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## Embassy of Data

Linda Vlassenrood

A collection of innovative projects doesn't necessarily add up to a smart city. However fervently the city's communication strategists and various articles would have us believe it, Eindhoven is still far from being a smart city.[1] And it certainly isn't a smart society. Yet the existing gap presents tremendous opportunities. There is still room to shape the ways in which citizens take part in the conversation around data collection and how the city designs its data policy in order to encourage critical reflection.

Drawing 63,000 visitors, the *Embassy of Data* exhibition, which took place from 21 to 29 October 2017, during the World Design Event and Dutch Design Week, brought the DATAstudio's three-year programme to a highly successful conclusion. The "embassy's" purpose was to increase awareness around the possibilities and opportunities as well as the threats and shortcomings presented by the collection of digital data. To this end, we invited visitors to take part in a personal conversation about data – and more specifically an exhibition devoted to the data collection points located within a 400-metre radius of our location in a former V&D department store. We expressly chose an accessible, central location in order to raise awareness of this abstract yet everyday subject among the widest possible public.

In June 2017 we began making an inventory of those data sets in the research area over which the city of Eindhoven had control. Which data was being collected where, and for what purpose? And to what extent was that data accessible to the public? We also spoke with several companies that work with the city to collect data. We chose not to approach commercial parties such as Facebook and Google because of their notorious lack of transparency and our limited research time. Hacking to gain information was not an option; we explicitly wanted to do things the officially approved way. We therefore experienced first-hand the dilemmas around the availability and openness of data. Obtaining it turned out to be no simple matter, even though we were operating as a cultural institution and not as individuals. Much of the city's available data was either not public or not readily shared because of privacy concerns. The sets were unconnected, and hardly any real-time data was collected.

At the exhibition, a data panorama created by the information designer Richard Vijgen presented visitors with the beginnings of a never-before-visualised picture of Eindhoven's efforts to become a smart city. Though the panorama was unquestionably incomplete, it precisely mapped hundreds of data points within a 400-metre radius. For many people, it led to new, at times shocking insights. At the data desk, we talked with visitors about the value of data. How familiar were they with the subject? Which data did they think should be collected? And under which conditions would they be willing to

[1] Saskia Naafs, "De muren hebben sensoren", *De Groene Amsterdammer* 49 (2017), 18–23. Also see: https://www.groene.nl/artikel/de-muren-hebben-sensoren, retrieved on 10 February 2018.

contribute their own? The exhibition sparked countless conversations with experts and with citizens of all ages. Their engagement with the topic was impressive.

In this article, I will specifically discuss the content of the data panorama and some related observations about the current status of Eindhoven's ambition to become a smart city. The panorama showed hundreds of data collection points representing the locations of sensors, cameras, antennas and clusters of dwellings. These were grouped in 11 categories, including waste and water management, municipal CCTV, air quality, and the Stratumseind Living Lab. An overview follows.

1. Stratumseind Living Lab

Eindhoven's premier smart-city showpiece is the Stratumseind Living Lab. Stretching for 250 metres, Stratumseind is the Netherlands' longest nightlife strip. The four-year Living Lab – a series of experiments involving dozens of research institutions and private-sector parties – was set up here in 2014 to increase safety. The lab uses sensors, cameras and other monitoring instruments to collect data on the behaviour of mainly bargoing people. It also looks at the extent to which light colour and intensity influence that behaviour. The research findings are being combined to provide as much information as possible on how external influences affect people's behaviour.

So what sorts of things does the Living Lab keep track of? First, equipment monitors the numbers of individuals entering and leaving the area at five locations. The ViSense camera counts the (anonymised) people who pass through its frame, within an area up to 24 metres wide. ViSense was developed by the Eindhoven company ViNotion, a maker of software for interpreting video images. Sound levels and directions are also monitored at these five locations. At one end of Stratumseind, near the Catharinakerk, equipment measures the stress levels in people's voices with the aim of detecting aggression. The "sound cameras" pick up nearby sounds and vibrations using 64 tiny microphones and turns them into visual information. Developed by the Eindhoven company Sorama, they function as video cameras for sound. Also near the Catharinakerk, cameras anonymously monitor visitors' walking movements in a further effort to detect aggression.

Multiple Wi-Fi trackers in the street can see how many individuals are congregating where – but they're currently switched off, since no satisfactory way of anonymising the data has been found. Data on where visitors come from is collected, however, in the form of an anonymised percentage overview sent to the Living Lab by Vodafone after a one-week delay. The city is not permitted to collect this data itself because of privacy laws but may obtain it from a commercial party.

