# *EMPOWERING SMART CITY RESIDENTS THROUGH LEGIBILITY*

Masther Thesis by Paloma Esquivel
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"My formula for greatness in a human being is amor fati: that one wants nothing to be other than it is, not in the future, not in the past, not in all eternity. Not merely bear what is necessary, still less conceal it — all idealism is mendaciousness in the face of what is necessary — but to love it."

*-Friedrich Nietzche*

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# EXECUTIVE SUMMARY

The role that smart technologies play and the data they generate is becoming central in cities; cities are adopting technologies as a new way of governance and making policies based on data. Increasingly, governments and companies implement data-driven strategies, and the number of sensors in the public space is increasing. This translates into abysmal amounts of data about people, their behavior and habits.

While the use of smart technologies in cities and specifically in Amsterdam has many potential benefits—from improving local economy and transportation to quality of life and e-governance—there is a growing concern about the ethical risks. Martinez-Balleste et al. (2013) identify that their use in cities jeopardize citizens' privacy. Moreover, one of the main problems of smart technologies in the public realm is that they are often placed without users' consent and without providing any notice of their presence

At the same time, the attitude of smart city residents towards this new paradigm — along with the ethical, social and privacy implications that derive from it — is one of indifference. The misalignment between smart city residents attitudes and privacy behaviour is what motivates this project.

This project aims to engage smart city residents with smart technologies in order to create awareness, better understanding of the privacy implations and build a democratic process for smart cities. The design solution focuses on empowering smart city users by making smart technologies, its privacy implications and data insights legible for users. By building this knowledge and making privacy implications more visible, users will be able to notice smart technologies in the public realm and spread awareness. Moreover, they will be better equipped to make inform decisions about smart city projects and co-shape the city they envision.

Chapter 1, "Project Background", introduces the project, including its context, relevance and stakeholders. The scope and main research questions are discussed. Finally, the project assignment and the approach followed throughout this project is outlined.

Chapter 2 introduces the concept of smart cities and provides a general understanding of smart technologies. Next, Amsterdam Smart City is explored and a theoretical and empirical research on the scancar is provided. Finally, a user research activity on smart city residents perception towards public space and smart technologies is described.

Chapter 3, "smart technologies ethics", discusses the main risks and privacy implications that arise from the use and implementation of smart technologies in cities. Moreover, a user research activities and context factor analysis was undertaken to gain a better understanding of the domain.

In Chapter 4, theories on ethical principles for smart technologies are discussed in order to get a better understanding of how . A final user research activity was undertaken to gain insights on what the Netherlands residents would like to know about smart technologies.

Chapter 5 presents the synthesis process that was followed to bring all insights from previous chapters together. Next, a design goal and design requirements are outlined. Finally, a number of theories are outlined to serve as conceptual framework for the ideation phase.

In Chapter 6, "Final Proposal", presents the final design outcome: a digital tool to empower smart city residents. First, a general overview and motivation for the design concept are outlined. The digital tool aims at giving users better understanding on smart technologies and its privacy implication, in order to build a smart community that actively participates in the decision-making of their smart city. Finally, a theoretical argumentation is given to validate the design.

Chapter 7, the report closes with a reflection on the project, including a personal reflection and future recommendations for next steps.

# 01.

# Project Background

This chapter provides an overview of the project background and its raison d'être. First, it presents a short introduction of the domain. Then, it sets out the scope of the project, including research questions. Finally, the chapter presents the project assignment and design approach followed throughout the project.

# 1.1 INTRODUCING THE DOMAIN

Since the industrial revolution, humans have been engaged in a technological race—which has given birth to incredible and revolutionary inventions, such as the Internet and Artificial Intelligence. These and other technologies along with the formation of a global economy have forced societies to undergo a major structural transformation that resulted in connected; interdependent nations, best described by Manuel Castells (1999) as 'informational societies'. Along these important breakthroughs, cities have been witnesses to mass migration and rapid urbanization—becoming 'global' and concentrating industries, technology hubs, key infrastructure and intellectual assets (Peng et al., 2011).

As a consequence of the aforementioned, post-industrial societies—especially highly urbanized cities— face important social, economic and environmental challenges. This includes challenges related to waste management, air pollution, deteriorating conditions in mobility and aging infrastructures (Chourabi et al., 2012). New and smart technologies represent an area of opportunity for cities to explore solutions and applications that address these challenges and to ensure the quality of life of their inhabitants (Rodríguez-Bolívar, 2015).

The adoption of technologies by cities governments at the core of their management strategies and the transition into data-driven policies can be defined as 'smart'. In a smart city, smart technologies "enable the extensive monitoring and steering of city maintenance, mobility, air and water quality, energy usage, visitor movements, neighborhood sentiment" allowing a more deep analysis and understanding of the city.(van Zoonen, 2016)

The city of Amsterdam has equally implemented the use of smart technologies as a strategy to tackle the urban challenges and wicked problems encountered in the city—positioning it as a smart city. In the near future, the goal of the city is to increase the use of smart technologies to tackle the imminent challenges and collect meaningful data about the city. Moreover, the Amsterdam Economic Board aims to position the Amsterdam Metropolitan Area as the most important place in Europe for data-driven innovation by 2025 (Amsterdam Economic Board, 2020).

> *A Smart Technology can be understood as a physical element that can communicate with other objects (through/ enabled by a network) and is embedded with some form of intelligence that allows them to process environment data and act independently under certain conditions. Moreover, it have an embedded operating system and they usually can have actuators, sensors, or both (González García et al., 2017).*

While the use of smart technologies in cities and specifically in Amsterdam has many potential benefits—from improving local economy and transportation to quality of life and e-governance—there is a growing concern about the ethical risks. Martinez-Balleste et al. (2013) identify that their use in cities jeopardize citizens' privacy as unprecedented amounts of information are being gathered everyday by these, and the increasing use of sensors, data analytics and artificial intelligence (AI) has the potential to undermine human and social values.

Moreover, governments are increasingly outsourcing services to private companies, losing control over the data of its citizens (Naafs, 2018). Additionally, the collection of data in public space is done by multiple parties, both from the public and private sector, but no information on who the owner is and for what purpose it is being used is given, generating uncertainty and skepticism of the legality and morality of these technologies.

Additionally, the outbreak of a global pandemic at the beginning of this thesis project triggered a trend of mass surveillance in different parts of the world, including The Netherlands. An ethical debate with opposing opinions towards these controversial measures is gaining momentum and proves the relevance and pertinence of this thesis project.

## 1.1.1 PROJECT RELEVANCE

In the near future, cities will increase the use of technologies; on the one hand as a response to mitigate the problems of rapid urbanization, climate change, social phenomena, and — as has been seen recently — a worldwide pandemic. On the other hand, as a new way of governance and making policies based on data. The scenario, as a result of this foreseen future, is a proliferation of smart technologies in the public realm and constant collection of data by different parties, both from the public and private sector, that could endanger the privacy of people.

One of the main problems of smart technologies in the public realm is that they are often placed without users' consent and without providing any notice of their presence leading to unaware users generating data without their active participation—phenomenon referred as 'passive data' (Maher et al., 2019). Moreover, smart city governments are increasingly outsourcing services to private companies, losing control over the data of their citizens (Naafs, 2018).

Additionally, modern societies now rely heavily on digital services—including social media, government digital platforms, e-commerce, among others—to which users give all sorts of personal data that can be linked for multiple purposes as city indicators (van Zoonen, 2016).

The importance of this issue becomes even more relevant due to the significance and central role that public space plays in shaping communities and the experiences it facilitates. Carr et al. (1993) describe public space "as the common ground where people carry out the functional and ritual activities that bind a community, whether in the normal routines of daily life or in periodic festivities (...) for buying or selling, for gardening, for self-improvement through exercise, or for simply finding a place to exist".

***Figure 1*** *Public manifestation in Amsterdam (Photo by Shane Aldendorff from Pexels)*

Throughout history, the public realm has provided common ground for people to come together, but technology is endangering the democratic role of public space, as well as the

rights of citizens. The ethical risks and privacy concerns that smart systems pose for society at large urge for a critical response from designers to counteract them; design has the potential to inform and build upon better ethical practices on the use of smart technologies in the public realm.

This project aims at adding a better understanding of the privacy concerns smart systems raises among citizens and the ethical consequences of their use in the context of smart cities. Most design efforts are in supporting the design of ethical AI systems or offering an overview of sensors in the public realm but with no meaningful purpose. I would like to focus on supporting the city of Amsterdam in creating awareness of smart systems among citizens in order to counteract their invisibility.

### 1.1.2 THE CITY OF AMSTERDAM

This project is a collaborative effort with AMS Institute (Advanced Metropolitan Solutions) and the City of Amsterdam.

AMS Institute is an international consortium along with TU Delft, Wageningen University & Research, and MIT—based in Amsterdam, the Netherlands. The Institute is a platform for innovation which uses the city of Amsterdam as a living lab; through experiments, research and projects they design advanced solutions for the city's complex challenges. They collaborate with both public and private partners and integrate citizens in their research projects, securing a city that is innovative, sustainable and just. Its mission is to tackle metropolitan challenges from a technological science perspective by developing a deep understanding of the city through data.

AMS Institute together with the City of Amsterdam recognize the ethical risks of smart technologies and have a strong interest in ensuring that they are used in an ethical and responsible way. Specifically, the municipality of Amsterdam has developed a Digital Agenda that envisions a free and inclusive digital city where the digital rights of people and their privacy must be guaranteed (Amsterdam Municipality, 2019). Moreover, the agenda outlines the importance of incorporating the TADA principles (Figure 2)—outlined in a manifesto to help design responsible digital cities—to city projects.


***Figure 2*** *TADA principles retrieved from tada.city*



# 1.2 ASSIGNMENT

## 1.2.1 SCOPE

This project focuses on the ethical risks and privacy concerns that arise from the use of smart technologies in the public realm, using Amsterdam Smart City and the scancar—a technology employed by the municipality of Amsterdam—as a case study. This scope has been selected with the purpose of supporting the City of Amsterdam in understanding the concerns of citizens towards smart city projects implemented in Amsterdam and help addressing those concerns in order to foster better ethical practices.

The project will focus primarily on the privacy implications and ethical risks that surfaces from the collection of data in public space. In order to understand how the collection of data is enabled, a definition for smart technologies within the smart city framework will be presented. The concept of both smart cities and smart technologies is too broad, therefore, the research will only describe those aspects that are of interest for this project.

For the purpose of this project, the city of Amsterdam will be studied as a smart city; that required understanding the goals, future objectives and ongoing projects; as well as the city ambitions for the coming future.

Moreover, the scancar will serve as a case study to guide the project research and inspire the design outcome. Therefore, it was very important to understand the role and functioning of the scancar, and moreover put special emphasis in understanding the perception and concerns raised by the scancar case among residents of the Netherlands.

As such, the ethical risks of other uses of smart technologies as well as the ethics of algorithms are beyond the scope of this project.

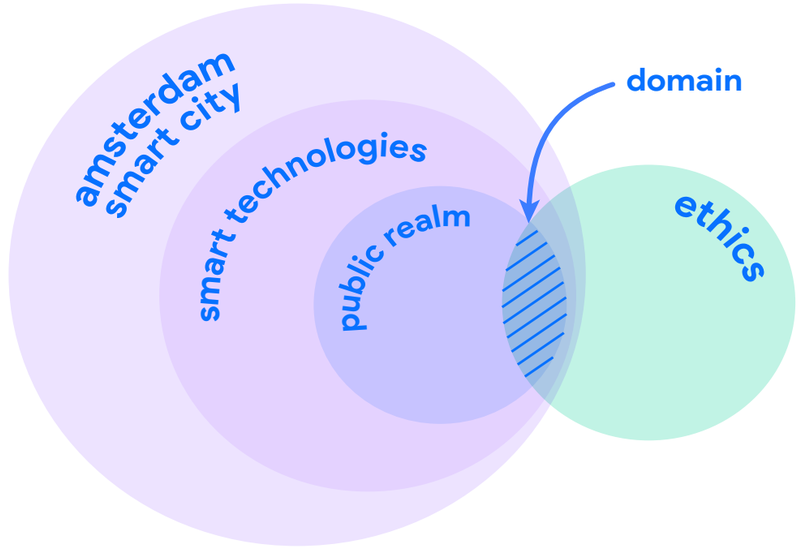


***Figure 3*** *Visual representation of the domain*

## 1.2.2 PROJECT AIM AND RESEARCH QUESTIONS

The central aim of this project is to explore how people perceive the use of smart technologies in the public realm through an extensive literature review and a series of qualitative research methods.

The goal is to design a tool that supports the city of Amsterdam to meaningfully inform the public about the use and presence of smart technologies in Amsterdam based on what people find relevant and meaningful with the goal of fostering awareness and public understanding of the privacy implications in order to build and foster citizen participation in smart cities.

### *Research Question*

**How can the city of Amsterdam employ smart technologies in the public realm in a more ethical and responsible manner?**

To explore the research and design space, this main research question was divided into three subsequent research questions:

- ***What are the ethical risks and challenges of using smart technologies, such as the scancar, in the public realm?***
- ***What are the attitudes of citizens with respect to the use of smart technologies in the public realm?***
- ***How can the presence and purpose of smart systems in the public realm be meaningfully indicated in and around Amsterdam?***

# 1.3 PROJECT APPROACH

At the beginning of the project, an attempt was made to adopt a society-centred design approach by following the different stages of the Social Implication Design (SID) method, but as the project progressed, I realized the nature of the project didn't quite fit the logical order of the SID method. Nevertheless, several steps from the method and concepts from the society-centred approach were substracted.

Thus in order to understand the domain, society-centred design advocates for a holistic approach by following systems thinking. Systems thinking helps designers understand the relationships between the different components in that system in order to get beyond the problem (Tromp & Hekkert, 2019).

Moreover, an effect-driven creative thinking was adopted, which means the design process goes from end—defining the desired societal impact first— to means— designing the design intervention (Tromp & Hekkert, 2019).

Therefore, the project was restructured in two phases: research and design.

During the research phase, the context was explored through different research methods in order to understand the domain. This process was not linear, and many methods were combined to arrive finally to relevant findings that helped define the design direction. First, a literature review was done on smart cities and smart technologies. Next, different methods were used to explore Amsterdam as a smart city and the scancar use case. Finally, both a literature review and qualitative research was conducted to understand the ethical issues and privacy concerns that arise from the use of smart technologies in the public realm.



The second phase started with a synthesis process, where the main findings were transformed into a design goal and a list of requirements for the final design. Moreover, a conceptual framework was outlined to guide the design. Next, an ideation process took place, where different ideas were evaluated. After having explored the design space, a final concept was selected and developed into a proof-of-concept.

A number of research methods were selected, including literature review, interviews, generative sessions, as well as context factors analysis.

# 02.

# Amsterdam and the scancar: from a smart city perspective

This chapter details a number of research activities that were undertaken in order to gain a better understanding of Amsterdam as a smart city and the scancar. First, a literature review on the phenomenon of smart cities is explored along with a general understanding of smart technologies in this context. Next, a brief introduction to 'Amsterdam Smart City' is explored through a literature review. Finally, an in-depth analysis on the scancar is presented, result from multiple research activities like semi-structured interviews, generative sessions and literature review.

# 2.1 THE SMART CITY

In order to understand Amsterdam in the context of a smart city and the scancar as part of it, it was important to outline the concept of smart cities and the technologies used within this framework. Literature review on both concepts was explored.

By conducting literature review, I explored the landscape of smart city definitions and available frameworks. Next, I reviewed the challenges that current smart city models face.

Finally, the concept of the technologies used in the context of smart cities were researched and translated into a taxonomy.

As mentioned earlier, the smart city concept was born as a response to the problems that cities face as a consequence of urbanization; climate change; industrialization; migration; among others. These challenges prompted cities to seek smarter ways to counter them and ensure livable conditions (Nam & Pardo, 2011).

The smart city term or label is still a very fuzzy concept. In the contemporary debate there is still no common definition of what a smart city is, despite being a concept that was first introduced two decades ago (Mora & Bolici, 2017). Within this array of definitions, three dimensions have been identified at the core of a smart city concept: 1) Technology: use of smart technologies and required infrastructure, 2) People: creative, educated and skilled citizens 3) Institution: political willingness and good governance (Papa et al., 2013).

Mora & Bolici (2017) define the smart city as "urban areas in which information and communication technologies (ICTs) are used as a tool for providing a solution to the multi-faceted problems that limit their sustainable development in social, economic, and/or environmental terms". This definition synthesizes the most relevant elements described by different authors and integrates the three dimensions previously identified by Papa et al. (2013).

Smart City models around the world are implemented in different ways and the approach varies from one government to another; some models put more emphasis on sustainability challenges, others on economic matters, others on social ones. But in theory, it has been possible to identify a set of factors that are essential for the success of these models. Next, a conceptual framework that encompasses these key factors will be presented:

## 2.1.1 CONCEPTUAL FRAMEWORK FOR A SMART CITY

Chaurobi et al. (2012) propose an integrated conceptual framework (Figure 4)—result of an extensive review of literature from various disciplinary areas—with a comprehensive set of factors that are essential to understand the concept of smart cities.

This framework consists of eight core components "that can be used to characterize how to envision a smart city and design initiatives". The eight core components are (1) management and organization, (2) technology, (3) governance, (4) policy, (5) people and communities, (6) the economy, (7) built infrastructure, and (8) the natural environment.

- ***Management and organization:** for a smart city project to succeed it is important to have a solid structure, alignment of organizational goals and project, identification of relevant stakeholders, end-user involvement, and innovative funding.*
- ***Technology:** a smart city relies on the use of smart technologies to manage infrastructure and services in real-time to help cities make more intelligent decisions and enhance the management and functioning of a city.*
- ***Governance:** it refers to a smart collaboration among multiple stakeholders, the presence of leadership, citizen participation and private/public partnerships that interact to support city governing activities enabling transparency and accountability.*
- ***Policy context:** the transition to a smart city requires institutional readiness to remove barriers; it also requires a coordination between political and institutional components, such as city council, city major, policy agendas, to make the necessary changes in policies.*
- ***Economy:** a key indicator of a smart city is its economic growth; it can be observed in business and job creation, workforce development, improvement in productivity.*
- ***Built infrastructure:** for a smart city to succeed it needs to provide a robust high-performance ICT infrastructure which includes wireless infrastructure and service-*

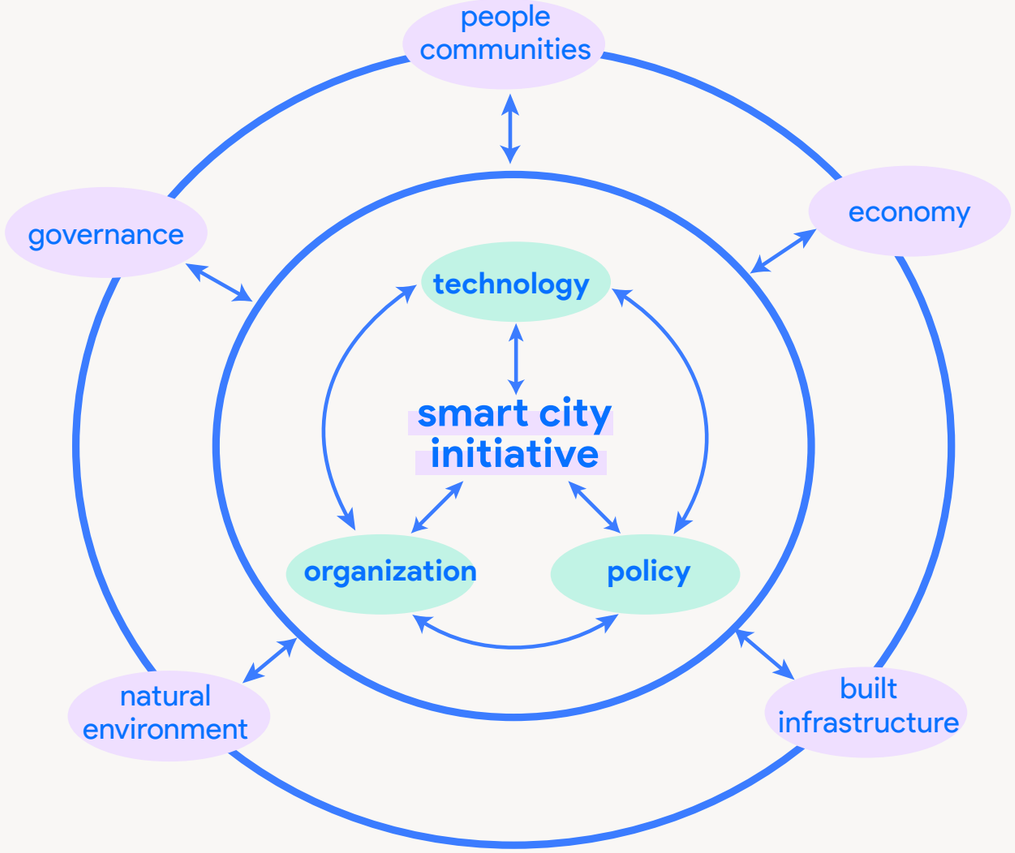


***Figure 4** Smart City framework: 8 core components by Chaurobi et al. (2012)*

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***oriented information systems. It also should contemplate security and privacy.***

- ***Natural environment: one of the core drivers of a smart city project is on increasing the sustainability of the city and to better manage their natural resources. It also aims to counteract climate change and provide a better future of its inhabitants.***
- ***People and communities: smart city projects should aim to foster more informed, educated, and participatory citizens since it will impact on their quality of life. Additionally, it is needed to enable them to participate in the decision-making and become active users in the management of the city.***

This framework outlines the most important factors that in current practice are considered essential in order for smart cities to thrive, moreover it also serves as a guide to asses where smart cities need to improve or invest more resources.

