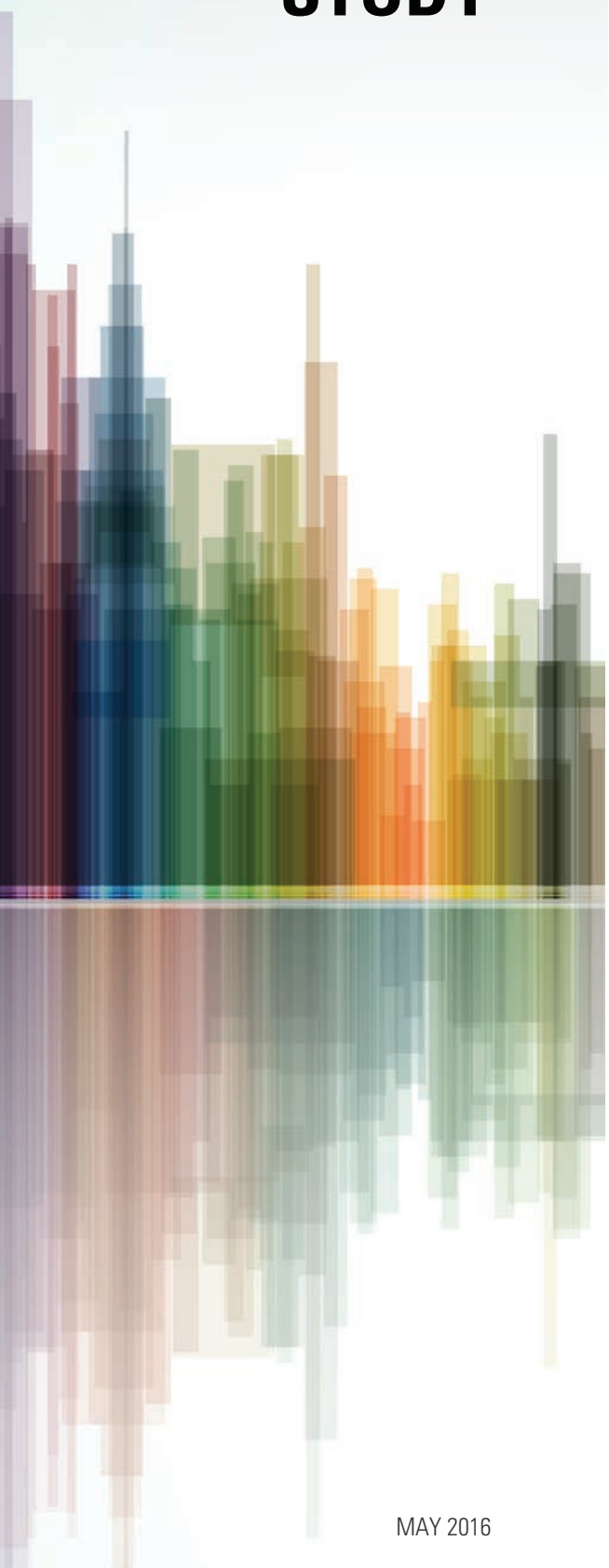
MIT Sloan Management Review

CASE STUDY



DATA & ANALYTICS CASE STUDY SERIES

Data-Driven City Management

A Close Look at Amsterdam's Smart City Initiative

By Michael Fitzgerald

MAY 2016

REPRINT NUMBER 57470

AUTHOR

MICHAEL FITZGERALD is a contributing editor to *MIT Sloan Management Review.*

This case study is part of a series of *MIT SMR*-produced stories exploring the analytically-driven organization. This story is based, in part, on interviews with public- and private-sector executives. Both the featured company and the case study sponsor reviewed this case study prior to publication.

To cite this case study, please use:
M. Fitzgerald, "Data-Driven City Management," *MIT Sloan Management Review*, May 2016.

