contribute to solutions to these challenges, or that do not create real and unforeseen opportunities are “smart technologies” only in name.

In Austin, smart programs

- Must measurably deliver on the important community values of equity, economic, education and health opportunity, affordability, and environmental stewardship.
- Must provide testable hypotheses and pilots for repeatable, scalable adoption by other communities.
- Must build a foundation for Texas-wide partnerships on Smart City policies, services and outcomes.

In the absence of these or similar imperatives, Smart Austin will be just a denigrating label connoting a playground for technologists.

### **Three Dimensions of Smart: Projects, Policies, and Language**

Austin’s Smart City vision continues to change. In fact, even as this chapter is being written, Austin city staff, elected officials, community representatives, private sector leaders, and university researchers are having conversations that are at once spirited, innovative, methodical, frustrating, serious, playful and hopeful about the challenges and imperatives of “smart cities.”

The rest of this chapter discusses three examples of Smart City challenges. These examples are but illustrations of the kinds of challenges and opportunities a city faces. Deeper and broader discussions can be found in the rest of the book. The example challenges are

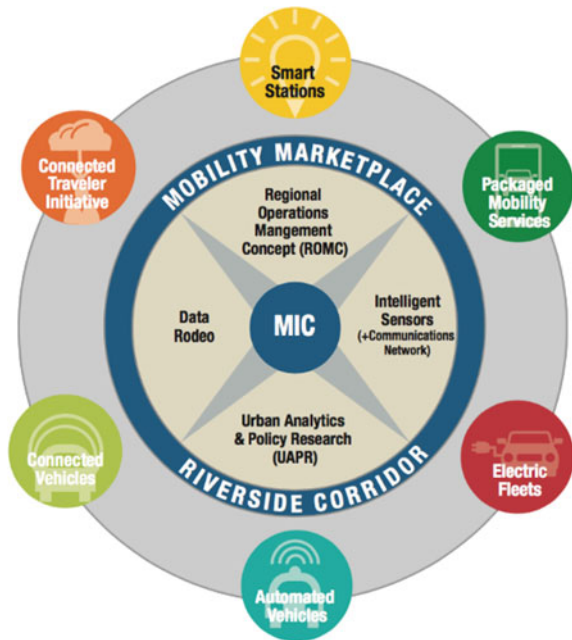
1. What is a smart project?
2. What kinds of policy changes encourage smart activities?
3. What is the language of smart engagements?

#### ***Smart Projects***

The following projects are derived from Austin’s US Department of Transportation Smart City Challenge Proposal [8] (Fig. 1.2).

Austin proposed “Smart Integrated Mobility Solutions” consisting of the projects like the following:

**Fig. 1.2** Integrated smart Austin mobility solutions (Austin Transportation Department)



- **Smart Stations** bring together a wide variety of mobility, health, retail, and other services and opportunities useful to travelers. One common characteristic of contemporary American cities is the need to travel “all over town” for work, education, food, medical, and other services. One might imagine a twenty-first-century implementation of traditional or even “old world” transportation hubs that not only take travelers to work and home, but have medical, legal, and grocery services that emphasize convenience and equitable access. These stations would also serve as centers for the deployment of autonomous and connected vehicles, urban freight logistics, and electric fleets (Fig. 1.3).
- **Connected Corridors** that link the Smart Stations, with new transit services (including a deployment of electric bus rapid transit), dedicated transit lanes and signal priority, better facilities for active transportation, and a sensor and beacon-rich environment that allows not only deployment of V2V and V2I connected-vehicle technology, but also encourages exploration of how to use the connectivity to improve community cohesion and prosperity.
- A **Mobility Marketplace** that connects travelers to their best packaged mobility options and provides an ecosystem for the development of new mobility services, with integrated payment options (including options for the unbanked) real-time travel information via app or kiosk. To ensure that a technology-based marketplace is accessible across the digital divide, this would also include a human-driven outreach component—Smart Ambassadors who will work on the neighborhood level to educate and help people take advantage of the marketplace.



