Broken Promises of Civic Innovation: Technological, Organizational, Fiscal, and Equity Challenges of GE Current CityIQ

Dr. Lilly Irani
Associate Professor
Institute for Practical Ethics
Design Lab
UC San Diego

Cedric Whitney
Visiting Scholar
Institute for Practical Ethics
UC San Diego

Version: May 3, 2020

Introduction

The claimed public benefits of the Intelligent Cities project, billed as the 'the World's Largest Smart City Platform' by the city, were promoted as creating data for sustainability, promoting civic innovation, and saving energy on lighting. The City states that this project 'is a tremendous technological benefit to the city and our citizens'[1], and that 'from easier parking and decreased traffic congestion, enhanced public safety and environmental monitoring, enhanced bicycle route planning, to enhanced urban and real estate development planning, this platform can improve the quality of life in our city and boost economic growth'.

The city has already spent three years and millions of dollars on this platform implementation. Yet these aspirations for civic empowerment and sustainability data have not been realized. This project has been limited by technical breakdowns, organizational limitations, and an opportunity structure that adversely affects lower-income San Diegans.

Instead, the city is left with a surveillance system that pervasively records video in public thoroughfares and near homes, workplaces, and places of worship – and the city, not citizens, access and use the data. Ongoing data recording incurs costs of data storage, data transmission, and the electricity required to maintain operations of the networked computer system.

This report summarizes the results of investigation of the system at the Institute of Practical Ethics and Design Lab at UC San Diego into the implications of CityIQ smart streetlights for privacy and inequality.[2]

---

[1] Smart Streetlights Program – City of San Diego. https://www.sandiego.gov/sustainability/energy-and-water-efficiency/programs-projects/smart-city.

[2] This research was conducted by Lilly Irani, Cedric Whitney, Simrandeep Singh, Elizabeth Quepones, Lauran Irion, and Steven Rick at UC San Diego.

Key findings:

- The planning data produced by the streetlights system is highly unreliable three years and approximately $7 million in loan repayments into the implementation. Smart streetlights, in effect, are only reliable as a video and audio surveillance system.[3]
- Three of the data modalities that are vital to the purported use cases (pedestrian, parking, and traffic data) have major operational flaws, including < 0.5% (only 12) of the cameras currently reporting pedestrian data.
- Despite promises to support civic innovation, technical infrastructures and organizational support are lacking and require ongoing and expanded financial investments.
- The City states that the platform has not led to a single running, externally created application on the platform. It is not in a position to be used by citizens or entrepreneurs.
- City of San Diego is using tax payer funds to beta test for GE Current, bearing risks and costs of a largely untested and highly complex public infrastructure. It is also paying taxpayer funds as GE Current learns how to fix its system for future clients and deployments.

San Diego is the first city to deploy the CityIQ smart city platform. The problems in implementation, including technical flaws in the CityIQ platform, can be attributed to problems that arise in the development and stabilization of any new complex technological system. However, policy makers and tax payers should evaluate whether the costs of unstable, early stage systems should be borne by the company that markets and profit from the system. High-tech companies often market their internet platforms as "permanently beta" and subject to adaptation, but costs and risks of system failure are currently borne by the City of San Diego.

---

[3] The City has stated that CityIQ audio recording is available but not been enabled.

Flawed Systems, Broken Assumptions, and Untrustworthy Data

To realize civic benefits, the system and the cameras must accurately report data, and the City has promised to make that data accessible to the public. The City states that it is an 'open platform, meaning it collects and makes data available to private software developers who can innovate new solutions for residents and businesses.

Of over 3000 smart streetlights, we found that only 12 report pedestrian data (see map of functioning streetlights in Appendix).[4] After validating this finding with other developers (see Appendix 4), we learned that more cameras used to be online. The City took them offline to validate that each sensor was functioning properly and has been slowly restoring them to function. That process was completed in October 2019. Six months later, the count of functioning pedestrian sensors is still <0.5% of the total cameras. This casts doubt on the value of the data generated for sustainability planning purposes over the last three years of streetlight operation. The pedestrian data is absolutely vital to the city's purported mission of creating smart infrastructure for improved quality of life, environmental sustainability, and economic growth.