### 2.1.2 CHALLENGES OF A SMART CITY

Despite the great success that smart cities have had due to the remarkable benefits of implementing technologies as a governance tool, the present models raise certain concerns among different groups. In this section I will enumerate some of the challenges that different authors have identified since the smart city phenomenon took off.

The first challenge that has been observed is the level of influence that the market and private companies have on the smart city agenda. In this situation, local governments are in danger of private companies pushing their interests, leaving aside the needs of citizens. In addition to this possible risk, there is the situation in which being a smart city is more of a political strategy where the concept is considered an 'urban label' (Papa et al., 2013).

Another challenge that smart cities face is the speed at which technologies are developed and implemented as part of their strategy, but which is exceeding the capacities of the state to generate public policies that regulate them. Moreover, the enormous amount of data smart cities are collecting requires ever more resources to store it, analyse it and protect it, testing the infrastructure and resources of the smart city (van Zoonen, 2016).

The sensitive nature of the information that is collected in a smart city—for different purposes such as data for city maintenance, mobility, air and water quality, energy usage, visitor movements, neighborhood sentiment—calls for stronger oversight mechanisms that can assure the ethical use of information and protect citizen's personal information (van Zoonen, 2016).

***Figure 5*** *A CCTV camera in the public realm (photo from Mads Thomsen from Pexels)*

Finally, governments are increasingly outsourcing smart city services to private companies for cost-efficiency reasons or others, and as a consequence of outsourcing smart city services, governments are losing control over the data of citizens and jeopardizing their privacy (Naafs, 2018).

These are some of the overarching challenges that smart city models are dealing with, a more thorough research on the ethical and privacy risks will be presented in chapter 4.

## 2.2 SMART TECHNOLOGIES IN A SMART CITY

Smart technologies have been around us for a few decades. Since the Digital Revolution we have been witnesses of an exponential growth in the creation of new technologies and its applications, from the everyday objects that we own, such as smartphones, to complex smart systems that can manage cities' resources,—e.g. a smart lighting system which can optimize the street lamp intensity according to the time of the day, the weather condition, and the presence of people (Zanella et al., 2014). Now more than ever, smart technologies are deep embedded in our daily lives and the public realm, extending our digital world.

The central use of smart technologies to manage and solve the cities' problems is what has made the smart city concept tangible. Smart technologies emerged as the combination of different disciplines such as computer science and data science, and concepts such as smart objects (SO) and Internet of Things (IoT) and have been adopted by smart cities as a tool for a number of applications.

In this context, I am going to define smart technologies, its functioning and the architecture that enables it.

### 2.2.1 A TAXONOMY OF SMART TECHNOLOGIES IN A SMART CITY

For the purpose of this report, I will focus on defining 'smart technologies' within the smart city framework and more specifically those that are employed in the public realm. There is no single or clear definition, but an attempt to define them based on literature review will be made in the following paragraphs in order to provide a general understanding.

As previously mentioned, smart technologies are understood to be the combination of different disciplines or concepts that enables them. To further understand how they are constituted I will present the following taxonomy. The taxonomy is the result of an exhaustive analysis of several definitions and frameworks from literature. The suggested taxonomy describes the main elements that are part of the smart technology network in a smart city and that enable its operation.

It should be noted that this taxonomy does not include items that are outside the scope of the project. It should be noted that this taxonomy does not include elements that are beyond the project scope.

#### *Urban IoT*

In today's world, it can be assumed that the IoT is everywhere, which "anticipates a world saturated with installed smart objects (SOs), interconnected through the Internet" (Ghosh et al., 2018) and "gathering data on everything they can in order to make predictions, improve processes, etc" (Dorsemaine et al., 2016).

IoT is at the intersection between objects, intelligence and the internet, and as its name explains it, the internet is a central factor, the one that allows interconnectivity between different "things".

In a smart city, the urban IoT (see Figure 6) provides a communication infrastructure

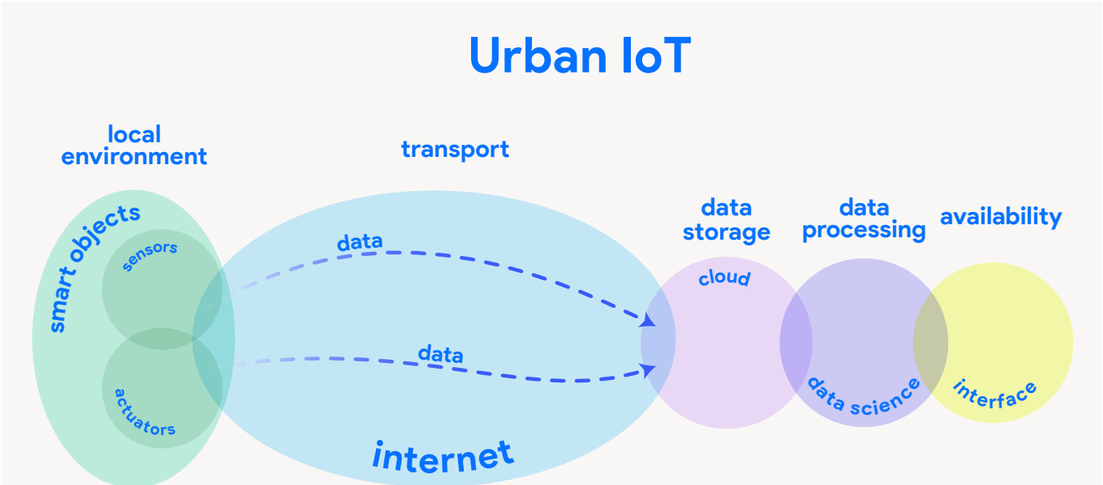



***Figure 6*** *Urban IoT infrastructure and processes*

capable of integrating and interconnecting a wide variety of smart objects deployed over the urban area that generate different types of data that are then delivered through suitable communication technologies to a control center, where data storage and data processing are performed (Dorsemaine et al., 2016; Zanella et al., 2014).

*Thus, in the smart city's context it could be said that the IoT paradigm is what enables SOs to become smart technologies by allowing them to communicate with one another.*

The main purpose of an urban IoT is that it allows smart cities to collect enormous amount of data about the city generated by the interconnected SOs. This data needs to be made accessible to authorities and citizens so that it can be translated into insights that will allow cities to make a better use of the public resources, such as transport, parking, lighting, surveillance and maintenance of public areas or increasing the quality of the services offered to the citizens (Zanella et al., 2014).

A simple example of urban IoT that we can identify in the smart city is traffic monitoring which "may be realized by using sensors and GPS installed on modern vehicles, and also adopting a combination of air quality and acoustic sensors along a given road" (Zanella et al., 2014).

To illustrate this example, in Figure 7, the traffic lights are embedded with sensors which are collecting data generated at intersections; then this data is send through the urban IoT network to a control center where data is stored and processed using data analysis techniques to produce insights which are then available through a dashborad, for example, in order to reduce congestion.

In the smart city domain, although the principle is the same, the IoT becomes even more complex given the volume of interconnected smart objects, the massive amount of data they collect, and the large-scale resources needed to process all data.

## *Smart Objects*

In the smart city context, an object that is 'smart' is one that is provided with an operating system that allows it to interact with the environment and make sense of it. This is possible thanks to the use of sensors, actuators, or both and its ability to interpret what is happening allowing it to act independently, communicate with other objects and exchange information with people (González García et al., 2017; Kortuem et al., 2010).

In order to act independently, objects would need to be equipped with artificial intelligence (AI) that would allow them to make 'smart' decisions. Some AI applications in smart objects include: object identification, facial recognition, voice recognition, speech and expression identification, computer vision, etc. (Ghosh et al., 2018).

But not all the smart objects that are found within the urban IoT system are necessarily provided with some form of AI; many are limited to sense the environment, send and receive data, and execute an action.

More importantly, in an urban IoT system, a smart object is capable to communicate with other SOs and the overall system, enabling the transport, storage, processing and access to the generated data (Dorsemaine et al., 2016). Due to this network, traffic lights are able to communicate with each other and adapt to traffic conditions enhancing the traffic flow.

## *Sensors*

Sensors are specific physical elements that allow us to measure a concrete physical parameter — light fluctuations, temperature, sounds, movement — or detect something of the sensor's immediate environment. Through sensors, it is possible to gather all sorts of information about the city. In the traffic monitoring example, traffic lights are deployed with sensors that measure and monitor the number of vehicles that pass through a specific point.

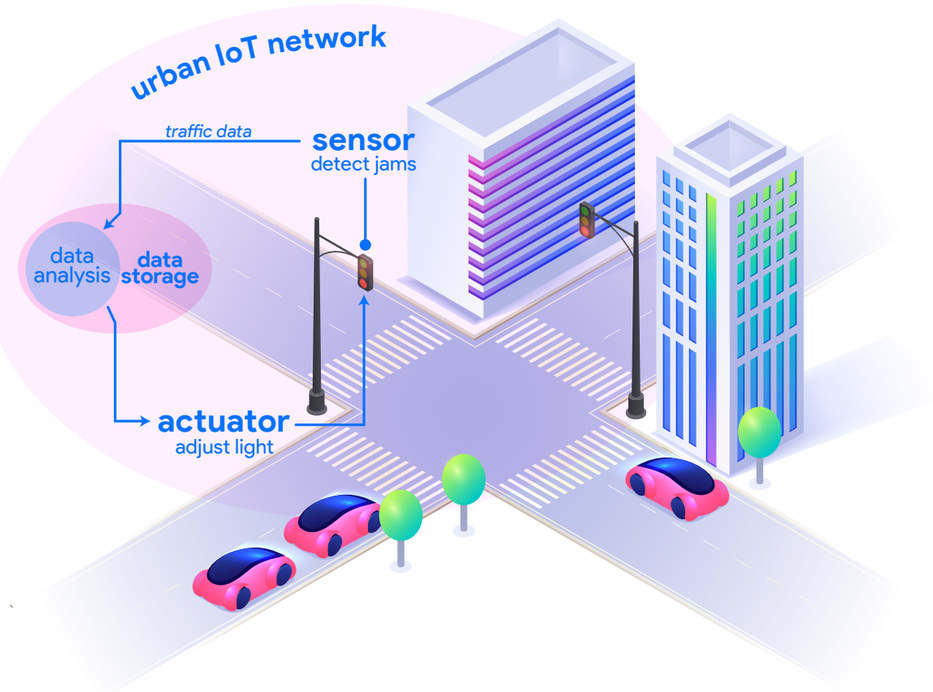



***Figure 7*** *example of an intelligent intersection (image: freepik.com)*

### Actuators

As their name suggest, actuators are mechanisms that allow devices to perform physical actions by converting an energy signal into movement. Sensors and actuators frequently complement each other; actuators are used to execute an action that was taken with the data collected by the sensors. In a traffic light, actuators enable lights to change in response to traffic congestion captured by the sensors. For this reason, in a smart city the use of both sensors and actuators is common since they facilitate the execution of tasks and control of actions remotely.

### Artificial Intelligence

Artificial Intelligence (AI) can be defined as any intervention made by a computer to emulate human cognitive functions, where the computer has almost complete autonomy, minimizing the intervention of the human being (Ghosh et al., 2018; Jiang et al., 2017).

AI-based systems are taking over repetitive tasks that usually required a human mind. They are evolving rapidly in terms of application, adaptation, processing speed, and capabilities and have helped reduce human efforts giving results in comparatively less time (Ghosh et al., 2018), thus being of great use for smart cities.
In a smart city AI can be employed for different applications, but its primary use is as a tool to analyse and process the large amount of data generated by the city's sensors. Without AI it would require a big human effort to process all the city data due to its volume, unstructured nature, varied data sources, and continuous flow. The use of AI has helped cities process data in an efficient manner so that it is understandable, meaningful and bring out hidden insights.

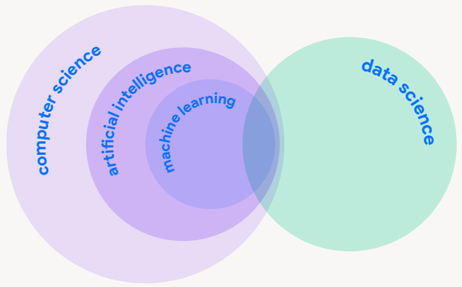



***Figure 8*** *Overview of fields from where AI, ML emerge.*

Some smart objects have a processing module that allows them to have some form of AI to process data in real time and be able to act independently and adapt to their environment.

### Machine Learning

Machine Learning (ML) is a branch of AI and it's used to achieve intelligence in a system. ML can be defined as a set of algorithms that have the ability to learn and improve through experience (Ghosh et al., 2018; Hamet & Tremblay, 2017). ML allows a system to get smarter by learning from past experiences just like human intelligence by imitating the natural learning process.

In the Urban IoT system where the volume, variety, velocity, and complexity of the data are overwhelming, it becomes impossible to do it manually, thus, ML techniques are employed to evaluate and analyse all the data that is generated by smart objects (Ghosh et al., 2018).

## KEY TAKEAWAYS

- ***Smart cities were originated as a response to the wicked problems modern cities face; such as mass-migration, rapid urbanization, climate change.***
- ***Cities found a more efficient way to manage cities through implementing new technologies and by adopting data-driven approaches.***
- ***There are a number of (ethical) challenges that arise from smart city practices and that threatens the privacy and freedom of citizens.***
- ***The IoT concept is what enables technologies to communicate, therefore making possible the smart city paradigm.***
- ***The main role of AI and ML within smart cities is to analyse the enourmous amount of data and find insights.***



# 2.3 AMSTERDAM SMART CITY

In this section, a brief introduction to the city of Amsterdam as a smart city is reviewed.

Then, the scancar was explored through literature review and semi-structured interview with the developer toblabla

A third research activity was undertaken to understand the city of Amsterdam from the municipality perspective and the aim and goals for the city. 7 interviews were organized

Finally, a number of generative sessions were organized to map users's perspective on public space and their city.

The city of Amsterdam is a complex dynamic ecosystem with a great tradition of inclusion, innovation and sustainability. The multicultural and livable Dutch capital attracts and promotes the creation of many technological startups. Amsterdam is a city that has had a significant urbanization process due to its key location, innovation and progressive culture, bringing together different industries, but standing out as a hub for technology and innovation companies.

At the same time as a consequence of the urban population growth, rapid urbanization and climate change, the city faces complex issues such as congestion, crowded streets, misalignment of public transport, and air pollution (AMS Institute, 2020), plus social and organizational challenges that are perceived as wicked. As a response, the city has been implementing smarter ways to mitigate these challenges and maintain a "good standard of quality in infrastructure, facilities, public services, waste processing, healthcare, public transport and mobility" (Wamelink, 2017).

Amsterdam was one of the first cities in Europe to develop a strategy to become smart. In 2009 the "Amsterdam Smart City" project was created—as a collaboration between Amsterdam Innovation Motor and the energy-network operator Liander and the municipality of Amsterdam—with the aim to use smart technologies to solve its environmental problems and build an urban environment that is sustainable (Somayya & Ramaswamy, 2016). Ever since, the city has been an example of a 'smart city' to others; an icon of a sustainable and livable city (Chourabi et al., 2012)

At the same time, several initiatives have emerged within the city that develop, promote and support projects through the use of smart technologies. One of such initiatives is a program created by the Amsterdam Economic Board called 'Amsterdam Smart City' (Figure 10)—an open urban innovation platform for managing smart city projects, collaborate and share data to create innovative solutions for metropolitan issues (Amsterdam Smart City, 2020).


***Figure 9*** *Amsterdam Smart City celebrated its 10 year anniversary in 2020 (retrieved from https://amsterdamsmartcity.com/)*

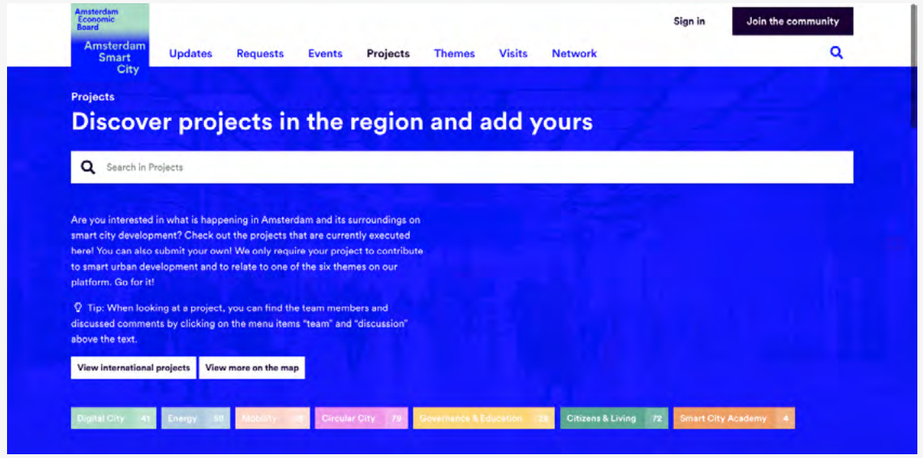



***Figure 10*** *Screenshot at ASC platform where smart city projects can be consulted (retrieved from Amsterdamsmartcity.com/)*

In 2017, in an effort to consolidate a national vision on smart cities in The Netherlands, a group of experts co-created a strategy that was presented to the Prime Minister. The document exposes a number of challenges Dutch cities face and proposes five preconditions needed to overcome these issues. The overarching goal of the strategy is to make a shift from many fragmented initiatives towards large-scale projects (Wamelink, 2017).

