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THE RESPONSIVE CITY CYCLE

Stephen Goldsmith and Betsy Gardner

 DATA-SMART
CITY SOLUTIONS

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About Data-Smart City Solutions

Data-Smart City Solutions is working to catalyze adoption of data projects on the local government level by serving as a central resource for cities interested in this emerging field. We highlight best practices, top innovators, and promising case studies while also connecting leading industry, academic, and government officials. Our research focus is the intersection of government and data, ranging from open data and predictive analytics to civic engagement technology. We seek to promote the combination of integrated, cross-agency data with community data to better discover and preemptively address civic problems. Our website, datasmart.ash.harvard.edu, and our broader work are housed at the Bloomberg Center for Cities at Harvard University.

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THE RESPONSIVE CITY CYCLE

Executive Summary

Trust can take a long time to build and short time to lose. In the past two decades trust in government has declined precipitously, including a drop in trust in local government which traditionally scored highly on trust metrics with residents.¹ This paper presents a form of trust-building based on responsiveness with a focus on harnessing digital tools and 21st century methods for engaging with and learning from residents.

Additionally, cities are at an inflection point due to the influx of billions of dollars in federal funding through the American Rescue Plan Act and the Bipartisan Infrastructure Law. This presents an opportunity for cities to meaningfully engage residents around spending, repair, and construction decisions and gain back trust through the “loop of responsiveness” we introduce in this paper.

Digital engagement tools form the backbone of this new loop. Current technology can be split into both active and passive methods, sorted by level of stakeholder work required. Passive sensors are low-effort and include sensors for monitoring air and water quality or catching early cracks in bridges too small for the eye to see. Active sensors require greater effort from stakeholders, including attending community meetings (virtually or in-person), writing to local officials, or submitting a request to 311. These methods can be mixed and matched together to cover a broad scope of engagement.

One clear benefit of the passive tools is that cities can respond to complaints or input without overly taxing residents. Sentiment mining, which gathers anonymized information shared in the public realm through sites like Twitter or Facebook, provides valuable insights without requiring any additional effort from residents. While active engagement asks more of residents, it also provides more direct and topical input. City leaders can present residents with 3D models or simulations of infrastructure changes and receive direct comments on proposals.

The second half of the loop is the outputs from local leaders. Collecting active and passive data without acting on it erodes trust further, so it is imperative that leaders close the loop by responding. This includes altering existing policies or introducing new ones, exploring alternate methods for accomplishing common goals, inviting the public into the budgeting process, and centering equity in historically exclusionary systems.

We feel that 21st century, digital infrastructure is the prime use case for the loop of responsiveness. Not only are cities currently funded for these endeavors, but intelligent infrastructure also has the passive sensing capabilities that help form the first half of the responsiveness cycle. The formation, operation, and iteration stages of connected infrastructure offer opportunities to both engage with and listen to residents ultimately earning trust, increasing equity, and improving quality of life.

What is a Responsive City and Why is it Important?

Cities, counties, and states are facing increasing complexity, distrust, and instability. Yet at the same time, local officials possess more financial and technological resources with which to respond. A wise local government looks to build not just capital projects but trust. An equitable investment structure raises not just returns but quality of life. Local officials build trust on a foundation of responsiveness. The building blocks require enhancements in how leaders listen to and engage with residents—and which in turn help them prioritize equity, address areas of neglect, open new avenues of communication, and, as a result, enhance trust.

In 2014 Susan Crawford and Stephen Goldsmith co-wrote a book, *The Responsive City: Engaging Communities through Data-Smart Governance*, which defines the responsive city and highlights the importance of data-driven government. Responsiveness includes many elements—how city officials engage with residents in decision making, how they perform basic services, how broadly they listen, and whether they act early in the life cycle of a concern. In the nine years since publication, strides in technology, societal upheaval, and a global pandemic have indelibly altered the landscape of governance.