CONTENTS

CASE STUDY
MAY 2016

3 / Introduction

4 / The Smart City In History

- Sidebar: Smart City Definition

5 / Amsterdam's Smart City Initiative

5 / Spotlight: Selection of Key Smart City Participants

- City Managers Spotlight
- Project Spotlight: Waste (Not Wasteful) Analytics
- Partner Spotlight: A Cofounder's Story
- Institute Spotlight: Early Efforts at AMS
- Sidebar: Smart Flood Protection

10 / The Smart(er) City

11 / Commentary: Tensions Between CONTROL and KAOS in Using Data to Get Smart

Data-Driven City Management

Introduction

Despite the raw, rainy November afternoon in 2015, Ger Baron, Amsterdam's chief technology officer, was radiating good feeling. Earlier in the day, city officials had finalized an agreement to share their traffic data with a major technology company. In exchange, the company would provide algorithms that Baron's team could use to alleviate congestion on Amsterdam's crowded streets.

Baron hoped this arrangement would trigger a cascade of civic-boosting partnerships between the city and outside companies, aimed at making Amsterdam a truly smart city. Data and analytics were crucial features of Amsterdam's eight-year-old Smart City initiative, a public-private partnership that had produced more than 80 pilot projects across the city touching many areas of urban life.

Baron himself had led the Smart City initiative prior to his position as the city's CTO. One activity his team had helped organize was an effort called Apps for Amsterdam, which challenged app developers to take publicly available data and build apps to improve the lives of residents and visitors. The initial projects weren't quite what Amsterdam had envisioned, however. The first app developed had been a public toilet finder, which drew chuckles. Another early app had pointed out the best places to burgle houses, by triangulating data about public street lighting, the most expensive houses, and distances from police stations.

The burglar app was a sign that the city needed to refine its approach to using its troves of data to address city management issues. Partnering with companies to find data that met shared interests seemed like a fruitful path, especially for addressing traffic congestion on Amsterdam's Reformation-era core city

streets. Many of these are barely wider than a truck and are shared by bicycles, cars, pedestrians, trains, and buses. Amsterdam is a world leader in encouraging alternatives to car travel and in its electric vehicle infrastructure. The city also draws tens of millions of tourists a year to its vibrant fairs and floating flower markets, red-light district, cannabis coffee shops, and world-famous museums. Improving traffic and parking would support commerce, safety, and tourism.

Baron says using private-sector data is key to changing policy. "This is where the real disruption for us is going to come from," he says, citing two more examples. A municipal campaign to encourage children to eat more vegetables tapped grocery store data to determine whether people were in fact buying more vegetables. Instead of trying to evaluate the program's impact after a couple of years, the city can now make speedier assessments of, and adjustments to, its outreach efforts. The city is also using GPS data from an Amsterdam-based navigation software and technology provider to help manage traffic flow in real time. This is a big improvement over Amsterdam's existing traffic management models, which were built on data from 2011. That data is no longer particularly useful, since the city has 25% fewer cars and 100% more scooters than it did in 2011.

As he reflected on the implications of these data partnerships from his third-floor office in Amsterdam's wharf-like city hall, Baron acknowledged that Amsterdam was not yet a "smart city." It faced complex questions without clear answers. Which of the 80 pilots should get the full backing of the city, and perhaps even a bit of budget? Could the city government actually do any of its potential projects itself, or was it going to be mostly reliant on others?

The Smart City in History

Amsterdam's quest to be a smart city seems like a 21st-century phenomenon, but cities have been using computerized data analysis to try to offer better city services since the 1960s. One early experiment took place in Los Angeles, which established a Community Analysis Bureau in the 1960s, aiming to take advantage of its "three solid-state computers and four electromechanical data-processing installations."[1] Ultimately, the Community Analysis Bureau failed to have much influence on city policy, thanks to an inability to connect with planners, policy makers, or advocates.

The modern smart city movement was jumpstarted by former U.S. President Bill Clinton, whose foundation challenged Cisco Systems Inc. in 2005 to put technology to civic use, prompting Cisco to set aside $25 million for smart city investment.[2] But it was the Great Recession that galvanized the smart city movement. Anthony Townsend, technology expert and author of a book on smart cities,[3] says large technology companies were desperate to replace corporate revenues just as governments were using stimulus plans to ratchet up spending. The stimulus efforts didn't last long enough to create a smart city boom, but they did produce some pioneering case studies on Rio de Janeiro, Barcelona, and a few other cities, including Amsterdam. Those efforts captured the imagination of government planners and policy makers.[4]

Imaginations were especially active in Europe, where policy makers at the European Union grabbed onto the smart city ideal as a way to help older European cities cope with rising carbon dioxide levels. The EU encouraged and even funded city efforts to develop digital master plans. Cities like Barcelona, Copenhagen, and Dublin began to create institutional

"SMART CITY" DEFINITION

There is no widely accepted definition of smart city. Wikipedia's definition is under development; its landing page for "smart city" is emblazoned with the caveat, "This article may be unclear or confusing to readers."[i] Broadly, the basic idea behind a smart city initiative is to improve the integration of information technology with city services.[ii]

expertise around using digital technologies to promote better city services. Amsterdam's smart city initiative helped secure funding from the European Union's 7th Framework Programme for Research and Technological Development, part of an ongoing series of investments in technology research and development across Europe.

