Master Thesis

TNO innovation for life

UNIVERSITY OF TWENTE.

Dynamic Roles in Smart City Development
Blurring Boundaries in Smart City Pilot Projects

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ABSTRACT

A smart city can be understood as a city in which information and communication technologies are applied to improve quality of life; taking into account the social, cultural, economic and political processes that take place within the city. Several scholars have called for 'including people' in the development of smart cities, but do not address which people and in what role to include them. Smart city applications are developed within specific projects. Within smart city projects the distinctions between design & use and between government & citizen are blurring. Because of these blurring boundaries the roles of actors within smart city projects change. Therefore the following research question is addressed within this thesis: *How are roles of actors in specific smart city projects shaped within project dynamics, and how do these roles in turn influence the project dynamics?*

In this thesis smart cities are conceptualized as socio-technical systems which can be studied from a Science & Technology Studies (STS) perspective. The theoretical framework builds upon actor-network theory and is extended with role theory to be able to address the different roles within project dynamics. A new framework has been developed to describe the dynamics between roles and human & technological actors in smart city projects, using the concepts of configuration, appropriation and translation. This framework has been used to analyze the roles and project dynamics within two case studies. The first case consisted of a project around the smart citizen kit, with which citizens can monitor air quality themselves. The second case focused on increasing house burglary safety by improving social cohesion in streets through an online platform. Within these cases several new roles were negotiated and several factors that were important in the project dynamics were identified. For each case study an overview of these roles is presented and several aspects that are of importance in the mutual shaping of roles and project dynamics are identified.

In conclusion, the mutual shaping of roles and project dynamics can be described by three separate dynamics, related to blurring boundaries between citizen & government (1) and design & use (2) and dynamics related to project processes (3). The first discusses roles and project dynamics related to the blurring boundaries between citizen and government. The changing relation between citizen and government results in new roles of the data producer, the facilitating professional as data interpreter and knowledge contributor, and a role in taking action based on data and information gathered. One of the aspects shaping these roles is the accessibility of data. The second dynamic is related to the blurring boundaries between design & use. The roles of user, tester and co-creator are expected of citizens. These roles all are related to the role of the developer, but their expectations of a developer differ. The relation between developer and user, tester and co-creator is mediated by the technology under development, and these roles and technology mutually shape each other. The blurring boundaries in smart city projects contribute to the development of smart cities. Blurring boundaries between government & citizen contribute to smart citizenship and smart governance, and blurring boundaries between design & use can contribute to the development of technologies in smart city context.

The last aspects in the mutual shaping of roles and project dynamics are related to the project process. They include content and process oriented focus of the project; a central actor and open approaches; and the configuration, appropriation and re-configuration of roles. These aspects at first seem to consist of contradictions, but if they are approached as complements instead of contradictions, these can actually contribute to aligning the dynamics of smart city projects.

These conclusions are translated into six lessons for dealing with these blurring boundaries when setting up smart city projects.

Samenvatting

Een 'smart city' kan beschreven worden als een stad waarin toepassingen van informatie- en communicatietechnologie worden ingezet om de kwaliteit van leven te verbeteren. Hierbij zijn sociale, culturele, economische en politieke processen in de stad van belang. In literatuur wordt geregeld gevraagd om mensen onderdeel te laten zijn van de ontwikkeling van smart city's, maar welke mensen in welke rol te betrekken wordt niet besproken. Smart city toepassingen worden ontwikkeld in specifieke projecten. In smart city projecten zijn het onderscheid tussen gebruik & ontwerp en overheid & burger vervaagd. Door dit vervagende onderscheid veranderen de rollen van de actoren in smart city projecten. Daarom wordt in deze scriptie de volgende onderzoeksvraag geadresseerd: *Hoe worden rollen van actoren in specifieke smart city projecten gevormd, en hoe beïnvloeden deze rollen op hun beurt de projectdynamiek?*

In deze scriptie worden smart city's geconceptualiseerd als socio-technische systemen die bekeken kunnen worden vanuit een Science & Technology Studies (STS) perspectief. Het theoretisch kader is gebaseerd op actor-network theory en is uitgebreid met role theory om zo de verschillende rollen binnen de project dynamiek te kunnen adresseren. Een nieuw raamwerk op basis van de concepten van configuratie, appropriatie en translatie is ontwikkeld om de dynamiek tussen rollen en menselijke & technologische actoren in smart city projecten te beschrijven. Dit raamwerk is gebruikt om de rollen en projectdynamiek in twee casussen te bestuderen en analyseren. De eerste casus bestaat uit een project rondom de smart citizen kit, een kastje waarmee burgers zelf luchtkwaliteit kunnen meten. De tweede casus richt op het verbeteren van inbraakpreventie door de sociale cohesie in straten te verhogen door middel van een online platform. In deze casussen zijn verschillende nieuwe rollen gevormd. Voor elke casus wordt een overzicht van deze rollen gepresenteerd, en worden belangrijke aspecten in de wederzijdse beïnvloeding van rollen en project dynamiek besproken.

Concluderend kan de wederzijdse beïnvloeding van rollen en project dynamiek beschreven worden in drie aparte punten, gerelateerd aan het vervagende onderscheid tussen burger & overheid (1) en ontwerp & gebruik (2) en op procesmatig vlak (3). De veranderende relatie tussen burger en overheid resulteert in nieuwe rollen als de dataproducent, een faciliterende ambtenaar als data interpreteerder en kennis bijdrager en in een rol in het ondernemen van actie op basis van de verzamelde data en informatie. Een van de aspecten die van invloed is op deze rollen is de toegankelijkheid en beschikbaarheid van data. Het tweede punt is gerelateerd aan vervagende grenzen tussen ontwerp & gebruik. De rollen van gebruiker, tester en co-creator worden verwacht van burgers. Deze rollen zijn allemaal gerelateerd aan de rol van ontwerper, maar de precieze invulling van deze rol verschilt in relatie tot gebruiker, tester en co-creator. De relatie tussen ontwerper aan de ene kant en gebruiker, tester of co-creator aan de andere wordt gemedieerd door de technologie die ontwikkeld wordt. Deze rollen en technologie vormen elkaar dus. Dit vervagende onderscheid in smart city projecten draagt bij aan de ontwikkeling van smart city's. Vervagend onderscheid tussen overheid & burger draagt bij aan smart citizenship en smart governance, en vervagend onderscheid tussen ontwerp en gebruik kan bijdragen aan de ontwikkeling van technologie in smart city context.

De laatste aspecten in de wederzijdse beïnvloeding van rollen en project dynamiek zijn procesgerelateerd. Deze aspecten zijn gelinkt aan inhoud- en procesgerichte projectdoelen; een centrale actor en een open benadering; en de configuratie, appropriatie en re-configruatie van rollen. Deze aspecten lijken in eerste instantie tegenstellingen, maar als ze benaderd worden als aanvullingen op elkaar kunnen ze juist bijdragen aan het afstemmen van de dynamiek in smart city projecten.
Deze conclusies zijn vertaald in zes lessen voor het omgaan met dit vervagend onderscheid in het opzetten van smart city projecten.

PREFACE

This thesis focuses on the topic of 'smart cities', a city in which information and communication technologies are applied so to improve quality of life. My first encounter with the concept of smart cities was about four years ago, when I arrived in Rome to start an internship for my bachelor thesis at ENEA, Italian Agency for new technologies, energy and sustainable economic development. I left the Netherlands assuming an assignment related to street lighting, but these plans completely turned around in the first week of my internship. My supervisors asked me to design a pavilion to introduce the concept of 'smart cities' to citizens. This first encounter with the concept was unexpected, but smart cities have been of my interest ever since, allowing me to focus upon the topic in many different contexts.

Within the master program Philosophy of Science, Technology and Society at the University of Twente I have been able to reflect and touch upon different aspects of the smart city, ranging from citizen participation in urban planning and the domestication of public spaces to smart energy systems, autonomous vehicles and smart shopping. Several months ago, I continued developing my knowledge of and interest in smart cities, starting my master thesis project at TNO at the department of Strategy & Policy. The informal talks with colleagues at the department and the weekly lunch presentations opened my eyes to the possibilities of what to do with an education in Philosophy of Science, Technology and Society. I'd like to thank my colleagues in the department and especially the team Environmental Planning for sharing their knowledge and their interest in my project. I'd like to thank Roel for his supervision of my project, guiding the process and always being available to talk to. It motivated me and created a pleasant atmosphere to work in. Beitske, thanks for saying the things that had to be said sometimes, they not only benefited this thesis, but me personally as well. I'm grateful for the support of my supervisor from University of Twente, Ellen, thanks for your close reading and very detailed feedback during meetings in Den Haag, Delft, Enschede and on skype. I'd like to thank Adri as a second reader for his feedback, reminding me to get out of the details and reflect upon the bigger story.

The process of writing a thesis can be challenging, not only in content, but also mentally and physically. My thanks to Marije, Wiesje, Marlijn, Renske, Petra, Albert and Wietske for their help and support throughout the process. A special thanks to Maurits for his support, not only during the last two months, but also in the months and years before.

Not only is this thesis the final part of my master, it also marks the end of my student life. To my parents, I'm very grateful for your unconditional support throughout all these years in good and more difficult times. You've made it possible for me to make my own choices and to become who I am now.

I've always enjoyed my student life in the city of Enschede. To all my friends of student association AEGEE-Enschede, including dispuut Quenouille: Thanks for the fun, the good conversations and keeping the association going, it improved the quality of my student life and my personal development. Let's keep recalling memories and make new ones. The master Philosophy of Science, Technology and Society was even better with my fellow students: Thanks for the nice discussion during classes and in breaks, for sharing philosophical frustrations and especially for the nice filosofeestjes, whether in Enschede, Den Haag or Paris. Let's continue these throughout the years.

Hanke Nijman
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In the Smith household, citizens of London in 2050, life revolves around the domestic computer network. This tells everyone what they are doing each day, gives them alarm calls on their smartphones for virtual appointments, controls the family's food supplies, tells them how much they have recycled each day and how much water and energy they have used. It regulates the internal climate of the house, rolling up blinds for sunlight and rolling down screens for insulation. Lighting is sensor-controlled. The home network is linked to their local authority, transport system and neighborhood health center, which receive data from them, and inform them about local activities and whether they have met their local carbon-use and recycling targets.

It is the weekend, so it is time for some shopping and family organizing for Katy Smith. Katy does not really need to do any food shopping beyond making a few rudimentary checks on her house computer network. The barcode-enabled fridge and fresh-food delivery system linked to her chosen online supermarkets make sure the kitchen cupboards are well stocked. Food, clothes and most other household purchases are delivered by a driverless electric postal truck, directed by street sensors and GPS tracking to her front door. But Katy needs a day out and today she is going to Oxford Street to do some serious window shopping. Before leaving the house, she taps a code into her smartphone and is connected to the automatically controlled car pool, which locates the nearest suitable vehicle. A few minutes later, an

electric car arrives. With a touch of her smartcard – the latest version of what was once known as the Oyster card – the electric vehicle moves off.

Katy's husband, Alan now works largely from home, like most people in the 21st century. While he has been eating breakfast, the computer-controlled household admin system has laid out his virtual desk with jotter and touchpad, turned on the communications systems, and opened the files it knows he is going to need today. Alan clicks on the secure company intranet. On a second screen on the wall is a football match taking place on the other side of the world. Leisure and work are seamlessly integrated. This morning, Alan needs to contact a lawyer in West Africa. In the early days of his career he relied on old-fashioned webcams, Skype and instant messaging to talk to people on "the outside". But a conference call today is just a matter of summoning work colleagues into your own virtual study environment and discussing sales figures face to face, even if you are all sitting tens of thousands of miles apart.

But everyone agrees there will remain a need for human interaction every now and again. So, on Tuesday night, Alan will go by electric taxi, paid for by universal credits transferred to his smartcard, for a sociable after-work drink with a colleague, a real human being. And they'll talk about the football and the shortcomings of the latest computer-controlled oven. Some things never change." (Shortened version of a smart city scenario by Durham (2013))[1] "

1. INTRODUCTION

'Smart City' by Guglielmo. Retrieved from http://www.guglielmo.biz/images/smart_city_guglielmo.png

The scenario on page 10 describes a possible situation of living in the smart city of London in 2050. In the last decade, the concept of smart cities has developed in literature from different research fields as well as in several projects focusing on the development of (often self-proclaimed) smart cities. Different definitions of the concept of smart cities exist, trying to understand the ongoing development towards smart cities. This thesis focuses on the role of different actors in smart city development. Paragraph 1.1 introduces the concept of smart cities and the actors involved in their development. Within smart city development, two distinctions between actors seem to be blurring, which is discussed in paragraph 1.2. This leads to

the research question in paragraph 1.3. This introductory chapter ends with the social and scientific relevance of the research and an outline of the thesis in paragraphs 1.4 and 1.5.