In this paper we argue that city leaders must develop and utilize new tools and methods for engaging with and learning from residents, in large part to diversify inputs. Current methods of resident interactions take too long to turn into action and involve the voices of too few people. Too often, even a well-structured community meeting skews to the views of the well-connected or very verbal few with participation limited to those whose schedules and responsibilities are more flexible. When Stephen Goldsmith was deputy mayor of New York, he convened six neighborhood meetings a week to solicit ideas from small groups about how city hall could help their communities—but even six-a-week in-person meetings represented too small a slice of those who needed to be heard, and the city employees who need to listen simply have too little time to expand those interactions much.

Even if the number of civic meetings were unlimited it still would not produce a truly representative sampling of community concerns. The results of a national study on civic health sponsored by the Corporation for National and Community Service (AmeriCorps) and conducted by the National Conference on Citizenship found that only nine percent of respondents had attended public meetings in the preceding two years.ⁱⁱ A Pew survey of U.S. municipal managers found that 94 percent of respondents reported “offering opportunities for citizen engagement.”ⁱⁱⁱ Yet even so, when asked whether they involved citizens in the decision-making process related to the 2008 fiscal crisis, only 29 percent reported doing so.^{iv} A large gap exists between opportunity and meaningful involvement.

In this moment cities have large amounts of infrastructure funding through the American Rescue Plan Act (ARPA) and Bipartisan Infrastructure Law (BIL), creating a unique opportunity to not just engage residents on spending and building decisions but also pay attention to the virtuous circle or “loop” of responsiveness. Local leaders need more than just

to hear from certain residents about what they want at a pre-defined time. They also need to build digital inputs that can broaden the range of people whose views they consider, accelerate the process of acting on what they hear, and gather information about things that residents themselves identify as important. For example, if residents in a low-income area express concern about poor air quality, local leaders can use infrastructure funding to explore carbon capture cement or other air improvement methods and install sensors that will monitor the air quality. In this way, the city will receive inputs before residents elevate concerns or experience health problems and take steps to improve the situation while continuing to transparently communicate air quality results.

A byproduct of such a process is greater trust in local government. In this period of eroding confidence in public officials, impending massive expenditures (like those funded by ARPA and BIL) should be allocated in a manner which furthers a government “of the people, by the people, for the people.” *For the people* requires that public employees listen to those they are supposed to serve. *By the people* means policies crafted by experts with local knowledge or input. *Of the people* denotes full participation and engagement in all aspects of the civic process. Fulfilling this ideal requires new processes. Too often the underlying structure of twentieth-century government sidelines the people government is supposed to serve.^v

One of the clearest examples of systemically silencing resident voices is the construction of highway systems in the 1960s, when interstate construction ripped through and displaced many Black neighborhoods and other communities of color.^{vi} The folks who remained in those areas are still exposed to exceptionally high levels of environmental toxins today.^{vii} Equity must be woven into all aspects of the responsive city and its “loop” of engagement—listen, react, iterate, measure results and listen and act again.

The Responsive City Cycle

Digital engagement tools including the ones detailed below must be understood in the context of both active and passive sensing. In the paper *Harnessing Sensing Systems towards Urban Sustainability Transformation*, lead author Adrienne Grêt-Regamey and co-authors present a conceptual model that combines spheres of influence with active and passive sensing loops to frame how urban sensing systems can serve sustainability goals.^{viii} The two categories of sensors are sorted by level of engagement required. For example, passive sensors are categorized by low stakeholder engagement: satellite images or air monitoring sensors are passive. An active sensor has high stakeholder involvement. In this sense citizens are active sensors when they self-select to become involved.

Building off the “spheres of influence” idea proposed by University of Oslo professor and climate scientist Karen O’Brien, Grêt-Regamey and colleagues position active and passive sensors within three different spheres: practical, political, and personal. The practical sphere is closest to implementation, followed by the political, and then personal. These are arranged

based on the idea that the further away from the center, the more difficult it becomes to influence changes.