Moreover, the 'NL DIGITAAL: Data Agenda Government' lays out concrete priorities related to digital rights, privacy, data use, and citizen inclusion. In this agenda, the government recognizes that there is an "increasing trend to use sensors and when it comes to collecting data on citizens in the public domain, the government is 'only' one of the parties involved" (Dutch Digital Government, 2019).

Personal data is sometimes collected and stored by governments and companies, but the purpose of doing so is not always clear beforehand. Together with national partners such as the Ministry of the Interior and the Association of Netherlands Municipalities, regulations are being drawn up on how to deal with personal data collected in public spaces (Amsterdam Municipality, 2019).

In the city there are already multiple projects that are being carried out through the use of smart technologies. For example; currently 200 beacons are installed on almost all bus and tram stops in the inner-city with the intention of offering people a 'seamless journey' (Amsterdam Smart City, 2020). Another example is the 'Digital Perimeter' project which intends to provide visitors to the ArenA-area a better experience by using facial recognition, smart infrastructure, bodycams (5G), Blue-force tracking and smart sensors; "The project's goal is to find out whether the selected solutions and applications are feasible, scalable, accurate, user-friendly and above all ethically responsible" (Amsterdam Smart City, 2020).

The city of Amsterdam wishes to continue implementing smart city projects and data-driven innovation as part of their strategy towards a sustainable future, thus raising a number of ethical challenges to overcome; what will be the implications for society and what measures should be taken to protect the privacy and well-being of citizens?



# 2.4 THE SCANCAR


***Figure 11*** *A scancar driving through Amsterdam retreived from Rtlnieuws.nl/*

One prominent case of the use of smart technologies in Amsterdam is the scancar (Figure 11), a camera-equipped car that is used to efficiently manage parking spaces in the city and enforce parking control. The main purpose of the scancar is to identify illegally parked vehicles more efficiently and streamline the parking fine's issuing process—saving time, money and resources.

The parking management in Amsterdam is outsourced by the municipality through a tender process that takes place every 5 years; it is currently being run by Egis Parking Services—which is responsible for the entire operation of the parking service since 2016 (interviews, 2020). Their scancar is deployed with a 'ScanGenius' unit—an advanced camera system developed by dutch company Arvoo Imaging Products B.V. (Arvoo, 2020).

Egis owns a total of 12 scancars which are being used in strategic areas in the city of Amsterdam. These areas are determined depending on the incidence of parking violations, trying to incentivate users to pay for the parking service and at the same time, maximizing tax collection for the municipality (interviews).

Moreover, the municipality of Amsterdam makes use of de-identified—(process that removes personal identity information)—data gathered by scancars to identify parking behavior. This data analysis leads to the implementation of measures that improve the parking situation in Amsterdam and enhance the experience of residents.

Similar uses of cameras and image recognition are now being investigated for a range of new use cases such as social distancing due to Covid-19 pandemic, detecting trash on roadsides and automatically taxing businesses for storefront advertisement.

## *How it works*

The ScanGenius unit employs 12 ANPR cameras, processing units, 2 GNSS systems and 12 panoramic vision cameras located in

the car's roof top (Figure 12), which allows it to perform simultaneous number plate scanning covering up to 360 degrees (Arvoo, 2020).

The ANPR cameras have a resolution of 2.3 Megapixels (enabled with infrared visual light technology) to speed up image processing as well to ensure people's privacy; 99% of images taken with the ANPR cameras don't include people since they are pointing down to a license plate's height (Arvoo, 2020).

The scancar is part of the Amsterdam parking service which is enabled by a digital parking system. Vehicle owners need to register their vehicle's license plate in the digital platform through the parking service app or the parking machines located around the city of Amsterdam.

The scancar drives through the city scanning license plates enabled by the ANPR (Automatic Number Plate Recognition) technology along with panoramic images of the area. Number plate information can be augmented with location and time (accuracy of 1 cm) using a Global Navigation Satellite System (GNSS) (Arvoo, 2020).

The Automatic Number Plate Recognition process follows 3 main steps (Figure 13); first an algorithm detects a license plate in the camera frame; once a license plate is detected, a segmentation process takes place, where an algorithm extracts the license plate characters

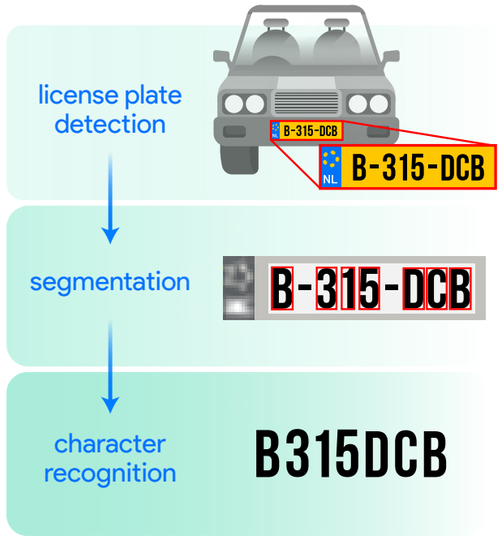



***Figure 13*** *ANPR algorithm process*

and discards everything that's not of interest from the image; finally, extracted characters go through a recognition process using an OCR (Optical Character Recognition) algorithm to determine the alphanumeric characters on the license plate (interviews).

Once a license plate number has been extracted, a parking fee validation process starts as can be seen in Figure 14. First, the system cross-checks the license plate number with the Netherlands Vehicle Authority (RDW) database to check if the license plate is valid, then it cross-

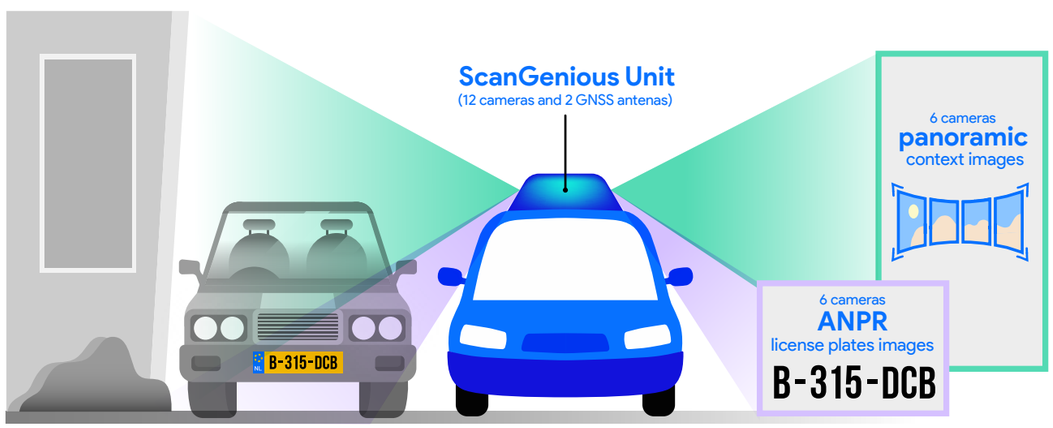



***Figure 12*** *ScanGenious unit components (Arvoo, 2020).*
*some graphic elements were taken from freepik.com*

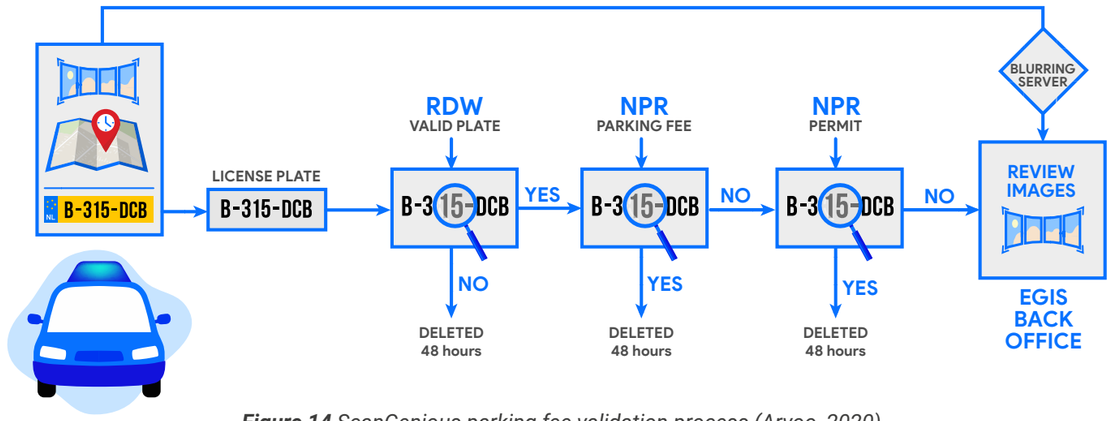



***Figure 14*** *ScanGenious parking fee validation process (Arvoo, 2020)*
*Some graphic elements were taken from freepik.com*

checks it with the Nationaal Parkeer Register (NPR) to verify if the user has paid the parking fee. Finally, it cross-checks one last time with the National Parkeer Register to check if the license plate has a parking permit that exempts it from paying. The process can result in the two following escenarios:

- ***If there's a payment registry or permit attached to a license plate the information is discarded within 48 hours.***
- ***If there's no payment information attached to a license plate the data is send to Egis's back office facility for revision.***

Thus far, the ANPR process have been done by the ScanGenius's Artificial Intelligence. Once the AI has determined there hasn't been a payment, the ScanGenious system sends a digital file containing 4 panoramic images; time and location; and license plate number to Egis Parking Services back office.

The digital file is sent through a wireless network where an Extraordinary Investigating Officer ('buitengewoon opsporingsambtenaar' or BOA in dutch) will assess whether there is a special situation—such as loading or unloading, passangers getting on or off the vehicle—or if an error occurs during the ANPR process—i.e. the wrong character was extracted by the algorithm. The assessment is based on 4 panoramic images taken by the scancar which first go through a blurring software that blurs people's face for privacy purposes.

Finally, If after assessing the panoramic images doubt remains, the officer will send a parking inspector to check the situation on site. If it is determined that there wasn't a special situation and the parking violation is clear, a fine will be issued and sent to the vehicle owner via mail.

## Additional facts

If a parking ticket has been issued, the data regarding to this license plate is stored for 90 days in the NPR system, simultaneously the municipality is legally obliged to keep this information in the national database for seven years (Gemeente Amsterdam, 2020).

It is possible to object in case a citizen do not agrees with the decision made; the municipality advices to take action within 2 weeks after the fine was issued. This can be done via online or mail through the municipality (Gemeente Amsterdam, 2020). The municipality then forwards the objection case file to Egis Parking Services which verifies if the objection proceeds by going through the images and information available. A decision is send via mail to the citizen by Egis Parking Services (interviews).

A fine is never issued automatically by the ScanGenious service, an Extraordinary Investigating Officer is always involved in the decision making.

The municipality of Amsterdam as well as Egis Parking Services adhere to privacy regulations like the GDPR and ISO 27001 certification, which describes how the data should be stored, processed and handled in order to protect user's privacy (interviews, 2020).

## 2.4.1 MUNICIPALITY PERSPECTIVE

Given that this project studies the scancar as a use case, it was necessary to interview some stakeholders to understand the context and vision of the municipality. For this reason, several interviews were carried out with actors directly and indirectly involved in the scancar. Since coronavirus crisis made it impossible to meet face-to-face, the interviews were conducted virtually. This research process was done in collaboration with fellow student Siddhart Daswani—a fellow design master student researching the scancar case—where we both collaborated in the planning, interview material and execution.

### *Method*

A total of 7 qualitative interviews were conducted with experts from the Municipality of Amsterdam, Municipality of Rotterdam, AMS Institute, ScanGenious unit developer Arvoo and TADA organisation. The backgrounds of the experts were rather diverse, but they all have experience with the scancar. The purpose of these interviews was to unveil the values embedded in the municipalities, future vision for the scancar, functioning of the scancar and the ethical dimension within municipalities.

The interviews were semi-structured with a duration of approximately one hour. The decision to use a semi-structured format was to allow the interviewees to expand on their answers as well to explore topics that were emerging (Patton, 2002). Therefore, questions started with more general topics such as their job description and moved into more specific questions. All interviews were voice recorded and notes were taken simultaneously for further analyses. Example interview protocols can be found in appendix A.

As part of the interviews—and with the purpose to trigger deeper layers of knowledge— generative exercises were used with participants (Sanders & Stappers, 2012). Since the interviews were held online, the exercises took place via Mural—an interactive platform that allows in real-time collaboration and create collages. The content of the generative exercises was tailored depending to each interviewee, but the overarching topic of all interviews remained the scancar. Some of the exercises covered stakeholder mapping, innovation process journey, institution values mapping.

From this point forward, the following research activities were conducted individually since the design objective of Siddhart's project differ from mine.

### *Analysis*

Since the data gathered during the interviews was qualitative, an adaptation of the 'on the wall' analysis approach was taken from generative research methodology (see Sanders & Stappers, 2012).

All seven interviews were audio recorded and transcribed. I went through the transcript in search of interesting quotes which I transferred onto post-it notes adding my own interpretation. Each quote with its interpretation was then coded with relevant themes and then clustered multiple times to find patterns and gather insights related to the research questions. An image of the clustering process is shown in Figure 15

### *Results*

From the analysis I was able to identify four main topics which will be described next:




***Figure 15*** *'on the wall' analysis overview*

**results**

## Municipalities motivation to implement smart technologies

> ***"Helps improve the development and maintenance of public space in a data oriented way.***
>
> -interviewee 2

- Every municipality have to fulfill certain metrics—such as '99% of public lights should be working at all times'—which lead them to constantly look for ways to innovate.
- New technologies implementation ideas are taken from other (dutch) municipalities or when private developers approach them with their product/service.
- Normally the CTO (Chief Technology Officer) proposes the implementation of a new technology in order to make more efficient certain process or as a response to an existent need.

- Municipalities use smart technologies to supervise and improve public spaces in neighborhood areas, for example road pavement, public lighting, green area uses. Sensors help improve accessibility, safety & quality of public spaces.

## Scancar Benefits for Municipalities

> ***"The amount of people who pay for tickets has gone up: now chances of being fined are higher thus citizens make sure to pay***
>
> -interviewee 1

- The municipality uses the data generated by the scancar to monitor parking statistics like parking incidence in neighborhoods, successful payment percentage. Furthermore, they employ ML to predict parking occupancy in areas where the scancar doesn't run often.
- Scancar is able to review 1200 cars per hour approximately. Since the scancar was implemented there have been an increase in parking tax collection of 65% in Amsterdam that goes to the Tax Department.
- Scancars has helped in reducing conflicts between parking inspectors and car owners.
- Enforcing costs have gone down: it's faster, you don't need that many employees.

## Privacy measures taken by Municipalities

> ***We follow the ISO certification which e.g. says we need to store data in different rooms and we are not allowed to use servers that are located outside the EU.***
>
> -interviewee 4

- There is a Chief Privacy Officer and several privacy departments within municipalities. They make sure companies supplying a service comply with ISO/GDPR policy.
- The municipality of Rotterdam uses the Ethical Data Assistant developed by the University of Utrecht and are looking to develop their own ethical framework for internal use.
- Egis deletes the data within 48 hours if there was a payment, or 90 days if there wasn't. Only Egis and the Municipality of Amsterdam can access this data. That data has already been de-identified.
- TADA principles are not enforced; "TADA is not a law, so it shouldn't be enforced, it's a value framework".
- Municipalities employees are trained to identify and align to the TADA principles. A way to implement the TADA framework is to score projects based on the principles, and from there ask 'what could be done to improve the system so that the score becomes higher?'.
- TADA employs a methodology called moral judgement. Within TADA, there's an ethical bureau where they try to solve ethical dilemmas. The bureau offers capacitation and training on the methodology.

## Municipalities limitations

> ***The department involved in the scancar makes sure everyday parking fines are being collected, innovation or research is not of its interest"***
>
> -interviewee 5

- Implementing ethical practices requires a lot of brain work and time, and the benefits are not immediate, thus finding people that are willing to listen, work and implement the principles is hard. It's more of a long-term investment.
- The municipality take citizens into account to some extend but rarely; they do it through local assemblies, "questionnaires" to consult with residents if they agree with a certain project or civil servants.
- Municipalities sometimes outsource services to private companies—through a tendering process. Therefore, involving third parties in smart city projects. Municipality assess outsourced services and companies through KPIs.



# 2.5 UNDERSTANDING THE DOMAIN FROM A USER PERSPECTIVE

The purpose of this research activity was focused on understanding how people living in The Netherlands experience their city and the public realm by using generative design research techniques. I wanted to deepen on what people value in public space, what activities they carry out and how would, to their belief, smart technologies in the public realm affect their lives.

Generative design techniques are meant to help designers get a deeper understanding of the user's dreams, latent needs and their context, since they are the experts of their own experiences and lives (Sanders & Stappers, 2012). The first phase of this research activity was done in collaboration with fellow master student Siddharth Daswani, which entails the planning, preparation and execution of generative sessions. The second phase — analysing the data and finding insights — was done individually.

### *Method*

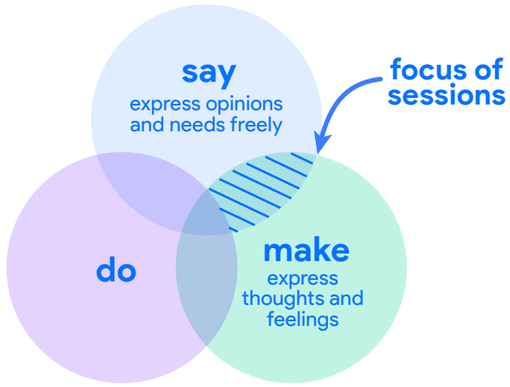
In order to gain and collect insights from users, it was decided to use generative design research techniques since these would allow us to understand how they experience public space by enabling them to freely express their needs and thoughts. The significance of this method is that it elicits everyday people's creativity to express an infinite number of ideas by employing generative techniques (Sanders & Stappers, 2012). It was decided to use 'say' and 'make' techniques to uncover opinions, needs, thoughts and feelings.

A total of 7 participants joined the sessions. To get participants, we used different communication channels such as facebook, linkedin, technology forums and through AMS

> *"It is in the public places of cities, its squares and streets accessible to all of the city's inhabitants, that all can see and hear each other. Here, persons different from one another, and present in public places for diverse purposes can come together. In the public realm, many perspectives and the common world may be found; within the public realm, young and old may learn about, and from each other.*
>
> -Suzanne Lennard

Institute. The majority of participants live in Amsterdam; it was important to get participants who fit within the scope of the project. The sessions were conducted online as meeting face-to-face was not an option due to the COVID-19 pandemic, and all sessions were video recorded.

To prepare for the sessions, it was important to determine the goal and research questions, then selection and recruitment of participants was made. Finally planning of sessions and



creation of the material to be used before and during the sessions was also prepared. A sensitizing booklet was distributed among our participants 4 days prior to a session. A day before the session participants were required to send back the filled-in booklet so we could analyse it previous to the session.

### Sensitizing Booklet

Sensitizing is a method used in generative design research to prepare participants for a session. We designed a sensitizing booklet in order to prime users with the content of the session ahead, by asking them about their surroundings and making them aware of smart technologies in public space. These were designed purposely to incite users to share their underlying feelings rather than to get superficial information (Sanders & Stappers, 2012). A complete overview of the sensitizing booklet can be found in appendix B.

## *Sessions*

We were able to facilitate three different sessions, each one with a duration of an hour and a half approximately and with at least two participants per session. We used a collaborative online platform called Mural to facilitate the workshop.

A cognitive toolkit, containing simple shapes, words and images, was designed in order to help participants to express their thoughts and feelings.

The session started with a brief introduction of the project, followed by a short presentation from participants and a brief discussion of their impressions about the sensitizing booklet. We then instructed participants to make a collage individually about what they value in their cities using the digital cognitive toolkits via Mural (An impression of an ongoing session can be seen in Figure 16.