1.1. SMART CITIES

Many conceptual differences of the understanding of smart cities exist in as well literature from different research fields as in smart city developments in practice. In general, the smart city is understood as a city in which information and communication technologies (ICTs) are applied to improve quality of life, taking into account the social, economic, cultural and political processes that take place

within the city. The scenario on the Smith family (page 10) provides several examples of these ICT applications. Giffinger*, et al.* (2007) have identified six characteristics of the smart city: (smart) economy, people, governance, mobility, environment and living. These characteristics highlight the involvement of different actors in the smart city, and take into account the aims of improving quality of life in a sustainable manner. Giffinger *et al.* describe the smart city characteristic *Smart Economy* by factors around economic competitiveness such as innovative spirit, entrepreneurship, a flexible labor market, international embeddedness and an ability to transform. *Smart People* is not only described by the level of qualification and education of citizens, but also by the quality of social interaction, such as social and ethnic plurality, open-mindedness and participation in public life. *Smart Governance* includes transparent governance and the level of public and social services as well as participation in decision making. Transportation systems and ICTs are part of *Smart Mobility*, comprising aspects of local and (inter)national accessibility and availability of ICT infrastructure. *Smart Environment* includes sustainable resource management, environmental protection and pollution issues. The last characteristic identified by Giffinger *et al.* is *Smart Living*, focusing on the quality of life including culture, health, safety, housing and social cohesion. In these six fields, actors from public, private and civic background are involved.

Within these six different characteristics, technological applications (often ICTs) can contribute to

the quality of life in the city. While the smart city can be characterized and described as a whole, in practice it is developed from specific technological applications. Manville, *et al.* (2014) make a distinction between the smart city, smart city initiatives, and smart city projects. Within smart city initiatives, different actors work together and new ways of collaborating are created with the aim to develop the smart city. Each initiative has its own aims to develop one or some characteristics of the smart city. To achieve these aims, smart city initiatives develop specific projects. It is these concrete projects in which concrete smart city applications are developed. Although many smart city projects are developed within an initiative, this is not necessary. Individual projects can be developed independent of an initiative. Within smart city projects, many different actors and technologies are involved.

The relation between a smart city and its different aspects, smart city initiatives and projects is represented in figure 1. Interactions take place as well between the smart city, its different aspects, initiatives and projects as within these levels (e.g. between (actors in) different projects, between initiatives or between different aspects of the smart city).

The linkage of these different networks is typical for a smart city (Manville, *et al.*, 2014). This network character is facilitated by ICTs. ICTs not only enable the use of information and communication in projects on a micro-level, but also allow to connect different projects and initiatives to improve collaboration and coordination of such projects and initiatives on city level. It is this interconnectedness of different characteristics, initiatives and projects,

including actors and technologies involved, what makes a city *smart*.

There is no city without its citizens, and thus social aspects are important in the development of smart cities. The importance of the social, economic, institutional or human perspectives within these developments has been highlighted by several authors (Chourabi, *et al.*, 2012; Giffinger, *et al.*, 2007; Hollands, 2008; Nam & Pardo, 2011). These authors have called for 'including people', but do not address which people and in what role to include them in the development of smart cities. This research addresses the role of different actors in smart city development by focusing on existing projects in which technological applications are developed with the use of ICTs, so to improve quality of live in the city.

1.2. BLURRING BOUNDARIES

Within smart city projects, two distinctions seem to be blurring, namely the distinction between design & use and government & citizen. As introduced in the previous paragraph, actors from both public, private and civic background play a role in smart cities. Different smart city projects are initiated by these different actors. Amsterdam Smart City (2013) and the 'smart cities and communities' call by the European Commission (2013) are examples of smart city developments by public actors on different levels. Private actors focus on smart city development as well, such as IBM's smarter cities program (IBM, 2013) or the development of the
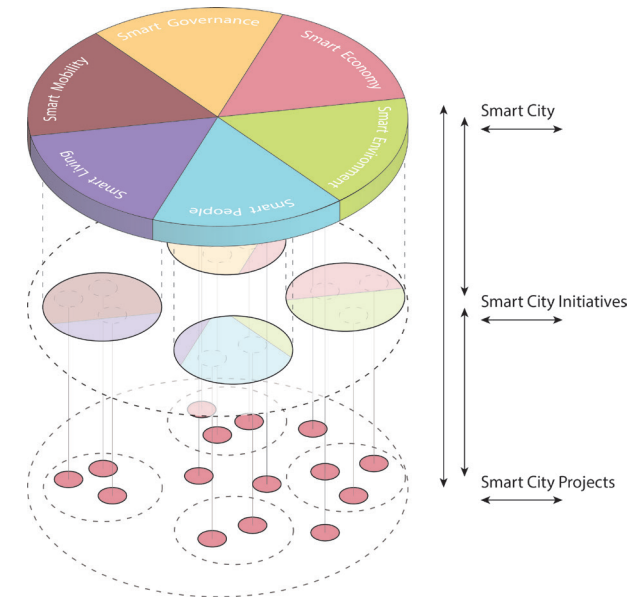
figure 1: Smart city characteristics, initiatives and projects

smart home (www.ihome.eu). These initiatives by policy and private actors can be characterized as top-down developments, although they started to alter towards also including citizen empowerment (Kitchin, 2014). On the other hand several examples by civic actors, such as a citizen's initiative on bicycle use (www.ring-ring.nu) and an entrepreneur's initiative on collaboration and social relevance (www.plugdedag.nl), can be characterized as bottom-up developments.

As described in section 1.1, citizen participation is in itself part of the smart city aspects of smart governance and smart people (Giffinger, *et al.*, 2007). Implementation of the Smart Citizen Kit in

Amsterdam (Waag Society, 2014) and local energy cooperatives such as www.hieropgewekt.nl seem to combine initiatives of public, private and civic actors. These projects are difficult to characterize as top-down or bottom-up directed and seem to have a more 'hybrid' approach, including collaborations between public and civic actors. Citizen participation in itself is a present day topic, and public actors feel a responsibility to link up with citizens' initiatives (WRR, 2012). Active citizenship changes the relation between citizens and public actors, but how this relation is changing is still difficult to describe (Van de Wijdeven, De Graaf, & Hendriks, 2013). In this, both top-down and bottom-up developments take place (Van der Steen, Van Twist, Chin-A-Fat, & Kwakkelstein, 2013). In this changing relation,

the distinction between government and citizen seems to become blurred (see figure 2).

This research centers on the development of technological applications to improve quality of life in the city. In developing new technological applications, designers design with a certain user in mind, followed by an interpretation of the technology by the real user (Akrich, 1992, 1995). In several smart city projects, it seems t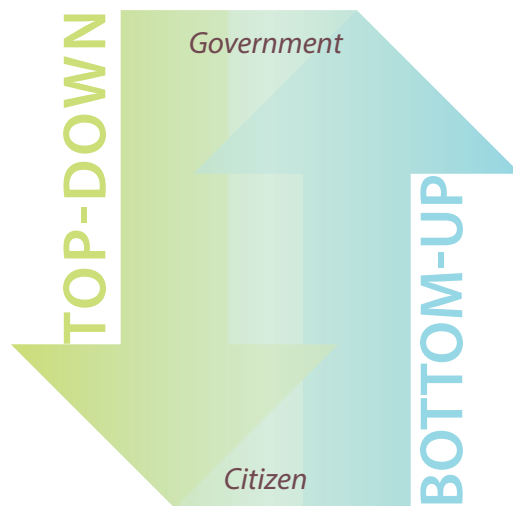hat the distinction between design and use becomes blurred (see figure 3). Several of the above mentioned examples (e.g. RingRing and Smart Citizen Kit) show that citizens are involved (sometimes leading) in the development of smart city applications and can be understood as both designer and user. The same holds

for policy actors, involved in the development of smart city applications, but also having a possible role as user of the application. Actors thus can have different roles, and these roles (e.g. user, designer, facilitator) are not predefined for specific actors.

Many different actors are involved in smart city projects, and distinctions between design and use and government and citizen seem to become blurred. The role of different actors in smart city development is thus an interesting topic for further research. This thesis focuses on the analysis of the roles of different actors in specific smart city projects.

1.3. DYNAMIC ROLES IN SMART CITY DEVELOPMENT

This research aims to gain a better understanding of the shaping of roles by different actors in the development of smart cities, so to gain insight in the dynamics of smart city development. These insights can contribute to aligning smart city applications with actors involved. This research will contribute to this understanding by studying the roles of different actors in existing cases of smart city projects. This leads to the following research question:

figure 2: Blurring boundaries between government and citizen

figure 3: Blurring boundaries between design and use

How are roles of actors in specific smart city projects shaped within project dynamics, and how do these roles in turn influence the project dynamics?

The co-shaping of roles and project dynamics is an interesting field to explore from the field of Science & Technology Studies (STS), which focuses on the relation between technological and human actors and the networks formed by these actors. Concepts from STS can contribute to clarifying the construction of roles by human and technological actors involved and to the mutual shaping of roles and project dynamics.

1.4. SOCIAL AND SCIENTIFIC RELEVANCE

This research is conducted at TNO. TNO is the Dutch organization for applied scientific research. One of the flagships of TNO is the Smart City, "a dynamic eco-system in which administrators, companies, citizens and research institutions collaborate creatively on comprehensive services and products that have a tangible impact and advance innovation" (TNO, n.d.). The aim of this thesis is to gain insights in the roles of different actors in smart city development. These results contribute to understanding how smart city products and services are taken up by these different actor groups involved, thus contributing to a more efficient implementation of these products and services in the city.

This research is conducted at the department of Strategy and Policy. From a governance perspective, insights in the changing roles in smart city projects can contribute to understanding how these dynamics and different actor groups can be included in smart city policies. The results of this thesis can be used to improve strategy- and policy consultancy in the context of smart city development.

The findings of this thesis can be valuable to the field of STS, in which both user-technology relations and science/technology-policy relations are fields of study. This thesis centers on technology development practices in which these often separately studied relations come together. Through the approach of detaching existing roles from specific actors, this thesis can contribute to the field of STS by explicating the influence of roles in a socio-technical system. To do so, role theory is integrated into STS. Next to that, the research field on smart cities is emerging, and several scholars call for further research. There are two calls to which this research contributes. Kitchin (2014) calls for empirical in-depth case studies of specific smart city projects, and Meijer and Bolívar (2013) call for addressing the socio-technical nature of smart cities from the field from STS. With an empirical approach building on STS insights, this research responds to these calls.

1.5. THESIS OUTLINE

The thesis consists of seven chapters. Chapter 2 introduces the theoretical framework on which the research is based, starting from Actor-Network Theory. Following the theoretical framework, the research question is further elaborated. Chapter 3 discusses the methodology used to answer the research question, two case studies will be conducted. These cases are introduced in this chapter. In the following two chapters the findings of the case studies conducted are presented. The findings from the first case, the Smart Citizen Kit, will be discussed in chapter 4. The second case, ClaimJeStraat, is described in Chapter 5. Conclusions of the thesis are presented in chapter 6, which summarizes and compares the findings of the two case studies. These conclusions are translated to six lessons for setting up smart city projects. The final chapter 7 discusses the findings and methods of the research. The chapter reflects on the theoretical framework, discusses the limitations of this research and includes suggestions for further research.

2. Theoretical Framework

In this chapter, smart cities are conceptualized as a socio-technical system (2.1), which can be studied building on an STS approach. Actor Network theory is introduced (2.2) and the framing of actors and roles within STS will be discussed. This is followed by the conceptual framework used in this thesis, building on insights from STS and role theory (2.3). Paragraph 2.4 presents an overview of the conceptual framework and the relation between different concepts in project dynamics. This leads to the elaborated research questions in paragraph 2.5.

2.1. SMART CITIES AS SOCIO-TECHNICAL SYSTEM

In the introduction, smart cities have been introduced as cities in which technological applications (often ICTs) are developed so to improve the quality of life in the city. Smart cities have a network-like character, where projects, initiatives and aims, as well as the people and technology involved are all interconnected.

Based on an analysis of the scientific discourse on smart cities, Meijer and Bolívar (2013) have shown that confusion exists on the technical and social nature of smart cities. To address this confusion, Meijer and Bolívar have called for the conceptualization of smart cities as a socio-technical system, building on insights from STS theories. As described in paragraph 1.1, smart cities exist of a complex network of different aspects, initiatives and projects, that all include different actors. Ojo, Curry, and Janowski (2014) introduce the conceptualization of smart cities as a 'Socio-technical System of Systems'. This term highlights the interconnected relation between smart cities, initiatives and projects, and addresses the complexity of the concept of smart cities. A smart city does not only have a socio-technical nature in itself, – including both technological applications and the social, economic and political processes in the city – but it encompasses several initiatives, projects or applications that can all be understood as separate, but interconnected socio-technical systems.

2.2. ACTOR NETWORK THEORY

To study the distributions of roles between different actors in specific smart city projects, two case studies were conducted. These cases are described by a framework building on Actor-Network Theory (ANT). ANT allows analysis of the network of different actors and technologies involved within the complex socio-technical system of the (smart) city.