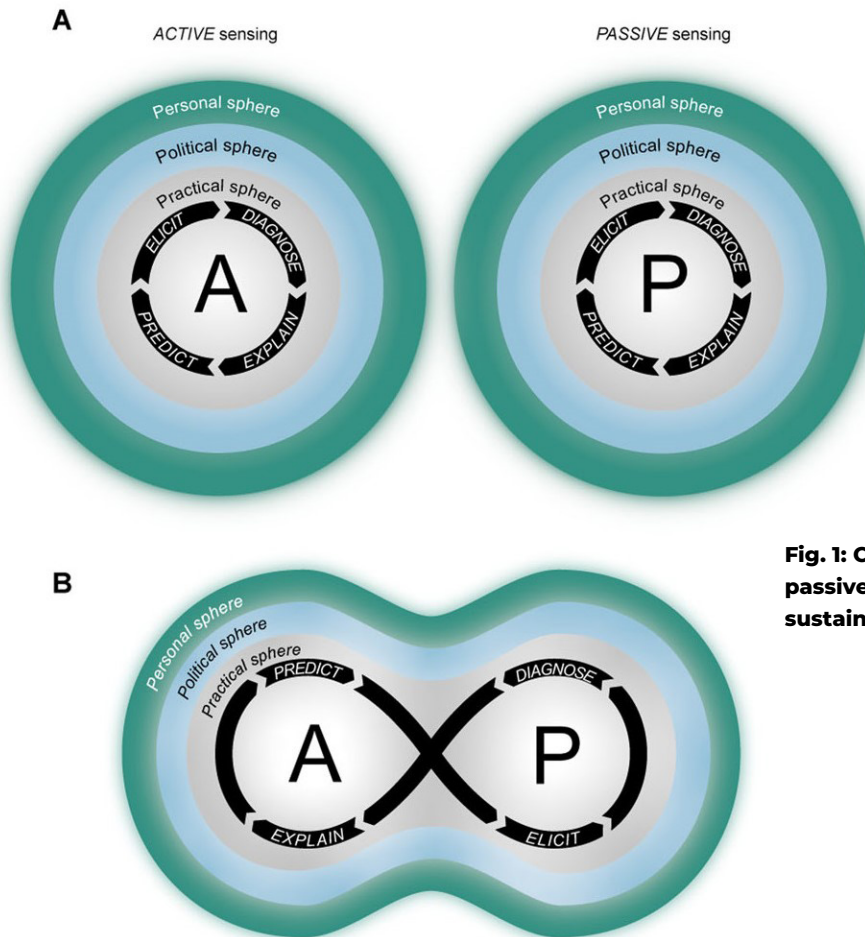


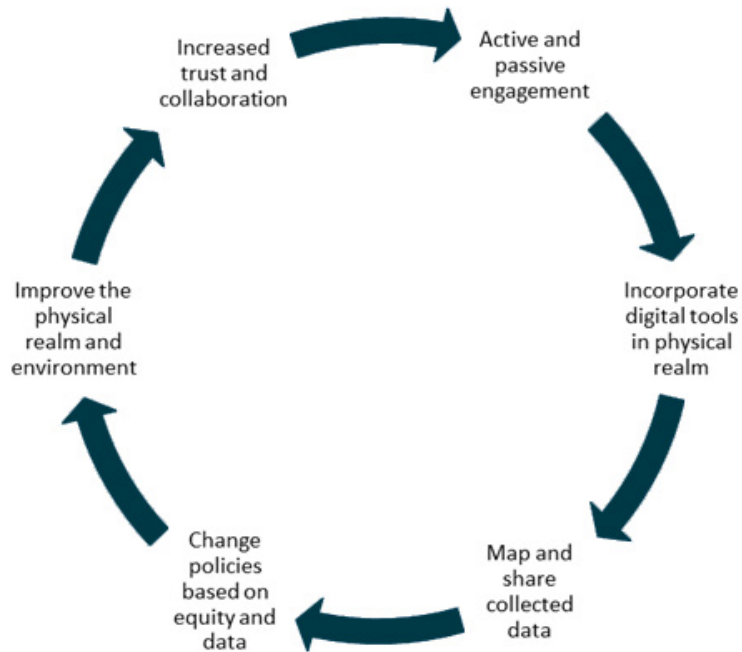
Fig. 1: Combinations of active and passive sensing to inform urban sustainability transformation

From: [Harnessing sensing systems towards urban sustainability transformation](#)

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While this paper won't focus on the spheres of influence specifically, nor solely on sustainability, we apply the active and passive sensing definitions to the responsive city model. Technology can support both active and passive means of collecting input, plus these methods can be mixed with each other or combined with more traditional means of community involvement. A responsive government recognizes and responds to changing behaviors or views more quickly when it deploys digital tools such as sentiment mining and online surveys, described below.

