



Appendix D: Staff Report - Learning from our Friends

As part of our research phase, City staff analyzed how other cities and jurisdictions are handling the introduction of new technologies. The following report describes our findings from other cities.

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Key Takeaways

Talking to cities about their approach to emerging technology led us to some incredible insights, best practices, and aspirations. We would like to ground our report with these takeaways as they can help guide San Francisco's policy-making efforts:

- **Articulate meaningful city goals to help companies communicate how they can help.** Cities and companies may have different goals, but they are not necessarily in conflict. Cities had an easier time working with companies when they had clear goals they wanted to achieve and they communicated them well. This means defining what it means to “advance equity” or “make technology accessible.”
- **Having an easy way to pilot new technologies is crucial.** We heard over and over again about the importance of testing a technology in one's own city before full-scale deployment and creating a nimble mechanism (like [demonstration projects](#)) to establish a pilot quickly. Cities described that use-cases of a technology in other cities was a good starting place. However, cities are sufficiently different in culture, demographics, politics, etc., meaning that learning from others cannot replace testing out the technology in one's own backyard. Many cities aspire to be “beta” cities or “testbeds.”
- **There will always be cases where cities need to be reactive, but proactive projects have the best results.** This one is obvious, but important. Cities are in different stages of proactive problem solving with technology. However, most describe better control over projects when they are proactive projects, rather than reactive ones. Being forward thinking leads to better collaboration with companies as well.
- **Technology might be use-case specific but the government process is not. Use this to your advantage.** Generally, cities thought that new technologies would have quirks and nuances that would require a different permit or pilot. (In some cases, cities tried to make a permit for one technology broad enough to apply potentially to a similar, even more emerging technology [e.g. dockless bike to electric scooters].) However, while the permit might be different, the process would remain similar. Cities spoke aspirationally about creating a standard or streamlined process to permit emerging technologies.
- **It's about people, not technology.** A good working relationship, consistent collaboration, and continuous stakeholder engagement (with both the community and the private sector) were cited as some of the most important factors for the success of a project.



Introduction







In the spring of 2018, the Board of Supervisors passed [Resolution 102-18](#). This resolution urged City Administrator Naomi Kelly to create a working group to inform future legislation on emerging technologies.

From July to December 2018, the City Administrator will convene an Open Working Group made up of a variety of perspectives — including members of the public, City stakeholders, academics, industry, community groups, and advocacy organizations — to inform the City’s engagement and governance of emerging technologies. The final recommendations will help the city realize its goal of using technological innovation to improve quality of life for the community while mitigating unintended consequences.

As an initial step, City staff conducted research on cities around the country and the world to understand their tactics for addressing the impact of new technologies. This research is fundamental to explore new and emerging technologies as well as learn about effective implementation models and strategies for promoting equity and engaging our community.

The figure below is a visual description of the steps of the Emerging Technology Open Working Group process. The findings from this research will help inform our final recommendations in December.

Figure 1. Project Journey Overview for the Emerging Technology Open Working Group

	RESEARCH PHASE. <i>Objective:</i> Staff advisory team begins work with comparative analysis on other city’s approaches to emerging technology. Team conducts interviews with experts to get perspective on problems and solutions.
	LISTENING SESSIONS. <i>Objective:</i> Gather information from the public on most important issues in order to identify problems for focus of the remainder of the project.
	NEED IDENTIFICATION. <i>Objective:</i> Consolidate feedback and provide a list of major values and issue areas we need to address.
	SUBGROUPS. OBJECTIVE: Subgroups are designed by issue area to establish criteria for success and develop specific recommendations.
	SOLUTIONS DEFINITION. <i>Objective:</i> Define what solutions must and must not do. Present and receive feedback on initial recommendations.
	FINAL RECOMMENDATIONS. <i>Objective:</i> Final working group meeting to review final recommendations and receive feedback.

From the City's perspective, we define emerging technologies as the new technologies, applications of technology, and business models that:

1. are in development and have only been tested at market level on a limited basis;
2. are expected to have a measurable impact economically, socially, or morally in the next five to ten years; and
3. do not fit within existing regulatory categories or schemes within San Francisco.

It is important to note that emerging technologies are separate but related to "smart city" technology. Generally, we view smart city technology as innovations that cities use to improve services. Adopting smart city technologies has led cities to grapple with how to use data better and try new technologies in a variety of new ways and at different scales.

In contrast, emerging technologies are generally led by private actors and the cities main role has been to provide oversight and regulation. And in the past, regulations have often been reactive.

In this report, we look at both emerging and smart city technology because we believe there are lessons that we can learn from "smart city technology" than can inform regulatory approaches. Additionally, we want to highlight the ways in which cities have proactively engaged with smart city technologies to solve problems and innovate since many of the objectives of smart cities overlap with our regulatory goals. In short, there is a lot to learn from smart cities!

This report offers a sampling of technology frameworks and projects from other cities. From our research and conversations with other cities, we identified common issues and priorities, including:

- | | |
|--------------------------------------|-----------------------|
| ● Clear vision and goals | ● Data sharing |
| ● Engagement and partnerships | ● Privacy |
| ● Digital divide and equity | ● Enforcement |
| ● Accessibility | ● Forecasting |

Each section features a brief description of the topic and relies on case studies to illustrate how various cities have approached the issue. The report then highlights some topics (such as cybersecurity) that we think merits more consideration and focus.

We hope this research will serve as part reconnaissance and part inspiration. It was designed to get people thinking about the spectrum of responses to emerging technology and how San Francisco might be able to move from a reactionary position to a more proactive, problem-solving one.



Themes

Clear Vision And Goals

Cities must have a keen understanding of what they hope to achieve through their use of technology as well as a set of goals to measure progress. This is especially true as the market for emerging and smart city technology grows exponentially. To frame this need, the market for sensors and other WiFi enabled Internet-of-Things (IoT) devices will reach [between 4 and 11 trillion dollars annually by 2025](#). Predictably, cities are increasingly inundated with sales pitches and are struggling to figure out what to adopt.

Without a vision, cities risk getting lost. They might make unsound investments or miss out on opportunities for collaboration with the private sector and communities. City departments might all implement technology without talking to and learning from one another. Instead of leading the dialogue, cities risk being reactionary instead.