**Fig. 1.3** Smart stations (Austin Transportation Department)

All three of the above pilots are integrated into a set of **Ladders of Opportunity Initiatives** [9] that use Smart Stations, Connected Corridors, and the Mobility Marketplace to improve access to jobs, education, healthcare, healthy food, and other areas of need.

Supporting these kinds of programs require infrastructure and technologies that include

- A “One System” regional operations and management concept, integrating and enhancing travel management operations between the City of Austin, Capital Metro, Central Texas Regional Mobility Authority (a toll road operator), the Texas Department of Transportation, and other communities.
- A network of rich intelligent sensors that will feed more and better data to transportation agencies and help tackle a variety of persistent challenges facing local operations managers, public safety agencies, and planners.
- A two-way open data portal, known as the Data Rodeo, which will integrate and curate data from public, private, and nonprofit sources, including data providers beyond the transportation sector, and make data available to enable research and education as well as support application and tool developers.
- An Urban Analytics and Policy Research platform that plays an integrated role in performance management, metrics, and evaluation for the entire Smart City effort. All of these efforts would be supported by regular stakeholder engagement with rapid assessment and documentation of both successes and failures,



guided by a governance structure that brings together local agencies and non-profit partners in a consortium model, with executive-level authority residing within the city organization.

### ***Smart Policies: A Smart Kiosk Example***

Smart Kiosks [10] are increasingly popular technology items being proposed by vendors and others for providing interactive community portals to way-finding, search engines, browsing, Wi-Fi, advertising and social media. Physically, they are often about the size of a tall twentieth-century phone booth, with video screens and contemporary styling.

These kiosks are often proposed for high pedestrian traffic locations or community centers. In keeping with Austin's interest in using smart technology to strengthen and improve communities, these technology stations are being considered for areas in Austin wishes to develop into community centers. There is an interest in piloting various implementations since Austin wants to explore the positive and negative uses of the kiosks so that we iteratively improve on their uses.

Cities implement and abide by laws, even if those laws do not have language concepts for smart technologies. For example, Austin's sign ordinance was originally crafted in the 1980s. Although it has been widely praised for its control of blight in Austin, it was written before the Internet, smart phones, Wi-Fi, web browsers, search engines, and way-finding maps existed. As such, smart technologies with visual components, such as smart kiosks, often find themselves reviewed under admittedly outdated rules.

For example, is a kiosk that provides search directions to nearby businesses (as well as their websites) just another kind of advertising sign or is it something very different and unknowable by ordinances conceived in the 1980s? Amending those ordinances to understand and regulate smart technologies is a long community discussion that necessarily includes diverse and often incompatible viewpoints.

To inform those discussions, some cities are implementing temporary exemptions from ordinances in carefully selected geographies or "corridors" so that the communities can explore uses of smart technologies and the reaction of residents and businesses to them.

### ***Smart Language: Assets, Valuations, Cost and Projects***

Let us imagine that you are part of private sector, university or non-government organization and you have worked for several months helping your community and city imagine, design, plan, and commence implementation of a great Smart City

project. Suddenly, near the end of this process, you learn that no one budgeted for archiving all the data the project is generating.

“We thought the data was for operational uses”.

“We are only keeping a standard, fixed, multi-month revolving window of data to comply with open government rules. The City will delete data once it ages beyond that window”.

The possibility of such a scenario arising is mitigated if you and the community understand the language and concepts used by cities. That language is an under-analyzed and often ignored complication in public–private partnerships: the language of the concepts, motivations, laws and rewards guiding government, public sector and university might be the same, but the meanings are often subtly different.

The likelihood of success of a community’s smart projects increases if the meaning of language used is commonly understood.

In scenario above, data was not considered an asset. Data is not something physical. It cannot be “touched” or pointed at. For many cities, assets are physical. You can point at them. You can touch them. If data is not an asset, it cannot be assigned a cost or a value.