The Responsive City Cycle



Broadening the Base of Input

Broadening the base of voices heard requires more creative use of digital tools, including attention to how questions are presented, how sentiment and views are gathered and curated, and how government reacts to what it hears.

Listening in a New Way

One way of broadening—and sustaining—resident input is through passive tools. As explained in the definition above, passive tools require far less stakeholder engagement and can be mixed into the initial stages of the responsiveness loop for earlier alerts of important facts while supporting a constant stream of well-visualized data that furthers continuing interaction.

While residents care about their cities and neighborhoods, communicating with city hall does not rank high on their list of priorities. Even when something stands out—a pothole, or a broken swing, or a malfunctioning traffic signal—people more readily express their concerns to their friends or neighbors than through a more formal complaint to the city.^x With 93 percent of American adults online, expressions of concern about the places where they live are often shared on social media. A majority of Facebook, Snapchat and Instagram users say they visit these platforms daily, and usage statistics do not vary materially by race or geography.^{xi}

Paying attention to civic sentiment on these platforms can provide useful insights, not otherwise available. Using only anonymized information in the public realm, a city can enlarge the percentage of residents from whom it learns and responds. An 18-city initiative about vaccine hesitancy, conducted in 2021, utilized sentiment analysis to understand how people felt about vaccinations and what influenced the likelihood of receiving a vaccination among diverse groups.^{xii} The results informed officials about the efficacy of their message; success depended on the message and the messenger, with both varying by subgroups in the community. For instance, minority communities, more than majority ones, were more likely to be influenced by respected community leaders than officials from city hall.

Listening to social and online comments about community problems enhances the voices of those often ignored and neglected, or who are disenchanted with formal avenues, by revealing priorities and issues otherwise unheard. Cities with higher levels of resident interactions with city-run social media accounts measured lower levels of negative vaccine sentiment among residents.^{xiii}

Another way of pulling broader, valuable information is through Internet of Things (IoT) sensors. The city of Chicago, in conjunction with Argonne Laboratory, was an early leader in the use of sensors in its Array of Things initiative.^{xiv} These sensors, placed throughout the city, measure temperature, barometric pressure, light, vibration, carbon monoxide, nitrogen dioxide, sulfur dioxide, ozone, ambient sound pressure, and pedestrian and vehicle traffic. The gathered data is shared with the public, as is the privacy policy that protects collected Array of Things information.^{xv}

Sensors can collect and communicate with no effort required by residents. In Chicago, residents do have the opportunity to be engaged if they wish. Through the Sensor Community initiative anyone can purchase a do-it-yourself sensor kit to capture data on particulate matter.^{xvi} The global sensor network creates and illustrates crowdsourced environmental data; people from various locations and backgrounds engage with the online forum to discuss air quality based on the DIY sensor data. And officials can and should provide structured feedback loops, spatially visualizing the data in order to drive action and inform residents of evolving results.

While cities can mix and match different ways of engaging residents, passive engagement helps provide voice to low-income residents whose participation is historically less robust. Augmenting information in this way makes engagement more equitable and broader, without adding additional burdens. As we discuss below when addressing digital infrastructure, “incorporate digital passive tools” is one of the mid-points in the responsive city cycle.

Engaging in a New Way

The first half of the responsive city cycle is about inputs—specifically, broadening

inputs to both include historically marginalized voices and broadening the methods of inputting data, goals which complement each other.