A clear vision for the future helps to address this problem. It does not mean cities need to have everything figured out, but rather a vision helps create an approach to technology that is tailored to a given city's needs and values. To that end, there is a broad spectrum of goals and approaches cities have taken to plan for the future. Below are examples from Singapore, Kansas City, and Boston, which illustrate the spectrum of how cities are envisioning the future of their cities.

Singapore and autonomous vehicles

In 2016, the World Economic Forum ranked Singapore as the most [“technology-ready” city in the world](#). This was the result of a concerted effort. The government realized new technology was being implemented across agencies without any higher coordination. This meant there was a fair amount of redundancies and lessons learned were not leveraged across agencies.

As a result, Singapore took deliberate steps to create a vision for the future and assign leadership to make it happen. In Singapore, this took form by creating a central innovation office. With their leadership, they split their focus in two directions: promoting **adoption** of new technologies and creating appropriate **regulation**.

With clear leadership, the innovation team began tackling strategic priorities such as improving transportation in Singapore by reducing reliance on private transportation and increasing use of public transportation. The transportation innovation team worked with the transportation departments to think through how technology could be used to solve problems. An increase in travel demand, a labor shortage, and an aging population led Singapore to look to autonomous vehicles (AV).

Looking to the future, Singapore now has created a five-year testbed for AVs. Officials worked to pass the Road Traffic Act which granted broad authority to the Minister of Transport to create new rules regarding the timeline and scope of AV trials, equipment required, and data sharing standards. The government also worked with Nanyang Technological University to establish the Center for Excellence for Testing and Research of AVs, which would create testing and certification standards. Finally, Singapore built a test park for AVs and released a request for information (RFI) to find AV companies seeking to pilot their technology.

Together these actions created a large and nimble regulatory “sandbox” for AVs which has allowed for the slow integration of AVs from the test park to city streets. This flexibility has led to several pilots, including piloting AV trucks with Toyota and Scania, AV public buses with ST Kinetics, and AV cars with A*Star, nuTonomy, Delphi, and Smart. Singapore is now looking ahead to integrating their AV pilots with vehicle-to-vehicle and vehicle-to-infrastructure communication technologies. At the end of the five year sandbox regulation period, Singapore will evaluate the pilot to determine if it should either enact more permanent legislation or extend the testing period.

Kansas City and its Comprehensive Smart City Partnership

In June 2018 the City Council of Kansas City, Missouri unanimously authorised the City Administrator to release a [request for proposals](#) (RFP) for a Comprehensive Smart City Partnership. In the RFP, Kansas City states their vision of becoming the “first true smart city in the world,” by building on past initiatives and partnering with a private sector firm to design and build “a fully integrated suite of sensors, networks, and data and analytics platforms.”

Kansas City began their smart city initiatives in 2016 after Google Fiber chose the City to be the first metropolitan area to get high speed Internet access. The City underwent a major revitalization project with the creation of a new, free streetcar through downtown Kansas City and took the opportunity to make the area more connected through a partnership with Cisco. Initiatives include free WiFi (provided by Cisco and Sprint), smart kiosks that provide way-finding and hyperlocal advertising, and smart streetlights that dim and brighten as needed.

The 2018 RFP builds on this progress and is the first of its kind in duration and scope. The partnership will begin after the City's five year contract with Cisco ends and last between 10 and 30 years. The new partner will be responsible for maintenance of the Cisco system and in exchange for public right of way access and data, the partner will provide capital and build data analysis platforms. Proposals are due on July 31, 2018. Atlanta, Georgia and Columbus, Ohio recently have followed suit and issued similar RFPs.

Boston and its Smart City Playbook

In 2017 Boston, Massachusetts released its [Smart City Playbook](#), a webpage that acknowledges the City is not yet sure what the smart city trend means for Boston, especially in the long-term. The purpose of the playbook is to provide advice to technology companies, researchers, journalists, and activists who want to work with the City as it develops a long-term vision.

Boston's goal is to create a strategy for sensor-technology that is “people-centered, problem-driven, and responsible.” The City's core advice to companies is to help Boston grapple with the details and implications of the smart city:

- **Stop sending sales people.** Boston wants to talk to people who know about cities, who have examples of successes and failures in other cities, and who address concerns raised in the playbook.
- **Solve real problems for for real people.** Boston is looking to improve quality of life for its residents. Companies should talk to residents of and advocacy organizations centered in Boston about issues people are facing in the City. Companies must be able to evidence the problem and how their technology helps solve the problem.
- **Don't worship efficiency.** While important, efficiency implies that government knows what it ought to focus on and simply needs to make processes cheaper. Boston wants companies to engage with them not only on cost and efficiency but on what and how to problem solve.

- **Make better decisions, not (just) better data.** A lot of the technologies that are pitched to Boston talk about long-term cost savings from data insights. However, these savings frequently are dependent on behavior or policy change as well, which is difficult to guarantee. The City wants more than potential improvements based on data; it wants partners who have thought about these challenges, concretely and in the context of Boston, and who can help make decision-making easy.
- **Platforms make them go “_(☺)_/”** . Boston is trying out new technologies on a case by case basis to see what they can learn. The City is not ready for platforms because they do not know what sensors will be used, how they will be networked, where they will be located, or what technical standards will be applied to them.
- **Towards a public privacy policy.** Boston is concerned about the amount of personal identifiable information (PII) that will be collected as the city starts to deploy more sensors and is looking to build an infrastructure that will collect as little data as possible. The City is interested in learning how companies are handling PII, including what they are collecting and what methods are used to anonymize data, as well as general data management and sharing practices.

Engagement And Partnerships

Community engagement is a critical component of local government for shared decision making and collective problem solving. As emerging technologies are deployed across cities in new and novel ways, cities are grappling with how to educate the public on the specifics of various technologies and installation plans, how to solicit feedback on the project, how to identify problems and solutions as a community, and how to be accountable and share lessons learned.

In addition, high costs, civil liberties concerns, and the technical knowledge required to evaluate technology often necessitates that cities engage outside partners to help with a project, from the private sector to academia to community organizations.

Below are two examples — from New York and Chicago — of how cities are engaging communities and relying on partnerships when deploying emerging technologies.