In the next exercise the participants were asked to make a second collage thinking of a future scenario where the use of smart technologies was predominant in public space and again use the cognitive toolkit to express how this future would make them feel. After finishing each collage exercise they were asked to explain what they have created to the facilitator and the group in a non-structured way, making use of the 'say' technique.

## *Limitations*

Due to the COVID-19 pandemic, organizing the sessions and recruiting participants represented a great challenge. For that reason, most of the participants had similar backgrounds which affected to some extent the discussion.

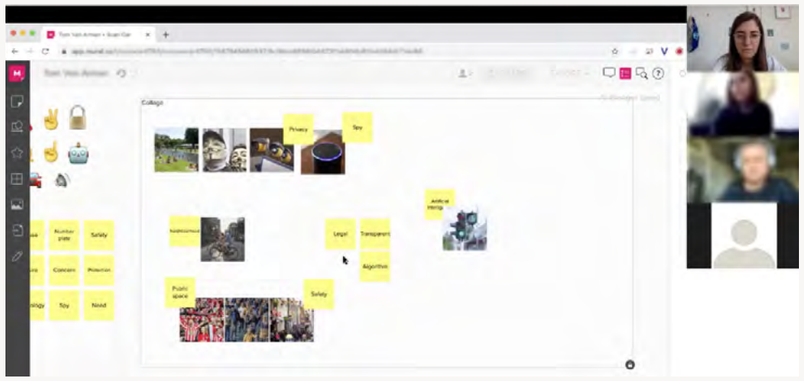


***Figure 16*** *Screenshot of session's set-up (Mural plus Zoom video-call)*



## *Analysis*

This phase of the research activity was done individually since the design objectives of Siddharth's graduation project were different to mine.

The following step during this process was to gather all insights from what participants had to say about their collages since these reflect their experiences and latent needs and desires (Sanders & Stappers, 2012).

An adaptation of the 'on the wall' analysis approach was also taken to analyse the data from the sessions. First, I went through all the video recordings of the sessions and collected a number of interesting quotes from each participant, resulting in a total of 66 quotes (See appendix B for a complete overview of selected quotes). As a next step I rephrase all quotes and clustered them to find patterns and gather insights related to the research questions.

## *Results*

Through the use of images, words and icons, participants visualized how they feel about the public realm, the current use of smart technologies and a possible future scenario where the presence of smart technologies will be prominent. A number of valuable insights were discovered from the sessions and the analysis.

All participants mentioned the great significance public space has in their well-being and social interactions. For example, one participant mentioned that she likes to spend the majority of her leissure time in the city since that way she feels more connected to the city and part of a community.

Participants also expressed that they would like to shape their community, and that the city should seek to involve actively citizens in the planning of public space. the lack of inclusion of residents to be not only informed but also have some sort of input in these decisions.

> ***"Using data and technologies to make our cities more resilient, and more inclusive and sustainable."***
>
> **-Participant 3**

Participants recognized the multiple benefits in using smart technologies to improve public services. Moreover, some participants agreed that smart cities models help create a healthy environment for people to work and live in.

All participants showed concern, to some degree, towards the collection and use of data. Some questions that were mentioned: who's owning or storing the data, who has access to the data or what data is collected. Moreover, a participant showed concern about the lack of transparency of how the systems have been designed.

A concern towards the use of technologies for surveillance and enforcement was also identified. Participants expressed concern towards the enforcement measures that are being implemented due to the Covid-19 pandemic through the use of smart technologies.

> ***Making things too smart might have an adverse reaction. in a few years people moving to the country side to avoid smart techs."***
>
> **-Participant 5**

# KEY TAKEAWAYS

The insights from the sessions helped form a first impression to one of the research questions: what are the attitudes of citizens with respect to the use of smart technologies in the public realm?

Moreover, a number of other relevant takeaways related to the concerns that smart technologies arise in users were identified.

# 03.

# Smart Technologies Ethics

This chapter summarizes the research activities that were undertaken in order to understand smart technologies ethical implications, as well as to explore the risks and consequences from their use. First, a literature review on smart technologies ethical risks was explored. Next, a user qualitative research was conducted in order to understand how users perceive the scancar and smart technologies. Finally, a context factors analysis is detailed.

# 3.1 THE SMART CITY ETHICAL LANDSCAPE

Throughout this section I will explore the ethical dimension of smart technologies following a number of research activities. The first research activity undertaken was literature review. First, ethical issues that arise from the use of smart technologies in smart cities were researched. Next, a review of ethical principles related to smart technologies was explored.

The second research activity was focused on understanding how people perceive the risks from using smart technologies in cities. A thematic analysis method (Clarke & Braun, 2017) was followed to analyse data extracted from four articles' comment sesction in order to gain insights.

A final research activity was undertaken to understand the domain from a user perspective by looking into the immediate context. This was done through a context factor analysis taken from the Social Implication Design method (Tromp & Hekkert, 2019).

As I previously explained, the development of new technologies has been exponential in recent years and its use and potential applications have expanded, permeating our personal and public life. Nowadays countless smart technologies are embedded into the fabric of urban environments and can be found in the public realm. Moreover, cities are implementing strategies based on smart technologies and data to make a city's management more efficient and benefit its citizens. The analysis of data provide novel and useful insights into cities, their citizens and systems (Kitchin, 2016).

The presence and use of smart technologies in public spaces has different purposes, among them is to monitor the state of public infrastructure and make its maintenance more efficient, to have a better understanding of how public areas are being used, to improve services — such as the parking service in Amsterdam — ensuring the safety of citizens and visitors, among others. The deployment of these technologies in the city has made possible the rapid and exhaustive collection of data about the city allowing to improve the quality of cities.


*data about people and their lives — this phenomenon of converting aspects of our life into data is known as 'datafication'*

There are clearly a number of ethical issues that arise from the deployment of smart city technologies and the growing amount of data being generated in terms of volume, range and detail about people and their lives — this phenomenon of converting aspects of our life into data is known as 'datafication' (Kitchin, 2016). Several ethical risks have already been identified and discussed by multiple experts; some of these risks include privacy implications of data collection on citizens; the ubiquity of smart technologies and its "hidden" nature; lack of notice or request for consent when placing smart technologies in the public realm; the collection of data from private companies.

Moreover, smart cities functioning is very complex and requires many resources and the sum of efforts of different stakeholders. Technologies in the public realm are owned by multiple government departments, but also by private companies or other public institutions; thus the data collected by these is being "analyzed and stored without any kind of central coordination or collaboration" (van Zoonen, 2016), resulting in an increase in data vulnerability and compromising the privacy of citizens.

For years, privacy and data protection policies— such as the General Data Protection Regulation (GDPR) and the NL Digitaal (NL DIGITAAL, 2019) — have been in place to protect citizens' rights and impose restrictions on companies collecting data. However, these policies are mainly focused on the collection and management of data, but there are no concrete policies to counteract some of the ethical risks resulting from the use of smart technologies in public spaces, such as being unaware that you are being subject to data collection.

The GDPR law assigns various rights to citizens, including the right to be informed (about what data is being collected, by whom and for what purposes). However, subjects can only use these rights effectively if they know that they actually possess them and how to exercise them (NL DIGITAAL, 2019).

***Figure 17*** *Sensors in public space highlighted in blue (original image from Pexels.com*

# 3.2 THE RISKS OF SMART TECHNOLOGIES

The thriving of smart cities and its shift towards data-driven urbanism has been enabled by networked smart technologies embedded into the urban environment. Such technologies include digital cameras, sensors, actuators that process and send an enormous amount of real-time, contextual and actionable data about cities and their citizens (Kitchin, 2016).

Unlike the digital world where there are thousands of privacy policies, in the physical world there are almost no privacy notices or setting panel where you could choose your privacy preferences, and even though users feel overwhelmed by the bombardment of privacy policies in the digital world, they are at least provided with some control over privacy settings in mobile apps or websites (Das et al., 2018).

Smart technology systems in smart cities originate a number of ethical issues regarding privacy, surveillance and datafication (aspects of our life captured as data). A further complication comes from a lack of awareness, many of those smart systems are being used without providing information on who the owner is and for what purpose it is being used, generating uncertainty, unawareness and skepticism among citizens.

Notice and consent are an empty exercise or is absent: one of the major privacy problems is that users aren't always aware when a device is collecting personal data. IoT devices' ubiquitous nature means that a person can easily not know when sensors are present (Chow, 2017).

Moreover, within big smart cities the oversight of data is becoming a challenge for local governments due to the data diversity since it differs in size, in purpose, in complexity, in ownership, among others, demanding better practices and collaboration from all stakeholders.

While some of the data are generated by local authorities and state agencies, much of the data is considered a private asset. Moreover, governments are not the only entities collecting data in the public realm; there are multiple parties, both from the public and private sector, collecting data without any coordination which makes legislation essential to guarantee the achievement of privacy (Martinez-Balleste et al., 2013)

Likewise, new technologies are frequently developed and implemented, without going through a trial period to know the social risks. For this reason Van de Poel (2016) suggests that these technologies should be subjected to extensive ethical scrutiny as if they were medical experiments. He also mentions that once the technology has been adopted and is rooted in society, it is very difficult to makes changes despite representing a risk to society (van de Poel, 2016).

Moreover, an often-observed social phenomena when studying user's behaviour in relation to their privacy concerns shows a contradictory behaviour. On the one hand, users claim to be concern about their privacy, but on othe other, their acts lack an appropriate secure behavior. This contradiction between concerns and behavior has been known in literature as the 'privacy paradox' (Kokolakis, 2017; van Zoonen, 2016).

With the data available, despite being de-identified, it is possible to make inferences. Users have limited understanding of what might be inferred or learned from sensor data, and systems will only get better at learning from data (Chow, 2017). But not only data from sensors is being used to make inferences, the data present in city registers, the data from government or corporate surveys and the data from social media updates are ever more often combined and linked (van Zoonen, 2016).

Finally, despite companies being obliged to practice data minimization, which means data can only be used for the purpose for which it was collected and when this purpose is fulfilled it must be disposed of, they resort to unethical practices such as selling repackaged data (data that has been made anonymous or derives from other data) which is later used for different purposes other than the original without the need to give notice or consent to those that the data concerns.

There are clearly a number of ethical issues—some issues more alarming and pressing than others —that arise from the creation and deployment of smart technologies in cities which represent challenges for cities and could have serious repercutions for individuals and communities. It is very important that smart cities planners and smart technologies developers become aware of all possible risks and try to counteract the negative implications for people.

## 3.2.1 USERS' CONCERNS

In order to better understand the risks and threats perceived by users of smart cities, a qualitative analysis was undertaken.

Four online articles discussing the use of smart technologies, two specifically reporting the use of scancars, from different news websites were selected. The articles' comment section reflect the opinion of hundreds of users, therefefore bringing valuable insights to the research.

The articles came from the following online platforms: two from a Dutch newspaper called Tweakers, another from the New York Times and a last one from platform Medium (See Figure 19 for more details). The four articles discussed and reported on the use of smart technologies in cities as a security measure to prevent the spread of cases due to the COVID-19 pandemic.

First, The New York Times documented the case of China in the fight against coronavirus and described it as "A new system uses software to dictate quarantines — and appears to send personal data to police, in a troubling precedent for automated social control."

The dutch new's site Tweakers, through two articles, reported on the use of two scancars in the city of Rotterdam to enforce a lockdown and

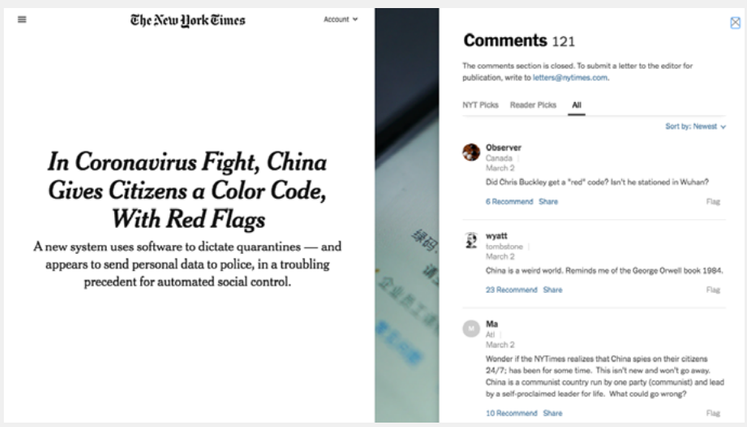



***Figure 18*** *Screenshot at NYT article (NYT, 2020)*

| website | title | date | number of comments |
|---|---|---|---|
| New York Times | In Coronavirus Fight, China Gives Citizens a Color Code, With Red Flags | 01-03-2020 | 20 |
| Tweakers | Rotterdam zet auto met 360-gradencamera in tegen overtredingen coronamaatregelen | 10-04-2020 | 31 |
| Tweakers | Rotterdam gebruikt camera-auto's voor coronatoezicht ondanks kritiek AP | 12-05-2020 | 29 |
| Medium | We Mapped How the Coronavirus Is Driving New Surveillance Programs Around the World | 09-04-2020 | 11 |

***Figure 19*** *Table enlisting the four articles: source, title, date and number of comments analysed.*

persuade people to avoid the streets — through real-time monitoring where an inspector was going through the images that the scancar was taking.

Finally, plataform Medium, specifically OneZero editorial, wrote an article about surveillance measures different countries were taking around the globe—"governments have a way of holding onto tools that undermine citizens' privacy long after the moment of crisis has passed."

## *Method*

First of all, the information from the Tweakers newspaper had to be translated to english since the content and comments were in Dutch, the translation was done using google translate and double-checked by a dutch citizen in order to verify the intention of the user's comment.

After making a complete reading of all the comments of the four articles, a total of 91 comments were selected for the analysis, discarding those comments that did not meet the criteria: only comments containing a personal opinion on the use of smart technologies were eligible. Each comment was manually copied to an excel file for further analysis. Since all comments were anonymous, there was no need to go through a de-identification process to protect the privacy of users.

## *Analysis*

In order to analyse the data gathered from the comment's sections I decided to use 'thematic analysis' method —where the data is coded, clustered in themes and categories that emerge— since it allows to identify patterns and interpret topics in a systematic way, being very useful and flexible for processing qualitative data (Braun & Clarke, 2012).

I started this process by going through all the comments and identifying topics, later I assigned each comment a code (the complete codebook is available in Appendix C). The method suggests naming the code in a way that captures the essence of the comment. The next step was to analyze all codes and cluster them multiple times to find patterns and gather insights related to the research questions. An image of the clustering process is shown in Figure 20.

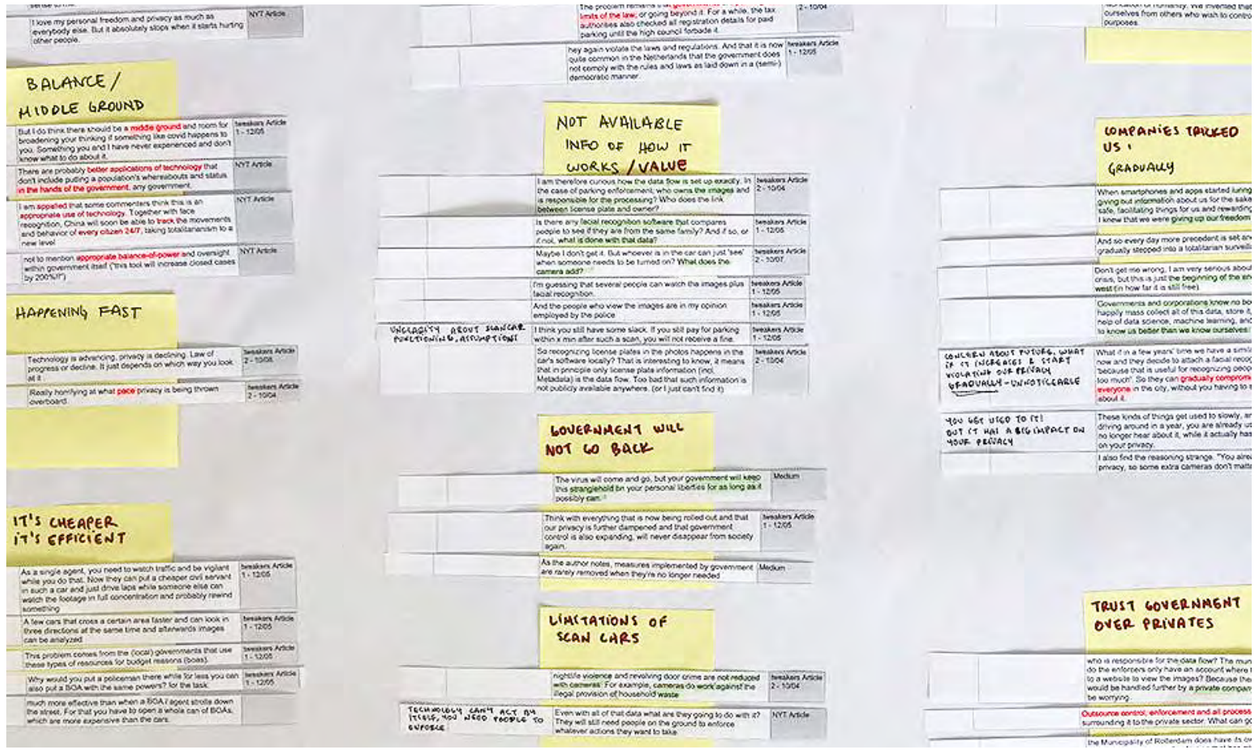



***Figure 20*** *Overview of coding process (The complete codebook can be found in Appendix C)*

## *Results*

The result of this coding process ended in a table with 4 different categories and a scancar dimension, encompassing a total of 20 themes. An overview of this table can be seen in Figure 21.

The findings from this research activity served as input for the following research activity, context factors analysis. In the next section I will conduct a context analysis and expand on the result complemented by the comments analysis.

# 3.2.2 THE SMART CITY ETHICS LANDSCAPE

In chapter 2, literature review was explored on smart cities and smart technologies. Moreover, a brief introduction to the history of Amsterdam Smart City was reviewed and an indepth analysis into the scancar use case was researched. In chapter 3, the ethical challenges that smart cities face was first explored. Next, the specific risks raised by smart technologies in the public realm was researched. Finally, a thematic analysis on online users' comment was undertaken in order to understand users' perception towards the use of scancars and other smart technologies in cities. The main findings from all previous the activies that I just described, served as input for a context factors analysis.

Society-centred design approach suggests that to have more impact on society we should aspire to design something for the future world. Although it is impossible to predict how this future will be, the SID method proposes to anticipate changes, make assumptions of what will remain the same and build a vision grounded in knowledge and research (Tromp & Hekkert, 2019). For this analysis it is required to look at society directly, both as a collective and as individual users.

Tromp & Hekkert (2019), propose to make an analysis of what is currently happening in the world and pay attention to those factors that concern our domain. They propose that these factors can be divided into four categories: trends, principles, states and developments. The first two are constantly changing factors—such as changes in human behavior or technological advances—that allow us to anticipate future changes. The last two are more stable factors—such as natural laws or a political ideology—that are maintained over time.