Temperature, wind strength, precipitation and sunlight are also measured. Each week, the Living Lab receives an anonymised report from the police listing incidents by time, place and type. Every quarter, beer companies provide data on the amount of alcohol delivered to Stratumseind. The car park under Stadhuisplein transmits records of how many cars are inside. Eindhoven University of Technology programmes the lighting and keeps track of light levels and colours. Finally, a calendar monitors noteworthy events, such as full moons and final exams.

Visitors to Stratumseind did not know until at least late 2017 that they were walking into a laboratory, as there were no information signs to notify them that data was being collected. Only the figures on visitor numbers and sound levels can be found on the city of

Eindhoven's open data portal, but unfortunately the lack of contextual information renders them meaningless to outsiders.[2]

2. Stadhuisplein car park

The car park under Stadhuisplein counts the number of vehicles driving in and out on the basis of the movement of the gates. The figures are sent to the city of Eindhoven's dynamic parking management system through an API (Application Programming Interface). On big electronic signs around town, the system tells drivers how many spaces are left. The API also sends the figures to the dashboard of the Living Lab in Stratumseind, where they are stored in a database. Data collected in the car park is the property of Q Park and is not public.

3. Traffic

"Traffic control installation" is the official term for a stoplight. Each installation continuously keeps track of whether or not cars, cyclists or pedestrians are present at its various detection loops and push buttons. It also constantly monitors whether each light is green, yellow or red. The raw data is used to measure traffic levels but also to calculate other figures, such as waiting times and queue lengths. All this information is logged and stored by the department of traffic and environment so the city can use it later – for instance, to process complaints about traffic lights or to assess their effectiveness. Data obtained from traffic control installations is not currently publicly accessible, but the city plans to make it available in the near future.

4. Waste management

Around the world, many cities aim to make themselves cleaner, safer and more efficient through the use of data. Monitoring air quality and keeping track of waste, electricity and water streams always feature prominently on the agendas of cities seeking to become "smart", Eindhoven included.

Since 2008, every new resident of the city has been issued with a city card. It enables them to park their cars, drop off bulky items at the waste facility, and open local rubbish containers to deposit their bin bags. Each of Eindhoven's 950 underground bins has a card reader that unlocks its barrel. It also contains a depth gauge – a sensor that measures how full the 2.6-metre-deep container is.

Data from the depth gauge is used to report fullness. No data is sent regarding how often the container is opened or closed, so no link is made between an individual's card and how much rubbish he or she deposits. Once a night, each bin's sensors send a fullness report to Cure Afvalbeheer's headquarters via a 3G link. The data is used the following day to determine the most efficient routes for the refuse lorries.

The waste disposal system is the joint responsibility of Cure Afvalbeheer and BWaste. Cure Afvalbeheer collects the rubbish; BWaste provides the software and hardware. The system allows Cure Afvalbeheer to see the location of every container, whether it's broken, how full it is, and when it was last emptied. The system is not linked to other information sources, and its data is not shared with other organisations. While Cure Afvalbeheer is extremely transparent about its data, it is not officially public and therefore not available online.

[2] See: https://data.eindhoven.nl/explore/?q=stratumseind&sort=modified, retrieved on 31 January 2018.

5. Air quality

AiREAS is a private initiative of Jean-Paul Close and Marco van Lochem. Their goal is to use air quality monitoring to make Eindhoven a cleaner city, working in partnership with citizens, businesses, research institutions and government. Their intelligent measuring system was installed in autumn 2013. Its 35 AirBoxes test the air for fine and ultrafine particulates and ozone. Thirty units are suspended from lampposts scattered through the city's neighbourhoods, and the other five are designated for mobile use at events and in emergencies. They show the concentration of polluting particles in each neighbourhood.

The AirBox was developed by Philips and ECN. Axians provides a software platform for reading and storing the measurement data. The Institute for Risk Assessment Sciences at Utrecht University uses the data in combination with other types of information to carry out health research. The city of Eindhoven and the province of Noord-Brabant provide support for the project. AiREAS is also active in the cities of Breda and Helmond.

Real-time monitoring results from the AirBoxes are posted on the AiREAS website and the city of Eindhoven's open data portal.[3]

6. Water management

Eindhoven's surface water, sewage system and groundwater contain hundreds of sensors that help the city to deal with constantly changing water conditions. Around town, 170 locations are equipped with up to six sensors each. They're in fountains, wastewater pumps, storm basins, rainwater pumps, drainage pumps, the river Dommel, and car, cycle and pedestrian tunnels. The sensors measure water temperature, water quality, amount of precipitation, groundwater levels and surface water levels. The eight sensors on Catharinaplein, for example, monitor groundwater; they are part of a temporary project intended to determine why newly planted trees on the square keep dying.