New York City and the NYCx Co Lab Brownsville Project

In 2017 the Mayor’s Office of Technology and Innovation in New York, New York launched the Neighborhood Innovation Lab also known as the [NYCx Co-Lab](#). The intent of the lab is to solve local problems using technology in collaboration with local residents, technology companies, community organizations, and other stakeholders.

The first collaboration was in Brownsville, a small neighborhood in Brooklyn with high poverty and public housing and a history of low investment from the City. Osborne plaza was chosen to be the anchor site for the project, and the team decided to install smart furniture for residents of Brownsville to test out. They installed:

- BigBelly solar trash and recycling containers that alert the sanitation department when full,
- Soofa park benches that can charge residents’ cell phones using solar power and collect data on when and how frequently the plaza is used, and
- LinkNYC kiosks that provide WiFi and information on city services.

Technology workshops and trainings for community members of all ages also take place in Osborne plaza, as part of this effort.

In addition to the above pilot, the Co-Lab also hosted brainstorm sessions and community forums over the course of several months to identify need. Out of this collaborative needs assessment came two priorities: one to enhance and encourage residents to use public spaces at night and another to reduce waste and increase recycling rates. These needs became the subject of two NYCx Co Lab challenges titled “[Safe and Thriving Night Corridors](#)” and “[Zero Waste in Shared Space](#).” These challenges called for technology solutions to each of the problems, and selected winners would each receive \$20,000 to pilot their solution in Brownsville.

Chicago and the Array of Things

In 2016, Chicago announced a partnership with the University of Chicago and Argonne National Laboratory to install environmental sensor nodes around the city. Together, the nodes create a network of sensors (mounted on light posts) that collects a host of real-time data on Chicago’s environmental surrounding and urban activity. The nodes can hold up to 15 sensors and also include a computer, two cameras, a microphone, and a cooling fan. In addition, the software, hardware, specifications etc., are open source. The project is known as [Array of Things](#) and is thought of as a “fitness tracker” for the city.

Since the Array of Things involves multiple, networked cameras and sensors, a key part of Chicago’s community engagement was related to privacy. The City engaged subject matter experts, including the Electronic Frontier Foundation and the American Civil Liberties Union, to write a draft policy. This was then released for public comments using [Madison](#), a platform that allows residents to leave comments and annotations on legislation as well as see what other residents have commented on. From here, the City incorporated feedback and the policy was then approved by an oversight council (which was advised by a technical privacy and security working group) and again made [public](#).

Smart Chicago Collaborative, a civic organization funded by the MacArthur foundation, the Chicago Community Trust, and the City of Chicago, began educational outreach soon after the program was announced. Initially Chicago sought input on policies and where nodes should be located. However, the City soon realized it first needed an educational component that described the technology (including what it could and could not do) to a lay audience as well as the broader goals for the technology.

Chicago also launched its first effort at youth education and engagement with Array of Things, called “Lane of Things.” Lane of Things is an 8-week course taught to Lane Tech High School

students. The course covers computer science topics and teaches about the sensors deployed around the city as well as uses for the data. Chicago hopes to expand this program to other schools in the coming years.

Digital Divide And Equity

Many cities have begun to attempt to correct for the systemic racism and injustices that guided policymaking for decades. Some cities are attempting proactively to promote inclusion, offer tailored services, and provide opportunities for economic growth to underserved neighborhoods, people of color, those with disabilities, and other communities that face discrimination.¹

The implementation and distribution of technology in a city can further marginalize communities, offer solutions that improve the safety and quality of life for these communities, or a mixture of both. By making equity an explicit focus for emerging technologies, cities can help to ensure they grapple with how technology might disproportionately impact underserved communities and/or make proactive policy that seeks to improve quality of life.

Below are two examples of how Portland and Seattle think of equity and emerging technology.

Portland and it's Smart City PDX Framework

In June 2018, Portland City Council in Oregon adopted the [Smart City PDX Priorities Framework](#), the result of a collaboration between 14 departments and all five City Commissioners' offices. Portland's framework established guiding principles for evaluating proposals and choosing data and technology investments throughout the City, with a stated focus on "addressing the problems of and reducing disparities for communities of color and people with disabilities." These principles, which must be adhered to in order to receive PDX funding, include:

- The community should lead identification of needs, priorities, and solutions. The community should also be involved in designing projects and making decisions.
- Evidence-based interventions and success metrics decided with community input
- Commit to ongoing refinement and evaluation of projects
- Make data freely available and accessible so that the public can evaluate decisions and create their own solutions
- Be effective partners with outside groups including academia, non-profit organizations and national consortiums, other agencies, and private sector companies

Portland identified the following focus areas for its framework:

- Economic Prosperity
- Public Safety
- Human Health
- Environmental Health
- Transportation/Mobility
- Education
- Housing
- Resiliency

¹ Note: the section titled Accessibility will seek to explore equity with regards to those who are differently abled.

The City will use its Smart City Steering Committee to implement the framework and share, manage, and evaluate smart city policies and projects, funding opportunities, and potential partnerships. The Committee is led by the Bureau of Planning and Sustainability (BPS), Mayor's Office, Portland Bureau of Transportation (PBOT), Office for Community Technology (OCT), and the Bureau of Technology Services (BTS).

Seattle and dockless bikes

Seattle, Washington was an early [adopter of dockless bicycles](#). The City began a pilot in early 2017 after ending their municipal docked bikeshare program due to financial problems. To participate in the pilot, companies needed to apply for a permit and meet requirements across several criteria including safety, parking, insurance, data, and equity.

To encourage hiring and other opportunities for underserved communities, Seattle has identified a [tier of neighborhoods](#) throughout Seattle that are economically distressed and should be prioritized. The tier is based on three indicators:

1. rate of people living 200% under the poverty level,
2. unemployment rate
3. and the number of people over 25 without a college degree.

For the dockless bike permit, the City required that companies include neighborhoods in this tier in 20 percent of their service area.

Unfortunately this requirement did not act as intended. Companies simply designated their service area as "Seattle" rather than noting specific neighborhoods. The companies argued that because they are dockless, it is hard to say where the bicycles will end up.