# THEMATIC ANALYSIS RESULT

*This table provides an overview of the final 20 clusters that were found during the thematic analysis. Within the final 20 clusters, I was able to identify 4 categories - challenges, enforcement, trust and moral dilemma. Moreover, the dimension of the scancar was highlighted.*

| CHALLENGES | ENFORCEMENT | TRUST | MORAL DILEMMA |
|---|---|---|---|
| win-win situation: negotiation between government and citizens to adopt better practices. | “It’s a control tool”: people think government are using technologies to know their wherabouts at all times. | Companies should inform about the use of technologies and ask for consent | People can sacrifice individual interests for group interests: a greater good. |
| Smart Technologies are being produced faster than regulations. | Laws are no impediment for governments to enforce new measures that they find convenient. | Dangers of technology: if employed incorrectly technology can be very dangerous, freedom can be compromised. | it’s cheaper but less ethical: this problem comes from the governments that use smart technologies for budget reasons. |
| “People don't respect scancars”: Scancars can be effective for certain issues but not everything can be solve with them | Governments always find an excuse to justify what they do (in this case increasing surveillance). | Many people believe that their privacy is protected and they shouldn't doubt the government. Democracy protect them. | Knowing how technologies work is important for a positive perception |
| Not available information of how it works: people seems curious to know how scancar work, from basic questions to high level. | It's really hard to reverse measures taken by the government, at some point they become permanent. | “Technologies are everywhere”: governments and companies have no bounds. | Users have the perception that technologies are implemented gradually till they stop noticing them, losing freedom. |
| Lack of standarization: why is every municipality in the NL doing things their own way. | BOA’s rejection: dutch residents don't trust BOAs influencing the perception of scancars. | Dutch government is more trusted over private companies: companies can make use of people’s data for their own benefit. | How do we make sure governments and companies are following regulations when installing technologies. |

**SCANCAR**

***Figure 21*** *Screenshot of NYT article (NYT, 2020)*

### *Method*

The first step of the context factors analysis is to gather and search for relevant factors within the context. As I mentioned, findings from the previous research activities were taken to serve as context factors. To complement the analysis, further observations and trend and desk research were done. A total of 31 factors relevant to the domain were identified and classified into one of the four categories—trends, developments, states and principles.

After having identified all the factors and placing them in its corresponding category, the next step in the SID method is to cluster them, thinking out of the box and finding interesting patterns or connections between them by systematically bringing pieces of information together. The goal is to end up with an original perspective on the domain that reveals opportunities for interventions that are outside the present context.

The goal of this final structuring process is to use the resulting future context as a point of reference for my design, identifying where it could have more impact in the long-term.


***Figure 22*** *Overview of all context factors included in the analysis*

### *Results*

The context analysis allowed me to see the domain from a broader and social perspective, identifying interesting behaviours and concerns among citizens, as well to forsee future trends.

My analysis concluded in seven clusters, each one encompassing a number of factors. I structured them using a Venn diagram (see Figure 23), where the relation between some of them overlaps with others, and surfacing interesting insights at the intersections. In the following paragraphs I describe each of them.

### *Go private and go home*

With the increase of smart technologies in the public realm, it's becoming difficult to protect one's privacy and stay in privacy outside one's home. By simply being present in the public space, users are generating data for different entities, and those data sets are owned by those entities. Moreover, governments are outsourcing smart city projects to private companies, making public space less public and safe (in privacy terms) for citizens. Finally, people are changing their own behaviour in public space influenced by the presence of smart technologies — e.g. CCTV cameras — making you wonder how far could it get.

### *Sneaky technologies*

The use of the term sneaky is to describe the devious and furtive practices of some entities that own smart technologies in the public realm. Many of these technologies are placed without any sign that announces their presence, making people unaware of being under the presence of sensors and collection of data. Moreover, government and companies don't ask for consents to technologies placed in public space.

### *The occupation of public space*

People and society at large recognizes the value of public space in their everyday lives and in shapping neighbourhoods dynamics. Many activities are undertaken in the public realm; exercise, social encounters, manifestations, which all cotribute to people's well-being. Moreover, social movements have always made use of public space to manifest their ideas, but as recently experienced in some countries, smart technologies could endanger this practice.

### *Unknown territory*

Many of the technologies implemented by governments or companies are put into use without knowing the social risks that they represent; becoming some sort of social experiment. This situation becomes more pressing since many cities are adopting smart city models without being totally aware of the consequences. Moreover, governments are transitioning into data-driven governance, a new paradigm for governance.

### *Wicked problems, wicked technologies*

Urban problems are more complex than ever and traditional approaches are not as effective as approaches enabled by smart technologies. Thus, this is directly

proportional to how complex technologies can get. The more complex the problem, it requires a more complex system to solve it which translates into more complex functions that are difficult to contest or understand by users.

### *Vicious circle of ignorance*

A common behaviour observed among users of smart systems is to link all their social networks and IoT systems, despite knowing how bad this is for privacy: this paradox is known as the 'privacy paradox'. This behavior is fueled by the overwhelming privacy policies that accompany technologies; privacy policies are often exaggerated in length, discouraging users from reading them, fueling the vicious cycle.

### *Unbound social bounds*

Technologies are having profound effects on societies. On the one hand, digital technologies are causing ruptures in social relationships, changing the way people interact and making them more lonely. On the other hand, other technologies are also changing the nature of jobs, replacing manpower and provoking unemployment.

The overall purpose of the context factor analysis was to recap the main findings from chapter two and three, and provide a more inspiring overview of the domain that could inspire the design process.


***Figure 23*** *Visual of final future context structure.*

# 04.

# Towards better smart cities

This chapter summarizes a number of research activities that were undertaken in order to build up knowledge on better ethical practices in the context of smart cities.
First, a literature review on the landscape of ethical principles of smart systems and AI was explored. Next, better ethical practices for smart cities and technologies were researched. Finally, a qualitative user research was undertaken to collect context-specific users' opinions.

# 4.1 ETHICAL PRINCIPLES OF SMART TECHNOLOGIES

After gaining a deeper understanding of the risks and privacy implications of smart technologies through review of ethical theory and qualitative research, described in chapter 3, the next stage of this project aims to explore better ethical practices and principles in the context of smart cities.

First, a review of ethical principles in the context of smart systems was explored, along with a review of ethical expectations from users.

Next, a review of social theory on smart cities was explored in order to understand how ethical smart city's models should be approached.

A final research activity was done via online surveys in order to deepen into the experiences of users living in the Netherlands with technologies.

The proliferation of smart technologies and its possible implications for society has sparked an international debate that has been going on for several years now.

This debate has primarily focused on principles—the 'what' of AI ethics—rather than on practices, the 'how' (Morley et al., 2019). The debate has resulted in a plethora of principles and guidelines for ethical artificial intelligence (AI). These principles come from a diverse set of stakeholders, from both the private and public sector, that reflect the need for ethical guidance and which are aimed at assisting with decision making (Jobin et al., 2019).

A recent study conducted by Jobin et al. (2019) did an exhaustive review of 84 existing documents containing frameworks and guidelines for the ethical AI issued by research institutions, public sector organizations and private companies. Although there isn't a consensus on a single principle across all documents, Jobin did find an emerging convergence around five ethical principles that appeared in more than half of the documents.

**These five principles are:**

## TRANSPARENCY

To make an AI system transparent, it would need to be explainable so that users can understand how the AI system works, how is it making decisions and how the data is being used. Primarily, transparency is presented as a way to minimize harm and increase disclosure of information. It should be a tool to enable dialogue and participation. The provision of explanations "in non-technical terms" or auditable by humans is encouraged (Floridi et al., 2018; Jobin et al., 2019).

## PRIVACY

Ethical AI sees privacy both as a value to uphold and as a right to be protected. For an AI system to protect privacy it must protect data, comply with data regulations and only use data for the stated and agreed-upon purposes (Floridi et al., 2018; Jobin et al., 2019).

## RESPONSIBILITY AND ACCOUNTABILITY

AI systems need to include policies that establish acting with integrity and clarifying the attribution of responsibility and legal liability for their output. Very different actors are named as being responsible and accountable for AI's actions and decisions: AI developers, designers, institutions or industry. How could it be determine legal liability and make AI systems auditable and covered by existing whistleblower laws (Floridi et al., 2018; Jobin et al., 2019).

## NON-MALEFICENCE

"AI shouldn't cause harm, which is interpreted as discrimination, violation of privacy or bodily harm"; it must take into account that technological progress might outpace regulatory measures. For each AI system it needs to be assessed the negative impacts on long-term social well-being, infrastructure or economy and be ready to address all kinds of risks (Floridi et al., 2018; Jobin et al., 2019).

## JUSTICE, FAIRNESS AND EQUITY

For an AI system to be fair it must be provided with mechanisms for prevention, monitoring or mitigation of unwanted bias, and discrimination. For it to be just, it should take into consideration diversity, inclusion and equality. Users should be able to appeal or challenge decisions. Moreover, society should have access to AI, data and the benefits of AI. Providing information and raising public awareness of existing rights and regulation; better inclusion of civil society or other relevant stakeholders in an interactive manner are also important (Floridi et al., 2018; Jobin et al., 2019)

These five principles —transparency, fair, non-maleficent, responsible and privacy— are commonly find in most proposed frameworks, but these frameworks has primarily focused on principles—the 'what' of AI ethics—rather than on practices, the 'how'. The availability of these agreed principles supports but does not yet bring about actual change in the design of smart systems (Morley et al., 2019). It is very important that designers and technology developers find a way to put these principles into practice and ensure ethical technologies, thus focusing the debate in improving the 'how'.

In the next section I will explore what users would like to be informed about, and their privacy expectations for smart technologies.

## 4.1.1 BETTER ETHICAL PRACTICES

Although smart technologies and their use can bring many benefits to cities and users, it is important that better ethical practices are implemented and adopted by cities, organisations and developers. There is a need for transparency, control, and new tools to ensure that individual privacy requirements are met (Naeini et al., 2017). The ethical principles described in the previous section can be used and adopted as guidelines to achieve ethical smart systems, but in the context of smart cities, these and other ethical practices must be adopted to address the concerns that arise from their use in the public realm, as discussed in chapter 3.

The General Data Protection Regulation (GDPR), among other privacy and data regulations, requires from companies the adoption of ethical practices in the context of smart cities, by providing guidelines for data collection, data management, data protection, transparency, among others (Das et al., 2018). These regulations alone are not enough, citizens needs and concerns must be heard and integrated into data collection practices. "The government must — in consultation with society and the business community — determine where the boundaries are for using data" (Dutch Digital Government, 2019).

"While people generally care about their privacy, they feel they have little awareness of – let alone control over – the collection and use of their data. For instance, there is no way of determining whether an area is under video surveillance and what algorithms might be applied to the footage captured by cameras (e.g., facial recognition)" (Das et al., 2018). Moreover, as people interact with an increasing number of sensing technologies, it becomes difficult for people to keep up with the many different ways in which data is collected and used. In order to change this situation, entities behind smart technologies in the public space should provide notifications to promote awareness.

### *Privacy Expectations*

A study with 1,007 participants by Naeini et al. (2017) was conducted to measure privacy expectations and preferences of users. They discovered that people demand information about the entity collecting data, the purpose of the collection, the benefit they receive from it, and the retention period of the collected data. Also, if it is shared with third parties and possible security risks associated (Naeini et al., 2017)

Similarly, Lee and Kobsa (2017) identify that users want to know who was collecting the data, where the data was being collected, what kind of data was being collected, the reason for collection, and the persistence of collection. (Lee & Kobsa, 2017).

Other findings discovered in the study conducted by Naeini et al. (2017) were:

- ***Participants were more comfortable with data being collected in public settings rather than in private places and are more likely to consent to data being collected for uses they find beneficial.***
- ***Participants are less comfortable with the collection of biometrics (e.g. fingerprints) than environmental data (e.g. room temperature, physical presence).***
- ***Participants are more likely to want to be notified about data practices that they are uncomfortable with.***

### *The Importance of Legibility*

To fully realize the potential of smart technologies, individuals need to be sufficiently knowledgeable and aware to make informed decisions. This knowledge can be achieved through legibility.

Legibility refers to making comprehensible technologies by providing intelligible and constructive information to the end user: what data is collected, how are inferences drawn from it, and what the implications of those inferences are—making a clear distinction between transparency (i.e. not hiding what is going on) and legibility (i.e. making what is going on comprehensible)." (Lindley et al., 2020) Signs, symbols, logos, labels and icons make interactions more legible; highlighting where services are available, what the consequences of specific interactions might be, and communicating relevant information (Lindley et al., 2020).



## 4.2 THE IDEAL SMART CITY

It is evident—as mentioned by several authors—that the planning and constitution of a smart city must be done for and with citizens, this represents a challenge for cities and also presents a paradigm shift that sociologist Richard Sennett (2016) describes as an 'open city'. He makes the distinction between two types of smart city mainly distinguished by their management and infrastructure—coordinated and prescribed. Where the former encourages intellectual development in its citizens and the latter stuns us.

A 'closed city', or prescribed, is condescending to people. Sennett describes it as a city where smart technologies are at the service of politics; to make cities more efficient but also to prescribe how people should live. By collecting tons of data in real-time on citizen's behavior it makes it possible to foresee how the city will function in the same way that it's predetermined. These technologies are employed to make people's lives easier while making them useless. Homogeneity, monitoring and centralization prevail. Everything is designed in such a user-friendly way that the city operates smoothly, leaving no space for curiosity or problem solving.

On the other hand, Sennett mentions that an 'open city', or coordinated, is one that instead of using smart technologies to control it does so to coordinate. This means that it respects the individuality of its citizens and develops human intelligence. Contrary to a closed city where citizen's data is collected without their consent and involuntarily, in an open city the citizen is given more control over their data—"The coordinative smart city honours limitations on its own data, then processes and relates that information to other groups".

In a smart city, technology can be used as a tool to communicate projects and decisions to citizens, therefore enabling them to participate and make decisions over urban design. In a closed city type, such information has already been synthesized so that the user has little influence on it and practically cannot question. In an open city, the information is presented in such a way so that the user 'sees' alternatives and makes decisions.

A prescriptive system is hermetic, that is, it's hidden from the citizens, while a coordinated system is hermeneutic, that is, "people have to get engaged in the data, interpreting it (hermeneutic) and acting on it". Big data now make it possible to coordinate participation at a megacity scale. Finally, a last distinction that Sennett points out, is that the prescriptive smart city is inherently authoritarian, while the coordinative smart city is democratic, bottom-up and flexible where changes could be made over time.

In the same way, Papa et al. (2013) analyse both types of cities and conclude that in the close city, top-down decisions build new cities from scratch, while in the open city type the development towards a Smart City happens within several bottom up stages. Some failures of the first and the achievements of the second suggest that the smart cities of the future will not be those created from the top down, but "those that have grown organically more intelligent".

## 4.2.1 THE ROLE OF CITIZENS

Chourabi et al (2016) identify citizens as a core component of smart cities and mention that this matter "traditionally has been neglected on the expense of understanding more technological and policy aspects of smart cities", many other authors emphasize the importance of making people central to smart cities and engaging them in planning—whether as co-creators, or evaluators.

Moreover, Batty et al. (2012) discuss that smart cities should be constituted by a 'smart community', which means a community that actively participates in the planning and design of the city. Currently, citizens are involved to some extent by informing them of decisions and measures implemented in their neighborhood area but lack an active role in the constitution of a smart city, which according to Batty et al. could be informed using data and scenarios all facilitated by smart technologies.

The urgency and importance of enabling civic participation has two reasons of being: first, since it takes place in the public domain (the smart city infrastructure), citizens must be informed about whatever project they are being part of - either passively or actively - and also let them know how it benefits them. The other reason, equally important, is that since we are all part of this infrastructure, each citizen is producing an enormous amount of data over which they should be given more control and communicated by whom and how it is used (Batty et al., 2012).

In conclusion, the citizen's dimension is key in the construction of a fair, transparent and responsible smart city; As Papa et al (2013) mention, a smart city is not made by infrastructure alone, or the use of smart technologies with the purpose of saving resources—"it is about being able to function as an integral part of a larger system that also regards participation, human capital, education and learning in urban development"

***Figure 24*** *(image: freepik.com)*



# 4.3 CITIZENS EXPECTATIONS: A SURVEY

An essential aspect of this graduation project was the users' dimension: to map their concerns about smart technologies, whether they are aware of the use of sensors in the public realm, if they know that AI is embedded in many public services, and gather any personal experience and ideas of what they value.

The goal of this section is to uncover and collect insights about what people know and/or they would like to know about the scancar and other smart technologies in the public realm, and how they would like to be informed. Through an online survey, I explore how familiar or knowledgeable people living in the Netherlands are in regard to scancars and smart technologies.

The online survey was shared through several communication channels (Facebook, LinkedIn, and friends) to get participants living in the Netherlands.

### *Method*

To deepen the understanding of how people perceive smart technologies in the public realm, in particular the scancar, I set an online survey using google forms. The aim of this survey was to know if people living in The Netherlands are familiar with the scancar, how they feel about it or would like to know.

The survey consisted of two sections; the first section gave an introduction to smart technologies in public space along with visual examples of these, including the scancar, with the goal to uncover concerns and assumptions they had towards these. The second section consisted of questions deepening in their understanding of smart technologies and what like to know, with the goal to uncover what

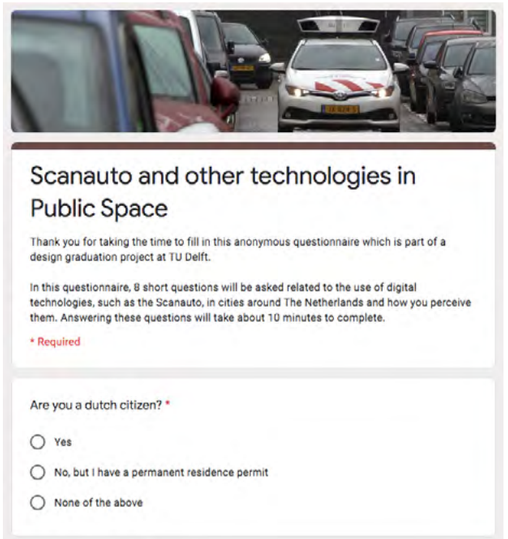



***Figure 25*** *Screenshot from online survey introductory part (June, 2020)*

information would be valuable for them. A complete overview of the online survey can be found in Appendix D.

This method allowed me to reach to more people since the time required was considerable shorter compared to the sessions described in chapter 2.

### *Limitations*

The survey wasn't answered by enough users to consider it as valid scientific research. However, the survey gave a big amount of insights that helped identifying key concerns and needs among people living in the Netherlands.

### *Analysis*

In total, 25 participants filled the online surveys, of which 80% were dutch citizens, 15% had a permanent residence permit and the remaining live in the country with a temporary residence permit. The analysis process of the data gathered through the online surveys followed a similar process to the one used to analyse the data from the generative sessions, an 'on the wall' analysis.

From the ‘on the wall’ analysis I was able to identify 4 main topics — concerns about data, concerns about surveillance, concerns about scancars and what (information, measures) is missing — which I will describe next:

## CONCERNS ABOUT DATA

Most of the participants main concern was regarding to data; questions like what type of data is collected, how is it processed, managed or stored were frequent. 20% of the answers also questioned if their data is shared with other companies.

> *“Are anonymous datasets available for research purposes and extend their use?”*

> *“What exactly happens with all the data that is collected about me?”*

> *“Who has access to the data generated by these technologies? Is it only the government or companies as well?”*

## CONCERNS ABOUT SURVEILLANCE

A frequent concern among participants was the use of smart technologies for surveillance purposes. Participants expressed being okay with the use of smart technologies as long as they are not use as a surveillance tool.

> *“Is there anything preventing companies or individuals from just collecting data because they can, without it serving any real purpose?”*

> *“How many of those [smart technologies] are used? How much of public space is under surveillance?”*

> *“A lot is very effective and useful while other technology can be mismanaged and create great risk.”*

> *“I don’t mind the ‘utility’ gadgets like the Fill level sensors. I think those can make life a lot easier. But I’m worried about the surveillance technologies”*

## CONCERNS ABOUT SCANCARS

Answers were mixed. Some stated that they don’t really feel concerned about the use of scancars, they think their privacy is protected by the government. Some other would like to have more information because they don’t know how exactly they work. Others were wondering if scancars take pictures of people’s faces.