Within ANT, technological development is understood within its actor network. Within this heterogeneous network not only human actors are an active agent, technological artifacts play an active role as well (Latour, 1992). An actor, either human or non-human (technological), should be understood within its network, in relation to other actors. These relations take shape in interactions and

negotiations between actors. Technology should thus be understood as an active agent within the actor network, for example, the domestic computer network of the Smith family (scenario on page 10) performs actions and tasks, and is an active agent in the household.

A technology prescribes certain things for other actors. It allows or inhibits specific actions, the fridge and fresh-food delivery system inhibits grocery shopping for the Smith family (scenario on page 10). What a technology allows or inhibits is a result of the script (Akrich, 1992) of a technology, this script is inscribed by designers or developers of the technology and prescribes certain actions for users. Users can either accept (subscribe to), reject or modify the script, which can result in the development of antiprograms, for example Katy can decide to go out for grocery shopping and (over) stuff the fridge. In the case of ongoing technological development, the script can be modified, or re-inscribed by other actors. Translations of agency can be made from human actors to technology or the other way around, and these translations are a result of negotiations about agency. In the example, the agency to stock the fridge is translated from a human actor to technological actors (the fridge and delivery system). In this negotiation, the technology influences the distributions of roles in the actor network, resulting in a 'geography of responsibilities'(Akrich, 1992).

Human and non-human (technological) actors span up a network that can be understood as a socio-technical system (see paragraph 2.1 on the smart city as socio-technical system) Important in this network is the relation between these actors, both relations between humans and non-humans. It is in these relations that the shaping of technology by human actors and the impact of technological actors on society (human actors) can be found. In this thesis, I use the term 'actor' to describe both human and non-human actors.

2.3. FRAMING ROLES AND ACTORS

Thus, building on Actor Network Theory means not making an a priori distinction between human and non-human actors and placing users, designers and policy actors within this heterogeneous network. This allows the study of the role of public, private and civic actors without framing the distribution of roles between these human actors in theory. Within the field of STS many insights on user-technology relations have been developed, often building on ANT. Oudshoorn & Pinch give an overview of the variety of studies focusing on user-technology relations, discussing concepts like 'configuring the user', 'lead users', subscription, de-inscription, anti-program and users' programs; the focus on users and their diversity and the maxim that 'users matter'(Oudshoorn & Pinch, 2008, following concepts developed by Woolgar, Von Hippel, Latour & Akrich and insights from feminism studies). Oudshoorn & Pinch discuss these concepts and show the importance of user focused research in STS, in contrast to early STS research focusing on design or production phases. Blurring boundaries between production and consumption or design and use have led to concepts such as 'designer-users', 'prosumers' and 'innovation users' (Ibid.).

While the turn to the user in STS research and concepts developed within this field have contributed to many different insights in human-technology relations, the developed concepts have several limitations when studying practices where boundaries between design and use seem to become blurred. Starting from a conceptual framework based on users has resulted in new concepts as designer-user, user-as-designer and more as discussed above. Using these concepts frames actors within research, and seems to imply that the focus is on studying the user (in its variety of forms) and technology, instead of studying heterogeneous actors. In this thesis, I aim to gain insights in the shaping of roles of different actors involved in smart city projects. Here, 'user' or 'designer' can be seen as a possible role. Below, a conceptual framework is described that allows to study the practice in which these actors take up certain roles, including the role of the user.

2.3.1. ROLE THEORY

To study roles of different actors, the framework based on ANT will be combined with insights from role theory. The concept of "role" can be understood in multiple ways. In most versions of role theory, roles are shaped by expectations (Turner, 2001). A role can be described as a pattern of expectations about behavior that apply to a particular social position, such as mother, mayor, student or hero. These expectations are not related to the

individual occupying the social position, but to the position itself (Ibid.). The expectations of behavior related to the role results in certain obligations and responsibilities, as well as privileges related to the role. (Biddle, 1986; Sieber, 1974). The expectations that shape roles are forms of social interactions between individuals and groups, and roles are shaped in these interactions. Roles often come in sets, such as child and parent, leader and follower. These sets can also be equal or in groups, such as the role of friend, which presumes other friends to interact with. A role thus interacts with an *alter role* (Turner, 2001). All these roles are shaped in interaction with each other, and changes in a role also affect the alter roles.

Turner (2001) distinguishes between four types of roles. The first, *basic roles,* is associated with expectations linked to a general social position for example related to gender or age. *Position* or *status roles* are linked to formal positions in organizations or groups, such as a mother in the family, CEO of a company, designer or user. Examples of *functional group roles* are leader, mediator or communicator, these roles emerge spontaneously and are not formalized in the way that status roles are. *Value roles* also emerge spontaneously, but have specific values attributed to them, such roles are hero, saint or villain.

Role-taking describes the process of an actor taking up a certain role. Because roles are shaped in interaction with each other, the process of role-taking requires to have some knowledge about the alter roles, and how they interact with the role. The role is however not predefined in the interactions with alter roles, the background and abilities of the actor influence the role that he takes, and by that, also influence the alter roles. For example, someone's character and skills influence how he takes up the role of manager, and by his way of managing, he also influences the roles the team members have. The process of an actor engaging in a role is thus not only role-taking, but *also role-making* (Franks, 2007; Turner, 2001).

A role is shaped by expectations of behavior, as well in action as in sentiment, resulting in certain privileges and obligations. Sieber (1974) distinguishes between two kinds of role privileges: liberties, which do not require any specific behaviors from alter roles, and legitimate demands, which do require behavior from alter roles. These legitimate demand thus also shape the alter role, resulting in certain role obligations for the actor with the alter role.

An actor is not limited to having one role, but can have multiple roles. One person can for example combine the roles of being a parent, manager, neighbor and volunteer. This multiplicity of roles can result in *role conflict,* where different roles demand conflicting things from an actor, such as a possible conflict between a role as parent and in a career. This conflict can also occur within a role, when different alters have conflicting expectations of the role. Role conflict can result in stress, tension or frustration which is referred to as *role strain* (Hindin, 2007; Turner, 2001).

2.3.2. A VOCABULARY OPEN TO DIFFERENT ROLES

Role theory provides a useful framework to study the shaping of roles in specific smart city projects. However, the theory, stemming from sociology, focuses purely on social relations between human actors, not including the technological agency which is central in ANT. This paragraph introduces a vocabulary open different roles of actors, but also including technological agency. The vocabulary introduced below combines insights from role theory and STS. By combining insights from these two fields, the vocabulary allows the analysis of roles in smart cities while taking into account the socio-technical nature by using an ANT perspective and in the meantime staying open to the seemingly blurring boundaries (described in paragraph 1.2) building on role theory.

Van Lieshout, Egyedi, and Bijker (2001) have developed a perspective that combines several STS concepts in a heuristic framework. This framework allows the analysis of both human and technological actors, without framing human actors in specific (user) roles. Van Lieshout *et al.* combine the concepts of configuration, translation and appropriation building on respectively Woolgar, Latour and domestication theory. Below, the three concepts of configuration, appropriation and translation are introduced and linked to concepts from role theory.

CONFIGURATION

Woolgar introduced the concept of *configuration* in the context of design and use, and the concept is aimed at describing how designers configure the user in their design (Oudshoorn & Pinch, 2008; Van Lieshout*, et al.*, 2001). For example, Katy (from the scenario on page 10) is configured in the design of the smart transportation system, she has to have a smartphone and smartcard, has to understand how to use them and has to bring them. The process of configuration is not limited to designers configuring the user. The other way around, users also configure designers and several authors have broadened this view to include the configuration work of many other actors (Oudshoorn & Pinch, 2008). Human actors are configured in the actor-network by both the human and technological actors. In this thesis, configuration is primarily analyzed on the level of a process between two actors: the configuration *of* actor A *by* actor B.

Van Lieshout*, et al.* (2001) distinguish between hard and soft configurations. Hard configurations, are often inscribed in the technological design, and are difficult to alter or negotiate, they allow or inhibit certain actions that are difficult to get around, for example requiring a code to use the traffic system. Soft configurations on the other hand are more easily negotiated, examples are guidelines or (social) expectations. The combination of soft and hard configuration of actions of an actor results in the configuration of a certain role for the actor.

In role theory, roles are shaped by expectations. In this thesis, I analyze these expectations as the configuration of roles. The roles of actors are configured by other actors in the network. In this configuration, a distinction can be made between soft configurations (social expectations as a result of the interactions with other human actors and the relations with alter roles) and hard configurations (configurations inscribed in technological actors involved). Role conflict can occur when different role configurations conflict.

APPROPRIATION

Appropriation describes the process of users becoming owner of a technology or product (Van Lieshout*, et al.*, 2001). The concept of appropriation is part of domestication theory, which aims to describe how technologies or products are 'tamed' or 'domesticated' by the consumer. Silverstone and Haddon (1996) describe appropriation as a dimension of consumption in which individuals decide to accept the technology or product in their domestic environment, Silverstone and Haddon distinguish two aspects of appropriation. By *objectification*, the technology literally gets a space in the home, and is installed and for example placed in a room, on a desk or outdoors. *Incorporation* describes incorporating the use of the technology in daily life practices. The technology not only has to be placed somewhere, it also should be used to be fully appropriated. This might require learning new skills and practices.

In the case of smart city projects, technologies are often still under development or in pilot phase, therefore, hard configurations inscribed in technologies are under development as well. Nevertheless, the technology under development is often appropriated by the actors in the project, they can also adapt the technology, thus influencing the hard configuration. Thus, appropriation of a technology can also change the configuration of other actors. In smart city projects, actors not only appropriate the technology under development, but can also act within the project. Actors involved shape the project dynamics by taking certain roles within the project. To analyze this role-taking I will translate the concept of appropriation of a technology to the appropriation of roles. To take a role in the project, actors have to take a place within the project, by *joining in*. Examples of this joining in are signing up for a program or going to meetings. Being there however does not result in appropriation of a role in the project. Just as appropriation of a technology requires both giving the technology a place (objectification) and actively using it (incorporation), the appropriation of a role requires not only to join in and be there, but also to *engage*, to take part in the process. Following role theory, roles always stand in relation to alter roles, and influence each other. Hence, appropriating a role also influences the soft configuration of other actors.

In this thesis, appropriation thus is analyzed at two levels, as appropriation of the technology by objectification and incorporation, and the appropriation of a certain role in the project by both joining in and engaging. How actors appropriate both a technology and a role is influenced by how they are configured. The configuration of actors invites and

inhibits certain actions and roles. Appropriation is thus shaped by configuration. Actors can either subscribe to this configured role (role-taking) or can individually shape and adapt the configured role (role-making).

Translation

In the processes of configuration and appropriation translations are constantly made. A translation is a transformation from one state to another in an actor network (e.g. a change in the meanings actors attribute to certain things, a change in technological function, a delegation of agency or a shift in the aims or goals of a project). A translation is a change that is a result of the actions or interpretations of actors within the actor-network. In both the development and the use of a technology, translations are made (Latour, 1992). In a design choice, translations can be made in the functioning of a technology, in where agency is located, or of what is expected from the user. On the other hand, users can develop alternative uses for a technology, thus translating its function.

Van Lieshout, *et al.* (2001) make a distinction between long- and short-term translations. Short-term translations are located at the individual level. These short-term translations can be found in negotiations about a specific role or technology. Long-term translations are society-wide or on actor-network level. An example of a society-wide translation can be found in the scenario on page 10 in the implementation of the new transportation system including autonomous vehicles.

Examples of long-term translations on actor-network level can entail changes in the meanings or aims of a project or roles, or a total re-distribution of roles.

Within the processes of configuration and appropriation, short-term translations are constantly made in negotiating about roles and technology. The processes of configuration and appropriation in the total project dynamics can lead to long-term translations as outcomes of the project.

2.4. STRUCTURING PROJECT DYNAMICS

Concluding, the dynamics of smart city projects are influenced by both human and technological actors and their interactions. Configuration and appropriation are not sequential processes, but take place simultaneously. In this, constant short-term translations are made, eventually leading to long-term translations. The processes of configuration and appropriation are thus intertwined and iterative.