Amsterdam's Smart City Initiative

Amsterdam's smart city effort comprises a sprawling, complex group of activities, projects, partnerships, and entities. The technology-oriented transformation of urban management by city officials like Ger Baron is one among many efforts. Another is the public-private platform that is formally named the Amsterdam Smart City (ASC) initiative, which encompasses projects across eight categories: smart mobility, smart living, smart society, smart areas, smart economy, big and open data, infrastructure, and living labs. Quasi-governmental entities, such as AEB Amsterdam, the waste company serving the city, and Alliander NV, the Dutch energy utility,[5] are another source of smart city–related activities, with some but not all linked to the ASC platform. Numerous commercial interests, academic, nongovernmental, and intergovernmental organizations, plus the citizens of Amsterdam, also have an active role in the development and deployment of smart city activities. These groups have different histories with, and connections to, the ASC platform.

In 2009, the ASC was formed and funded by Alliander, Amsterdam Innovation Motor (effectively the ASC's predecessor), and the city government. The ASC's initial projects focused on ways to "green" the city's infrastructure, transportation systems, working patterns, and buildings. Its initial set of 16 projects reduced energy usage by 13%.[6] The ASC operates as a function of the Amsterdam Economic Board, a trade group that acts as a booster for the city.

In April 2013, the City of Amsterdam held a design contest to create an international technology institute. The winning entry, from a collaboration of Delft University of Technology, Wageningen University, and MIT, proposed a research institute to help develop urban solutions (in areas such as water, energy, waste, and data management) through collaborations involving academic and research institutions, enterprise, municipalities, and local residents. With a $50 million initial investment and a 10-year runway to get established, the Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute) is a key player in Amsterdam's smart city efforts: running pilots, coordinating public and private groups, and educating students.

Spotlight: Selection of Key Smart City Participants

While no single organization or person coordinates all of the distinct efforts to improve the integration of information technology with Amsterdam's city services, the city is well-placed to determine which of the many ASC pilots should be expanded. The following sections spotlight key city managers, a smart city project, a founding member of the ASC platform, and the AMS Institute.

City Managers Spotlight

Baron became Amsterdam's chief technology officer in March 2014, almost despite himself. While working on the project that ultimately led to the foundation of the AMS Institute, he had advised the city to create a chief technology officer post. He recognized that the city needed someone with a vision for technology and cities, someone who was looking at how outside organizations were using technology, and told the city it needed to avoid being a bunny on the highway while big technology trucks were bearing down on it. That kind of city will try to regulate change away and forbid innovation from happening. He also recommended five other people he thought would be good CTOs.

Instead, Amsterdam offered him the job. He did have the credentials, having spent six years running the

Amsterdam Smart City Initiative and its predecessor organization. After so many years working on the smart city, Baron had intended to return to the private sector. But when Amsterdam offered him the CTO job, he signed on.

One thing Baron knew perhaps better than anyone were the headaches cities face when trying to be smarter. Extensive publicity for the Internet of Things and big data made it sound like breakthroughs would follow quickly: People would cut their commute in *half*, always find a parking spot, and save energy doing it. The reality was that cities weren't ready. Companies that come to Amsterdam, for instance, expect "data that's structured, that's suitable, and everybody actually thinks we have that. We don't even know how many bridges we have," says Baron, a large man with unruly hair, wearing on this day an "I Amsterdam" polo shirt. In the case of the bridges, that's because the city's individual districts used to maintain the bridges within them, and their data has not been centralized. "We have a lot of stuff. It's not structured at all," he says.