Eindhoven's city management department has been working with the company Inter Act since 2007 to build a fully digitised water management system to enable problems to be quickly identified and even prevented with the aid of real-time data. The vast amounts of data collected also allow the city to make better predictions about water levels and to anticipate heavy rainfall and likely outages. The system can also supply information to emergency services so they can know in advance when tunnels are flooding or flooded and therefore impassable. Data collected by the water management system is not otherwise publicly available.

7. CCTV

The purposes of CCTV are to prevent crime, increase citizens' feelings of safety, and raise the number of on-the-spot arrests. Four areas in Eindhoven are currently monitored by CCTV. Three are in the centre: the Stratumseind nightlife area, Dommelkwartier (including Stationsplein) and the shopping district (including Markt and 18 Septemberplein). CCTV surveillance is also in operation on Baekelandplein in Woensel-West. The city has installed 30 cameras in the centre. Images are processed several times a week in the regional control room at the police station on Aalsterweg. They are monitored live on market days and weekend evenings. The images are stored for four weeks.

[3] See: https://data.eindhoven.nl/explore/?q=aireas&sort=modified, retrieved on 31 January 2018.

In May 2016, as part of the national project Camera in Beeld[4], the Oost-Brabant regional unit began mapping the locations of Eindhoven's CCTV cameras – official ones in public places but also private ones at shops, businesses and homes. The police urge every citizen and business to register every camera, so that if a crime is committed nearby they will know who might have images and how to obtain them quickly. In creating the data panorama, we had information only on the locations of municipal cameras. The number of registered private ones in the city centre currently stands at 36, and the list is far from complete.

8. Citybeacon

The Citybeacon is a single object combining the functions of the cameras, information signs, signposts, antennas, advertising spaces and video screens that have proliferated in public space. Twenty of these multifunctional four-metre pillars are stationed around the city centre. Two companies, Eindhoven247 (responsible for providing public information in the city) and Citybeacon, launched the project in 2016. Each pillar is equipped with various sensors and cameras. Two contain cameras in the top section to monitor goings-on in public space. The second highest section of each pillar contains sensors for counting passersby and measuring air quality and sunlight. Each Citybeacon also has speakers and a screen for transmitting messages to those in the immediate vicinity or even across the city centre all at once. Each pillar also houses a Wi-Fi hotspot and 4G antennas to boost the local mobile network. Finally, embedded in a smaller screen at eye level is a camera that passersby can use to take selfies.

The sensors in the pillars are currently switched off, mainly because Wi-Fi tracking in public space is illegal. At the moment, the Citybeacons' only function is to deliver advertising.

9. Reporting problems in public space

Bothered by a non-working lamppost or a loose paving stone? Spotted an abandoned bike? Got something to say about the maintenance of a local park or garden? You can report the problem to the city of Eindhoven through the BuitenBeter app, on the city's website, or by phone.

The app allows residents to report problems directly to the city's area managers by sending a brief description and, optionally, a photograph. The city will try to solve the problem as quickly as it can. Everyone who makes a report will receive a reply, sometimes with photos showing what has been done.

The municipality's open data portal contains the location and subject of every report made, but not its contents or who filed it. The BuitenBeter app allows users to search a database of all reports. Problems roughly break down into complaints about rubbish, nuisances and infrastructure respectively. BuitenBeter[5] is an initiative of the Dutch company Yucat Mobile Business Solutions.

10. Mobile network

The most important sensors in town are inside our mobile phones. Though tracking in public

[4] See: https://www.politie.nl/themas/camera-in-beeld.html?sid=ecd77e3b-5321-42eb-bf3e-3e281850fc06, retrieved on 14 March 2018.

[5] See: http://www.buitenbeter.nl/english, retrieved on 14 March 2018.

space over Wi-Fi is legally prohibited, our phones are constantly being monitored over the 3G and 4G networks. It's not only the various service providers that do this but also shops, companies and advertisers. Ultimately, the Dutch Data Protection Authority can only control the extent of Wi-Fi tracking to a limited degree. As a result, these private parties know a lot about where we live, how we move through the city, and where we spend our time.