The objective of this thesis is to gain insight in the different roles of actors involved in specific smart city projects. These roles are configured by both hard configurations (inscribed in technologies) and soft configurations (social expectations). In the meantime, how technology is appropriated also influences the configuration of roles. Most of these processes take place within the project dynamics, but these are also influenced by the first setting of the project, or the project aims. Thus, project aims,
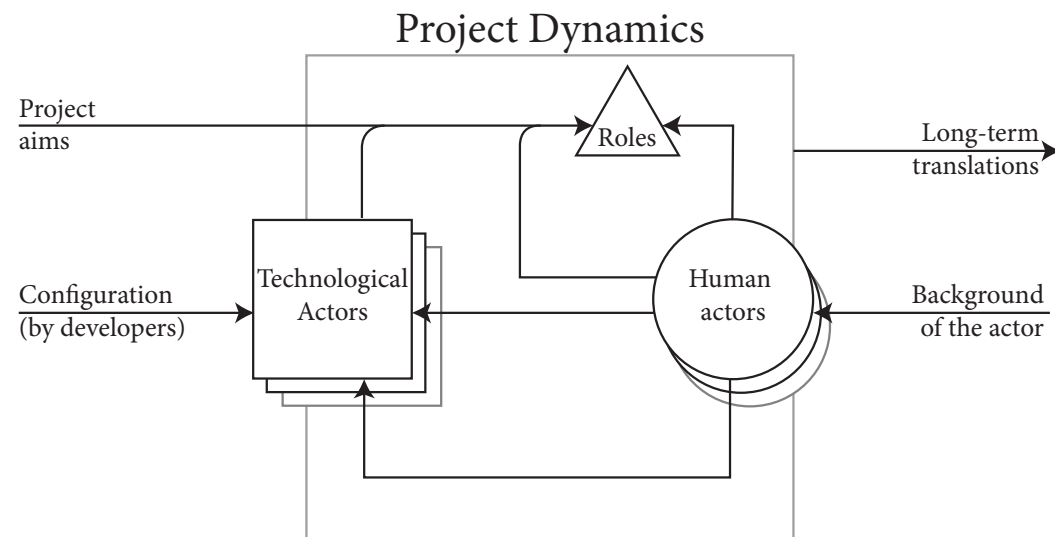

figure 4: schematic overview of configuration, appropriation and translation within project dynamics

hard and soft configurations result in a certain configured role. This configuration is not set in stone, as described by role theory, the background of an actor has impact on how a role is appropriated. Roles are thus negotiated or translated in the processes of configuration and appropriation. Figure 4 illustrates how technological and human actors and their roles are related in the project dynamics through processes of configuration and appropriation. In this, configuration and appropriation are displayed by arrows.

Roles of actors are thus a result of the processes of hard & soft configuration and technology & role appropriation which take place concurrently, resulting in ongoing short-term and long-term translations.

2.5. ELABORATED RESEARCH QUESTIONS

The research question introduced in chapter 1 states as follows: *How are roles of actors in specific smart city projects shaped within project dynamics, and how do these roles in turn influence the project dynamics?*

The theoretical framework described how configuration and appropriation result in translations that redistribute agency and roles within the actor network (see figure 5). To address the main research question, different actors in as well public, private, and civic sphere as the technological context have to be identified, addressed in the first sub question:

(Q1) What different actors are involved in specific smart city projects? As described in the theoretical framework, configuration and appropriation are processes taking place between different actors, and roles are formed in relation to alter roles. This leads to the following sub question: *(Q2) How do processes of configuration and appropriation of roles & technology take place between different actors?*

figure 5: Actors, interactions & roles

Within these processes of configuration and appropriation, roles are negotiated, leading to question *Q3: Which roles can be discerned in the relations between different actors?* The processes of configuration and appropriation and the actors involved are all part of the project dynamics and shape the

roles in the project. The other way around, configuration and appropriation lead to both short- and long-term translations, thus influencing the project dynamics. This leads to the fourth sub question: *(Q4) how do configured and appropriated roles influence the translations in the project dynamics?* As described in the introduction, several authors have called for including people in the smart city, but how to do so is not addressed, this leads to the final sub question: *(Q5) What lessons for setting up smart city projects can be learned from the insights in roles and project dynamics?*
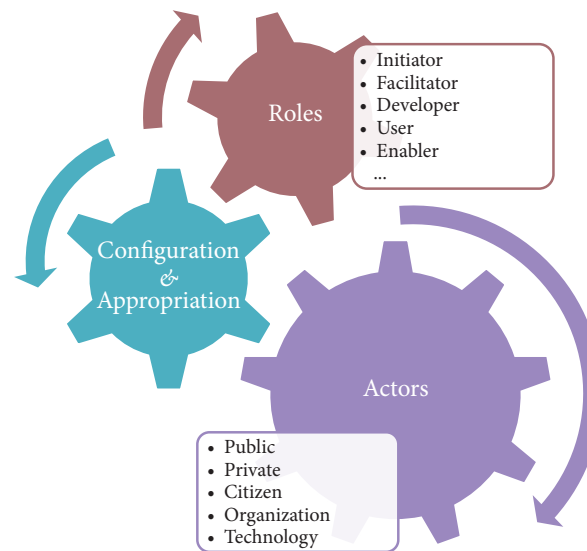
3. Methodology & Case Selection

To answer the research questions addressed in paragraph 2.5, two case studies were conducted. This chapter describes the case selection and introduces the two cases, followed by the methodology used to study the cases.

3.1. CASE SELECTION

To study the role of actors in specific smart city projects, qualitative in-depth case studies were conducted. The first criterion for the selection of cases to study is that they take place in a smart city context, contributing to several smart city aspects (as described in section 1.1). The projects include the development of a smart city application using ICTs, and take place in an urban context. To study the role of different actors involved, cases were selected

that include several different actors. During the selection of cases, practical reasons were taken into account, such as the expected willingness of different actors for interviews and whether the planning of the project fits within the time schedule for this research.

The two selected projects, the Smart Citizen Kit and ClaimJeStraat are described in the next paragraphs. Although originating from a bottom-up development, the Smart Citizen Kit project in Amsterdam can be described as a 'hybrid' approach. On the other side, ClaimJeStraat is developed from a top-down perspective, but aims at citizens actively taking ownership in the development. The combination of these two different approaches, both aiming at a more hybrid cooperation between

government and citizen, but originating from either a bottom-up or top-down perspective, provides an interesting sample. In both cases, technology is still under development and in pilot phase. The two cases will be introduced below.

3.2. SMART CITIZEN KIT

The smart citizen kit is a small box with a computer and sensor board that measures air quality, light intensity, sound levels and temperature. Citizens can place the kit outdoors and link it up to the network so to collect this data. Within the project in Amsterdam, Amsterdam Smart City[2] has made 70 kits available, which are distributed amongst interested citizens. The project aimed at exploring the implications of citizens having measuring devices to produce data on air quality in their own surroundings. This exploration aimed at the technological possibilities and the implications on society (Interview Waag Society, July 17, 2014). Waag Society has facilitated the process of the project (Waag Society, 2014).

The smart citizen kit is developed by FabLab Barcelona, and use of it requires a certain technical expertise. Waag Society has attracted users through a newspaper ad and has made the translation towards lay users. Kits were distributed, followed by a phase of installing the kits, resulting in quite some (technical) challenges for citizens and Waag

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2. Amsterdam Smart City is a public-private partnership initiated by the Amsterdam Economic Board, the Municipality of Amsterdam, electricity network operator Liander and telecommunication company KPN

Society. During three months, 70 kits were deployed, of which over 60% has produced data (Van den Horn & Boonstra, 2014). In this period, several meet-ups were organized around different themes, such as the technological aspects, the complexity of monitoring air quality linked to citizen science and a final evaluation meeting. In these meetings citizens participating in the project engaged in dialogues with several other actors, either involved in the project or the topic of air quality measurements. At the end of the project, participants could either return their smart citizen kit or keep it at a discounted price. Out of the 73 participants, 7-10 people decide to buy the smart citizen kit (Interview Waag Society, July 17, 2014). Waag Society has published a report written by Van den Horn and Boonstra (2014) on their findings of the project.

3.3. CLAIMJESTRAAT

ClaimJeStraat (Claim your street) is an online platform which aims to get residents to 'claim their street' so to improve safety and security in the street. The idea originates from the Learning Network Home Burglaries[3], and further developed by TNO[4]. The project aims to improve safety and security in

3. Lerend Netwerk Woninginbraken, part of the Living Lab Safety (www.livinglabveiligheid.nl), a network with participants from Politie, Interpolis, VEBON, Verwey-Jonker Instituut and TNO has developed the basis for ClaimJeStraat in co-creation (ClaimJeStraat, 2013b)
4. TNO works in many different fields, ClaimJeStraat is a project of the department Networked Organizations.

the street by improving social cohesion and ownership of the street by its residents. It is developed as a catalyzer for the transition from ascribing action to the government to a government facilitating active citizen participation (ClaimJeStraat, 2013b). The idea of ClaimJeStraat centers around the five aspects of home, neighbors, street, do it yourself and reporting.

To facilitate residents to claim their street, an online platform is developed with a focus on organizing activities and communication between residents. Next to the platform, several other technological concepts[5] to improve safety and security on street level are under development within the project (ClaimJeStraat, 2013a).

The platform is initiated from government and technology developers, starting from a 'top-down' approach, but is seeking citizen participation and citizen engagement (or residents 'claiming their street'). The initiative of ClaimJeStraat is under the attention of the Dutch ministry of security & justice. The platform is launched, tested and further developed in several pilot streets in the Netherlands. In June 2014 the first ten small pilots will end, and a few pilot streets are set up in accordance with the police department Noord-Holland. Within these pilots, the developers are facing challenges on the role of the platform in facilitating citizen initiatives (I. Weima, personal communication, May 20, 2014). To analyze the interactions between

5. Developed concepts are smart keys and locks, sensors for in-house human presence, burglary sensors, smart street lighting, and a platform to connect sensors on house and street level.

different actors in the project, this research zooms in on one of the pilots of the project, Julianastraat.

3.4. METHODOLOGY

The two cases are studied based on qualitative research, conducting semi-structured in-depth interviews with different actors involved in the projects. Interview respondents were selected using a snow-ball method. The first human actors to interview were identified in consultation with the contact person for the project, interviews with more actors were scheduled based on mentioned actors in the first interviews. An overview of the interview respondents is presented in table 1. In-depth semi-structured interviews are conducted, based on the methods described by DiCicco-Bloom and Crabtree (2006).

Following the schematic overview of my conceptualization of project dynamics as presented in section 2.4, the interviews addressed the background of the human actor from which they joined the project; the project aims; the interaction with non-human actors, including technology appropriation and hard configurations; interactions with human actors including the soft configuration of roles; the appropriation of roles and translations made within the project. These topics were translated into 25 interview questions. The interview questions and their relation to the above mentioned topics of can be found in appendix A.

The empirical data is analyzed within the framework building on Actor Network Theory and Role

theory (as described in chapter 2), so to describe the network of human actors and technologies involved in smart city development. Data is structured using coding software (Atlas.ti) and analyzed and coded on different types of actors, technologies, different roles and the processes of configuration and appropriation and translations made. These codes were divided into more specific codes. For example, the group of human actors was specified by codes such as actor_citizen, actor_WaagSociety, actor_RIVM; for non-human actors distinctions were made between different types of technologies, such as technology_device_smartcitizenkit, technology_onlineplatform and technology_socialmedia_facebook, but also on expectations of a technology. In coding, a distinction is made between soft and hard configurations, and appropriation is specified by joining in, engaging, objectification and incorporation. Building on the coding work, an analysis is made of the configuration and appropriation of roles within the relations in the project dynamics. This analysis is structured based on the relations, resulting in several smaller networks within the actor network of the project.

The sub networks of relations in the project dynamics are schematically presented similar as the schematic overview of my conceptualization of project dynamics presented in section 2.4. Between two actors, several processes of appropriation and configuration can take place simultaneously, an arrow can thus indicate multiple interactions. Throughout analysis, it appeared that the processes of configuration and appropriation are ongoing.

Not all appropriations or configurations fully occur or are clear. *Partial configuration and appropriation* can occur, for example by only some of the people in the street community, by vague expectations or by appropriating only part of a technology or role. If actors see possibilities for roles or technologies in the future, these are indicated as *conceptual configuration and appropriation*. It is also possible that actors do *not appropriate* the technology or configured role. As described in the theoretical framework, the processes of configuration and appropriation are intertwined, and negotiations about these interactions might be ongoing. If configuration and appropriation 'match', the negotiations are described as *aligned* configuration and

figure 6: different types of interactions

appropriation. Negotiations about interactions can result in translations. Translations in one place in the network can influence other negotiations, successful negotiations can thus change over time.
In the schematic overview of the sub networks, the different types of interactions are indicated

by different arrows, displayed in figure 6. In these overviews, human actors are displayed as circles, technological actors as squares and roles as triangles. Because multiple roles are configured and appropriated, these roles are not displayed in the schematic overviews detail. A triangle can thus indicate multiple configured and appropriated roles.