Once Baron took over as Amsterdam's first chief technology officer, he launched a data inventory. The task, he says, is "a boring, boring job. But very useful!" The city has 32 different departments, mostly heads-down on their own areas: Housing deals with housing, economic development with economic development, social services with social services. The inventory showed that Amsterdam had 12,000 different datasets and listed whether each dataset had an application program interface, a measure of its accessibility. Baron says that analytics don't have to be focused on big data to help cities be smarter. The analytics can use small data, as long as it points toward better ways to help citizens.

He also knew that the various companies involved in creating smart cities didn't really understand cities. "Every company that comes here and tells us how it works. They're wrong, because they don't have a clue how a city works," he says. "There's a big difference between how people think it works and how it works." Right now, delicate conversations were happening around things like smarter lighting. Multiple companies wanted to attach transmitters and sensors to the old city's distinctive street lamps. Amsterdam's government was pushing back to make sure corporate interests didn't overwhelm civic ones.

TROUBLE COMES TO LIGHT

Officials in many cities think they can use sensors and analytics to develop smart lighting, dimming streetlights when there are no people around, replacing lights in a timely fashion, and saving both energy and money. But it turns out that this is a challenging task. Modern LED lights can be programmed at the factory to dim at certain hours, based on traffic patterns. But what if those patterns change? In Amsterdam, city workers would have to change the streetlights, light by light, potentially all 150,000 of them. Using people to change that many lights is not practical, says Arnan Oberski, a manager in the city's lighting department; and that's even before factoring the upfront costs of putting in smart LEDs and the devices needed to wirelessly connect with them.

Meanwhile, the city faces challenges even when focusing on a discrete area, like the central city. Amsterdam's grid dates back to an era when the city had its own electric department and its own telephone utility. The former telephone grid is still used to switch the streetlights on and off. Because it's analog, it would require major investment to use it for IP connections. It also was privatized in the 1990s, meaning Amsterdam must negotiate any changes with the company that runs it.

And that's just the complication for lighting. The same issue applies for putting sensors, which also need IP connections, on lampposts to monitor environmental factors or traffic flow. Meanwhile, wireless phone companies would like to use the lampposts as part of their networks. But multiple boxes on the historic lampposts would spoil their charm. The city asked wireless companies to form a consortium so they could share a single box, but the companies could not agree. Oberski then suggested using a waterproof box that could go under the base of a lamppost and attaching an antenna at the top of the post. One is being prototyped. Another suggestion involves putting boxes underground in telecommunication access points.

MR. INSIDE

If Baron is Mr. Outside for Amsterdam, meeting with companies and universities and looking for things Amsterdam can bring in to make it run better, Mr. Inside is Berent Daan. Daan was hired in February 2015 to become director of what had been Amsterdam's department of research and statistics. It was rechristened under him to be the department of research, information and statistics. Daan has a unique background for a department head; he'd worked in the technology industry, then spent eight years as a *wethouder*, an elected alderman, in an Amsterdam suburb. Baron, who sat on the interview committee that hired Daan, says he brought a unique blend of data savvy and political savvy.

In an effort to speed responsiveness, Daan implemented agile development processes for his teams, now organized into what he calls investigation teams. They go to individual departments in the city government, offering their help in seeing if data might help solve problems. The department has about 50 researchers, statisticians, and support staff, and also employs between 20 and 30 project workers part-time. Their projects include one called Top600,[7] which uses algorithms to determine the 600 residents with the worst criminal records. The city uses this data to figure out which of these people have younger brothers or sisters, in hopes that it can apply extra social services to help keep them from following their elder siblings into lives of crime.

Daan's department also researched levels of depression across the city, using information gathered from insurance companies. It connected that data with the cost of treatment and found that some areas with high levels of people with depression were not receiving proportionate levels of care. In part, these people were resisting being treated or acknowledging their disease. The city was able to dedicate more resources to education, and overall boosted the numbers of people receiving medical care. He calls it "a very clear way of how you can, just by investigating the data, find out things that otherwise would not be uncovered."

One of Daan's first moves was to help launch a data lab. The data lab was deliberately set at street level in a government building, to make it easy to find for anyone who needs access to data or help using it. There hasn't been much of crowd there yet; the data lab is just a few months old, and hasn't been actively promoted by the city. Even so, Daan's department has used data to help sort out permitting for Amsterdam's many street markets. The market bureau, which regulates the markets, was having trouble with issues like merchants creating counterfeit passes for market stalls. Daan's department created an app to register merchants and handle payment for their stalls. This resulted in a database that provided insights into the use of street markets, such as which stalls are being used on market days, by whom, and where space goes unused. Vendors now can be directed toward markets that are more likely to have room.