> *“Does the scancar match vehicle number plates with geographical data? If data is combined (e.g. faces, number plates, and geolocation) people can be followed.”*

> *“I don’t own a car myself, but I feel the cars are an invasion of privacy.”*

> *“Are photos taken of people’s faces as well?”*

> *“I would be concerned if the Scancar is going to be driven unmanned. I think a human is needed to evaluate the nuance of human ethics in some circumstances.”*

## WHAT’S MISSING

The last part of the online survey was intented to know what participants would like to know and how they would like to be informed. Many participants agreed that information on scancars is missing, saying that they would like to be able to consult the data scancars collect in a meaningful way. Other participant suggested that the data collected from scancars should be made available to citizens in order to spark ideas.

> *“Visualize the data on a special insight website/app, show where data is collected and how it is used.”*

> *“It would be cool if we can see some sort of output of the data in a way that we understand what they’re working on.”*

> *“Would be cool if we could ‘play with the data’. It makes it less mysterious what they are doing and safer. Also highlight the ‘good’ they will try to do with it.”*

> *“More details on how personal privacy is ensured with the increase of public monitoring.”*

# 05.

# Empowering Smart City Residents

In this chapter, a synthesis of the most important findings of the research activities described in chapters 2, 3 and 4 is presented. From that synthesis, a design direction and objectives are defined. Then, a conceptual framework to guide the ideation process and the final design is lined out.

# 5.1 BRINGING INSIGHTS TOGETHER

In this section, I try to bring the most important findings from the previous chapters into meaningful insights to spark a design direction. First, I categorize all insights into 6 groups, each group describing the most important findings.

Then, I analyse the especific challenges that arise from the use of scancars and the current interaction. Next, I define a design statement with some specific goals and design requirements.

Finally, I discuss some theories that will serve as a conceptual framework for the design stage.

## HOW THE SCANCAR IS PERCEIVED

Dutch citizens and residents of Amsterdam haven't been informed about the use of scancars and what the scancar does. Moreover, they ignore where they can find information about it and the Municipality fails in delivering meaningful information (desk research). They have a number of concerns related to data, such as "how is the data from scancar managed, how is it protected and where is it stored?" (survey participant). And privacy "it is not clear if it records faces" (survey participant 2). Nevertheless, user research shows that dutch citizens don't mind the user of scancars because they trust their government (comments analysis, online surveys, desk research)

## AMSTERDAM AS A SMART CITY

The city of Amsterdam is using smart technologies to improve accessibility, safety and quality of public spaces, such is the case of scancars, which are used for improving the parking situation in Amsterdam. The city has ambicious plans to implement a number of technologies to make the city more efficient, sustainable and liveable. Moreover, according to different documents issued by the municipality where several strategies are outline there is a long-term plan to consolidate Amsterdam as a smart city and increase the use of smart technologies; becoming a data-driven city in the near future (literature).

While some of the data is generated by local authorities in public domain, much of the data is considered private. Moreover, the municipality quite often outsources tasks to private companies, such is the case of the scancar, losing control over citizens data. (literature, expert interviews).

## PRIVACY PARADOX

Everyday users are confronted with a number of privacy decisions; every time they enter a new website, link their smart devices, etc are asked to set their privacy preferences, but this seems to overwhelm them and even though there's concern, they face a paradox every time. This paradox is know in literature as the privacy paradox, which is the misalignment between what people say and what they do in regeard with their privacy practices. Despite people's clearly expressed concerns about their privacy, there is a simultaneous lack of appropriate secure behavior. Moreover, they share their personal information on numerous social media sites, despite the fact that they do not trust the companies behind them.

## SMART TECHNOLOGIES IN PUBLIC SPACE

There's an urgent problem with smart technologies being placed in public space without regulations, giving notice or asking for consent from users. Moreover, a number of inferences can be made from "anonymized" data for which companies should provide warnings to users (literature). City data emerges from a wide variety of governmental departments, from private and public stakeholders, from individual citizens and visitors, and are collected, analyzed and stored without any kind of central coordination or collaboration (literature).

Furthermore, people must have the right to know if they are being subject to data collection in public space since it is data generated by them, they should be given more control and information about it (literature). People are no longer users but subjects in the public space due to the dense presence of technologies in the public space. Technology development move so fast that it exceed institution's capacities to regulate them. (literature, online surveys)

## PRIVACY ILLITERACY

There is a generalized indifference attitude among citizens towards smart technologies, data collection and privacy due to several reasons: people feel overwhelmed about the amount of privacy policies they encounter every day; there's no indication of the presence of technologies in public space; companies and government present technologies in a way that personal implications are unapparent and incomprehensible; people don't know enough about how smart technologies work in order to realize the implications (literature, online surveys, generative sessions).

## RESPONSIBLE SENSING

One of the main problems with the available ethical frameworks is that they are missing enforcement mechanisms. Moreover, implementing ethical practices as part of companies R&D activities requires long term investment, resources and time, discouraging companies to do things right (interviews).

An understanding of inferences wouldn't just help users understand what the system is learning about them but would also help systems protect privacy by translating user preferences. Users have limited understanding of what might be inferred or learned from sensor data, and systems will only get better at learning from sensor data. (services must explicitly provide basic inferences).

According to literature bottom-up smart cities have more success and should aspire to be flexible, open and put emphasis in developing human intelligence in order to build a smart community which actively participates in the planning and design of the city. Moreover, people aren't against technologies if they are informed about the benefits and/or if it serves a greater good, the problem is that currently that information is missing generating concern among city residents. (literature, online surveys)

## 5.1.1 IDENTIFIED SCANCAR-SPECIFIC CHALLENGES

From the investigation I was able to conclude that there are the following problems regarding the scancar:

- ***People do not know what the scancar is used for; there is no to little information available at hand, this makes people have a number of assumptions about how it works, what it is used for, the risks it represents. Moreover, real privacy implications that the scancar could have are ignored due to this lack of information.***
- ***The municipality does not assertively communicate the use of smart technologies in the city; the information offered by the municipality is 'hidden' on its website. There is not a single website that summarizes the most important data and information in a concise way about the scancar. Contributing to a lack of awareness***
- ***The information currently provided is not comprehensive or detailed enough to be meaningful to citizens. The type and form in which this information is being given to citizens is not relelvant for them. By not giving meaningful information, the municipality is wasting the opportunity to engage citizens in giving ideas with the insights gathered from data.***
- ***Most of the people (in the Netherlands) have nothing against the use of smart technologies, they just have a lot of doubts and assumptions (due to lack of information), and their only concern towards technologies, is that they could be used for surveillance purposes. In general dutch people endorse the use of scancars to make their city more efficient and safe.***

From the researched theories (chapter 2, 3 and 4), I found the following arguments that supports the relevance of the identified scancar-specific challenges:

- ***"Anecdotal evidence suggests that the whole notion of 'smart city' or 'big data' and what it entails may be unknown to the majority of current city inhabitants and visitors" (van Zoonen, 2016).***
- ***There's a generalized lack of understanding and indifference attitude among citizens of the role smart technologies play in our lives.***
- ***'Privacy paradox' - despite people's clearly expressed concerns about their privacy, there is a simultaneous lack of appropriate secure behavior (Kokolakis, 2017).***
- ***"IoT devices' ubiquitous nature means that a person can easily not know when sensors are present." (Chow, 2017).***
- ***The promise of such large amounts of data for smarter management of cities extends to other sectors as well such as (predictive) policing, crowd control or public sentiment monitoring (van Zoonen, 2016).***
- ***People must have the right to know if they are being subject to data collection, and since it is data generated by them, they should be given more control and information about it.***
- ***Cities need to build a smart community that actively participates in the planning and design of the city (Sennett, 2012).***



## 5.1.2 CURRENT INTERACTION BETWEEN USERS AND SCANCARS

The city of Amsterdam is a busy, liveable city, visited by thousands of tourists every day. Its city center is hectic and dense. For this same reason, the parking situation became complicated in recent years and the municipality of Amsterdam ,to alleviate this problem, decided to explore the use of smart technologies, finding in the scancar a perfect fit.

Every day, the inhabitants of the city go to work, to school, to meet friends; tourists stroll through the center or nearby areas. Both residents and tourists travel the city by bicycle, walking, public transport or by car.

The scancar runs through the streets of Amsterdam, and both tourists and residents, for a moment, interact with it. The only thing that can be read when the scancar passes by is a small message that says it is owned by the municipality and a second one that reads, 'parkeercontrol', meaning that it is used for parking control, for those who don't speak dutch, guesses will need to be made.

Both residents and tourists do not receive more information about the interaction they just had, if they would like to know more, users can make an internet search that will tell them basic burocratic information, most of it in dutch.

How can this interaction be improved? What information should be provided? How can we include tourists and non-dutch speaker users in the information-loop? How can we build a better smart city?

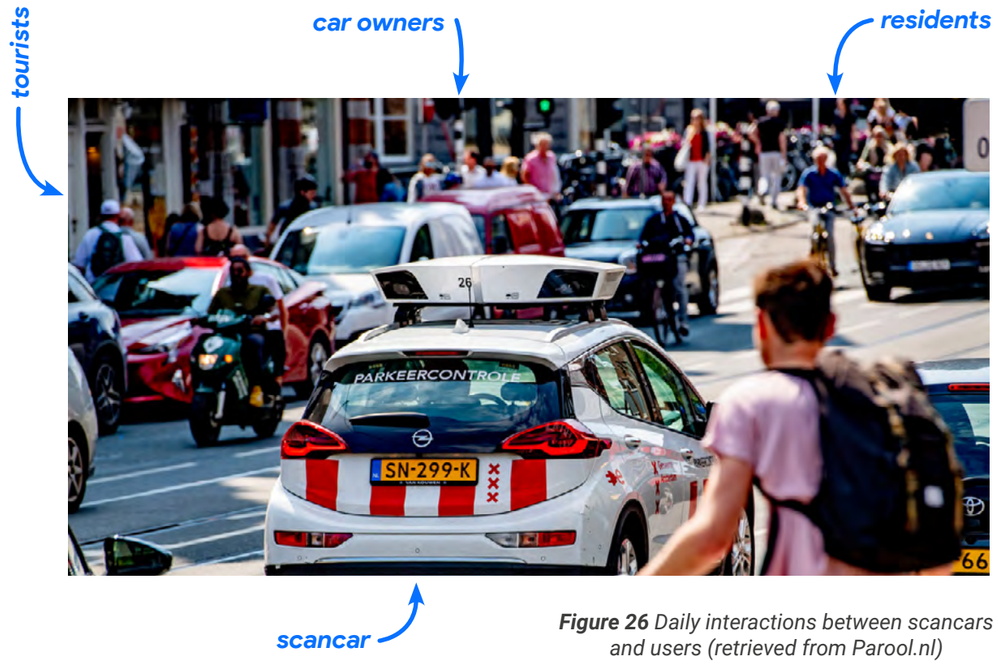



***Figure 26*** *Daily interactions between scancars and users (retrieved from Parool.nl)*

# 5.2 DESIGN STATEMENT

The following design statement was formulated based on the research synthesis and identified design opportunities. It brings together the original intention of the assignment with the insights of the research phase.

statement:

***To empower smart city residents, I want to help people better understand smart city projects and the privacy implications by providing comprehensible and meaningful information and a platform to co-shape their city.***

The design statement can be break into three objectives, which will be described below, these objectives serves the purpose of building on the main objective which is: to empower smart city users. These objectives should be covered in the design solution:

***build a smart community***

by providing comprehensible information which can be acted upon.

***spread awareness***

of the presence of sensors and data collection in the public realm.

***encourage civic engagement***

with smart city projects in order to build a participatory process.



## 5.2.1 DESIGN CRITERIA

The design solution should meet the following requirements, inspired by the design statement and the three objectives.

The design solution should:

- ***It should clearly communicate scancars' use and purpose in a comprehensible and usable way to the end user.***
- ***It should convey what users consider meaningful information.***
- ***Provide a space where users can act upon the information that has been given to them.***
- ***Make privacy implications of smart city projects, in this case, the scancar, apparent and comprehensible.***
- ***Engage users with the information and features.***

## 5.2.2 IDENTIFIED BARRIERS TO TAKE INTO ACCOUNT

From the research activities and the main findings, I was able to identify a number of barriers that could prevent the design from having a larger impact on users. These are:

- ***Complexity of smart technologies and systems.***
- ***Users are bombarded with privacy policies everyday, thus feeling overwhelmed by all the information.***
- ***Laypeople are not interested or show indifference towards smart city projects.***
- ***Usefulness of data insights for laypeople.***
- ***Different levels of cognitive capacities among users.***

*visual elements taken from freepik.com*

# 5.3 EMPOWERING SMART CITY RESIDENTS

Before proceeding to the ideation phase, I explored some theoretical background that served as a guide towards developing the design solution. The following section compiles relevant theories that inspired and guided the design qualities.

## 5.3.1 LEGIBILITY AS A DESIGN PRINCIPLE

In chapter 3 the importance of the legibility of the information was discussed, since as Lindley et al. (2020) making smart technologies transparent is not enough. The advantage of making a system readable is that it becomes understandable, in the end giving it meaning and a value that it did not previously have for the user.

New technologies collect an enormous amount of data, but most of that information is lost or used only by experts and technocrats, but when it does get out of that circle, it is offered in a format that is neither understandable nor constructive. Here comes legibility as a design principle; By making information understandable and intelligible to people, it becomes constructive and usable. “Without this, these technologies and the insights they offer are illegible to the laypeople that encounter them (Robbins & Stone, 2020)”.

The complex nature of data makes it difficult to produce intelligible and valuable information for laypeople. Extracting only what is meaningful and usable from the data represents a great design challenge. But if it is achieved, it can serve not only to inform, but also to promote engagement, since the user will be able to act with that information and have meaningful interactions (Robbins & Stone, 2020).

## 5.3.2 A PRIVACY FRAMEWORK AS A GUIDING TOOL FOR SMART CITY PROJECTS

Van Zoonen (2016), proposes a framework based on existing research about privacy preferences and concerns of people in smart cities. For example, people worries about who is dealing with their personal data, or that people assess for which purpose data is used and weigh the benefits that providing their data may offer them.

The framework (see Figure 27) identifies four types of “possible sensitivities” that people may have about smart city data. This framework could help identify which technologies and data-applications used in Amsterdam Smart City are likely to raise people’s privacy concerns.

There are two opossing quadrants in the proposed framework; on the one hand, when personal data is used for surveillance purposes and government control. On the other hand, when impersonal data is collected for service purposes. As expected, people’s reactions to these two possible situations are contrasting. Citizens seem to have no problems when technologies are used to improve the city and the quality of life of its residents. On the contrary, when they perceive that they are used for surveillance purposes plus collecting personal information, this generates a lot of suspicion and controversy.

Currently, most of smart city projects in Amsterdam concern impersonal data and are used for service purposes, but still inferences can be made and missuse of technologies are possible.

The privacy framework could be use to “understand the policy challenges that specific smart city technologies and data usage may throw up to local governments”, and as a moral compass to to in the IV quadrant.

## 5.3.4 A SMART COMMUNITY IS ESSENTIAL IN SMART CITIES

Nam & Pardo (2011), pinpoint the role of citizens and fostering creativity in smart cities: “creativity is recognized as a key driver to smart city, and thus people, education, learning and knowledge have central importance to smart city.” Batty et al. (2017) as well recognizes the importance of a smart community whose citizens can play an active part in their operation and design

As mentioned in a number of smart city frameworks, building a smart community is an important and central factor to smart cities. Moreover, many authors agree that citizens should be considered in the decision-making; they should be able to participate in the process, and contribute with their personal knowledge in the developing of smart technologies.

## 5.3.3 WHAT DO PEOPLE WANT TO KNOW?

Based on the literature research and the results from the qualitative user research, I identified that people are mostly concern about their data. They want to know how is it being managed, how is collecting it, for how long is it being collected, among other things. Moreover, people knowing the purpose of the data will benefit them or society at large, makes them more optimistic and receptive to data collection.

| | |
|---|---|
| Entity | Benefit |
| Purpose | Retention Period |
| Data Type | Location |

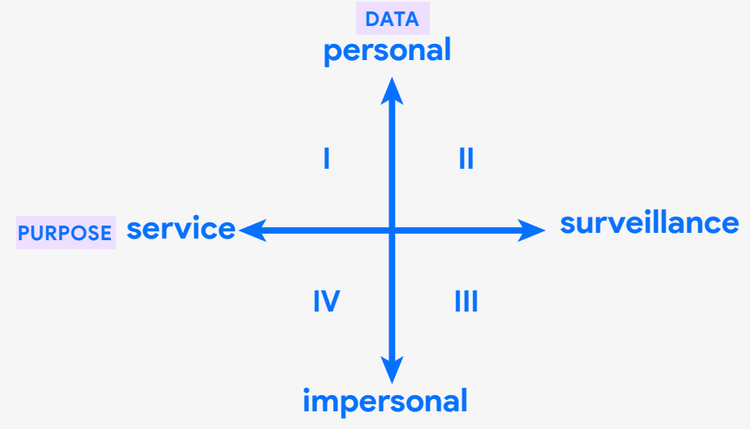



***Figure 27*** *Smart city privacy challenges represented in a two-by-two scheme, Van Zoonen (2016)*

# 5.4 FIRST IDEAS

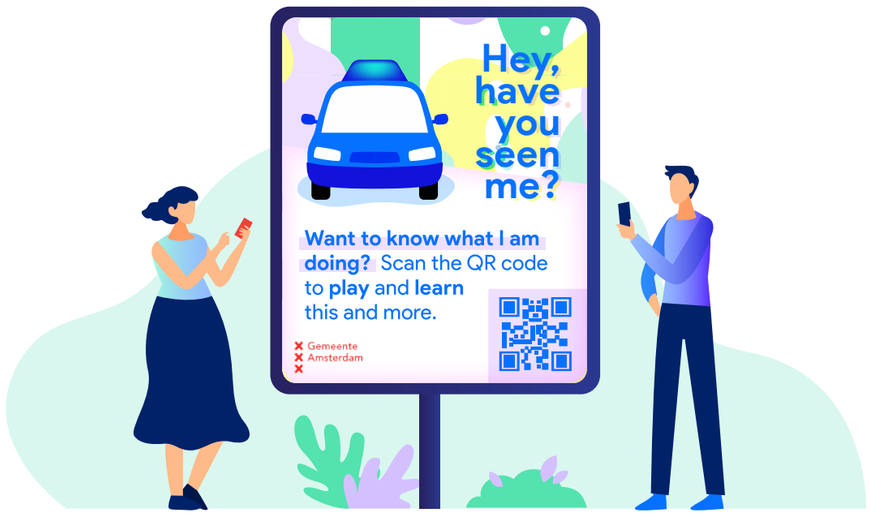
After setting a design goal and design requirements, a design exploration started. The theories described in the previous section, served as a conceptual framework for the idea generation along with the research insights from the analysis phase.

An ideation session was organized with a fellow designer to come up with potential design ideas. Brainstorming technique was used to come up with as much ideas as possible in order to explore the design space (see figure FIXME). Afterwards, three main concepts were selected to explore them further. The three concepts are explained next

## CONCEPT 1

This first concept was about engagement and building knowledge. By triggering curiosity on the streets, users could engage in a trivia game to learn about scancars. The idea was to have several touch points on different streets, each one giving different information and games. Each point touch point consists of a short message inviting users to learn more about the scancar by scanning a QR code that will direct them to a game platform.