Even ignoring that only 12 cameras are reporting pedestrian data, the other data modalities are also highly unreliable. Only 52 cameras are online and reporting bicycle data, and the parking and traffic data is reportedly inaccurate. Eric Busboom, a technologist and the director of the San Diego Regional Data Library who has been working with the CityIQ data since it became publicly available, stated that "the parking data is just wrong."[5] The CityIQ digital surveillance cameras detect objects – pedestrians, parking spaces, or cars, for example – by checking whether objects depicted in video (pedestrians and cars) cross lines – called "tripwires" – or move in and out of polygons (representing parking spaces, for example). Busboom reported

---

[4] We confirmed this at three time points: Feb 2020, April 2020, April 2019, and April 2018.

[5] Marx.

that many of these polygons and tripwires are placed incorrectly, generating incorrect counts. Investigation is required to determine whether this problem is one of faulty system implementation by GE Current, or incorrect use or maintenance by the city. The former is more likely. Details on how exactly these cameras have been verified, including the cost and who was responsible, as well as details around how the 12 cameras that are online were chosen, are not public.

In summary, after three years of expenditures, smart streetlights cannot accurately produce the promised sustainable planning data.

Organizational Limitations Stifle Civic Innovation and Sap Public Resources

Technologies create new possibilities and impose new demands on organizations – demands of maintenance, use, adaptation, and reorganization around technological processes. The CityIQ system has been conceived as a technology for civic innovation, yet there is little expertise or community support to enable effective interpretation and use. City officials have admitted, and journalists have reported, that the program implementation has been limited by lack of in-house city expertise in data science. However, citizens working to realize the civic potential of the streetlights largely work without technical support to address issues in data quality or system reliability.

For example, the city website that documents the public data resources, formally known as Application Program Interfaces, instruct developers that the system provides motorist, parking space, pedestrian, and bicycle counts. The website does not update developers on known errors and technical glitches. Nor is there support staff to call with questions about such glitches and errors. Our research team spent several weeks locating other developers who could independently verify that our data flaws were a problem with CityIQ rather than our usage of it.

Despite promises to empower civic innovation, there is currently no support for people to learn how to program on the system, interpret its results, or ask questions

to understand the implications – whether promising or dangerous – of this civic data for their lives and communities. Further, a truly public system, San Diegans without programming skills ought to also be able to direct the shape of applications and data analyses built from the CityIQ system. No substantive method of participation and influence currently exists. Public libraries would be an ideal site to locate coders-in-residence or community data scientists that could hold workshops and support community groups who want to create "smart and connected" tools that support community needs. Without funding community resources like libraries, open data will not serve most San Diegans. Worse, open data might endanger most San Diegans unprepared to exercise democratic oversight over their system.

GE Current had a duty of responsibility to highlight organizational preparedness as a part of the CityIQ deployment. The dependence of technology on supportive organizational structures is well understood in Organizational Science and Social Informatics, two fields that study these issues.[6] Software companies like IBM and Salesforce employ organizational consultants alongside engineers and sales people to guide clients through effective deployments. There is no evidence that such support was offered. This oversight is too common in efforts that focus on innovation and technology over maintenance work and organizational adaptation. Here, San Diego has been left with the growing pains and the bill.

---

[6] Ben Green's book *The Smart Enough City* (2019) synthesizes this scholarship from the perspective of a City of Boston data science and is an excellent and practical introduction to these issues. Just for example, MIT Business School Professor Wanda Orlikowski's "The duality of technology: Rethinking the concept of technology in organizations" (1992) and "Using technology and constituting structures: A practice lens for studying technology in organizations" (2000) are just two examples of such work. Books like *Acting with Technology: Activity Theory and Interaction* by scholars Victor Kaptelinin and Bonnie Nardi re-establish the interdependence and coevolution of technology and organizations in a different theoretical field.