Initial data suggests some diversity in ridership and good coverage in those tier one neighborhoods (riders skew white, young, and male). For the next phase of the permit, the City is looking into creating more specific requirements for promoting an equitable distribution of bikes throughout the city and encouraging companies to service areas in the far north and south areas of the City.

Accessibility

As cities become places where residents increasingly rely on technology for services and navigating the city, cities need to ensure that the technology used is accessible to everyone. This includes those with disabilities as well as older populations.

Cities should challenge themselves to ensure each product they install is accessible. Cities should also work to mitigate any harmful consequences that piloting or installing new technology might have on differently-abled residents (e.g. ensure scooters are not in the public right of way). Finally, cities should be responsive to feedback and look at how technology can be used specifically to solve problems for this demographic (e.g. accessible pedestrian signals).

Below are examples from Detroit, New York City, and the California Legislature, which is currently debating an accessibility bill with regard to transportation network companies.

Detroit and adaptable cycling program

Detroit launched its bikeshare program, called [MoGo](#), in May 2017. After a successful first year with over 120,000 rides, the City decided to create a pilot program that provided cycling options to those who cannot ride a traditional bike.

The [pilot program](#) is provided via a partnership with the City, a local bike shop called Wheelhouse Detroit, and a nonprofit called Programs to Educate All Cyclists (PEAC). The six month pilot provides 13 different types of cycles, including tricycles, hand tricycles, incumbents, tandem bikes, and cargo bikes.



Rather than the traditional bikeshare program where bikes are docked at stations around the city and ready to go at any time, the adaptive bikes must be reserved ahead of time and all are stored at one Wheelhouse Detroit location. Staff at Wheelhouse is trained to help riders find the appropriate bike and get set up and if the cyclist had a companion rider, the companion rides for free.

MoGo and PEAC are working on outreach to inform residents about the program. The City is also conducting surveys and focus groups to determine what works about the program and where there is room for improvement. After the pilot ends in October 2018, the City plans to evaluate the program and make necessary changes.

New York City and LinkNYC

In 2014, Mayor De Blasio issued a [request for proposals](#) (RFP) to reinvent New York City's payphones. The RFP asked for plans that would provide free WiFi and phone calls as part of a digital equity campaign.

The Mayor's Office for People with Disabilities got involved in the writing of the RFP to ensure it included accessibility standards. These standards were developed by looking to the Americans with Disabilities Act, web accessibility standards ([WCAG 2.0](#)), and a [digital toolkit](#) prepared by G3ict, a global initiative for inclusive information and communication technologies. Some standards include an appropriate height range, using braille on any buttons, and selecting a tablet that has built-in accessibility features. In addition to engaging early and getting accessibility language in the RFP, the Office for People with Disabilities also acted as one of the judges for the RFP.

A Google-funded company called CityBridge won with their LinkNYC kiosk. The 9.5 foot tall kiosks are equipped with device charging capabilities and a tablet that could browse maps, city services, and the internet. LinkNYC chose to use an Android tablet, which had accessibility features like screen reading, magnification capability, and the option to invert colors. However, CityBridge did not initially turn on these functions and the company was eventually [sued](#) by the National Federation of the Blind. The lawsuit was settled after CityBridge agreed to turn on these functionalities as well as create a dedicated shortcut key to request assistance with a Link, accessibility training for staff at CityBridge, and the appointment of an accessibility coordinator to ensure the changes were made. The Office for People with Disabilities has continued to work with CityBridge on improving accessibility and adding additional features.

California and SB 1276, transportation network companies (TNCs) and accessibility for persons with disabilities

California Senator Jerry Hill introduced bill [SB 1276](#) into the Senate in early 2018. The bill would require California Public Utilities Commission to develop regulations for transportation network companies (TNC) like Uber and Lyft regarding accessibility accommodations, including those who need a wheelchair accessible vehicle. The bill passed the Senate and is currently making its way through the Assembly.

If the bill is enacted, Public Utilities Commission would be required (by 2020) to conduct workshops with cities, counties, advocacy organizations, etc., to develop programs for on-demand services, service alternatives, and partnerships. The bill would also require each TNC to be accessible and would impose a fee on TNCs until they comply. This fee would then be applied to fund on-demand accessible transportation services for persons with disabilities. Any party that is funded would need to provide detailed reports regarding number of rides and geographic availability. Importantly, this bill would also alter TNCs liability and protect them from lawsuits from the disabled community.

Data Sharing

Data is what makes a smart city “smart.” By generating new and traditionally hard to come by data, sensors and other emerging technology can create new insights about how residents engage with their city and how the city can adjust its services or design to improve quality of life.

There is no shortage of examples from the private sector about the level of insights that can be made from a wealth of data. However, cities can have a hard time acquiring meaningful data from companies. Owning all or some of the data is also a challenge because more data means more security vulnerability.

Cities have taken different approaches to data sharing, from asserting ownership over the data to trying to collect as little as possible. Below are some examples from Boston and Seattle.

Boston and autonomous vehicles

In 2016 Boston Mayor Marty Walsh signed an [Executive Order](#) to begin testing of autonomous vehicles with the goal of making transportation more reliable, safe, and accessible. Mayor Walsh granted oversight to the Transportation Commissioner who would lead oversight and development of policies along with the Department of Transportation and the Mayor’s Office of New Urban Mechanics.

Generally, the City’s approach to data is to own as little as possible while setting out requirements to ensure companies are collecting data to evaluate the pilot. In the autonomous vehicle pilot, companies working with the city (like nuTonomy and Optimus Ride) must collect and provide upon request data necessary for evaluating the cars. The City also reserves a right to demand specific data (regarding unexpected occurrences, safety issues, etc.) if needed.

In addition to this policy, Boston requires companies to release data publicly, especially when devices are in the public right of way, as a transparency measure. For example, autonomous vehicle companies are required to create and make public quarterly usage reports. These reports must include information on crashes, miles and locations driven, conditions driven in, and failures and disruptions while in autonomous mode. Finally, companies must also host at least two public meetings to share their research agenda as well as thoughts on infrastructure needed, feedback on policy, data collection, and partnerships.