The findings are presented in chapter 4 and 5. An overview of the empirical data collected can be found in table 1 to table 3.
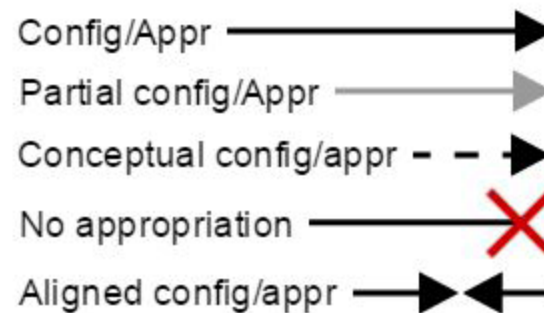
Type of Actor	Actor	Respondent	Interview date	Referred to as
Smart Citizen Kit				
Institution	National Institute for Public Health and the Environment (RIVM)	2 Representatives Centre for Environmental Monitoring	June 19, 2014 + presentation during Smart Citizen Café, May 13, 2014	RIVM
Institution	Public Health Services Amsterdam (GGD Amsterdam)	Representative Department Air Quality – Technical division	June 14, 2014 + presentation during Smart Citizen Kit Evaluation, June 16, 2014	GGD
Project Team	Waag Society	Project Coordinator	July 17, 2014 + several conversations	Waag
Citizen	Citizens	Citizen 1	June 26, 2014	Citizen 1
		Citizen 2	July 17, 2014	Citizen 2
		Citizen 3	July 15, 2014 + email conversation	Citizen 3
Developers	FabLab Barcelona	Smart Citizen Team	July 14, 2014 (Skype)	SCT
Project Team	Amsterdam Smart City	Program director	July 15, 2014	ASC
ClaimJeStraat				
Research Institute	TNO	Consultant (dept. Networked organizations)	June 17, 2014 + several meetings	TNO
Police	Police Noord-Holland	Innovation Broker	August 12, 2014	Police IB
Police	Police Haarlemmermeer	Police profession	August 6, 2014	Police P
Police	Police Zaanstreek	2 Local police officers	August 12, 2014	Police LO
Local Government	Municipality Zaanstad	District Manager	July 22, 2014	ZDM
Citizen	Residents	Resident 1	July 3, 2014	Lead resident
		3 residents	July 22, 2014	Residents

table 1: Overview of interviews

Attended Meetings	Content	Date
Smart Citizen Kit		
Smart Citizen Café: 'meten is weten'	Presentation RIVM Centre for Environmental Monitoring; Smart Citizen Helpdesk	May 13, 2014
Smart Citizen Kit Evaluation	Presentations: Waag Society, GGD Amsterdam dept. air quality, TNO dept. Urban Environment, participants, Amsterdam Smart City; Discussions	June 16, 2014
ClaimJeStraat		
Project Meeting	Developing session with representatives of TNO, Police, Municipality Haarlemmermeer, Julianastraat, Victim support the Netherlands	July 3, 2014
Residents Meeting	Progress update for all residents. Presentations by 3 teams: safety & burglaries, negotiations, traffic	August 14, 2014

table 2: Overview of attended meetings

Document Type	Content	Source/Referred to as
Smart Citizen Kit		
Final report	Eindrapportage Smart Citizen Kit Amsterdam - Meten is Weten?	Van den Horn and Boonstra (2014)
Website	Smart Citizen Kit project blog	Waag Society (2014)
Website	Website of smart citizen project	SmartCitizen (n.d.)
E-mails	16 updates for participants of the project	Waag Society (personal communication, March-August, 2014)/'Waag emails; date'
Document	Experiences with the installation of a smart citizen kit by one of the participants	Interview respondent, Citizen 1(personal communication, June 26, 2014)/installation experiences
Newspaper article	'Meten is Weten'	Lange (2013)
ClaimJeStraat		
Leaflet	Introduction CJS; mission statement	Lerend Netwerk Woninginbraken (2012)
Leaflet	Een geclaimde straat herkent u meteen; Living Lab Veiligheid	ClaimJeStraat (2013b)
Poster	Sociale en technologische innovatie voor het voorkomen van woninginbraken; Op zoek naar de ultieme sensoroplossing	ClaimJeStraat (2013a)
Presentation	Developing session during project meeting; July 3, 2014	Interview respondent, TNO (personal communication, July 2, 2014)/Presentation Project Meeting July 3, 2014
Presentation	CJS residents meeting, update working groups, August 14, 2014	Interview respondent, Resident 1, (personal communication, August 15, 2014)/Presentation residents meeting, august 14, 2014
Document	Groeidocument Claim Je Straat	Interview respondent, police profession (personal communication, July 2, 2014)/Groeidocument
Website	Public Claim Je Straat website; private pilot CJS platform	ClaimJeStraat (2014)

table 3: Overview of consulted documents
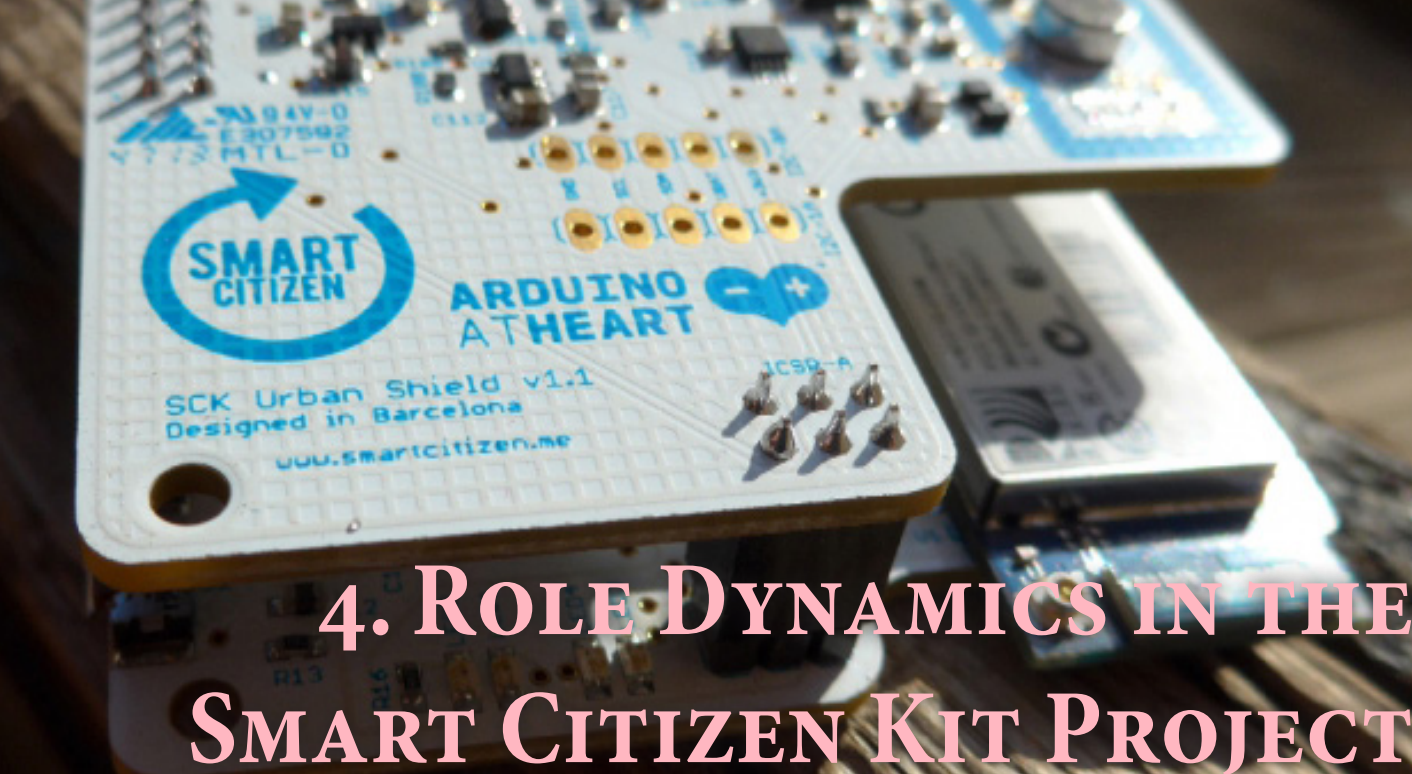
4. Role Dynamics in the Smart Citizen Kit Project

'Smart citizen kit' by FabLab Barcelona. Retrieved from http://waag.org/nl/nieuws/smart-citizen-kit-het-vervolg

In this chapter, the role dynamics of the first case study, the smart citizen kit (SCK) are analyzed. The project is introduced in paragraph 4.1 by describing the project aims, followed by an introduction of the actors involved (both human and non human) in 4.2. Section 4.3 describes the project dynamics, building on the relations between the different actors. These relations are shaped by configuration and appropriation of both roles and technologies, and eventually lead to translations in the network. These translations are analyzed in section 4.4, followed by the concluding paragraph in 4.5. This paragraph includes several aspects and roles that were of importance in the project dynamics.

4.1. PROJECT AIMS AND PROGRESS

The intention of the smart citizen kit project was that citizens can gather data about their environment. In the set-up of the project the intention was to learn by doing. The project team started with several assumptions, and these assumptions were tested throughout the project. The assumption was that citizens who collect data with cheap sensors can use the knowledge they gain on their environment in two ways. On the one hand the data can be used to validate their suspicions and citizens can use this information in contact with the government. On the other hand, based on this information citizens can actively change their own behavior or organize themselves in different ways. (Interview Waag)

Following these assumptions, the project team (a collaboration of Waag Society and Amsterdam Smart City) had both technological and social aims. The smart citizen kit is based on open hardware and open software, and offers several possibilities to tweak the technology. By testing the smart citizen kit with a group of citizens, the project team aimed at providing feedback for further development of the kit. Next to that, the project team investigated the possibilities to measure air quality with small affordable sensors. The impact of these measurements by citizens on society was investigated by the project team on two different levels, both the impact on individual citizens and on the relation between citizen and government were investigated (Van den Horn & Boonstra, 2014, p. 4).

The project is initiated by a collaboration of Waag Society - Institute for art, science and technology - and Amsterdam Smart City. Waag Society was informed about the development of the smart citizen kit through existing connections in a network of FabLabs. Waag Society and Amsterdam Smart City visited the FabLab Smart Citizen Team, the developers in Barcelona, in summer 2013. Both expressed to be grasped by the smart citizen movement and decided to develop a project in Amsterdam. After the visit in Barcelona, the project team was formed by a collaboration of Waag Society and Amsterdam Smart City. (Interview Waag). During the Amsterdam Urban

Innovation Week in September 2013, a meeting was organized to discuss the possibilities of the smart citizen kit in Amsterdam with the FabLab Smart Citizen Team, citizens and representatives of the municipality (Interview Waag). Following this meeting, the local newspaper published an article[6] on the smart citizen kit and measuring air quality by citizens, including a call for participants for the project. Throughout the project, several meetings were organized. Two of these meetings were joined by representatives from institutions monitoring air quality (the department of air quality of GGD Amsterdam and the Centre for Environmental Quality of the RIVM). An overview of the project activities can be found in table 4.

4.2. NON-HUMAN AND HUMAN ACTORS INVOLVED

In this paragraph the human and non human actors involved in the project are described. The smart

6. Meten is Weten (Lange, 2013)

Overview of Project activities	
Sept 2013	Meeting Amsterdam Urban Innovation Week; Newspaper Article in 'het Parool'
Jan-Feb 2014	Testing Smart Citizen Kit 1.1
Feb 23, 2014	First meeting with technologically oriented participants
Feb-Mar 2014	Adaptions on the kit and install procedures
Mar24, 2014	Install party for all participants
Apr 16, 2014	'Hacking and knowledge sharing', meeting with technological experts
May 13, 2014	Smart Citizen Café with RIVM
Jun 16, 2014	Smart Citizen Evaluation Meeting

table 4: Project activities as provided in the final project report by Van den Horn and Boonstra (2014)

citizen project centers around the smart citizen kit, which produces data that can be accessed on an online platform. Next to these three technological actors, the technological context of measuring air quality has its influence in the project dynamics. As described in the previous paragraph, the project is initiated by a collaboration of Waag Society and Amsterdam Smart City, further addressed as the project team. Citizens are part of the project, and institutions are involved during meetings. The smart citizen kit is developed by the FabLab Smart Citizen Team. The technological actors and the four human actor groups are described below.

4.2.1. SMART CITIZEN KIT
The kit is based on a small Arduino[7] computer and a sensor board. On the sensor board, sensors for temperature, sound, humidity, luminescence and

7. Arduino is "an open-source physical computing platform based on a simple micro-controller board, and a development environment for writing software for the board." http://arduino.cc/en/Guide/Introduction

gasses CO and NO2 are placed. To measure air quality properly, the website of the smart citizen project advises to place the sensors in open air, outside of the sun. On the other hand, the electronic components of the kit have to be kept dry.
The smart citizen team aimed to provide an affordable tool for urban sensing, and has selected affordable sensors. The selected CO and NO2 sensors do not fit requirements for monitoring air quality as defined in European legislation. The average levels of CO and NO2 in the Netherlands are outside of the measuring range of the sensors as provided by the manufacturers.

The smart citizen kit has been developed at FabLab Barcelona, in a 'high-tech community' with people with knowledge or skills in electronics and programming (Interview Waag). The website of the smart citizen project provides tutorials for installation.

4.2.2. ONLINE PLATFORM
The data provided by the sensors on the smart citizen kit can be accessed on the online platform[8]. The website has three different areas, shown in figure 7. The landing page of the website provides a map of the world that includes all current data provided by smart citizen kits. When clicking on an individual kit, two panes open. The pane to the right shows background information of the specific kit and of individual sensors. The data of the sensors is displayed in the small area on the bottom.