Mounting Costs to Taxpayers as Data Problems Overwhelm

The Mayor's proposed budget calls for spending $1.3 million on this initiative in 2021[7], still framed as an investment in sustainability planning and economic development.

Watchdogs have reported that the platform is already significantly over budget. As revealed in a memo by Erik Caldwell's, Deputy Chief Operating Officer of the city's Smart and Sustainable Communities program, City staff initially projected that each camera would cost the city $360 per year. Yet the actual cost is $667 per node, roughly twice the original estimate.[8] In that memo, Caldwell also detailed that the city will have to pay nearly $1.1 million in "unplanned operational expenses," and that "When the new lighting is fully installed, energy savings from the lighting replacement is projected to be approximately $800,000 a year less than when the agreement was initially executed."

GE Current's system is not a one-time infrastructural investment, with maintenance to managed by the city. Beyond the initial contract, the city has ongoing obligations to pay GE Current to store and transmit its data and to access algorithms to make sense of the data. In short, the system now installed incurs an annual subscription expense to use the installation. GE Current controls the cost of this ongoing expense. Since city streetlight data is now locked in to CityIQ systems, GE Current has significant leverage in setting costs as there is no possibility of competing service providers.

The GE Current business model typifies a dominant Silicon Valley business model called "software-as-a-service" (SaaS). In SaaS business models, customers do not

---

[7] Proposed Budget, City of San Diego 2021.
https://www.sandiego.gov/sites/default/files/fiscal_year_2021_proposed_budget.pdf

[8] Dorian Hargrove, Paul Krueger and Tom Jones. 2020. 'Memo Reveals Huge Cost Overruns For San Diego's 'Smart Streetlights.' *NBC News.* https://www.nbcsandiego.com/news/local/memo-reveals-huge-cost-overruns-for-san-diegos-smart-streetlights/2264320/

own their software systems. They are instead subscribers to the company that manages and controls the software centrally on "the cloud." Whereas one would purchas Microsoft Word and run it in their own computers, Google Apps adopts a SaaS model that requires users to access software managed and updated on Google.com. Adobe Photoshop offers another example of software that moved from shrinkwrapped or downloadable software-for-purchase to what is now only available through ongoing subscription.

Software-as-a-service models can appear less costly when contracts are signed as they customers to rely on the software provider for all updates and improvements rather than hiring in-house staff. (As we learned above, in-house staff is in any case required to make systems useful.) However, as Motley Fool reports, they often result in higher long-term costs than purchase costs agreed to up front.[9] This is why investors prefer SaaS models' ongoing and expanded revenue. SaaS models also lock up customer data in servers controlled by the software provider, locking in customer data and presenting difficulties in securing and controlling sensitive data. NYPD learned this the hard way when they subscribed to Palantir's software-as-a-service to store their policing data. When NYPD decided to move to an IBM computing solution, Palantir refused to return NYPD's data in a readable and usable format. NYPD sued Palantir.[10]

Privacy, Data Ownership, and Inequality

The contract signed by City of San Diego grants GE Current ownership of all "processed data" – any analytics and algorithms derived from audio, video, and sensor data taken from San Diegans lives. Data ownership generates several kinds of inequality: between the City and GE Current, as well as between San Diegans who

[9] Dylan Lewis and Brian Feroldi. "Business Model." https://www.fool.com/investing/2018/07/10/heres-why-software-as-a-service-is-a-great-busines.aspx

[10] Wiliam Alden. 2019. 'There's A Fight Brewing Between The NYPD And Silicon Valley's Palantir '. https://www.buzzfeednews.com/article/williamalden/theres-a-fight-brewing-between-the-nypd-and-silicon-valley#.cfryqemg5

have technical skills and financial resources and those who do not. Most San Diegans become "raw material" for app developers working with little ethical oversight.

