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

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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]

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[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 support are lacking to help realize these innovations.

- 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 has borne the risks of a largely untested and highly complex public infrastructure. It is also paying the financial price as GE Current learns how to improve the 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.

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[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 public and available (despite GE Current owning the data that's been analyzed for passing cars, pedestrians and bicycles). 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 to residents and businesses challenges, not the City, which is more efficient and a better use of taxpayer dollars'.[4]

Of over 3000 smart streetlights, we found that only 12 report pedestrian data (see map of functioning streetlights in Appendix).[5] After validating this finding with other developers (see Appendix 4) working on the data (and as reported by Voice of San Diego), we learned that there used to be more cameras online, and that the City took them offline to validate that each sensor was functioning properly. 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 cities 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 also highly unreliable. 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."[6] The CityIQ digital surveillance cameras detect objects –

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[4] Ibid.

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

[6] Marx.

pedestrians, parking spaces, or cars, for example – by checking whether objects (pedestrians and cars) cross lines - "tripwires" - or move in and out of polygons (representing parking spaces, as an example). Busboom reported that many of these polygons and "tripwires" are placed incorrectly, generating incorrect counts. This problem is most likely one of faulty system implementation by GE Current, rather than incorrect use or maintenance by the city.

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 (in some cases) 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.

To be 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. However, there is 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.

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.[7] Software-as-service businesses like IBM 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.

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 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

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[7] Ben Green's book *The Smart Enough City* (2019) synthesizes this scholarship from the perspective of a City of Boston data scientist 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.

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 the development of apps that may not generate a return. Lower income San Diegans can rarely afford such risks while working to earn high costs of living. It would take significant public investment in technology education as well as research and development funding for lower income San Diegans if we wish to see civic innovation that addresses everybody's civic priorities.

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.[8] 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.

Mounting Fiscal Costs Despite Data Problems

The City is proposing to keep spending $1.3 million per year on this initiative in 2021[9], still framed as an investment in sustainability planning and economic development engine, despite the fact that it has taken three years to confirm and rollout 12 cameras that can (purportedly) accurately count pedestrians, and parking data that is unable to reveal unoccupied parking spots. 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.

Watchdogs have reported that the platform is already significantly over budget. As revealed by Erik Caldwell's (Deputy Chief Operating Officer of the city's Smart and Sustainable Communities program) memo, reported by NBC, City staff initially projected that each camera would cost the city $360/year - the actual cost is $667 per

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[8] 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/

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

node, roughly twice the original estimate.[10] 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."

Appendices

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

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'

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[10] 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/

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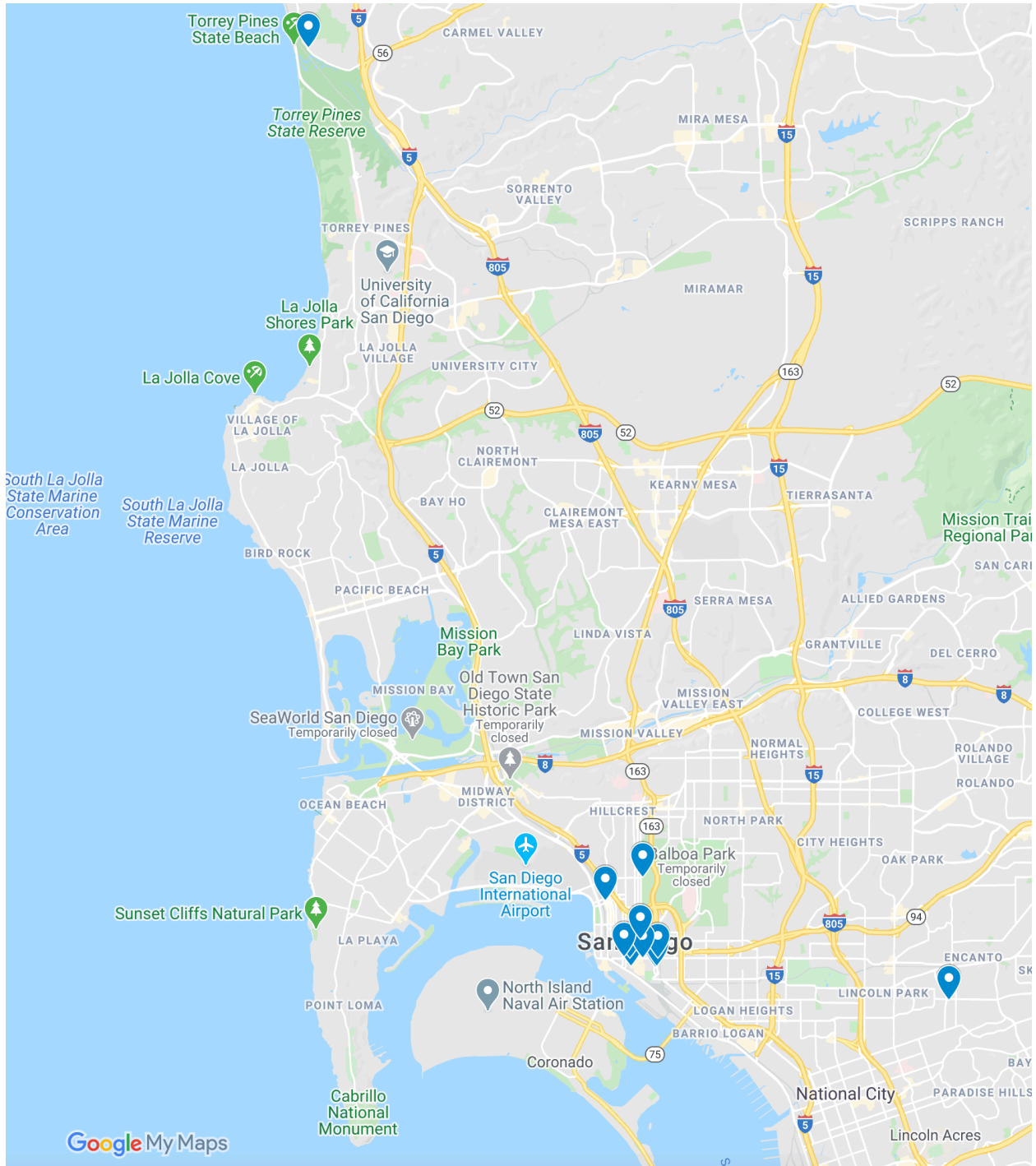
4. Graph of # of cameras reporting pedestrian data by time