Seattle and dockless bikes

As mentioned in the section “Promoting equity,” Seattle’s dockless bicycle pilot began in 2017. A challenge Seattle faced in getting data is that multiple companies were participating in the pilot. Since Seattle, like many other cities, has broad open data and request for data protocols companies were afraid any proprietary data collected might be made public and reveal business strategies to competitors.

To get around this issue, [Seattle partnered with the University of Washington](#) via the Transportation Data Collective. The University collected and analyzed the data and then rolled it up into reports that the City received. This collaboration was not perfect. For instance, because one of the companies was very small, one could identify them in the aggregated data. However, the partnership was a creative one that allowed for interesting insights and lessons learned.

For example, Seattle designed a mandatory survey that the companies had to administer to their riders via company apps. The University of Washington was able to tie the survey responses to rider identification numbers, which allowed the University to see connections between responses and how the respondent uses the service. The City also had to manage difficult situations such as how to handle companies who did not comply with administering the survey, who only somewhat complied by administering it to a few riders, or who changed the questions in the survey.

Seattle and traffic sensors

In 2016 Seattle began using adaptive signal control, a Siemens technology that automatically adjusts in real time the timing plan of traffic signals based on prevailing conditions and traffic demands. Simply put, the city set up sensors, transponders, and a data platform that allows for longer green lights and/or shorter reds along high traffic corridors when pedestrian traffic and cross-route traffic was low and adjust in real time as traffic patterns change.

The current program in Seattle is a pilot known as [Mercer SCOOT](#) for its location along Mercer street and an acronym for the system (split cycle offset optimization technique). Early data seems to indicate that the system reduces traffic time by a small margin but traffic reliability by a large one, meaning that while there is still traffic along the commute, it is more predictable (e.g. you know you’ll be in 20 minutes of traffic everyday rather than 20 minutes one day and 45 the next).

Seattle determines the best data ownership and sharing policy for each specific project. For the traffic sensor program, the City owns all of the data. The data goes directly to City servers and only goes to Siemens if there is a specific issue or need. The City owns the data partly because of the nature of the project using real-time information, and partly because the City did not want this data to be sold by companies. While the City owns the data, it does not own the software and thus is not responsible for key software updates and modifications, such as modifying the application programming interface (API). One lesson learned for the City was that establishing these policies required very knowledgeable attorneys on the topic of data sharing.

Privacy

Recent high-profile hacks and internal data misuse at private companies, nonprofits, and political organizations have put the public on notice about the safety of their personal information. This type of information is referred to as personally identifiable information (PII) and includes names, social security numbers, addresses, financial information, and any other data that could be used to identify individuals.

In light of concerns over data privacy, public institutions around the world have reacted in ways that will drastically impact how emerging technology can be used in cities. Most important is the European Union's recent enactment of the General Data Protection Regulation (GDPR), which creates stringent data privacy rules. Since this regulation is already shaping privacy practices globally, we include GDPR as a case study below along with privacy policies implemented in Oakland and Seattle.

European Union and the General Data Protection Regulation

The General Data Protection Regulation (GDPR) is in effect for any government inside the European Union (EU) as well as any private organization that collects information about citizens within the EU.² The GDPR establishes many regulations for handling PII, including requiring data protection by design and by default, data anonymization, clear public/customer notice of data practices, and the right of public/customer access to their personal data. These regulations were recently implemented and cities are currently grappling with how the regulation impacts emerging and smart city technology.

GDPR requires organizations to [justify the legal basis](#) for collection of PII, meaning cities and companies will have to use one of the following in order to justify collecting personal data:

- 1. Consent:** "the data subject has given consent to the processing of his/her personal data for one or more specific purposes." Ex: A customer buys a product online. At checkout, the company offers a check-box to "sign up for weekly newsletter," which includes information about data use as well as the right to opt out.
- 2. Contracts:** "processing is necessary for the performance of a contract to which the data subject is party to or in order to take steps at the request of the data subject prior to entering into a contract." Ex: To use a free trial, customers may need to share personal information like credit card or contact information.
- 3. Legal Obligation:** "processing is necessary for compliance with a legal obligation to which the controller is subject." Ex: A criminal investigation requires processing PII.
- 4. Vital Interests:** "processing is necessary to protect the vital interests of the data subject or another natural person." Ex: An individual is admitted to the hospital with life-threatening injuries. The disclosure to the hospital of the individual's medical history is necessary in order to protect her vital interests.

²There are some important exemptions for governments re national security, law enforcement, protection of national interests, etc. Countries within the EU can also apply for country-specific exemptions. There are also some nongovernmental exemptions for journalists, religious organizations, etc.

5. **Public Interest:** “processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller.” Ex: The tax authority’s collection and processing of an individual’s tax return
6. **Legitimate Interests:** “processing is necessary for the purposes of the legitimate interests pursued by the controller or by a third party, except where such interests are overridden by the interests or fundamental rights and freedoms of the data subject.” Ex: A company is seeking to provide its customers with more personalized services so it hires a consulting agency and shares market research which includes PII.

Oakland and its Privacy Advisory Commission

In 2013 Oakland attempted to expand to the entire city a monitoring system the city used to surveil its port, called Domain Awareness Center (DAC). This system would have combined data from cameras, microphones, and other monitoring devices throughout the city to create a system the Electronic Frontier Foundation called a “[city-wide surveillance apparatus](#).” A coalition of local activists and civil liberties organizations successfully blocked the expansion of DAC.

Oakland City Council responded to the DAC controversy by passing an ordinance that created a [privacy advisory commission](#). The commission includes a mayoral appointee as well as select members from city council. The commission is charged with providing “advice to the City of Oakland on best practices to protect Oaklanders' privacy rights in connection with the City's purchase and use of surveillance equipment and other technology that collects or stores our data.” Note the policy only applies to data collected from technology and is focused mostly on the narrow issue of surveillance technology.

Under the guidance of its privacy commission, the City recently passed one of the most stringent data privacy laws, called the Surveillance and Community Safety Ordinance. This law requires public notice for the proposal of a new surveillance technology by holding a public meeting of the privacy commission. The law also requires that “meaningful public input” is sought for all decisions regarding surveillance and that public opinion is significantly weighted.