Project Spotlight: Waste (Not Wasteful) Analytics

Amsterdam, like many cities in Europe, wants to sharply reduce fossil fuel usage while also improving livability in its cities and providing new jobs. One effort that encapsulates all three is taking place at AEB Amsterdam, which runs the largest waste-to-energy facility in the world, powering 75% of all households in the city.[8] The plant makes energy by taking garbage into its sprawling plant and burning it. But it wants to increase sustainability, so it is looking for ways to get people to separate out their recyclables and biomass. As AEB doesn't pick up trash itself, this year it ran a pilot to see if it could get citizens to voluntarily separate their trash.

To avoid having trash trucks making multiple trips to pick up recyclables, AEB's pilot featured different colored bags for four streams: biowaste, plastic packaging, glass, and paper. All the bags get picked up at the same time, and AEB sorts them by color at its facility. The pilot comprised 270 households, or about two city blocks.

The pilot area chosen presented some specific challenges because it is populated mostly by recent immigrants who are still learning Dutch. One of the challenges of analyzing the project's success was that AEB had trouble getting people to respond to

surveys, says Evert Lichtenbelt, strategic advisor & energy at AEB. He says the utility went so far as to send researchers door to door, but people didn't answer their doors. Of those who did respond, 80% said they had participated, but Lichtenbelt says that number does not reflect the actual separation rates AEB saw. "Even the people that did fill out the questionnaire were not completely honest," he says. But what AEB has been able to tell is that people who did participate separated out almost 100% of their waste. Lichtenbelt says this is immensely valuable, because biowaste that has been kept separate from metals and other plastics can be used at a higher value for energy or compost. The pilot finished in February. A recommendation on how to proceed will be submitted to higher officials at AEB.

Lichtenbelt says he expects that AEB will expand the pilot, as it does not cost much, though what people might be asked to separate out is still under discussion. One issue that is still being resolved is how to avoid the sense of being spied upon through one's trash. AEB could offer individualized tracking to citizens, who would in exchange have their waste-related taxes reduced. Citizens could also use their data to separate out items more efficiently. But AEB can't incinerate its data and doesn't want to keep data on hand that could be used to identify individuals. It is looking to a third-party group, possibly at AMS, to hold such data and keep it private.

AEB is also building a plant on its vast grounds in northeastern Amsterdam to separate items out of residual waste, so it can work to get to the point where 75% of Amsterdam's reusables are separate from its waste stream by 2020. Studies have shown that it will get the best results if it encourages separating waste in households as well as doing so at its plant.

Partner Spotlight: A Cofounder's Story

Alliander, an ASC cofounder, worked with Amsterdam back in 2007 to create an open dataset showing energy usage for 400,000 buildings. Alliander got involved in part because it anticipated that over time more of the city's energy would be coming from alternative sources, such as solar and wind, and it would need to begin moving away from centralized distribution. That would likely mean interacting more with customers, something the company rarely did. "We really did have programs in place preventing contact with the customer, because it makes it more expensive," says Pallas Agterberg, Alliander's director of strategy. For Alliander, the open data project represented a fundamental shift in the way it interacted with customers.

Agterberg says all utilities run on the same basic model set up by Thomas Edison more than 100 years ago, with centralized energy production. But alternative, sustainable energy sources demand decentralized distribution. Agterberg says utilities are simply not set up to for this, much like mainframe computers were not set up to handle widely distributed networks of users.

Alliander's dataset started very small; shop owners on the Utrechtsestraat, a upscale shopping street not far from the city center, approached the utility, asking how they could be more sustainable. They billed themselves as "Climate Street." Agterberg thought Climate Street presented a great opportunity to implement smart meters and use sophisticated metrics and analytics to help shop owners monitor things like whether their freezers worked harder when the sun was out, or a list of the top 10 sources of carbon dioxide within their businesses. "We thought they wanted fancy technology," Agterberg says. Instead, what shop owners wanted was an analysis once a year on how they could use less energy.

"The people in the streets, they are not acquainted with [new technology] at all. They don't know anything about it," she says. "We were thinking way too complex for people to understand."