The mobile communication and tracking network is made possible by a national infrastructure of masts equipped with antennas. *The Embassy of Data*'s research area contains 90 GSM (2G network) and UMTS/EDGE (3G network) cellular towers, owned by providers like Vodafone and KPN. People are making increasing use of mobile data services, and telecom companies are constantly adding new masts and transmitters to handle the traffic. The network is getting denser and denser. The Dutch national antenna policy dictates that environmental permits must be obtained for antennas more than five metres high. Smaller antennas do not require permits, but providers must submit a placement plan to the city.

The Dutch national antenna register[6] and OpenCelliD[7] show the locations of antenna installations in the Netherlands and around the world respectively.

11. Experian household profiles

The last category in the panorama, concerning data on individual households, unsurprisingly provoked the most questions from visitors. Experian is a US company active in the Netherlands since 1986 that collects, analyses and sells citizens' personal data. It specialises in compiling profiles of households relating to their creditworthiness. Experian helps businesses to manage risks around extending credit to consumers and small businesses. The company works on the basis of data it purchases – we do not know exactly what kind.

In 2016, the city of Eindhoven bought an Experian database for the first time. Its aim was to supplement and enrich its own existing data for use in analytics at the neighbourhood, street and postcode levels. For instance, Experian's record for each address contains the residents' education levels – details the city did not have. Each household's file also lists the number of people, their ages and the type of household (e.g., a single person, a couple, a family); the residents' income, education and employment situation; details of car ownership and purchasing power; the type of dwelling and property value; and whether the home is rented or owner-occupied.

Experian also creates group profiles. Using its Mosaic household classification system, it categorises households in the Netherlands according to lifestyle, buying behaviour, and demographic characteristics. Numerous businesses use Experian's group profiles to refine their marketing strategies. Consumer households are subdivided into 50 types, grouped in 14 clusters. Eight of these household types have been identified in *The Embassy of Data*'s research area: Mature Middle Class, Urban Good Life, Top-Rung Elite, Social Renters, Young Digitals, Kids and Career, Well-Earned Leisure and Senior Simplicity. Experian defines these groups as follows.[8]

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[6] See: http://www.antenneregister.nl/Html5Viewer_Antenneregister/Index.html?viewer=antenneregister, retrieved on 14 March 2018.

[7] See: http://opencellid.org, retrieved on 14 March 2018.

[8] These profiles come from Experian's 2012 booklet *Mosaic Profielen*, obtained through the city of Eindhoven.

– Mature Middle Class

'These seniors aged 50 and up belong to the Mature Middle Class. They've got their lives on track, and they're doing their thing. They go to work or are already retired; they keep their houses in order and maintain relationships with family and friends. They shop for groceries, go on holiday once a year – and that's it. The members of the Mature Middle Class don't ask for more out of life than that.'

– Urban Good Life

'The educated singles and cohabiting couples in the Urban Good Life group enjoy lives of freedom. They have nice apartments in the bigger city centres, with all the amenities a stone's throw away – cinemas, shops, nice bars. Some are still studying, part time or full time; others are busy with their jobs. They're hard at work building their careers or have already arrived.'

– Top-Rung Elite

'The members of the Top-Rung Elite group live in the nicest houses – often detached – in expensive communities like Laren, Bloemendaal and Wassenaar. For some, wealth has been in the family for years; others have worked hard to earn it themselves. The Top-Rung Elite likes to keep up with the news, particularly financial, and to relax at the golf course, the hockey club and the marina, where they keep their sailboats. They eat out regularly and frequently take expensive holidays abroad.'

– Social Renters

'The Social Renters are middle-aged singles and couples who rent basic properties from housing corporations. They don't have higher education; a large percentage is unemployed or retired, and others work part time. They don't have much money. Their daily concerns revolve around getting by, cleaning the house, walking the dog and buying groceries. Otherwise, they don't have a lot of obligations beyond keeping up a few social relationships.'

– Young Digitals

'The Young Digitals are still studying, working part time or looking for a job. They all spend time online, whether they're looking up information for essays, keeping up with social media services like Hyves and Schoolbank, or signing on to dating sites. They regularly play games and chat with friends, on computers as well as smartphones.'

– Kids and Career

'Members of the Kids and Career group shuttle back and forth between work and home. They're busy with their careers and invest time in them, but at the same time, they're striving to build a family life. The children go to day care or school, and in the evenings, the family catches up around the dinner table. Weekends are times to relax, but the computer sometimes gets switched on – not only so the kids can play games but also so Mum or Dad can read that policy report.'