Seattle and its privacy program

In 2013 Seattle was scrutinized after the discovery that the Seattle Police Department acquired two drones with facial recognition software via a grant from the Department of Homeland Security without informing the public, the Mayor, or City Council. Civil rights organizations like the American Civil Liberties Union and community members argued that the drones were a breach of civil liberties and privacy rights because they had the capacity to recognize and track individuals. Mayor Mike McGinn promptly cancelled the program.

Under the direction of the Chief Technology Officer and Chief Privacy Officer, Seattle created two committees that would develop privacy policies for the City. The first was an internal group of representatives from 15 city departments and the second was an external privacy advisory committee of academics, local companies, activist groups, and private legal organizations. These committees disbanded after the writing of the [privacy policies](#) but a Community Technology Advisory Board still meets regularly to make recommendations to the Mayor and City Council.

Seattle's [data guidelines](#) also include:

- providing clear public notice re collection and use of PII during time of collection and on .gov website
- collecting only the data necessary for the city to achieve its stated goals
- being accountable by appropriately securing data and ensuring no unauthorized access
- sharing information carefully and requiring outside vendors to agree to the city's privacy policy
- creating a data retention schedule. This schedule provides a timeline for disposing of personal information or de-identifying data and making public.

Enforcement

As cities build frameworks for emerging technology and increasingly test out new technologies with pilot programs and permits, one key challenge is enforcing the rules and regulations. Cities might want a technology to be accessible to vulnerable populations or might require that the technology be placed in a safe location that does not disrupt the use of the public right of way. However, enforcing those rules in a systematic way can be tricky and cities might not have sufficient staffing and budgetary capacity to appropriately inspect and enforce the rules .

Below are examples from Santa Monica and New York City that illustrate the challenge of enforcement.

Santa Monica and electric scooters

Electric Scooters (beginning with the Santa Monica based company, Bird) made their debut in Santa Monica in late 2017. After many complaints regarding safety, Santa Monica's City Council adopted an [emergency ordinance](#) establishing an impound fee for scooters parked in the right of way. Eventually this led to a lawsuit between the City and Bird for unpaid impound fees, which [Bird settled for \\$300,000](#). As part of the agreement, the company also agreed to run a weeklong safety advertising campaign on public buses.

The emergency ordinance is in place until September 2018, when a [16-month pilot](#) will begin with up to three companies being granted permits. The pilot may require scooters to have "lock-to" technology, or some mechanism that allows a user to lock the scooter to a bike rack or other piece of street furniture. This requirement would be unpopular with Scooter companies because very few scooters come equipped with this technology currently. However, lock-to technology would help the city ensure that the right of way be kept clear.

The pilot also allows the city to experiment with "geo-fencing" technology, which would allow the City to create digital perimeters around real locations in Santa Monica. These geo-fenced locations could specify valid parking locations to scooter users. Companies might then be required to move any scooters parked outside of the designated areas, and would be given a certain number of hours to do so. This system would need to be built, and whether or not Santa Monica would be able to determine systematically if companies were requiring with the rules would still need to be determined.

Both lock-to and geo-fencing offer Santa Monica potential solutions to enforcement that do not rely solely on resident complaints or hiring enforcement officers to issue citations however the solutions each come with trade offs.

Forecasting

Technology forecasting attempts to predict upcoming technologies and the anticipated impact they may have on society. Forecasting may also be used to help cities determine which technologies they should invest in for the long-term. This is an important topic as many cities are considering large-scale technology infrastructure projects that will shape the type of services they can offer in the future.

One feature of new technologies is especially important: connectivity to one another. By connecting traffic sensors to smart cars to parking sensors, your car can guide you on the quickest route to where you are going and find, as you approach your destination, available parking spaces within a specified distance to where you're going, taking into account parking restrictions. However, these insights require interoperability of various devices, fast WiFi, and ubiquitous deployment. This gets complicated if a city is developing its system of networked devices over time, as is the case with almost all cities. What if first generation sensors are not equipped to speak to 10th generation devices? What if you invested in a new technology that became obsolete rather than the industry standard?

Below is a case study from our friends at the Federal level on how to create space and bring experts together to forecast on technology and policy.

President Obama and the President's Council of Advisors on Science and Technology

Initially began by President George W. Bush, President Barack Obama rechartered the [President's Council of Advisors on Science and Technology \(PCAST\)](#) with an Executive Order early in his first term. The Council was made up of 21 Presidential appointees who were not in federal government and had distinguished careers in science, technology, and/or innovation.

The Council brought together scientists, engineers, health professionals, etc., to provide a “diversity of experience and views to advise national strategy to nurture and sustain a culture of scientific innovation.” The Council engaged scientists in the work of public policy, often by asking them to forecast and make recommendations to plan for the future of various industries including health, energy, education, networking and information technology, advanced manufacturing, and nanotechnology, among others.

For example, PCAST produced a report regarding the [future of the United States' health information systems](#). The report urged the government to adopt a universal exchange language, which allows medical records to be transferred more easily while updating privacy and security measures applied to health records. PCAST argued this system would better enable the country to improve patient care (lowering future costs) and create new healthcare markets.



For Further Discussion

Emerging technology is amorphous by its definition. Smart Cities' nascency means that there are several issue areas that are challenging or currently left unanswered. This section lists some of the areas we feel need to be discussed further when it comes to emerging technology in cities:

- **Economic sustainability.** How can cities ensure the long-term economic sustainability of a permitted project that relies on private companies for service (many of which are new)? Is procurement more economically sustainable? What are the tradeoffs? What are the economic implications of long-term contracts? How can cities determine the best economic model for a project?
- **Future proofing.** How can cities ensure today's devices will be compatible with tomorrow's technology? How can cities assess technology for longevity and interoperability? How can cities ensure their practices are environmentally sustainable and minimize e-waste?
- **Data and decision-making.** How can cities ensure more data leads to better decisions? What practices can cities follow to make data easy to analyze and combine with other data sets?
- **Security.** How can cities ensure the physical safety of devices? What about cybersecurity concerns? How have cyber threats changed over time? What are best practices regarding risk management for cybersecurity? How can cities deal with changing cybersecurity standards over time? How can city staff at all departments be more familiar with cybersecurity protocols?
- **The changing privacy landscape.** How will the GDPR impact smart city development in the EU? What can other regions learn from the EU in case similar policies are passed? How are companies thinking about privacy in light of the shift towards government ensured privacy?