8. www.smartcitizen.me

figure 7: Overview of the online platform

It is possible to select data for a specific sensor, or to view multiple sensors at one time. This displays all data of the same kit in one graph. The platform offers a possibility to view data from each smart citizen kit installed worldwide, but does not provide a possibility to compare different kits on the platform. The platform offers the possibility to citizens to download the data of their own kit, but data of other kits can only be viewed on the platform.

Next to the online platform, the data is accessible through a smartphone app (currently only available for iPhone). The app displays current data produced, and does not provide graphs of levels over time. It thus allows to check the current situation at the smart citizen kit on the go, but does not provide an instrument for analysis, such as the graphs displayed on the online platform.

4.2.3. DATA
As described above, the data provided by the smart citizen kit can be accessed through the online platform and app. Data in itself however does not provide insights in the monitored air quality. Data has to be interpreted before it provides information. This information has to be understood before citizens acquire knowledge of the air quality in their surroundings. The CO and NO2 sensors measure an electric resistance that corresponds to a certain level of pollution. The smart citizen platform only provides the measured electric resistance (in kΩ), and does not convert to ppm (parts per million) the standard unit to express the concentration CO/NO2 in the air. According to the website and the FabLab Smart Citizen Team this is done because of questions on current reliability of the sensors. In the beginning of the project, values in kΩ were incorrectly displayed in ppm. This has been resolved and currently the correct unit is displayed. The graph for NO2 is directly proportional to the changes in resistance, while CO levels are inversely proportional.[9] Thus, when the value for CO on the online platform increases, CO pollution actually decreases.

Data is presented in detailed numbers. In the geographic overview and data visualization data is shown with units displayed on the side in small size (see figure 8).

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9. The sensors measure a varying resistance (Rs) and have a basic resistance (R0) which is fixed, but can slightly differ per sensor. To translate the sensor output to concentration levels both values are needed. R0 is currently unknown, when this value is known, sensors can be calibrated by testing them in a closed environment next to a reference measurement of CO or NO2. Absolute numbers thus currently cannot be given. The NO2 level is directly proportional to Rs/R0, meaning that if the varying resistance (the output of the sensor) increases, NO2 levels are rising. The CO level is inversely proportional, meaning that if the output of the sensors increases, CO levels decrease (SmartCitizen, n.d.).
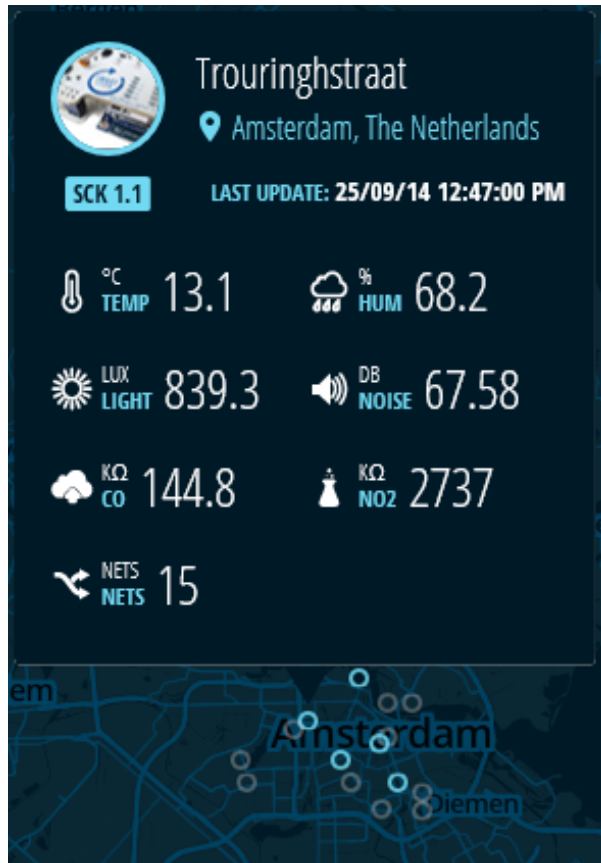
figure 8: display of data

4.2.4. MEASURING AIR QUALITY

The initial focus of the project centered around citizens measuring air quality. Measuring air quality in itself is a complex topic. Interview respondents of institutions responsible for monitoring air quality (GGD and RIVM) described shifting focus in monitoring air quality over time, depending on different substances (e.g. NO2, particles, soot,

ozone) and their health implications. CO levels are measured as well, but are not of interest for a general insight in air quality (Interview GGD). Air contains many different gasses and particles, and distilling and measuring one specific substance is thus a complex process, especially when taking into account that some sensors react on multiple substances at the same time (Interview RIVM). The interest in monitoring air quality is based on the health implications it has. Interest for institutions lies on health implications for the whole population, while citizens are interested in the individual implications for their personal situation. However, perceiving air quality is often subjective, a bad smell cannot be recorded in the same way as disturbances in noise or view can be monitored. Similarly health implications are subject to perception. Research of official institutions might show that there are little health implications, but a citizens perception can be different (interview RIVM).

Both RIVM and GGD described to combine monitoring stations with computational models to calculate and measure air quality. Current computational models have a broad scale and can thus not provide specific local information (interview RIVM).

4.2.5. PROJECT TEAM

The project team is formed by people from two organizations, Waag Society and Amsterdam Smart City. Amsterdam Smart City is a public-private partnership that aims to develop the region of

Amsterdam as a smart city[10] (Amsterdam Smart City, n.d.). The organization has developed and supported many different projects in different collaborations and has developed a broad network, in which they aim to build sustainable relationships. The organization provides the possibility to test and experiment with new products, services and approaches in 'urban living labs'. (ibid.; Interview ASC)

Waag Society describes to explore new technologies in their societal context, doing so by including citizens in projects and exploring the possibilities of new technologies with participation from citizens or end-users. In this, Waag Society positions itself in the middle ground[11]:

"We take a place in the middle ground, between official institutions and the ordinary citizen who just want to do something. That's the case in this project, but also in projects in the field of healthcare, education or politics. In this, we don't assume that changes come from the professionals, but that it's a frictional engagement between everybody and everything involved. We're in the middle of that engagement." (Interview Waag Society, July 17, 2014)

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10. Amsterdam Smart City is initiated by the Amsterdam Economic Board, the Municipality of Amsterdam, electricity network operator Liander and telecommunication company KPN

11. The concept of the middle ground is introduced to describe communities and organizations that "act as intermediate structures allowing for the creative ideas to transit form an informal micro-level to a formal macro-level" (Cohendet, Grandadam, & Simon, 2009, p. 3)

Waag Society and Amsterdam Smart City have worked together before, although in different projects and formations. Within the smart citizen project, the smart city approach of Amsterdam Smart City and the participatory approach of Waag Society come together by experimenting and implementing a technology under development so to investigate as well technological possibilities and social impacts of the technology (Interviews Waag, ASC).

4.2.6. INSTITUTIONS

Two official institutions working with air quality were contacted for participating in the project: the department of air quality of GGD Amsterdam and the Centre for Environmental Quality of the RIVM. The interview respondent from the GGD explained to work on the technical aspects of monitoring air quality, the policy aspects related to this are located with other colleagues. One of the RIVM respondents has a background in data validation, a suspicious field by nature, his colleague has been working on other citizen science projects[12] and has a broad and open vision on citizen science (interview RIVM). The different views of complement each other, and show the different views within different departments of official institutions.

The two institutions have a legal task to monitor air quality over the whole country. This monitoring is done based on both measurements and computational models. Due to the strict regulations and

possible costs of policy decisions made based on the information provided by official institutions, precise data is very important. Both institutions are accredited for the reliability of their data (Interviews GGD, RIVM). Because of this required precision, monitoring networks are a little bit conservative by nature, and people working in the field are hesitant in drawing quick conclusions (interview RIVM).

4.2.7. CITIZENS

Citizens had different backgrounds and different reasons to join the project. Most citizens joined the project in reply to a newspaper article calling for participants[13]. The representative of Amsterdam Smart City described the participants of the project as higher educated men and women with often some technical experience and somewhat older men with less technical knowledge. Two of the interviewed citizens had broad technical knowledge, either with a background as electrical engineering and as a software architect for an air monitoring network or as an early-adopter of computer related innovations since the 1980s.

4.2.8. FABLAB SMART CITIZEN TEAM

The smart citizen kit is developed by the FabLab Smart Citizen Team. The team has been formed in FabLab[14] Barcelona, where the team was interested

in how to capture and visualize the data in the city that is currently invisible (Interview SCT). The focus has shifted to the 'smart citizen' later on, including people as part of the infrastructure. The FabLab community is a high-tech community with early adopters of new technologies. The developers of the kit thus are surrounded by technically experienced people. (Interviews Waag, SCT)

The smart citizen team aimed to developing a platform and initiating a movement of 'smart citizens':

> *"For us it's not about creating a product but about evolving a platform." (Interview Smart Citizen Team, July 14, 2014)*

The project in Amsterdam was the first formal deployment of the smart citizen kit, and the team expected to learn from the feedback and input of a first controlled user group.

4.3. SHAPING ROLES IN PROJECT DYNAMICS

The different (human and non-human) actors span up the actor-network of the project. Within this network, several processes of configuration and appropriation take place between actors that influence the project dynamics. In this section, the shaping of roles within the project dynamics is described building on the theoretical framework presented in chapter 2. The processes of configuration and appropriation of both roles and technologies describe the relations between different actors. The actor network of the project is complex, below, five smaller networks together give an impression of the total project dynamics.

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12. Amongst which the iSpex project. www.ispex.nl

13. 'Meten is Weten' (Lange, 2013)

14. "A FabLab (short for: fabrication laboratory) is a fully equipped fabrication workshop that gives everyone, from small children to entrepreneurs and businesses, the capability to turn their ideas and concepts into reality." Source: http://fablab.waag.org/content/about

This research builds on actor network theory, where technological actors are included in the network as active agents. Therefore, the first sub networks focus on the dynamics including technological actors. The first sub network analyzes the dynamics between different technological actors. The next sub networks focus on dynamics around the smart citizen kit, the online platform and data, thus addressing dynamics between human and technological actors. In these four sub networks several roles are negotiated. Next to the socio-technical dynamics, there are several dynamics between human actors, these are described in the fifth sub network.

4.3.1. DYNAMICS BETWEEN TECHNOLOGICAL ACTORS

Within the network, three technological actors have been identified. The smart citizen kit and its sensors produce data, which is sent to the online platform. On the online platform, the basic sensor values are translated to graphs and values are organized. Data is stored and the translated data is displayed on the platform. These dynamics are displayed in figure 9.
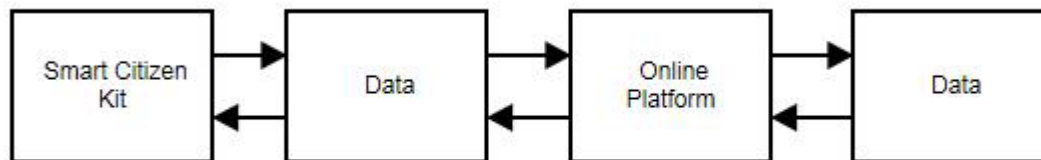

figure 9: Dynamics between technological actors

The types of data produced by the smart citizen kit thus limit the possibilities for design of the online platform. The other way around, the platform is designed in a way that it can process only certain types of data (indicated in figure 9 by two directions of arrows between data and kit and data and online platform). This limits the possibilities for tinkering with the smart citizen kit, because the online platform cannot be altered by citizens. Dynamics between human actors and one of these technological actors thus take place in context of the relation with other technological actors. Dynamics around the smart citizen kit are thus influenced by data and the online platform; dynamics around data are also shaped by the smart citizen kit and the online platform, etc.

4.3.2. DYNAMICS AROUND THE SMART CITIZEN KIT

The smart citizen kit is developed by the Smart Citizen Team at FabLab Barcelona. This kit was appropriated by the project team in Amsterdam. The project team made several adjustments to the kit before distributing it amongst citizens, resulting in a new version of the kit. Most citizens successfully appropriated this kit, some of them tinkered with the kit as well, resulting in other versions. The involved institutions are not included in the dynamics around the smart citizen kit, because these dynamics all took place in relation to data (described in section 4.3.4). The dynamics around the smart citizen kit are displayed in figure 10, and discussed below. The multiple blocks of the smart citizen kit indicate different versions, it is the same kit, but altered by different actors.

FABLAB SMART CITIZEN TEAM AND THE SMART CITIZEN KIT

"The main motivation to create the smart citizen movement is to provide the tools for people to have a more active role in what the city is now" (Interview Smart Citizen Team, July 14, 2014)

As the name of the smart citizen project implies, citizens are expected to be 'smart' and active in their environment. For the developers of the smart citizen kit the main motivation for the project is to enable people to have a more active role in the city. The smart citizen team configured other actors in their development of the technology, and has inscribed hard configurations in the smart citizen kit and online platform. By developing the smart citizen kit based on an open hardware/open software vision, the smart citizen team configured the project team and citizens to be able to tinker with the kit.