The distinction led to a less top-down, engineering-driven approach to working with different groups, including the creation of an Energy Atlas that showed people how much power their buildings used (the Atlas information is anonymized, making it practically impossible to identify how much power any individual is consuming). Many subsequent ASC initiative pilots have taken place in Amsterdam's

three "urban laboratories," sections of the city that are undergoing massive development projects, like the Southeast district, where a new athletic stadium and several large mixed-use buildings are being developed, all with the goal of being more sustainably run.

Ultimately, Agterberg says, she expects that every house and building could turn into energy generators and will need to be looked at as if they were nodes on a network. The most efficient homes with the most consistent exposure to sunlight will probably no longer need to be on the grid, and that could represent as much as 20% of Amsterdam's housing stock. That number is big enough that it would demand a radically different way of being funded than the current model of centralized energy. (Amsterdam uses conventional power as well as power from AEB's waste-to-energy plant.)

Alliander needs to get ready for this shift to distributed energy, says Agterberg, because while the market isn't ready yet, the technology is available to make it happen — and its adoption is inevitable.

Institute Spotlight: Early Efforts at AMS

That's the kind of halting progress smart cities face. Cities often don't control infrastructure, or find that different departments won't work together. Even for success stories like the new AMS Institute, with its $50 million commitment from multiple parties, issues can arise. AMS was doing research on crowd patterns during August 2015's SAIL Amsterdam festival, a massive tourist attraction that brings more than a million visitors to Amsterdam to see traditional wooden sailing ships. Part of being a smarter city is better crowd control, and the AMS researchers were studying the movement of crowds to better inform how they could deal with congestion and to prove they could do it without violating individual privacy. The researchers used data from cameras, Wi-Fi hotspots, GPS tracking, and social media posts.

They were able to monitor the crowds without invading privacy, but there were odd moments. Baron says he was watching at one point and the data were showing that something was delaying people at one spot on the map. The researchers started debating what could be the cause of it, when a police officer told them there was a trash can there and people were stopping to throw trash in it. The researchers said that couldn't be because it wasn't on the map. To Baron's amazement, no researcher walked over to check. Instead, they started to develop theories. "And I thought, 'This is happening?'" Real data, he says, is messy. Trash cans don't necessarily show up on maps.

Still, the AMS promises to be an important part of the city's ongoing move toward getting smarter, though it won't be starting its first master's degree program until 2017. It has a dozen projects underway to see what kind of data exists for various city functions. One of them is Rain Sense, a project that looks at where rain actually falls in Amsterdam as part of a project to help reduce the impact of flooding on traffic flow. Another is Beautiful Noise, which takes social media posts from sites like Flickr and Twitter and uses them to identify patterns that could improve the experience of tourists,

SMART FLOOD PROTECTION

Amsterdam's use of data to advance its public sector agenda is not a novelty for a country accustomed to using technology to survive an ever-present threat of flooding. The Netherlands relies on a complex system of dikes, levees, and barriers to protect the 55% of its population living in flood risk zones.[iii] Increasingly, information technologies are being used to manage this complex system, which generates at least 2 petabytes of sensor data a year.[iv] In 2008, for example, the Dutch Delta commission, a government entity designated to protect the country from flooding, mandated a 10-fold improvement in the protection standards across its dike system. A data-driven analysis conducted by a consortium of organizations (universities, government agencies, institutes, and consultants), showed that the new standards could be met by strengthening just three regions. This proposal, adopted in 2012, saved the country an estimated 8 billion euros relative to the costs of strengthening all of the dikes.[v]

for instance, by analyzing discussions about things like lines at museums, or to enhance livability for residents, for instance, by identifying delays in public transit.

The Smart(er) City

Amsterdam has been through several iterations of the smart city, from the concept phase to where it is currently: a city with "living labs," redeveloping areas where it is easy to try new kinds of infrastructure experiments. The smart city concept has endured skepticism and questions about whether it would get anywhere close to the hype around it. For Amsterdam, hiring Baron as CTO has helped to energize the city around analytics. The Smart City initiative also survived a city council election that saw several of its proponents replaced. The city is moving forward, out of phase two, the living labs phase, and toward broader adoption of some initiatives.