The GE Current contract sets up a power imbalance between GE Current, the city, and its citizens. First, the city lacks local agency to shape the technology. Coders who use the CityIQ system must go to GE Current with any problems they troubleshoot. They cannot go to the City of San Diego for help. As ScaleSD founder Daniel Obodovski told Voice of San Diego, San Diego does not control the functioning or improvement of this critical city infrastructure. This problem is not unique to CityIQ. Institutions often outsource IT services to private companies. However, in doing so they lose control over design, repair, and adaptation of systems to city needs or to local policies. Systems centralized in this way can be unresponsive to democratically generated policies and software requirements. Second, the CityIQ system is opaque. GE Current has no obligation to reveal the workings of algorithms it considers to be trade secrets or its private property, even in the face of known public harms.

Even if the City of San Diego owned its processed data, the system as implemented generates inequality between San Diegans who can code and those cannot. For a variety of reasons, Computer Science-related fields tend to exclude women, as well as African American, Latinx, and indigenous people. The reasons include cultural stereotypes, the devaluation of creative practices of communities of color, and the underfunding of educational support to enter engineering training. In short, the public CityIQ data – even if it worked properly – is not for everyone. Further, the entrepreneurial approach to making data publicly useful privileges those who have time and financial resources to invest in apps that may not generate a return. Lower income San Diegans can rarely afford such risks while working to earn high costs of living.

Most San Diegans instead become "raw material" for technology development based on the CityIQ system. This technology development will be shaped by monetization models that profit by profiling, targeting, and predicting human behavior – what scholar Shoshanna Zuboff has dubbed "surveillance capitalism." Alternately, the data contributes to the swelling of an economy of high-tech surveillance products sold to governments seeking fixes to problems of safety and economic development without disturbing existing power relations within cities.

Data generating systems, the contracts that govern them, and the organizational capacities set up to support them must be designed from the beginning to be accountable and responsive to public input and requirements, especially as civic understandings of technological need and vulnerability evolve. San Diego may have had a false start in working towards such a vision. As it stands, the only documented use of the system is for police access to video cameras. City officials have noted that they are unaware of a single public-facing app developed on the three-year-old platform.[11] The vision of a smart platform upon which citizens can shape the future of their city has instead ushered in a system that lends itself to surveillance from distance rather than engagement with communities, their contexts, and their questions and visions of public safety.

Appendices

1. Smart Streetlights Program – City of San Diego Resource
(https://www.sandiego.gov/sustainability/energy-and-water-efficiency/programs-projects/smart-city)

---

[11] Jesse Marx. 2020. 'Smart Streetlights Aren't Delivering the Data Boosters Promised,' https://www.voiceofsandiego.org/topics/government/smart-streetlights-arent-delivering-the-data-boosters-promised/

2. Camera IDs and coordinates of the 12 cameras reporting pedestrian events

| Coordinates	Asset UIDs
(32.71163629, -117.154756)	'a301292f-753d-4d75-9337-8d3849d2ca13'
(32.7097405, -117.1627473)	'e5479ddf-148a-41c9-8960-4343f73c7b62'
(32.72576703, -117.1702165)	'5b037bac-9256-4e67-a85b-f042f08df1c0'
(32.71163942, -117.1591283)	'fdc8e275-4e12-4d72-b41b-930f9e008e56'
(32.73150539, -117.1592884)	'41b97c8f-92c7-4706-932e-58289d4b6354'
(32.7115838, -117.1630017)	'7a0e9ae9-8049-4401-8ead-00ed2f075135'
(32.70931728, -117.1554569)	'cd389d59-eb9d-4994-8f04-e373d2e0c7e1'
(32.71632946, -117.1600229)	'32fc65f5-8205-4300-9324-a2e6030eae3b'
(32.711879, -117.164817)	'03affc64-5fdc-426c-98bb-8571da568449'
(32.70948847, -117.1550563)	'bd087aab-d9b7-4cd7-92e6-cd50bb525f16'
(32.70130945, -117.0693071)	'99b3cf15-cf73-459e-8811-904224c3dfd5'
(32.93620922, -117.2572871)	'f958e0ba-0549-47dd-b649-bbb82dfbf07d'