As described in section 4.2.3, the current sensors do not produce reliable data. The smart citizen team plans to either further calibrate the sensors
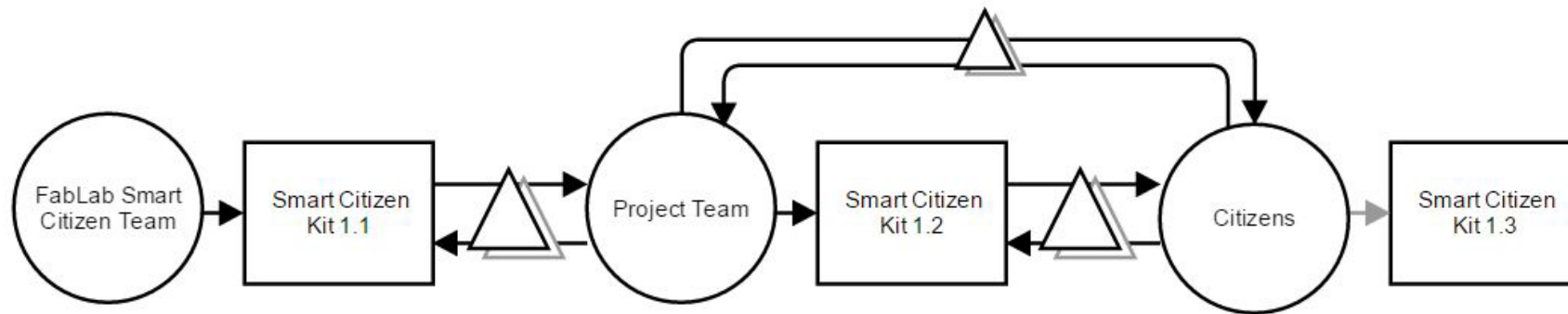
figure 10: Dynamics around the smart citizen kit

of the kit or to select new sensors so to improve reliability of the measurements of the kit.

Project team and the Smart Citizen Kit
Before the smart citizen kit was distributed amongst citizens, the project team appropriated it, by testing and adapting it, thus appropriating a role as tester and in re-configuring the kit, indicated in figure 10 by the triangles between smart citizen kit 1.1 and project team.

Before starting the project, the project team expected the kit to function properly, but was aware of the kit being under development:

"We thought that the smart citizen kit would have functioned better. But it's a new device, a new technology, the first televisions had a lot of defects that current serially produced TVs don't have. We knew we were part of an experiment, which means you don't know what exactly will go wrong. But we did take into account that something could go wrong. (Interview Amsterdam Smart City, July 15, 2014)

In the preparation phase of the project, the team thoroughly tested the kit on several operating systems and got insight in the challenges with use and installation. Based on these experiences, they developed a Dutch manual for participants and prepared a helpdesk for issues. This way, the project team prepared itself to help citizens with the installation:

"Before we started the project with participants, we had some kits and we started testing. Soon we encountered several issues. […] It was clear that the project was developed in the FabLab community with high-tech, early adopters of technology. So we worked on a Dutch manual and thoroughly tested the kit with many different operating systems. When we finally started the project we were prepared for some of the challenges ahead." (Interview Waag Society, July 17, 2014)

The FabLab smart citizen team excluded cables, shedding and adapter with delivery of the kit. Waag Society has made a casing for the kit that allows air

to flow through, but sheds the components from rain:

"Because of the lack of suitable housing (the kit is delivered without cables, adapter or housing) and the time pressure, we decided to use a standard Spelsberg installation box with transparent lid of which we opened the sides and bottom. We developed a shield to place in the box to protect electronics from rainwater." (Van den Horn & Boonstra, 2014, p. 12)

By this, Waag Society adapted the technology, changing the hard configuration inscribed in the kit (indicated in figure 10 by the arrow between project team and smart citizen kit 1.2). One of the citizens mentioned that this casing blocked a small button used to hard-reset the Arduino, thus making it more difficult for citizens to control the Arduino themselves. Throughout the project, Waag Society has been answering questions from citizens about technical difficulties and helped citizens installing and configuring the kit. In this the project team appropriated a role in communication and smoothing

technology appropriation for citizens, indicated in figure 10 by the arrows and roles between project team and citizens.

Citizens and Smart Citizen Kit

After citizens were selected as participants for the project based on their motivation, the first step of appropriating the smart citizen kit is the process of objectification. This can be understood as placing and installing the smart citizen kit and creating an account on the platform, were data can be accessed. Few of the selected participants did not collect their kit (8%), or did not manage to finish installation (6%). These citizens did not appropriate the kit. The kits were returned to Waag Society and some of them were redistributed amongst new participants. In the final report, Waag Society mentioned the technological complexity of the installation process as the main reason for people to drop out.

Before placing it, the kit had to be linked to a computer to be configured. Installation of the kit resulted in several challenges during the project, these challenges differed for the type and version of computer operating system (OS). Citizens on the Apple platform expressed to have installed the kit without big complications by following the installation tutorial provided on the website of smartcitizen.me and the manual by Waag Society. To follow the tutorial, citizens needed some technical knowledge about their computer and network, such as the type of Wi-Fi network. The installation on Windows computers provided more challenges (Van den Horn & Boonstra, 2014; Interview

Citizen 1). Some windows users had no big problems with installation (provided that they had some experience with and knowledge of the technical aspects), while other Windows versions provided severe challenges in installation, even for a professional software engineer with a background in electrical engineering (Citizen 1). He tried different versions of the OS before installation succeeded. With a background in electrical engineering and as a software architect, the citizen was able to solve the issues himself, but his vast knowledge on computers was required to finish the installation. It took the citizen several hours before he was able to view the data of the kit on the website. (Interview citizen 1)

Waag Society explained to have provided support were possible, especially on the Apple platform. Their experience with the Windows OS was limited, and here, Waag Society got support of tech-savvy citizens for more complicated problems (Interview Waag). Citizen 1 helped other participants to install their kit by answering questions at a helpdesk during a meeting and by providing Waag Society with information on the issues. In short, for some participants installation of the kit went relatively smoothly, while others faced severe technical difficulties:

> *"Well, I picked it up and placed it, we had to look for a spot where it would be safe for the wind. After a call with Waag Society we got it up and running. We have Apple computers, so it went quite smoothly" (Interview Citizen 3, July 15, 2014)*

> *"There were quite a lot of challenges in [installing the smart citizen kit], and maybe it's because I work in the software sector that I keep continuing until it works. I think I've invested several hours to get it working, but then again, I like to do it. […]. The aim should however be the use of the smart citizen kit, not providing a fun installation experience. You want to monitor air quality" (Interview Citizen 1, June 26, 2014)*

After instalation, it appeared that not all kits were assembled correctly. Thanks to the 'open hardware' vision of FabLab Barcelona and a background in electrical engineering, Citizen 1 could easily dis- and reassemble the kit to install a thermometer correctly. The smart citizen kit of citizen 3 had a loose wire a day after installment and has been replaced by another kit.

The open software/open hardware approach allowed citizens with enough technical expertise to tinker with the smart citizen kit. Citizen 1 dove into the soft- and hardware in the installation phase to get the kit working. Due to unreliable sensors, he decided to return the smart citizen kit when the project was over. The other interviewed citizens have decided to keep the smart citizen kit, because of the open technologies. Their interest was triggered by either possibilities to plug in new sensors if the developers come up with a new version, or by the possibility of tinkering with the kit, possibly connecting a solar panel, camera or otherwise (Interviews Citizen 2, 3).

Thus, some of the citizens did not appropriate the kit, some installed it without severe difficulties (citizen 2) and others adapted the kit either because it was not working or to tinker with it (Citizen 1 and 3). In this the project team appropriated a role in facilitating the installation process, indicated by the arrows between citizens and project team in figure 10. In interaction with the smart citizen kit, citizens appropriated several roles; as tester of the kit and tinkering with it (indicated by the triangles between smart citizen kit 1.2 and citizens in figure 10), this tinkering resulted in new versions of the kit, indicated by smart citizen kit 1.3 in figure 10. Next to that, citizens appropriated a role as helper, acting as helpdesk for other citizens.

CONCLUDING: ROLES RELATED TO DYNAMICS WITH THE SMART CITIZEN KIT

The open hardware/open software approach of the FabLab Smart Citizen Team allowed the project team and citizens to adapt the kit. Verhaegh, Van Oost, and Oudshoorn (forthcoming) have identified openness and fluidity as key characteristics for technologies in community innovation. The open and fluid character allows citizens to contribute to the further development of the technology. The main focus of the smart citizen project was not on innovation, but testing and contributing to the development of the smart citizen kit was part of the aims. With the open technology approach, each citizen could adapt his own kit, provided that he had enough technical expertise. As a result, each individual kit is different. In the dynamics around the kit, the FabLab smart citizen team has appropriated

a role as developers of the kit; the project team has appropriated roles as tester and re-developer of the kit and communicator and facilitator in relation to citizens. Citizens appropriated roles as tester of and tinkerer with the kit, and as helper acting as help-desk for other citizens.

4.3.3. DYNAMICS AROUND THE ONLINE PLATFORM

The online platform is developed by the smart citizen team, and thus is configuring the users of the platform. Citizens have appropriated the platform, but in the meantime miss several functions. One of the citizens used the platform for different purposes than intended. The project team appropriated the platform to follow the distributed smart citizen kits. These relations are displayed in figure 11 and discussed below. This paragraph focuses on the dynamics around the online platform, or how human actors access the data based on the configurations inscribed in the platform. How citizens interact with the data is addressed in section 4.3.4. Institutions are not involved in the dynamics around the online platform.

FABLAB SMART CITIZEN TEAM AND ONLINE PLATFORM

The online platform is developed by the FabLab smart citizen team, in doing so, they configured the users of the online platform. The online platform is accessible through a web page and by a smartphone app. In the next phase of the project, the FabLab Smart Citizen Team plans to focus on further development of the online environment
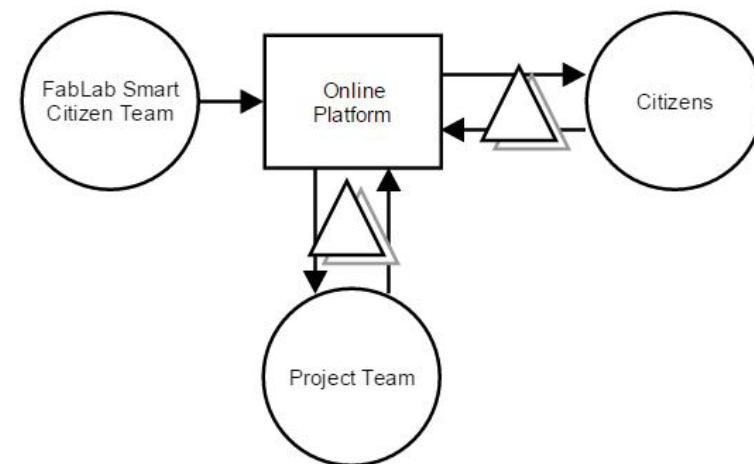
figure 11: Dynamics around the online platform

of the platform and mobile application, including improving server capacity and the usability of the platform (Interview SCT). They thus appropriated a role as (re)-developers of the platform.

CITIZENS AND ONLINE PLATFORM

After installing the smart citizen kit, citizens checked data generation on the website from time to time. The project team and citizens indicated that because of the small pane and small display of units of measurement, it is difficult to interpret data displayed on the platform, thus making it difficult to appropriate a role in data interpretation. As described in section 4.2.3 current data displayed on the platform is not reliable. Citizens interpreted the detailed numbers otherwise. As one of the citizens pointed out "a number of 500.9 gives me the feeling that it is an accurate value" (Interview Citizen 1). Some of the participants interpreted these numbers as accurate values in the standard unit of

measurement of air quality[15]. Citizens expressed a wish to place the graphs of several sensors (temperature, humidity, NO2, CO) next to each other. While this data is all available in the platform, there is no possibility offered to visualize it this way. One of the citizens developed a way to download all data so to be able to compare it, building on his programming background (Interview Citizen 1). He appropriated a role in tinkering with data and comparing data, but was only able to appropriate this role due to his programming skills.

In contrast to data on air quality, data for noise was relatively reliable. One of the citizens, suffering from noise disturbance left town because of a festival close by, and used the iPhone app as an instrument to inform herself about noise levels to decide when to go back home:

> *"I think the combination with an app is brilliant! When you're somewhere else, you can see whether it's 70 dB, it's lowered to 60 dB or now it's 80; we'll stay away and do something else. We really have a kind of instrument to decide whether we want to go home again"* (Interview Citizen 3. July 15, 2014)

The citizens appropriated the online platform, but expressed some additional requirements and wishes. These points of improvement have been communicated to the smart citizen team. Citizens appropriated roles as users of the online platform,

tinkerers with the online platform and as data comparator. These roles are indicated in figure 11 by the triangle between citizens and online platform.