Baron, as CTO, will help guide some projects beyond the pilot stage. While he wants to see them all succeed, some of the most promising include lighting. In addition to the city's own work, a deal between it and several companies for smart street light posts was announced in February 2016.[9] That project is in a living lab near the Amsterdam ArenA stadium (a more modern section of the city), but it combines adaptive lighting (which dims or brightens based on need), public Wi-Fi, and air quality measures. The companies said they expect to expand throughout this area, and then more broadly throughout Amsterdam.

Transit is also a promising area. Much of Amsterdam's parking meter stock has been replaced by pay-by-phone apps. And the potential for shared transit data also looks primed to scale in size and scope.

It is, Baron cautions, early days, even though Amsterdam's smart city initiative is more than seven years old. "I can give you the nice stories that we're doing great stuff with data and information, but I think we're very much at a starting point of the transformation," he says. "We are in a transformation, though. A lot of cities are not in transformation yet. They've not even started to think about this transformation, in which the first step of transformation is defining that you want to transform."

Baron's and the rest of the city's work is gaining recognition outside the city limits. In April 2016, the city won Europe's Capital of Innovation award by the European Commission.

TENSIONS BETWEEN CONTROL AND KAOS IN USING DATA TO GET SMART

Commentary by Sam Ransbotham

Certainly it is appealing to "get smart." Organizations everywhere see the potential of data and analytics to help this process. Data, however, is entropic — it is tough to bring the KAOS under CONTROL.

Data is particularly difficult to control for cities, which have a unique set of problems as they try to embrace data and analytics to improve municipal services. Cities have citizens, not customers. They don't have typical sales measures; instead, they are cost-focused. They operate in a political context that may restrict options or reward short-term focus. They must contend with regulatory restrictions, entrenched bureaucracies, diverse constituencies, and more. It is tough to get smart with all that working against you.

Against all these challenges, the City of Amsterdam case study illustrates a number of tensions that cities — and organizations in general — may face as they attempt to gain benefits from increased availability of data.

Amsterdam, in aggregate, wants efficient sustainable operations, a vibrant tourism industry, and a high quality of life for its citizens. However, individual and societal desires are rarely the same, and organizations can lose control of how data is used.

- User incentives may not be well aligned. The burglar app provided an extreme example early on; while a burglar certainly would benefit from data-driven decision making, those benefits would come at the expense of other specific individuals and the city's overall reputation. This example shows how data can be used for purposes that can both help and hurt a city and how the users of that data have different incentives than the city itself does. While crowdsourcing has benefits, it also has risks. When data is open, undesirable uses will occur; organizations must prepare to manage them. Amsterdam now focuses more on partnerships for data (e.g., vegetable purchase data) and analysis (e.g., traffic algorithms) rather than on completely open access. As a result, the city may avoid negative uses, but it also risks missing some novel beneficial applications.

- Even when there isn't a strictly "bad" actor, social benefits that accrue to everyone may cost some individuals more. Use of crime data to intervene early with potential criminals identified by family relationships could provide societal benefits. But the cost may be a loss of individual privacy for a protected population (children) who, by definition, haven't yet done wrong. In another example, AEB's recycling pilot program could certainly benefit from more data about trash habits but risks coming across as invasive, with city workers cataloging individuals' trash. In this case, the proposed waste-tax reduction could help redistribute benefits to better align costs and benefits.

- Established standards can help reduce cost and improve efficiency. But standards wars are common in technology, and organizational incentives are often poorly aligned with societal desires. A common box shared by multiple wireless companies would reduce cost, avoid a natural monopoly, and reduce visual clutter on lampposts in historic areas. But it is difficult to get companies to agree on standards; GE ran into similar issues trying to coordinate data with multiple organizations.[vi] The benefits to tourism, for example, are less relevant to vendors of wireless lighting components.

Amsterdam is determined to operate smarter. The transition requires hard work with analytical approaches in general.[vii] If anything, the unique challenges that cities face make it harder rather than easier.

- Successful analytics projects depend on solid infrastructures.[viii] The "fundamental first step" for Amsterdam was to inventory 12,000 datasets across 32 departments (each with its own idiosyncrasies and incentives). This can't have been fun, and it has little short-term payoff. It would be easy to get dismayed while mired in the task. But smartness depends on both accomplishing this fundamental first step and building a process to keep up with the relentlessly growing data supply.