In the game platform, a series of simple challenges will be given to the user in order to form knowledge using the 'generation effect' principle. The idea is to build up knowledge on the 5 most important aspects on privacy sensors that citizens value in a legible and playful way.



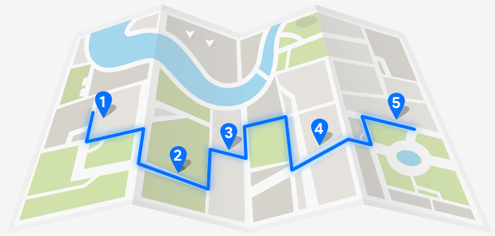

*visual elements taken from freepik.com*



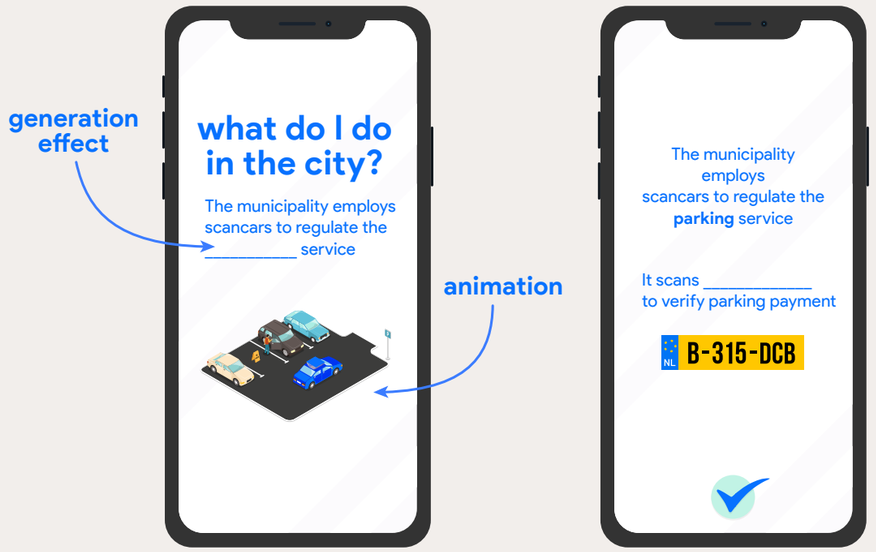
The idea was to convey the most meaningful information—purpose, benefit, type of data, location and entity— for users in a playful way, and by using generation effect theory, which states that it's easier to learn new information if it's generated by yourself. Below some examples of how could this theory be applied in the concept

The touch points would be placed strategically in areas where the scancar is frequently seen. Examples of how the first of these five steps would look like are given below:.

1. Communicate the purpose
2. Communicate the benefit
3. Type of data, storage & retention
4. Location
5. Entity behind



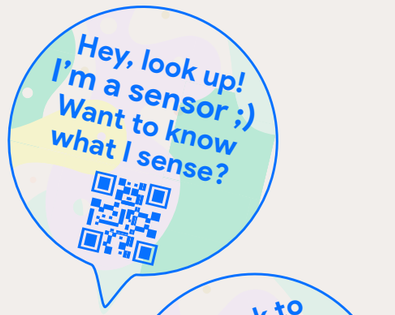

### 1 Communicate the purpose

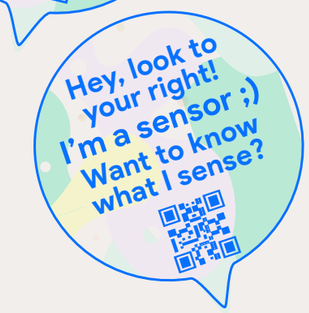


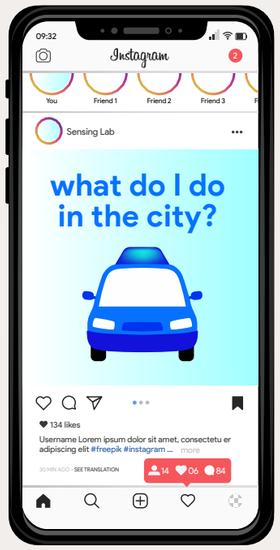

*visual elements taken from freepik.com*

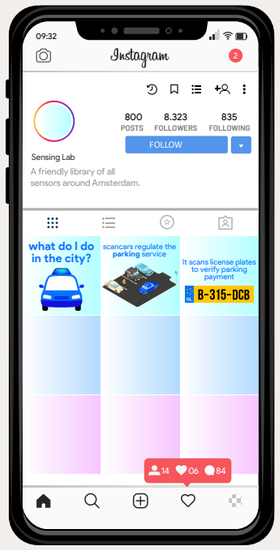
## CONCEPT 2

The idea behind this concept was to make users aware of the number of sensors present in the public realm by placing stickers in the environment that points towards a certain sensor so that the user first acknowledges the presence of the sensor. The sticker then provides a QR code that will send the user to an instagram page with a collection of sensors in the city, owned or outsourced by the municipality. The idea was as well to communicate the purpose, type of data, retention period, location, entity and benefit of the sensor through friendly graphics. The use of Instagram could also enable citizens to contribute to the library by using hashtags and tagging the “initiative”.






## CONCEPT 3

A public dashboard will be placed in a strategic point within an area where the scancar is frequently seen. The goal of the dashboard will be to present curated information about some smart technologies used in Amsterdam Smart City. Along this information, a short game will be included with the objective to foster curiosity by having to match sensors with its benefits; the concept of abduction (what-if knowledge) will be applied in order to make citizens question the what-if of sensors.

*visual elements taken from freepik.com*


These three initial concepts are just a representation of rought ideas that helped shape the direction of the final design.

From this initial concepts, some elements were abstracted and used as inspiration for the final design, which will be presented in the following chapter.

# 06.

# Final Proposal

In this chapter the final design solution will be explored; first an overview of the final proposal will be presented; then the overarching argumentation for the key features is explored, along with a detail explanation of each feature. Finally, a critical reflection is explored to evaluate the final proposal.

# 6.1 FINAL DESIGN OVERVIEW

This section introduces the final proposal. First a brief overview of the concepto is explored, along with the overarching intention and objective of the concept. Next, a description of the key features and their particular goal is provided.

Finally, a theoretical argumentation will be discussed to evaluate the final concept.

The final proposal consists of a digital tool for Amsterdam Smart City; which provides a platform for citizens and tourists to discover and engage with the ongoing smart city projects.

The goal of the digital tool is to foster engagement and public understanding of smart technologies by facilitating interactive and intelligible information about their use and the data they collect, in order to build knowledge and inspire smart city residents to ideate and co-shape their city.

***The ultimate goal of the digital tool is to empower smart city residents by first providing meaningful information so that they can become actively involved in the design and planning process of smart city projects, with the intention to foster a smart community that will co- shape an open and coordinative smart city.***

To achieve the ultimate goal, the digital tool's features can be seen as building blocks (a detailed overview will be provided in the next pages)—first, there's a need to foster better understanding of smart technologies; then it's necessary to engage citizens with the insights offered by smart technologies in order to build a broader perspective of the city; finally, once smart city residents are empowered by all these meaningful information, they can actively participate and generate ideas of how to improve the city through smart technologies.

*image from freepik.com*

***Participation and self-organisation are the cornerstones to building a global knowledge resource that, by design, will represent a public good, accessible to every citizen, institution or business (Batty et al., 2012).***

The three main features of the digital tool are:

- ***providing meaningful information about smart city projects used in the city; how they work, how it improves the city and their privacy implications.***
- ***provide intelligible and actionable data of the insights obtained from these smart technologies.***
- ***allow users to engage and participate in the planning of future smart city projects.***

# 6.2 APP FEATURES AS BUILDING BLOCKS

As mentioned in the previous section, in order to foster a smart community and empower smart city residents, it's necessary to build on knowledge that can provide them with a better understanding of smart technologies, it's possible uses, benefits and risks; share with them the insights obtained from these and allow them to get actively involved in the planning.

To achieve this, the digital tool was divided into three building blocks: discover, explore and act. Each block fulfills a function in building a smart community. The key features of the digital tool emerge from each block. Moreover, each building block serves to achieve the design objectives defined in the design statement (in chapter 5).

image from freepik.com

| BUILDING BLOCK | DISCOVER | | | EXPLORE | ACT |
|---|---|---|---|---|---|
| FEATURE | *Discover smart city projects* | *Offer meaningful information about their use and benefits* | *Learn about their privacy implications* | *Explore insights generated by smart city projects's data* | *Submit ideas on how to improve the city through smart technologies* |
| GOAL | Spark curiosity and create awareness about the existing technologies being used as part of Amsterdam Smart City, in and around the city | Provide and foster better understanding of smart technologies and how the city is benefiting from them. | Inform and help users to understand the privacy implications each smart city project represents for them. | Provide usable, comprehensible information about insights collected through the smart city projects in order to create understanding about the city. | Involve and engage smart city residents with the planning of their city by enabling them to participate and give ideas. |

*spread awareness and build a smart community*

*encourage civic engagement*

## 6.2.1 DISCOVER

The first feature allows the user to discover smart city projects that are being used in the city. Since this thesis project investigated the scancar as a use case, the current content is mainly focus on it.

A very important aspect of the app is the use of playful visual information to generate curiosity and engagement in users

First, a brief overview of the smart city project, in this case the scancar, accompanied by a short description and information about who runs it.

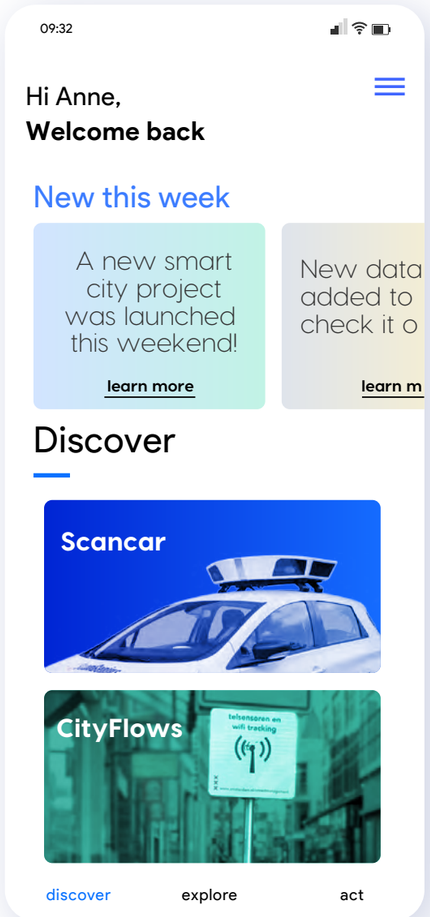
For each project, the user can explore three different levels of information:

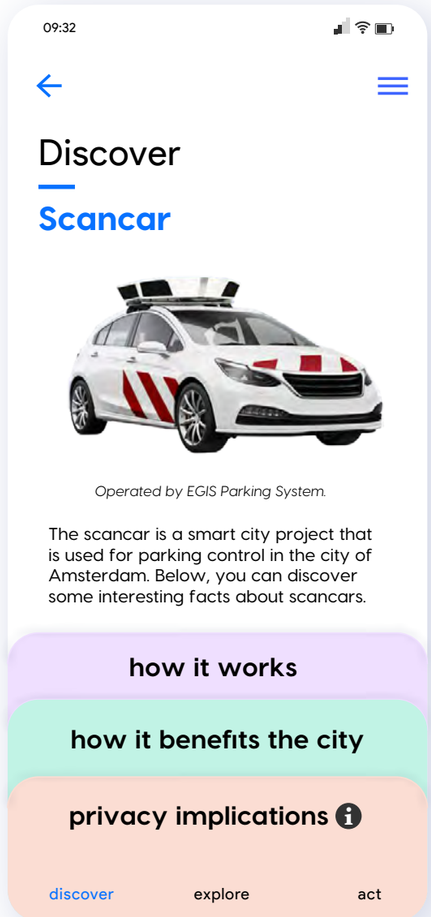
First, how it works; the technology it uses, the data it gathers. Second, how the municipality and the city is benefiting from it. Finally, the user is given the option to learn more about the privacy implications of the scancar.

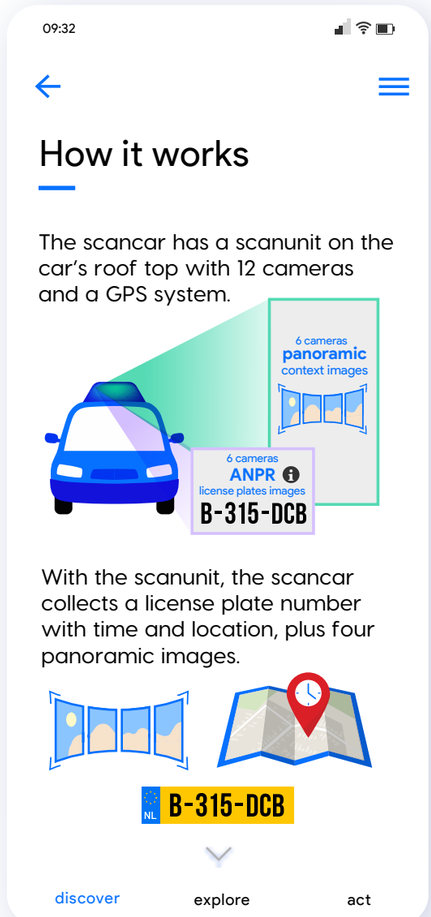
### *How it works*

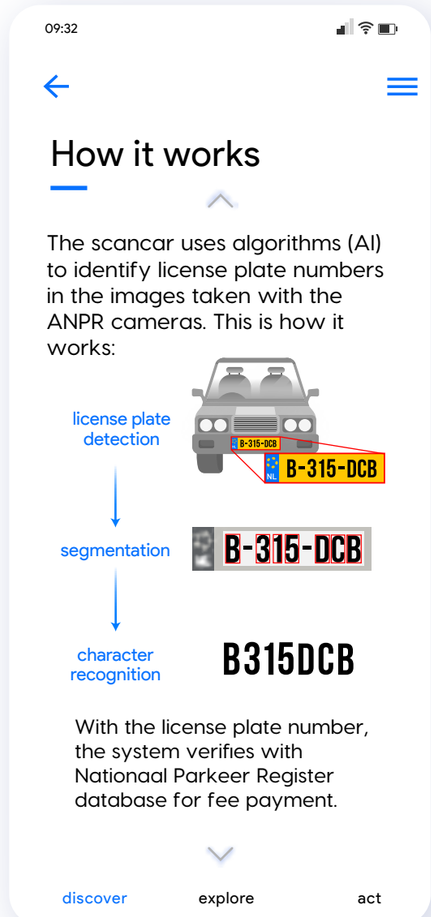
The objective of this section is to give the user specific information about the technology that enables the smart city project; how it works and what type of data it collects, what form of AI is it employing.

It is very important to start building a better understanding of the possibilities of each technology so that it can spark ideas in users.



## *Benefits*

As found through literature and user research, people would like to be informed about the benefits and how are they improving the city which each technology, that way, breaking down reluctance to certain technologies. Therefore, the objective of this section is to make evident the benefits and how the municipality is making good use of the scancars to residents.

## *Privacy implications*

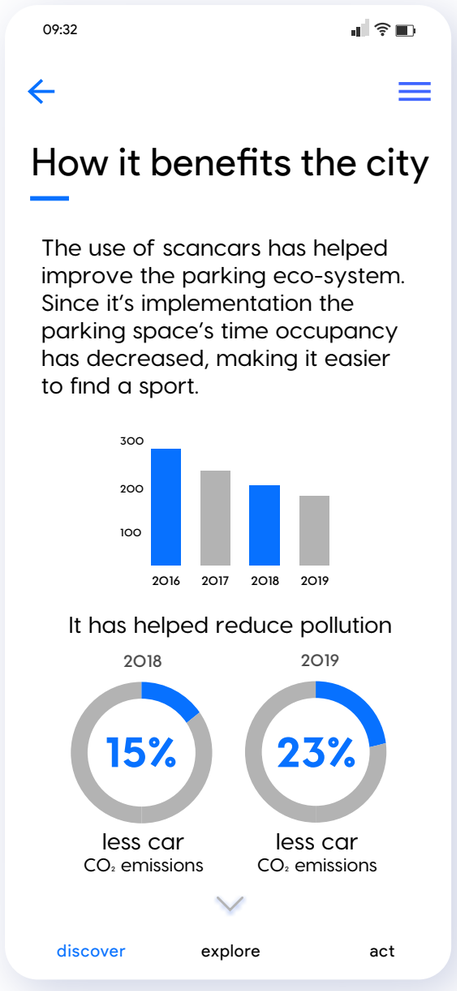
Finally, the idea is that each smart project will provide information about the measures in place to protect their privacy, and as well to provide possible risks, such as inferentes that can be made.

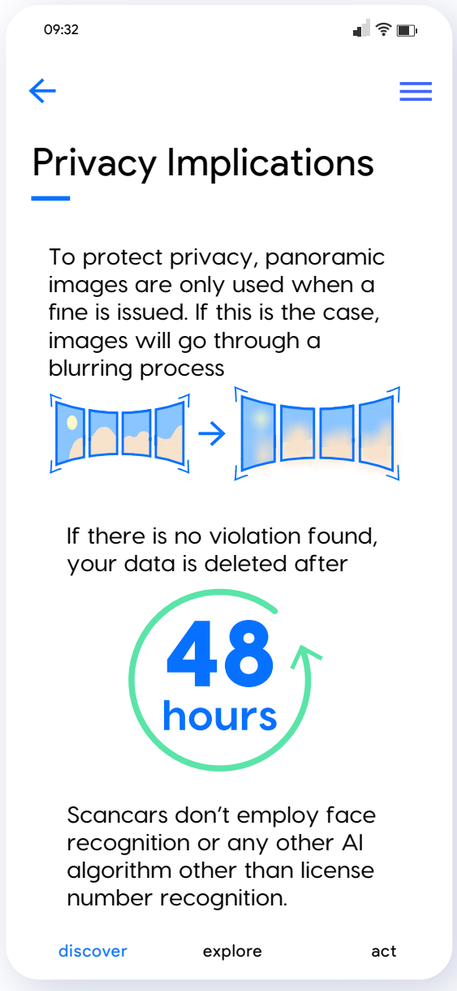
Moreover, the design tool should make evident and explicit privacy implications and not hide or mask this information.