Conclusion

We hope this report offers a glimpse into how cities are approaching and regulating emerging technologies. There is no one-size-fits-all model for responsible and smart implementation of new technology. However, we believe this collection of case studies demonstrates the spectrum of responses cities have taken and what they have learned in their approach. We hope more research and discussion will continue around the eight issue areas we focused on as well as the items listed in our 'for further discussion' section.

We are grateful to all of the cities who spoke candidly about their process, wins, and lessons learned. The insights we gained will continue to be invaluable as we develop a framework around emerging technology in San Francisco.



Appendix: Other Case Studies

Below is a collection of additional case studies that illustrate other ways cities are testing and using emerging technology. Many of them could be bucketed into the themes above, but we wanted to keep those sections targeted and readable. The case studies below illustrate the spectrum of what is possible.

San Jose and autonomous vehicles

Part of the “Smart City Vision” in San Jose, California is to become a “demonstration city” and reimagine the City as a laboratory for transformative technologies. This includes creating pathways for start-ups to access opportunities to pilot products via the City’s [Demonstration Partnerships policy](#) that City Council passed in 2008 and amended in 2011. This policy allows the city to enter pilots or testing projects³ — which often includes offering staff time, city resources, and/or policy exemptions — with companies if the project will accomplish one of the following goals:

- create new markets and new jobs or/and support existing local innovators
- improve quality and efficiency of City services and operations
- advance the City’s Green Vision and Economic Development Strategy
- educate the public about innovative solutions.

San Jose identified as a strategic goal to increase mass transit ridership and was interested in testing autonomous vehicles. To achieve this, the Mayor’s Innovation Office hosted two roundtables in 2017 with industry stakeholders to discuss city resources and goals as well as case studies from other cities. The City then released a detailed [RFI](#) (including a single point of contact, current infrastructure and resources, details on pilot locations, intended goals of the pilots, etc.) asking companies to submit AV project ideas. The City received 31 responses, 21 more than they expected to receive, and ultimately chose to interview 5. San Jose is currently working out data sharing agreements with a few companies before the pilot begins.

³ San Jose refers to “pilots” as a service, product, etc. that is already in the marketplace and that the city is interested in trying out. “Testing” projects refers to a service, product, etc. that a company approaches the city with in order to evaluate efficacy.

New York City and Soofa smart benches

After nearly 40 years and over \$60 million in restoration, New York City reopened Highbridge Park, which links Manhattan to the Bronx. The Parks Department wanted data on park use but the traditional method -- sending employees to monitor park entrances -- was onerous and limited in utility. Instead, [the City deployed smart benches](#) made by the company Soofa as part of its “Smarter Parks” initiative.

Soofa smart benches look like traditional park benches but with big box in the middle that is outfitted with a solar panel. Using this power source, the bench can charge park visitors’ cell phones and other devices. Most important, however, is a WiFi scanner that counts the number of WiFi connections that pass by (within 75 feet), meaning that each person carrying a smartphone or device will register (anonymously). This will help give staff an accurate picture of park volume at different times as well as the duration of stays in the park and, because of strategic placement of the benches, a sense of each visitor trajectory. The City says this data will help the park to justify capital improvements, guide investments, and schedule maintenance.

New York City and BigBelly trash and recycling bins

In 2017 Mayor De Blasio of New York City [announced](#) his office’s latest battleground: rats. The strategy was multi-pronged including limiting for apartment buildings the number of hours that trash could be on the street for pickup, replacing dirt floors in the basements of public housing with concrete ones, increasing fines for illegal dumping, and investing in new smart trash bins called BigBelly.

BigBelly garbage and recycling bins have trash compactors inside that allow them to hold eight times the level of garbage as a traditional garbage can. They are powered by solar and are also online, allowing the cans to communicate to the Department of Sanitation when they are almost full. Most importantly for rats, they are completely enclosed and therefore “rat-proof.”

New York City first piloted BigBelly in Times Square in 2013. The goal for that pilot was to both increase the recycling rate and make trash collection more efficient. The installation of the smart bins increased the recycling rate from 15 percent to 40 percent and reduced by 50 percent in time spent collecting trash.

The 2017 project will cost \$32 million in total, which includes a few million for 336 BigBelly bins (they cost \$7,000 per bin). The City is targeting the most infested areas: the Lower East Side and Chinatown in Manhattan, Bushwick and Bed-stuy in Brooklyn, and Grand Concourse in the Bronx. The goal is to decrease the rat population by 70 percent. While there are no current updates from the City, residents have been complaining that many of the BigBelly bins have been overflowing with trash because garbage pick up is too infrequent or because the opening of the garbage is too small for some objects. Maintenance costs have also been an issue for the City, which are expensive.

Austin and dockless bikes and electric scooters

Austin, Texas has a successful docked bicycle share program that is three years old and run by a nonprofit called Austin B-Cycle. In January 2017, the City approved another five-year contract funded mostly through a federal grant.

Later that year, however, dockless bikes begin appearing on city streets with prices that are several times lower than Austin B-Cycle. In February 2018, Austin City Council met to discuss a [resolution](#) and get public input regarding a dockless bike share permit pilot program. Companies hoped to share plans for their electric scooters as well but were not allowed. Bird released scooters on to the streets without permission days later and Lime followed.

Following the deployment of scooters, City Council voted to add dockless bikes and electric scooters to an existing ordinance prohibiting abandoned vehicles from blocking the public right of way. City Council also released the permit application, which applied to both bikes and scooters. Both Bird and Lime pulled their bikes and scooters from operating as they applied for licenses.

Soon after putting out the permit, the City put out emergency rules with the most important being the requirement that by August 1 all vehicles have “lock-to” technology. However, after discussing this more with companies in July 2018, the City decided [not to enforce](#) this component for the time being. The emergency rules will expire in September and will be replaced by updated final rules.

Washington, D.C. and dockless bikes

Washington, D.C. has the second largest docked bike sharing program in the country with about 3,700 bikes (the largest is New York City's). The docked system, which is owned publicly and operated privately by Motivate, has been very popular. However, as dockless bike companies began deploying around cities throughout the U.S., D.C. decided to create a pilot to test dockless bikes.