A common trigger of municipal action is a request for assistance, generated through an app or 311 call. However, this method presents limitations. Recently, Kim Desmond, the chief race and equity officer for the city of San Diego, cautioned against too much reliance on 311 calls and on the city's Get It Done app, which allows residents to make service requests on problems from potholes to graffiti.^{xvii} While traditionally cities measure success and performance by how quickly they resolve such requests, she is concerned that mapping response times among diverse neighborhoods provides an incomplete picture. "Who are we not hearing from?" she said, "An absence of reports does not mean that conditions do not exist that need fixing—just that they are not being reported."

Desmond identifies the gaps by mapping reports with geographic information system (GIS) tools and creating an index to drill into the data and see what is really going on in a community. She then pairs the official reported information with voices of stakeholders since these "produce a level of authenticity and granularity" beyond what the city could compile previously.

Desmond's caution aligns with that of Amen Ra Mashariki, the former chief data officer for New York City. During his time in the city, he reviewed the location of rodent reports to NYC 311 and was surprised that there no longer seemed to be rodents in the housing community where he grew up. Yet when he stopped by his old building, the maintenance manager told him that they still have rats, "we just quit reporting them as nothing seemed to happen."^{xviii}

These two stories underscore the need to broaden the sources of input to capture more diverse voices. Both 311 reports and the comments at civic meetings tend to bend the city's response to those who know how to work the system or to the few who organize and advocate more tirelessly than others.

San Diego, like many American cities, is allocating increased attention to the role of police and the purpose of policing. The San Diego Police Department (SDPD) decided to formally elicit views on the police, utilizing a tool developed by Zencity that surveys city residents online and in multiple languages. The questions focus on how much residents trust the police department and if they feel safe in their neighborhoods. According to SDPD Captain Jeff Jordon, the surveys offer a broader, more diverse perspective than the comments typically surfaced at community meetings. The tool expands community outreach and allows the SDPD to seek out ideas and concerns rather than only responding to a meeting or a complaint.

The surveys help identify trends and support community policing goals because the department can directly shape its priorities and hold officers accountable based on the real-time responses. As SDPD Chief David Nisleit explained, the SDPD is "using this as a barometer, to go back in and try to fix that community trust."^{xix} The San Diego example combines new tools with new voices, in order to best capture opinions (active engagement) and then create changes in the physical realm based directly on resident input.

Responding to Concerns

The second half of the responsive city cycle is about outputs and outcomes, or more specifically, results. Once city leaders have actively and passively engaged residents, collected data, and made changes in the physical realm, they can move to changing and restructuring policy—confident that the public they serve is centered in their decision making.

Researchers Sonal Shah and Hollie Russon Gilman noted in a *Stanford Social Innovation Review* article:

To move toward co-governance, we must examine and thoughtfully adopt durable models of institutional design to ensure that civic engagement is more than just a checkbox, a public relations campaign, or a one-off information-sharing exercise. We need a people-first feedback approach that is adaptive and responsive to communities and their needs, not just data dumps.^{xx}

Without the latter half of the responsive city cycle, the actively and passively collected data would simply remain a data collection exercise and potentially create more cynicism if it didn't produce results. A truly responsive city will move through the cycle to create change, support community members, and address concerns.

In Oakland, the Department of Race and Equity works across other agencies and departments to ensure that equity is well-understood and prioritized in decision making. The Oakland Department of Transportation (OakDOT) grasps its unique position to address systemic inequities in the city's history, particularly around urban planning. As part of a \$100 million paving plan in 2019, OakDOT mapped factors like race and income (according to Census and American Community Survey data) and school locations to visualize discrepancies in street and paving conditions between neighborhoods of color and majority-white neighborhoods.^{xxi}

The resulting equity-focused paving plan, called The Great Pave, heavily relied on data to demonstrate longer commute times, worse road conditions, and fewer protected bike lanes in areas with higher concentrations of people of color. OakDOT distributed funding and conducted repaving projects for local streets by a formula which included the share of underserved populations and local street miles in poor condition. This is an excellent example of combining active sensors (resident complaints about street conditions) with passive ones (Census data and school location) into a visualization to tell the story of why the city must respond to these poor conditions.