3. Map of the 12 cameras reporting pedestrian events
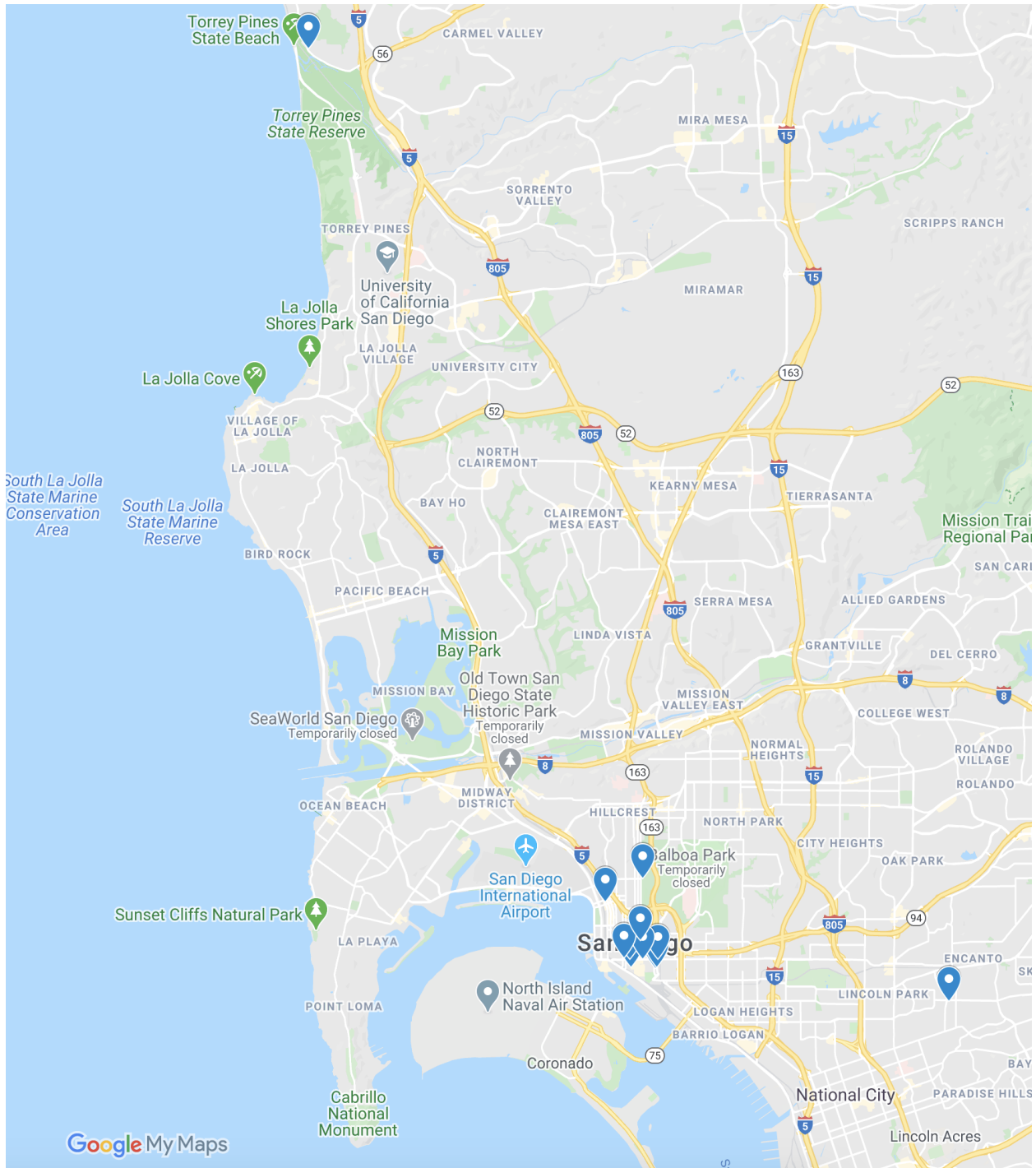
4. Graph of # of cameras reporting pedestrian data by time

Note that a significant number of cameras were taken offline because they needed to be validated and that they have not been brought back online.