In the fall of 2017, the District's Department of Transportation (DDOT) granted seven companies (Jump, Spin, ofo, Mobike, Limebike, Waybots, and Bird) [permits](#) that allowed up to 400 bikes each. In addition to standard rules requiring parking out of the public right of way and providing insurance, bike companies were also required to provide a monthly (anonymized) data report on bike usage, routes taken, number of bikes parked illegally, etc. These reports allowed DDOT to compare use to the docked program (however DDOT had a very [hard time getting these reports](#) from companies). [Early data](#) indicates that for the docked program each bike was used on average 5-6 times, compared to an average of 2-4 for dockless.

During the pilot, companies began complaining that 400 bikes was insufficient for economic sustainability over the pilot period, which they believed was too long. One company, [Ofo, pulled out of the pilot](#) and removed all bikes from the District. D.C. eventually expanded the pilot through the summer as it tries to decide how many dockless bikes to allow and what operating fees and regulations to apply in the post-pilot period.

Kansas City and smart kiosks

In 2016 Kansas City, Missouri opened its new free streetcar through downtown. The City decided to test a number of IoT devices along the 2.2 mile route as part of its effort to make Kansas City a “[living lab](#).” One of these devices was a smart kiosk.

Kansas City worked with Smart City Media to [install 25 “City Posts,”](#) giant tablet-like kiosks with touch screens and a number of apps that the company designed with the City. The goal of the kiosks are to provide hyperlocal information to users. This can include the history of the location you are nearest to, bikshare information, and neighborhood events and stores as well as streetcar times, city services, and way-finding. All 25 kiosks cost the City around \$1 million however due to revenue generated through advertising on the kiosk, Kansas City expects for the costs to be paid off in about five years.

Because of the broad authority given to the streetcar project, the kiosks did not go through a pilot process but instead were given a ‘fast track’ permit. In the first year the city made \$170,000 in cash back to the city and the kiosks were used nearly 300,000 times. The City also found that the kiosks were especially helpful in spreading emergency information, such as tornado warnings. The City is expanding its use of kiosks by adding 12 to the airport, 10 at the University of Missouri- Kansas City, and 68 along a new rapid bus transit line.

Barcelona and smart parking

In 1992 Barcelona, Spain hosted the Olympics and invested in something that would position it as an early smart city adopter: [a network of fiber optic cables](#). This connectivity has allowed for deployment of sensors for irrigation, controlling street lights, monitoring environmental conditions, and parking (among others).

[Barcelona first piloted](#) a parking system with a company called Worldsensing. Through a city program created to foster economic development using technology in the 22@Barcelona District, Barcelona provided office space and permits to Worldsensing to test their product. The City installed 100 sensors in the asphalt in the 22@Barcelona district. These sensors can tell when a car is parked in a given spot and transmit the information to an app.

After the pilot in 2014, Barcelona's software team ultimately chose to develop its own mobile smart parking system called L'apparkB. This system also allows drivers to pay for parking on the application. A year after adoption, the City issues about [4,000 parking permits every day](#).

Los Angeles and smart street lights

Los Angeles, California is in the early phases of testing out sensors installed on street lights, with a goal of full deployment of smart poles by the 2028 Olympics. The City is currently testing Philips' Smart Poles and one ENE-HUB pole, and is in discussion with vendors to have a larger scale pilot. The capabilities Los Angeles is discussing for their smart poles includes WiFi, gunshot detecting, lighting controls, electric vehicle charging, traffic control, cameras, and USB charging stations.

The City plans to fund this initiative with revenue made by allowing companies to provide 4G (or potentially 5G) LTE and charging them for this right. The City is also testing solar panels on the tops of street poles to generate electricity.

The potential of smart street lights to impact several departments across the city led to new levels of interdepartmental coordination and collaboration. Departments first met for a workshop to discuss priorities and system requirements and later formed a Smart City Coordinating Group that meets regularly.

San Diego and smart street lights

San Diego, California first looked to LED lights as a cost-saving measure during a fiscal crisis. Shifting 35,000 street lights from sodium vapor lights to more efficient LEDs led to less maintenance and [saved the city \\$2.2 million](#) a year. However, the City wanted to be able to tell when LEDs started to degrade so they worked with GE to connect the devices through a wireless network. This allowed the City to tell how much energy a streetlight was using as well as dim and brighten the lights as needed.

The City experimented with more street light technology with its pilot of 50 sensing lights designed by Current, a subsidiary of GE. The cost-savings potential of the street lights as well as the potential for new data to help solve problems led San Diego to expand this program to 3,200 sensing lights at a cost of about \$30 million (financed with GE Capital). The City expects the cost-savings to pay for the investment in about 13 years.

The current capabilities of the smart lights focuses on communicating to drivers open parking spaces. The City is exploring what additional items it will add on, including Shotspotter (a gunshot detector), sensing car crashed and alerting the proper authorities, and understanding more about dangerous intersections by looking at close calls as well as crashes.

The City is also making data publicly available and hosting, along with GE, [hackathons](#) to encourage software developers and entrepreneurs to create apps that help residents. Some that have already sprung up are an app that helps people find the quietest route to their destination, an app that uses the data to help the visually impaired cross the street, and an app that helps food trucks find an open space that is close to big crowds.

San Diego and autonomous drone delivery

In May 2018, the U.S. Department of Transportation announced that [San Diego was selected](#) (along with 10 others) to participate in an experimental commercial drone program. The [goal](#) of the program is to both test, in a real setting, using drones for commercial delivery and work with the Federal Aviation Administration to develop rules and regulations around commercial drone use.

The City has various partners for this pilot, including 20 regional partners like Chula Vista, company partners like Uber, and other organizations like the University of California, San Diego (UCSD). Each of these partners has a different interest in drones:

- Chula Vista is interested in drone usage for firefighters or police in emergency situations
- Uber is interested in food delivery via drones, and
- UCSD is interested in flying specimens to other locations for expedited review

Other partners include AT&T, Intel, GE Venture, Port of San Diego, and the San Diego Regional Economic Development Corporation, each of whom will provide connectivity, airspace monitoring, or other needs. San Diego is in the process of applying for expedited waivers and approvals for all of its regional partners in order to start testing.