How do we talk about data so that a city can design and provide for sustainable archival, analysis and use of the data generated by a city’s smart systems? There are four basic steps. They involve understanding how cities define and use concepts like assets, valuations, costs, and projects. If you do not express the thing you care about in these terms, you increase the risk that the organism we call a “city” does not even detect its existence.

The four basic steps for data are

1. Make data an asset.
2. Assign a cost to the asset.
3. Designate and measure the value returned for paying that cost.
4. To an existing or planned project, attach the asset, its cost and metrics for assessing the return value.

Let us consider each of these in order.

### ***Data as an Asset***

One begins to make data exist in the language of a city by identifying the physical assets that generate, carry, use, or store it. Assets as known by cities, at least in the case of the City of Austin, are tangible things. Things you can touch. Signs, roads, computers, swing sets are all assets. Data? You cannot touch data; so it is difficult to assign it an asset code. The devices that generate or store the data, however, can be treated as assets. So sensors, networks, and storage are assets. Even non-touchable cloud storage can be an asset because it has physical equivalents.

## ***Assigning Costs to the Data Assets***

The costs of these data assets can be expressed in terms like

- Dollars per Gigabyte of storage.
- Dollars per Gigabit per second of network demand.
- Dollars per unit of data processing capacity.

These costs can be tiered. For example, raw data from sensors on a city's streets might have one cost. Data combined and curated to produce neighborhood or corridor specific data might have another, larger cost.

## ***Designating and Measuring the Value Returned from the Asset***

Why is the city going to spend public dollars on these data assets? What value will the community derive? Importantly, the valuation of the return on a city asset does not have to be and often should not be expressed only in financial terms. For example these are values

- Reducing pedestrian injuries at intersections.
- Increasing or maintaining neighborhood satisfaction with its local parks.
- Being able to measure, understand, describe and eventually control green-house gas emissions.
- Understanding whether there equitable use of city parks and services.

Although each of these values may have correlates in terms of dollars saved or generated, expressing them in human-centric terms uses the language that is understood by everyone and not just actuaries and accountants. It is best to describe the value in the context of stated city objectives like reducing traffic fatalities, increasing access to affordable health care, walkable communities, etc.

Finally, the valuations need to be measurable. When assigning a value to a data asset, define value metrics the city can monitor as well as target values so that the city can assess the return it is getting. For example, base lining and tracking pedestrian traffic injuries at a set of intersections with a goal of reducing them by 30% would be a value metric and goal.

## ***Attaching the Data Assets to Projects***

Now that a city can recognize the existence, cost and value of the data asset, it cannot yet pay for it because the asset is not attached to any existing or planned and budgeted

project. In the case of Smart City projects, there will be many data assets included. They need to be recognized as assets and assigned costs, values and metrics.

## **Do Not Forget to Consider the Data Market**

Finally, you might ponder whether you want to propose that the city includes a cost recovery plan for the data assets. Instead of drawing on traditional revenue like the tax base, perhaps there are fees or other charges you can suggest the city imposes on external use of the data. For example, raw data might be free to the community, but curated or analyzed data might incur a charge. Or, if a business would like to make the data mission critical and therefore need Service-Level-Agreements on throughput and response time, you might propose a tiered pricing mechanism for these additional premium services.

## **Conclusion**

When considering the definition and implementation of a “Smart City,” the wise designer ensures that answers to the following questions make sense to the city leaders, the city inhabitants, and the constituents who partake of the city’s services

- Do technologies such as sensors, beacons, and data make a city “smart”?
- Does the use of social media, way-finding, and other electronic or connected activities make a city “smart”?
- Is a “Smart” City energy efficient, automated, and environmentally friendly?
- Do citizens in a “Smart” City have access to justice, safety, work, education, culture, and affordable living opportunities?

This chapter has discussed a few of the challenges being managed by the city of Austin, Texas in its search for answers to these questions. In presenting these issues, we have provided a sample of challenges faced by the government, the residents, and the private sector partners in the development of a city intent on maintaining the values which continue to be relevant regardless of the technologies implemented. We believe this is the most accurate definition of a “Smart City.”

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