Some residents in wealthier and whiter neighborhoods booed OakDOT's Sarah Fine at community meetings when she explained how the money was to be distributed. Yet most people understood that the combination of data presented an accurate picture of disinvestment in traditionally Black neighborhoods.^{xxii} The city improved its relationship with

residents in previously neglected communities by following through on promises to improve and pave the streets.

Too often the benefits of engagement are limited by the way the question and the data are presented. Stephen Goldsmith remembers receiving an important lesson as a new mayor in Indianapolis. He went to the ribbon-cutting for a new park, and instead of acclaim, residents greeted him with complaints concerning the location of the basketball courts. The late evening ball players now converged on the side of the park too close to where the seniors lived. He then overcorrected; after raising considerable philanthropic support for new parks, he and his team held a neighborhood meeting to ask the residents what they wanted. The first speaker said, “Mayor, the park planners work for you—give us a better idea of the options if you want our opinions.”

Those two interactions were opposite sides of the same engagement coin and an example of what is sometimes known as the “paradox of participation.” In early planning phases, “when there is still sufficient room for decision-making, only a few citizens participate, while in late phases, when decisions can usually only be revised at great expense, an elevated level of public participation can be observed.”^{xxiii} However, current city leaders have tools at their disposal to address this paradox and enable community participation—ones that Stephen Goldsmith could only dream of when he served as mayor: visualizations, online surveys, and augmented reality.

Augmented reality (AR) helps interested parties understand how design proposals will appear when construction is completed. The city of Boston relied on such tools to model and evaluate the shadows a proposed tall structure would cast on the Boston Common green space, based on what was at that time just a construction proposal.^{xxiv} Being able to see and experience the shadows as if the building were already erected marks a remarkable advance in urban planning, furthering capabilities for understanding siting and massing implications for proposed structures. The city has also used AR tools as part of the planning process for bus rapid transit. The Massachusetts Institute of Technology (MIT) Media Lab developed two City Scope Tangible User Interfaces for community engagement events with over 300 participants.^{xxv} The tools augmented information such as bus rapid transit trip duration, congestion, or construction costs, as well as station design, signage, and building facades.

Current Opportunities and Examples

Substantial federal funding coupled with new digital tools and a heightened concern about equity provide an opportunity to set a new level of responsiveness. City leaders can capitalize on this unique opportunity to create and strengthen a virtuous cycle that produces trust and confidence.

Examples of how digital infrastructure supported by federal funding might be implemented to further responsiveness include:

1. Formation

Officials should plan infrastructure investments with active and passive sensing approaches. These approaches should begin by visualizing historic decisions and, where applicable, their consequences. GIS visualizations can show previous capital investments; overlaying data showing the results of previous decisions can aid decision making. For instance, a city could examine whether highway congestion and resulting vehicle exhaust led to more asthma, sorted by the wealth and races of neighborhoods. Over the years, where have green trails and parks been located and how well have they been maintained? Visualizations of choices should be used first to map stakeholders who can provide feedback, second to determine priorities, and then third to scope specific projects. Active tools should include those that solicit digital feedback through polls, surveys, texting, and mobile apps in order to include people who do not attend meetings or normally volunteer their input.

Passive tools should also be used to provide critical information driving expert and community insights. Planners should use sentiment mining of anonymous social conversations to understand unvoiced local concerns better. Passive information includes IoT data, where available. For example, signalization sensors and connected vehicle data can predict dangerous intersections—those with hard braking, large numbers of cyclists, or too much red light running. When overlaid with GIS demographic data, the passive analytic information can paint an important picture for priority planning, helping officials compensate for past inequitable investment decisions.

2. Operation

Cities need to incorporate sensors for purposes of preventative maintenance and life cycle management, but they should also use digital information to attain a new level of responsiveness. That responsiveness includes learning about issues sooner and resolving them faster. Building sensors and monitoring capacity into new projects will equip officials with the knowledge to intervene before a streetlight burns out, or to recognize a pothole before it causes a crash. Air alerts can trigger public health responses. All of this information can be communicated to civic organizations and residents to help them make decisions.