– Well-Earned Leisure

'Life is good for the Well-Earned Leisure group. They've left behind the working world, fill their days with stress-free activities and have saved enough money to enjoy their leisure time. They live in nice, spacious houses, their children have left home, and they're free to do as they please – perhaps visit a museum, relax with a book, take a long bike ride, look after their grandchildren, or go on the odd holiday somewhere sunny.'

– Senior Simplicity

'The members of the Senior Simplicity group, as the name indicates, are over the age of 65 and live uncomplicated lives. What they lack in resources they make up for in time. In fact, they can often be heard saying, "I have more than enough free time." They generally live in rental properties belonging to housing corporations and spend their days as many retired people do: reading, watching TV, having a drink, enjoying time with their grandchildren, shopping for groceries and staying active. They don't ask for too much out of life.'

Conclusion

Eindhoven, like many other cities around the world, aims to collect as much data as it can with the hope of using it to solve all manner of problems better and faster. The underlying principle is: to measure is to know. To this end, the city uses an increasing number of digital tools that process data but also, to an increasing degree, generate it. Most people, though, have no idea what kinds of data are being collected, where, by whom, and for what purposes. The data panorama was far from complete and inevitably a snapshot. Nonetheless, it made the realm of data – the so-called black box – visible and therefore discussable for the first time.

Our research into the available data sets during construction of the data panorama also led to a number of important insights.

First, there is great tension between the municipal government's desire to increase openness around the data it holds and its justifiable reticence to do so in light of privacy issues. We see that the city of Eindhoven currently possesses 523 data sets but that just 38 are publicly available on its open data portal. The number of publicly accessible data sets will increase in the future, but most information will only be presented in a general way to safeguard residents' privacy.

Second, the smart city is a legal grey area. According to the Dutch personal data protection act, citizens must be informed in advance of which data are being collected and then be able to see how it is used. In practice, this rarely happens.[9] So it's no surprise that people wonder: how can the city collect data on me, sometimes working with a commercial party such as Experian, and then not share it with me because of privacy concerns? The city's reticence evokes mistrust among citizens about the government's role in data gathering.

There is also tension between the municipal government's promise to make Eindhoven a smart city and its limited control over what happens in the datasphere. The vast majority of data collected in public as well as private space is the property of commercial parties such as telecom companies, Google, Facebook and data vendors. In addition, the Netherlands has no laws governing the placement of sensors in public space.

[9] Saskia Naafs, "De muren hebben sensoren", 18.

Anyone can freely install them. So there are no records of which sensors are present where; what they are monitoring and for whom; or where, how and for how long the data is stored – nor how well it is protected. And we see the municipal government forced to work with parties like Vodafone to obtain certain data – usually for a fee – because privacy legislation forbids the city from collecting that data itself.

Eindhoven's smart city is highly fragmented. The municipality's data sets aren't linked or shared between departments, and very little real-time data is collected. Most of the 523 data sets are old-fashioned Excel sheets. The 38 sets available through the online open data portal are made up of numbers presented without context, so they don't tell the whole story and are hard for outsiders to make sense of. It is therefore impossible for citizens to make use of this data, though in a truly smart society they should be able to.

In sum, Eindhoven is still a long way from being a smart city or smart society. Our research for the data panorama has revealed that two design questions are pressing at the moment. First, how will business and government implement transparency and accountability with respect to how they handle data in public space? And second, is it possible to make data truly legible and manageable for citizens? From 25 May 2018, a stricter privacy law will come into effect in the form of the EU's General Data Protection Regulation (GDPR).[10] It will give citizens the right to even more information than before about how their data is used.

Public space belongs to us all, but nowadays it is far from clear which data is being gathered there about us and what is being done with it. The Stratumseind Living Lab is a clear example. Critical reflection on municipal and commercial parties' collection of data will benefit from greater transparency, and putting up a sign at the beginning of a street or the entrance to a train station won't suffice. Not everyone will notice a sign. And of those who do, how many will understand its implications? And will they know what to do if they don't wish to consent?

We would like to see the design disciplines work with municipal and commercial parties to come up with new ways of making the system of data gathering in public places visible and transparent. This will increase awareness among the population and, with it, the ability to decide whether or not to take part or to critically reflect on the activity in some other way. It will represent a small step in data empowerment, which must also be addressed in terms of data legibility. How can municipal governments make sure that when they provide data to the public, its meaning has truly been made clear and it can empower them to act? The Stratumseind Living Lab and the city of Eindhoven's open data portal are ideal places to start.

[10] See: https://www.eugdpr.org, retrieved on 14 March 2018.