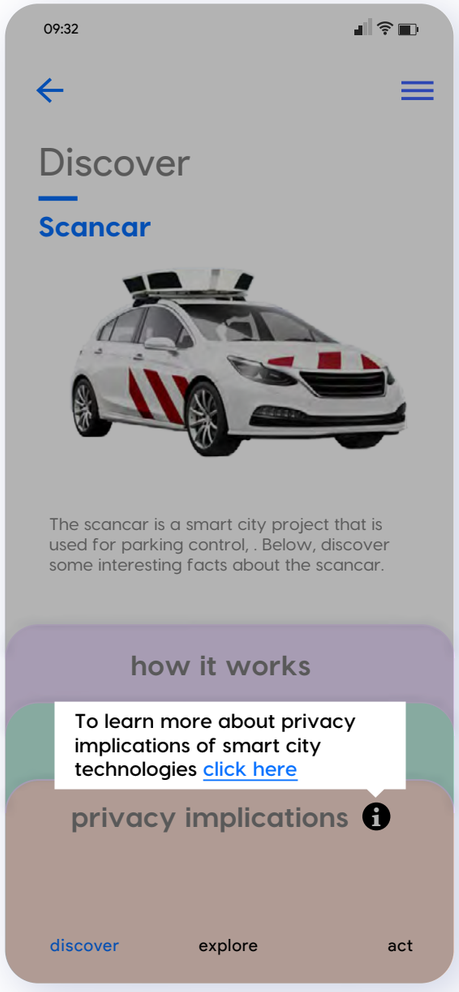
## *Extra Information*

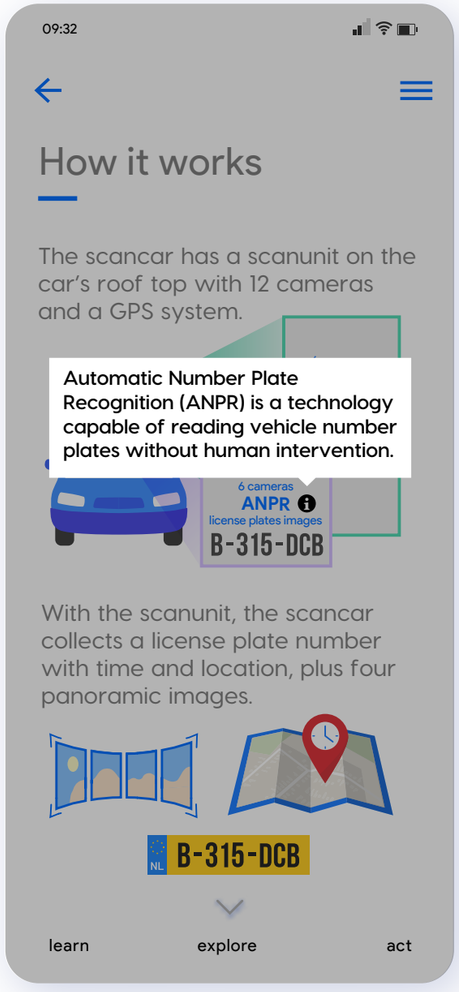
It's important to not take for granted user's curiosity and provide relevant and high level information for those who are willing to learn more detailed information.

To make users really aware of the privacy implications it is important to state the possible escenarios in which their data could be at risk.



## 6.2.2 EXPLORE

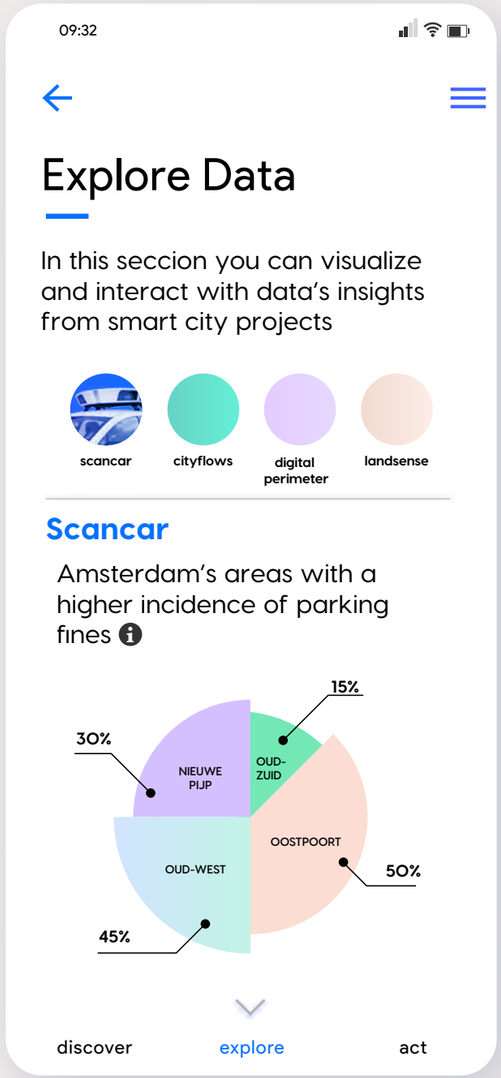
The second feature is about providing access to smart city residents to the insights generated by smart city projects. In the user research activities I conducted many of the participants mentioned that they have no problem or suspicion towards the scancar, but that they curious to know and get access to the insights obtained from the scancar.

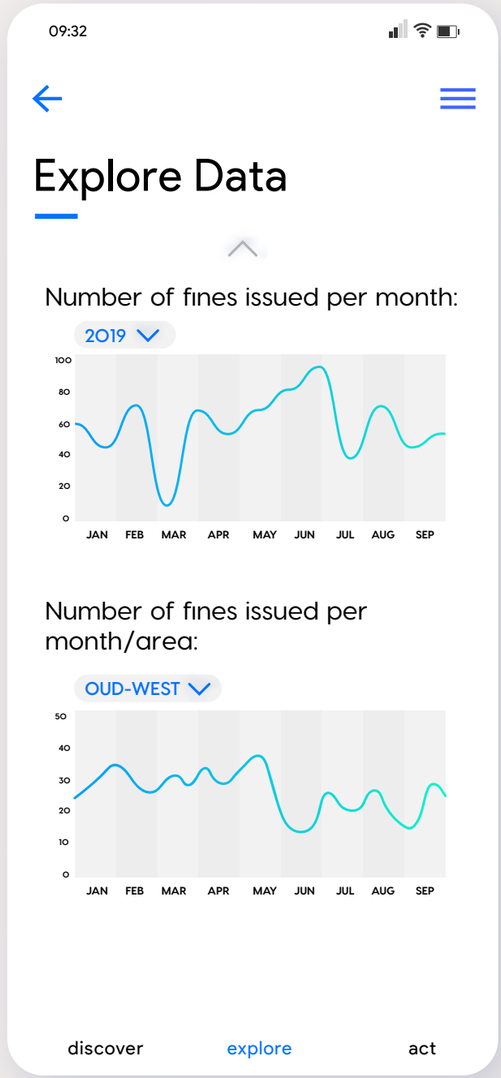
In practice, it is difficult to transform the data generated by smart technologies into meaningful information for laypeople. Data analysts analyze data sets in search of insights that allow the city to be more efficient, and the insights are only used and shared among this small group of experts.

By using legibility as a design principle, it's possible to translate technical insights into meaningful and intelligible information for users, this would allow them to understand how the municipality uses insights gathered by smart city projects and to spark new ideas among users.

In this secction, as can be observed in the image, it's possible to explore data insights for each smart city project. The municipality should select what insights are more meaningful and could spark ideas in citizens.

By using legibility as a design principle, statistics and gained insights from data sets are presented in a visual and engable way for users. The idea is that the user can explore different levels of data, change between years, technologies, so he can visualize how the city is evolving in different aspects.



## 6.2.3 ACT

The objective of this feature is to give users the opportunity to act on the information given to them in the 'discover' and 'explore' features, and in this way to actively involve them in the planning of current and future projects.

Involve residents that co-shape the city will be possible through a participatory process in which users first submit an idea, then experts select the most feasible ideas and together with citizens develop the ideas into concrete smart city strategies. Finally, users get to vote for their favorite ideas and the top voted ideas will be implemented by the municipality.

### *Submit ideas*

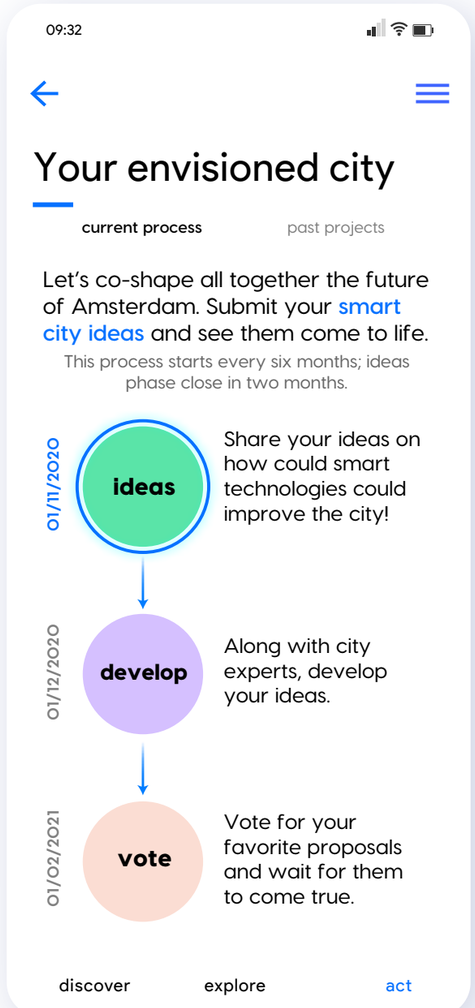
The user can submit any ideas related to smart city projects; whether with existing technologies, propose the implementation of new technologies, or by ideas sparked with the data insights from the projects.

### *Develop ideas*

In this phase of the participatory tool, the municipality would enable experts along with citizens to develop the selected ideas.

### *Vote*

In this phase, users can vote for their favorite ideas which will later by implemented by the municipality.




## 6.2.4 COMMUNICATE ETHICAL AND PRIVACY MEASURES TAKEN ON EACH SMART PROJECT

A very important dimension of this final proposal is the privacy implications, since as expressed by various experts, most users are concerned about their privacy.

In the final proposal, I propose that a section be added where citizens are informed of the ethical principles by which the municipality is governed, as well as the measures they are taking to ensure the protection of citizens' privacy.

In the prototype (right image), I give an example of how the privacy framework proposed by Van Zoonen (2016) could be used by the municipality, as well as to make the TADA principles and other guidelines they adhere to, known to citizens.

It is very important to inform citizens about the ethical values that the municipality adheres to in order to build trust among citizens.

# 6.3 THE BIGGER PICTURE

it is very important for the future of Amsterdam as a smart city to build a democratic process where residents can participate, and the city make responsible use of smart technologies,. Therefore, the proposed tool is only the first step towards this future.

The final proposal aims to contribute to the bigger picture: to build an open and flexible smart city that fosters a smart community and promotes a democratic process, so that together with citizens, the future of the smart city can be co-shaped.

As literature pinpoints, it is necessary to include citizens in the planning and decisions that are made within the framework of smart cities. It is important to build the future together with them, to make this possible a smart community is needed that has the information necessary to act and make informed decisions.

It is also necessary that all types of users are taken into account, including tourists and expats. As a multicultural city and the percentage of visitors and expats living in the city, Amsterdam has the responsibility to take these target groups into account. Therefore, the tool should should also be translated into physical touch points, so that tourists, for example, can be informed about what scancars do.

### *Spread Awareness*

Through informing the residents of Amsterdam about existing projects, the opportunity is given to measure the use and density of technologies used in the city, it is important to create awareness due to the ethical risks that these can imply, also because the research shows that most of the smart city residents are unaware of the existence of smart technologies and the collection of data about them in public space.

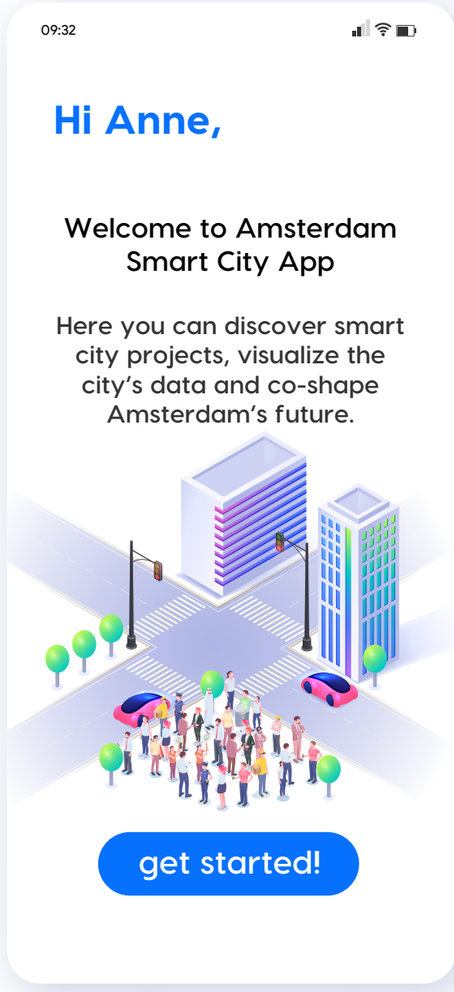
### *Build a smart community*

In a smart city, technology can be used as a tool to communicate projects and decisions to citizens, therefore enabling them to participate and make decisions; for a smart community to exist, knowledge is necessary, by presenting the user with relevant information about how they work, what they are used for and the insights they generate. give a better understanding and awareness of the privacy implications smart technologies have in people's lives. Invite users to be more attentitve to the privacy choices they make throughout the day.

### *Encourage civic engagement*

Civic engagement is the exercise through which citizens can participate in the decision-making of city policies. As a smart city, encouraging this behaviour is essential to build a democratic and responsible city. By informing citizens of smart city projects and providing them a space to submit ideas, a democratic and valuable exercise is fostered.

***"Technological propagation is not an end in itself, but only a means to reinventing cities for a new economy and society. A smart city is a humane city that has multiple opportunities to exploit its human potential and lead a creative life (Nam & Pardo, 2011).***



# 6.4 EVALUATING THE PROPOSAL: A CRITICAL REFLECTION

In this section a critical reflection on the final proposal is explored. First, I'm going to evaluate the final proposal based on the design criteria outlined in chapter 5. Then, I am going to reflect on the design based on theoretical argumentation.

## 6.4.1 EVALUATING THE FINAL PROPOSAL BASED ON DESIGN CRITERIA

### *It should convey what users consider meaningful information.*

The information that was conveyed in the final proposal is backed up by literature research. In chapter 4, privacy preferences of users was reviewed, and it was found out that users want to know who's the entity behind the technology, what's the purpose of use, type of data it collects, beneftis and retention period. Moreover, the user research exposed a need from users to know how the scancar work and to be able to visualize the data it collects.

### *It should clearly communicate smart city projects in a comprehensible and usable way to the end user.*

By using legibility as a design principle, the digital tool communicates data's insights from scancars in a comprehensible and usable way. It was very important to translate scancar data into information that could be meaningful to citizens and that could spark new ideas.

In the current final proposal, some examples of scancar's data insights are provided, but a more thorough process should be undertaken to select what could be more meaningful for users.

### *Provide a space where users can act upon the information that has been given to them.*

Literature and user research backed up the need to include citizens in the decision-making of smart cities. Many authors talk about a smart community that is involved and participates actively in deciding what technologies and how they should be implemented.

The final proposal aims at providing such a space where users can engage and participate, and feel empowered to act with the knowledge that have gained.

### *Make privacy implications of smart city projects, in this case, the scancar, apparent and comprehensible*

The main motivation for this project was the ethical risks and privacy implications of the use of smart technologies in public space, thus, it was very important that the privacy implications were stated and made evident in the final design. The final proposal aims at giving an overview of the privacy implications per smart technologie. In the current proposal, I present an example of how it should be communicated.

Literature and user research proof that citizens are mainly concern about their data and using smart technologies as a control tool, therefore the municipality should be clear and transparent about the data uses and the privacy measures they are taking.

### *Engage users with the information and features*

A second intention of using legibility as a design principle, is the opportunity it gives to promote engagement. The final proposal intented to achieve this by giving the user meaningful, constructive information with which they can interact and act upon.

## 6.4.2 THEORETICAL ARGUMENTS

Finally, a number of theoretical arguments will be provided to support the final proposal:

- ***People demand information about the entity collecting data, the purpose of the collection, the benefit they receive from it, and the retention period of the collected data (Naeini et al., 2017): the final proposal aims to incorporate the results from the research study conducted by Naeini et al. (2017)***
- ***"Legibility is concerned with the conscientious processes of mediation and exposition necessary to render technologies as intelligible and constructive to the end user (Robbins & Stone, 2020): the final proposal aims to practice legibility to translate data insights into intelligible and meaningful information for the user.***
- ***"Where legibility is concerned with providing information, agency provides the means to do something based on that knowledge" (Lindley et al., 2020): the final proposal provides a space for citizens to act and practice agency with the knowledge they have been provided with.***
- ***Batty et al. (2012) discuss that smart cities should be constituted by a 'smart community', which means a community that actively participates in the planning and design of the city: the final proposal provides smart city residents with a tool to actively participate in the decision-making of future smart city projects.***
- ***Users aren't always aware when a device is collecting personal data. IoT devices' ubiquitous nature means that a person can easily not know when sensors are present (Chow, 2017): the final proposal aims at making residents more aware of the ongoing projects around the city by making them available through the app to the users.***
- ***A smart city that is open and flexible, encourages intellectual development in its citizens and respects their individuality (Sennett, 2012): the final proposal aims at helping users to better understand smart technologies by providing them with layers of information.***
- ***"The benefits of 'sharing' data are most often stacked in favour of those capturing the data, especially when they are monetized or shared with third parties and used against individual interests" (Kitchin, 2012): the final proposal intends to contribute to a change in this practices, by sharing data with Amsterdam's residents, moreover in an legible manner.***

# 07.

# Conclusions

*In this chapter final conclusions on the outcomes of this project, as well as limitations and future recommendations for next steps will be discussed.*

*"The technologies—the cloud, big data, algorithms, and platforms—will not dictate our future. How we deploy and use these technologies will." (Kenney & Zysman, 2016)*

# 7.1 CONCLUSION

The smart city is not just a trend, over time more cities will adopt new technologies to tackle the urban problems they are facing, and those that already are, will become even smarter. For this reason, an ethical discussion around the risks of smart technologies and AI becomes even more relevant.

The process towards this smart future should be designed along with citizens, throughout the project a number of reasons why this is essential surfaced. As Richard Sennett proposes a coordinated smart city in his book Building and Dwelling, a city that is flexible and open to change will thrive along with its citizens.

Ideally, cities should take the role to educate citizens, enable them to understand what, how and why they are doing with technologies. My vision for the future of Amsterdam is to build a democratic process for the implementation of smart technologies, a participatory governance where citizens can decide how the municipality and companies can make use of this.

## *The Unforeseen Global Pandemic*

The world faces its greatest global pandemic in recent time—COVID-19—a virus that has spread in all continents and which has taken the lives of nearly 350,000 people globally. Governments around the globe are facing the problem and protecting its citizens in different ways but a number of countries have been experimenting with smart technologies to enforce social distancing measures, such as crowd monitoring, location tracking, smartphones' apps, etc. The pandemic has set a new precedent for mass surveillance by using data to regulate citizens' interactions. These last use of smart technologies have raised severe ethical questions and concerns among multiple actors.

The timing in which the pandemic unfolded couldn't have been more perfect to proof that, us, citizens need to start paying more attention to our sorroundings and noticing the smart technologies around us. Moreover, it's important to leave aside attitudes of indifference towards the privacy implicacions and privacy notices of technologies, and start demanding better ethical practices from companies and governments.

## *Personal Reflection*

I decided to get involved in this project because I have a great interest in urbanism and public space and the project offered the opportunity to look into the future of urban planning and how cities will be shaped by a number of smart technologies, making design practice adapt to the new paradigm.

Personally, it was difficult to stay motivated during the lockdown period due to the COVID-19 pandemic. Due to the pandemic most of the research and design activities have been conducted online, therefore, I believe the results would have been more relevant and significant if I would had been able to carry out the project as initially planned.

## 7.1.1 FINAL RECOMMENDATIONS

The proposal provides the City of Amsterdam with insights and a tool that could be implemented directly. There are however a number of recommendations that could support further iterations of the proposal:

- ***Further evaluation within the context of use and over a longer period of time would be needed to gain a better understanding of its value.***
- ***The current proposal only provides information about the scancar, but other smart city projects could be added to the app in the same format.***
- ***The city of Amsterdam should asses which smart city projects could be relevant and meaningful to users.***
- ***The participatory process needs to be revised in order to provide a more realistic schedule.***
- ***Since the city of Amsterdam receives thousands of visitors each month, it would be relevant to provide a meaningful overview in a physical format to tourists.***
- ***Since the number of expats living in the city of Amsterdam, it would also be important to have the english version of the app.***

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