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 *(10³ = 1000, 10² = 100, 10¹ = 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
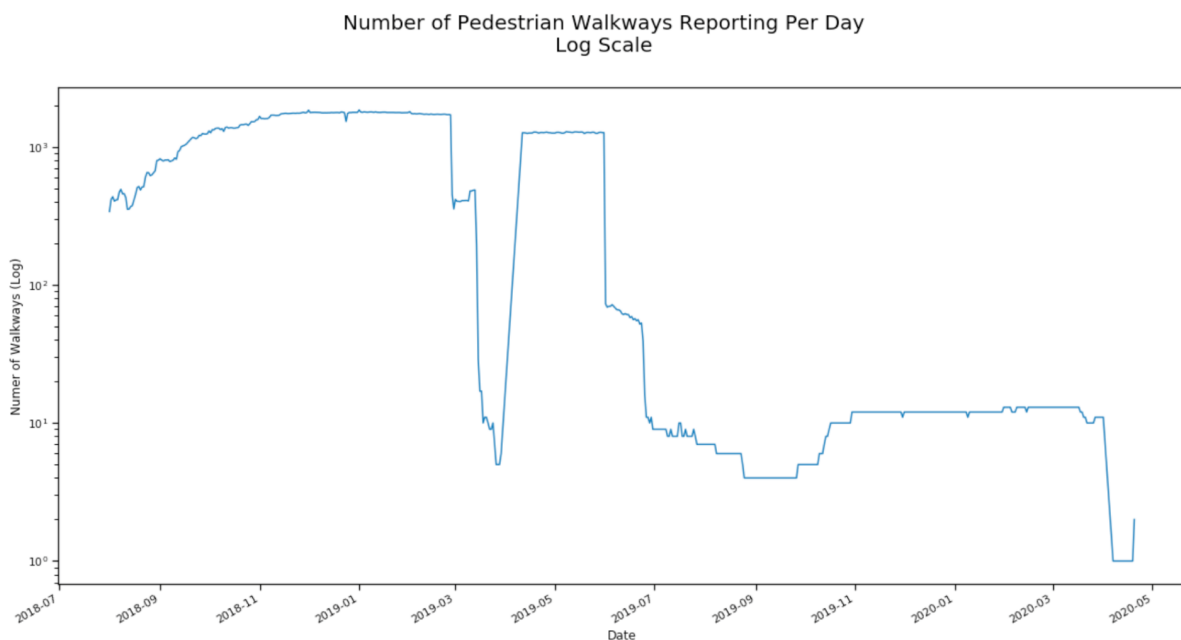
5. 'Smart Streetlights Aren't Delivering the Data Boosters Promised,' by Jesse Marx (https://www.voiceofsandiego.org/topics/government/smart-streetlights-arent-delivering-the-data-boosters-promised/)

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/)