- Amsterdam has already shown smarts by starting small with pilot projects, learning from them, and building iteratively. Small pilots differ from full scale, both positively and negatively. On the one hand, scale can create challenges to the data infrastructure and to the ability to use data for insight — reprogramming a few LED lights can be done by visiting each individually, but adjusting 150,000 requires a different approach. But scale can also yield economies of scale — the overhead associated with the first smart parking meter app is vastly larger than the hundredth or thousandth.

- Each step forward is not the last step. When Amsterdam decided to emphasize vegetable consumption, it evaluated the effect of interventions by measuring vegetable sales within a month. Previously, measures were only available after years. Certainly, quicker information is better. But increasing vegetable sales was not the actual goal — vegetable sales likely proxied a health-related goal. Future steps will be required to refine the outcome measure further and align it better with the underlying objective.

Cities will have problems getting smart, but lack of data probably won't be one of them. Instead, this case study illustrates the tensions cities face as they work to get smart. The good news is that there is considerable potential to improve municipal operations. These operational improvements can be precursors to future novel applications.

Sam Ransbotham *is an associate professor of information systems at the Carroll School of Management at Boston College and the* MIT Sloan Management Review *guest editor for the Data and Analytics Big Idea Initiative. He can be reached at sam.ransbotham@bc.edu and on Twitter at @ransbotham.*

ABOUT THE CASE STUDY

This case study is part of a series of *MIT SMR*-produced stories exploring the analytically-driven organization. This story is based, in part, on interviews with public- and private-sector executives. Both the featured company and the case study sponsor reviewed this case study prior to publication.

REFERENCES

1. Community Analysis Bureau, quoted in M. Vallianatos, "Uncovering the Early History of 'Big Data' and the 'Smart City' in Los Angeles," Boom, note 12, June 2015, www.boomcalifornia.com.

2. P. Swabey, "IBM, Cisco, and the Business of Smart Cities," February 23, 2012, www.information-age.com.

3. A. Townsend, "Smart Cities: Big Data, Civic Hackers, and the Quest for A New Utopia" (New York: W.W. Norton, 2013).

4. S. Mathis, "The Rise and Fall and Eventual Rise Again of the 'Smart City'," January 13, 2014, www.citylab.com. In September 2015, the U.S. government announced its commitment to spend $160 million to research and develop smart city technologies; see B. Miller, "Obama Places $160 Million Bet on Smart Cities, Internet of Things," September 16, 2015, www.govtech.com.

5. All of Alliander's shares are owned by Dutch provincial and municipal authorities. See "Legal Structure," 2016, https://www.alliander.com/en.

6. "Amsterdam Smart City," March 1, 2012, http://wwf.panda.org.

7. "Aanpak Top600," n.d., https://www.amsterdam.nl. Source in Dutch; translated here: https://translate.google.com/translate?hl=en&sl=nl&u=https://www.amsterdam.nl/wonen-leefomgeving/veiligheid/openbare-orde/aanpak-top600/.

8. "Amsterdam Smart City: Waste and Energy Company. (n.d.)" http://amsterdamsmartcity.com/projects/detail/id/134/slug/waste-and-energy-company.

9. M. Halper, "Philips Teams Up With Cisco and Dutch Energy Utility Alliander on Smart Lighting Project," February 12, 2016, www.ledsmagazine.com.

i. S. Quinton, "What Is a Smart City?," April 26, 2016, www.pewtrusts.org.

ii. "Smart City," May 2, 2016, https://en.wikipedia.org.

iii. T. Wolpe, "Big data deluge: How Dutch water is trying to turn the tide", October 1, 2013, zdnet.com.

iv. Ibid.

v. P. Horner, "Dutch Delta team earns Edelman," ORMS Today 40 no. 3 (June 2013), www.informs.org.

vi. L. Winig, "GE's Big Bet on Data and Analytics," February 18, 2016, http://sloanreview.mit.edu.

vii. S. Ransbotham, D. Kiron, and P.K. Prentice, "Beyond the Hype: The Hard Work Behind Analytics Success," March 8, 2016, http://sloanreview.mit.edu.

viii. S. Ransbotham, "Deodorizing Your Data," August 24, 2015, http://sloanreview.mit.edu.

MITSloan
Management Review

PDFs ▪ Reprints ▪ Permission to Copy ▪ Back Issues