Also note the log scale on the y axis *(10^3 = 1000, 10^2 = 100, 10^1 = 10).*

Taken from Eric Busbloom's "View from Streetlamps: San Diegans are Staying Home" article (https://www.sandiegodata.org/2020/04/view-from-streetlamps-san-diegans-are-staying-home/)

Number of Pedestrian Walkways Reporting Per Day
Log Scale
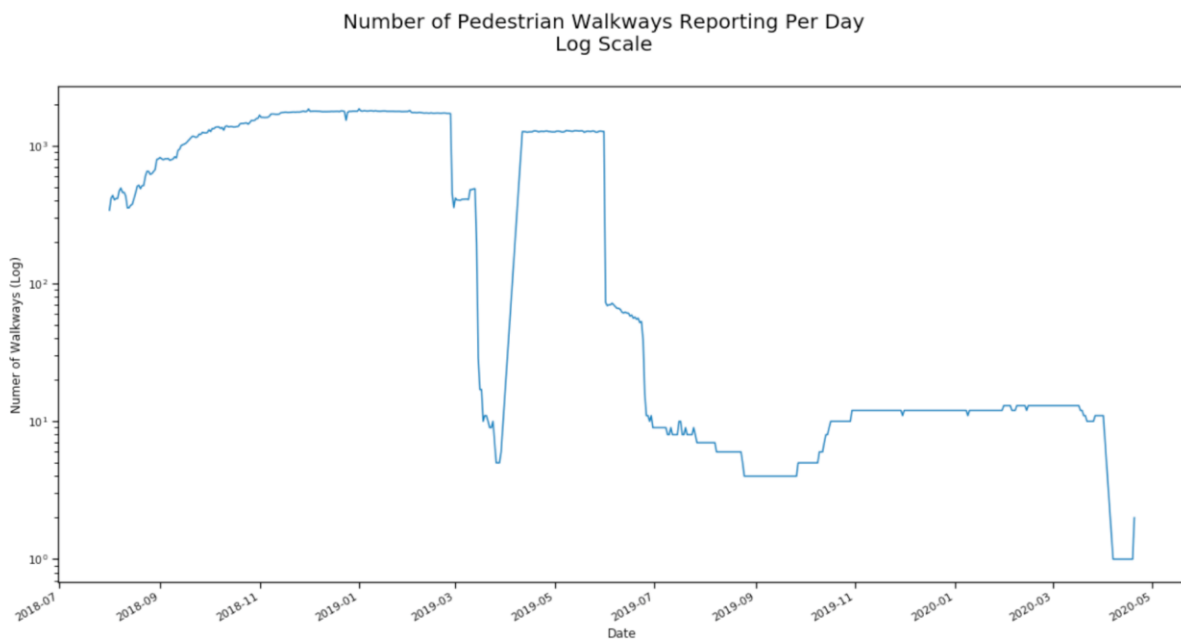
5. 'Smart Streetlights Aren't Delivering the Data Boosters Promised,' by Jesse Marx (https://www.voiceofsandiego.org/topics/government/smart-streetlights-arent-delivering-the-data-boosters-promised/)

6. 'Memo Reveals Huge Cost Overruns For San Diego's 'Smart Streetlights,' by Dorian Hargrove, Paul Krueger and Tom Jones

(https://www.nbcsandiego.com/news/local/memo-reveals-huge-cost-overruns-for-san-diegos-smart-streetlights/2264320/)