Information related to construction, alternative routing of vehicles, and retailer access should be communicated digitally to those who have signed up for updates as well as through user friendly mobile tools that help mitigate inconvenience while setting expectations about timelines. Return on investment analysis can demonstrate how sensors, such as vibration sensors in bridges, advanced digital routing of snow or garbage trucks, or braking or engine sensors in buses save money in operation.

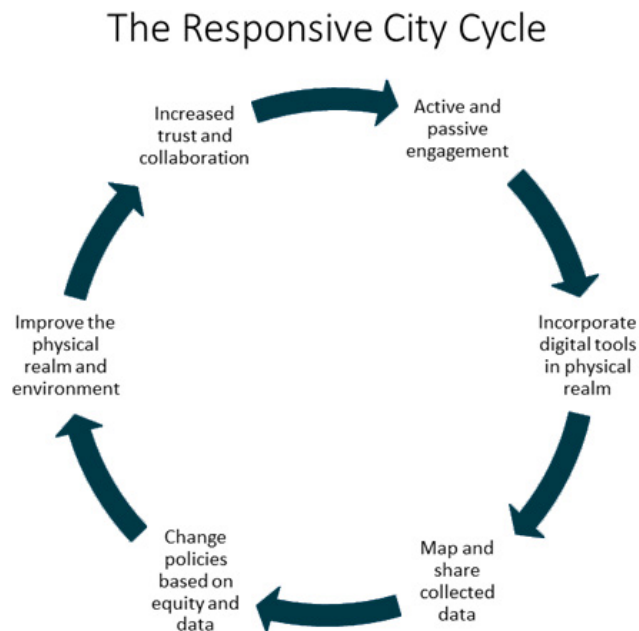
3. Iteration

Digital infrastructure more broadly utilized will provide policy makers real time information about safety and environmental issues. Available data can more quickly prove or disprove a concept such as whether camera analytics or traffic calming measures increase safety. In this example the neighborhood is not solely improved by better physical infrastructure and fewer crashes, but also through an increase in walking and biking. By supporting safer bike lines and prioritizing safe spaces for pedestrians, pollution is reduced, residents are more active, and quality of life is improved; this message and the data need to be continuously communicated with clear benchmarks and dashboards.^{xxvi}

Hearing about a problem, documenting and sharing it through open data, and then taking concrete steps to improve it makes an incredible difference in the relationship between communities and local governments. Local leaders will prove that they can be trusted to prioritize and respond to resident concerns, and residents will see the direct benefit of collaborating with government officials. This restarts the responsive city cycle (moving to active and passive engagement, either on the same or other issues) from an even stronger and more trusting position. Equally important to the extent that the public has concerns about a new investment, identifying those problems through sensors, community meetings or sentiment mining, allows the government to respond much more quickly.

Conclusion

Citizens need to be able to express their points of view more effectively and equitably so that political leaders understand and respond. In his important work, *Exit, Voice, and Loyalty*, Albert O. Hirschman emphasizes that voice has the function of alerting an organization (such as a city) to its failings or challenges. People who perceive they have been heard stay loyal and involved and do not exit. Those who feel ignored (and have the funds to depart) exit to another city or suburb. Listening ratifies voice and builds trust. It also leads to more representative engagement in designing and implementing interventions that meet community needs.



Responsiveness now requires the use of digital tools. Equity requires that city hall listens to those whose views are insufficiently represented in calls for action, and that officials listen earlier in the life cycle of an issue. Modern technologies and the almost ubiquitous use of smart phones provide the tools for change. Residents use digital platforms daily in their lives. Government needs to utilize the same approaches to deepen understanding, learn more from more people, create more equitable sources of information, and produce a higher caliber of community services.

When a responsive city meets the expectations and needs of its residents it gives them the confidence to invest both financially and with their time and energy back into the civic infrastructure necessary to build a better future. As the divide between residents and government widens, the search for more effective methods of engagement intensifies. Public leaders who understand and meet the needs and expectations of those living in their jurisdictions build the trust necessary to accomplish larger goals for their cities.

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