The project team and online platform
As described in paragraph 4.3.1 the project team facilitated the citizens in installing the smart citizen kit. This facilitation was not only based on requests by citizens, an email to all participants shows Waag Society took the effort to check all kits for correct installation and sensor values, using the online platform. This way, they notified citizens of broken temperature sensors, misplaced localizations or incorrect in- and outdoor configurations (Waag Society, e-mail update, May 13, 2014). The project team thus used the platform to follow and check installation of the smart citizen kits. Here, the project team appropriated roles as users of the platform and in checking to support installation of the smart citizen kits. This checking to support installation can be understood as part of the role of facilitator of the project team.

Concluding: Roles related to dynamics around the online platform
Citizens appropriated the current online platform, but identified several points of improvement. These have been communicated to the smart citizen team, who will focus on further development of the platform. In this, citizens appropriated a role as user and tinkerer. The project team appropriated a role in communication by providing feedback to the smart citizen team. The development of the platform is thus in progress, but in the meantime, the

platform is appropriated by the human actors who are intended as users. The FabLab Smart Citizen Team appropriated a role in re-development of the platform.

4.3.4. DYNAMICS AROUND DATA
Most dynamics around the online platform are related to interactions with the data that can be accessed on the platform. However, not all interactions with data go through the online platform. Therefore, the processes of configuration and appropriation around data are discussed separately. Both the project team and the citizens have partially appropriated the data. The involved institutions have appropriated the data conceptually. Both project team and citizens have interacted with institutions on this topic. This relation has influenced the interactions of project team and citizens with data. The relations are displayed in figure 12, and described below.

Institutions, project team and citizens
Experts from RIVM and GGD looked at the specifications of the sensors, and argued that the sensors are not suitable for measuring air pollution, because the average levels of CO and NO2 are outside of the measuring range of the sensors. They question whether the sensors will react on changing levels in CO and NO2 concentrations at all, and argue that data of the smart citizen kit is unreliable (Interviews RIVM, GGD). Institutions had a critical view on citizens using data gathered in the project, because data is currently seen as unreliable. The GGD feared that citizens would

try to make political statements based on incorrect data, possibly creating unnecessary turmoil and thus unnecessary work for the official institutions. Respondents from the RIVM recognized this issue, but also see possibilities in contributing their knowledge and the added value of relatively cheap forms of measurement, further addressed in the paragraph on 'Institutions and data'. Official institutions that measure air quality expect citizens to have limited knowledge on these issues:

"I noticed ridiculous values, which makes me think that it should be a dysfunctional sensor, but it appeared to be a different unit of measurement. Here you see that it's difficult for the general public to deal with something as simple as units." (Interview RIVM, June 19, 2014)

Throughout the project, institutions provided feedback on the reliability of data during meetings, accompanied by expectations about how project team and citizens dealt with the data. Both project team and citizens took up this feedback and expectations. In this institutions appropriated a role as knowledge contributor. By this they configured the project team and citizens to be open for their knowledge and to learn something. The roles of knowledge contribution and learner are affiliated. The knowledge and expertise shared by the RIVM in one of the smart citizen cafés is highly appreciated:

"We missed a lot of information on what a sensor is and does, on how you can make sure that a sensors behavior is in your advantage, by calibrating it, keeping temperature at a constant level

etcetera. This type of information is important, and then you should just take the time to listen to what experts have to say about it." (Interview Citizen 1, June 26, 2014)

On the other hand, among some of the citizens the feeling is that official institutions took a too critical stance, not being open to the intentions of the project:

"It's very nice that RIVM and GGD joined the project, but what the RIVM in fact did was giving a business presentation in which, although it was informative, they opposed the smart citizen kit project, instead of looking at what would be possible with the project and data. The same goes for the GGD". (Interview citizen 3, July 15, 2014)

Thus, the role of learner is only partly appropriated by citizens. Institutions could not fully appropriate a role in knowledge contribution towards citizens, because not all citizens appropriated the affiliated role. This partial appropriation of roles is indicated by gray arrows between institutions and citizens in figure 12. In the dynamics between the project team and the institutions, the roles of learner and knowledge contributor were successfully appropriated. The project team took was open for the feedback of institutions and took it into account in appropriating the data, described in the next paragraphs.

In further development of the smart citizen project and citizen science in general, several roles were suggested for official institutions. In the long term, institutions might play a role in data interpretation
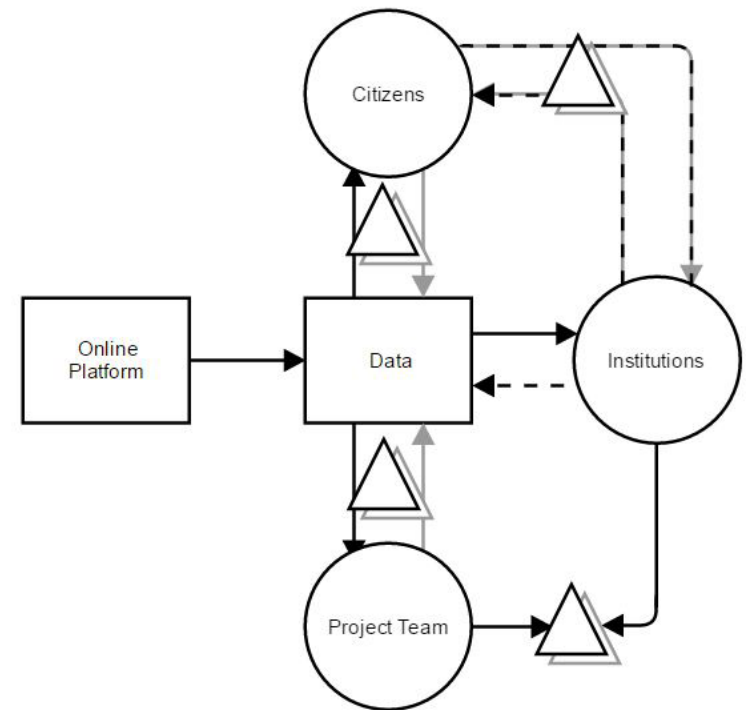
figure 12: *Dynamics around data*

and translating data into information and knowledge (Interviews Waag, Citizen 1). The RIVM acknowledged this, thus appropriating this conceptual role (indicated by the dotted arrows between citizens and institutions in figure 12). They expressed to be able to contribute by sharing their knowledge and expertise with citizens so to help them understand the complexities of monitoring air quality:

"The world is changing, measurements are changing and if we act upon that as RIVM, if we're open to that, it suits everybody. For us it's beneficial because we can use things that are already happening, and for citizens who are measuring its convenient that their data is connected with our

network because we can add a lot of knowledge to these measurements. Adding value to their measurements is a type of role that I'd like to see for the RIVM" (Interview RIVM, June 19, 2014).

Taking up these new roles would require different expertise from institutions, for example in different types and topics of communication with citizens (Interview RIVM). Therefore, the role in data interpretation is currently not appropriated, but RIVM expressed to be open for this role.

Project team and data

From the official institutions, the project team learned that data of the CO and NO2 sensor of the kit were unreliable. Therefore, the project team did not try to interpret this data. The noise measurements seemed to be reliable, so the project team focused on this data and developed a visualization of noise distribution over the city, presented in figure 13 (Interview Waag). The project team thus did not appropriate data on air quality, but did appropriate

figure 13: Sound visualization by Waag Society; source: http://sck.waag.org

the noise data (partial appropriation indicated by gray arrow from project team to data in figure 12). Here, they appropriated roles in learning from institutions and data interpretation. In making this visualization, the project team translated data into information.

Citizens and data

Interviewed citizens all described to be a data producer or measurer. One of the citizens mentioned a role as data interpreter, other mentioned to be a mere producer of unreliable data:

> *"In fact, we have been mostly data suppliers, but the data was unreliable or nothing happened with it. And user of the kit, the interesting thing is that data only gets meaning when you can really use it."(Interview citizen 3, July 15, 2014)*

Several citizens compared data on the platform with official measurements of the GGD, saw very large differences and started to question reliability of the data (Interviews Citizens 1, 2 and 3). Combined with information given by the RIVM in a meeting and in emails by Waag Society, they accepted that numbers on air quality were unreliable and unusable. Several citizens have expressed the wish to contribute to making sense of the data, and wanted to compare several data sources. Although the data was unreliable, citizens expressed that the fact that they are measuring themselves shows taking effort. Citizen 2 expressed the hope that showing this effort helps in being taken seriously. Here, citizens plan to raise a political voice, based on their efforts with the smart citizen kit. This is however different

than expected (or feared) by official institutions. Citizens do not aim to undermine data of official measurements, but want to gain a momentum on the problem on air quality. Citizens did thus not appropriate the data on air quality, because of its unreliability. Citizen 3 did appropriate data on noise, citizens thus partially appropriated data (indicated in figure 12 by a gray arrow). Meanwhile, citizens appropriated roles as data producer, data interpreter, data comparer and raising a political voice.

Institutions and data

For official institutions, appropriating the current data of the smart citizen kit is difficult, because they have an interest in reliable, validated data. The GGD expressed that of the claimed functionalities of the kit, the interest would be on NO2 measurements, and because of the unreliability of this data the GGD can and will not invest in the smart citizen kit:

> *"Well, you have to make a distinction between the different things the device can do. I'm not talking about light or sound, for me it's all about the NO2 measurements […]. For the technology used in this device you can question whether it will react on open air concentrations at all. Well, nobody knows. […] So, no, we're certainly not going to do anything with the technology." (Interview GGD, June 24, 2014).*

Next to that, the GGD expressed that with these extra data sources it is more time consuming to provide useful information on air quality, since all data has to be validated and interpreted:
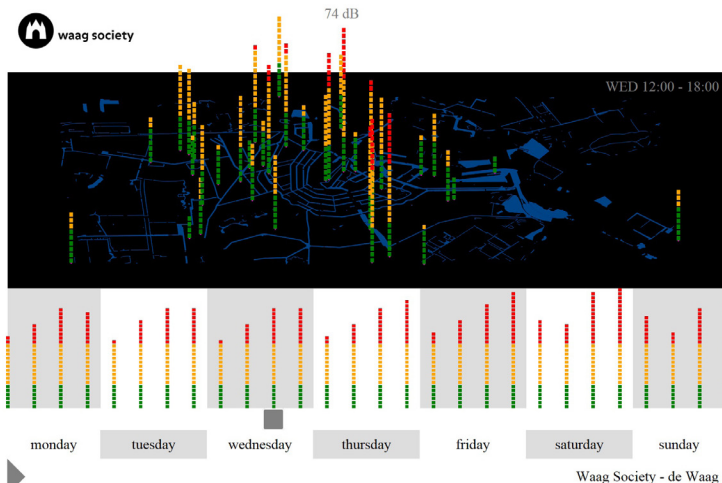
"We have 20 years of experience with data. We know that the less data, the better. […] All these different data flows are in itself quite interesting, but there comes a point where you can't see the wood for the trees." (Interview GGD, June 24, 2014)

On the other hand, both institutions see the potential of citizen science networks, because of the relative cheap forms of measurement. The idea of being in the center of society is a present-day topic at the RIVM, and this fits with citizen science ideas. The RIVM thus sees possibilities with data from citizen science project, under the condition that data becomes more reliable. The RIVM did not appropriate the current data of the smart citizen kit, but does see possibilities for using this data in the future. The RIVM thus conceptually appropriated data, under the condition that it becomes more reliable (indicated by dotted arrow between institutions and data in figure 12). In this context, respondents of the RIVM added that data does not have to be as precise as their current measurements. As long as relative data is reliable, it can be used to signalize certain trends. If these imply extreme values, this can be a good reason for more detailed investigation. In this sense, citizen sensor networks can be additional to the current official monitoring networks:

"It doesn't matter if there's a 50% error margin. Whether it's 3 or 4 times higher than the surroundings, doesn't matter, because you can see there's an issue. This certainly has added value for us, because after this indication we can start investigating why it's deviating, and if we find an

issue, you can do something about it." (Interview RIVM, June 19, 2014)

Concluding: roles related to dynamics around data

All human actors agreed that the data on air quality is unreliable, and all took a critical stance towards the data, following the configuration by institutions. The project team and some of the citizens did appropriate the data on sound, and thus a role in data interpretation. Institutions see added value in the data produced by citizens, provided that data is more reliable. If institutions appropriate data produced by citizens, different roles would be required from institutions and citizens. This can lead to blurring boundaries between official institutions and citizens. Citizens become data producers, facilitated by institutions. These possible changing roles are not limited to the dynamics around data, and are further discussed in the next section.

Within the smart citizen kit project, institutions appropriated a role as knowledge contributor, and the project team and several citizens appropriated a role as learner. Several citizens appropriated a role as data comparer or data interpreter. Data interpretation remains limited, due to the acknowledged unreliability of data.

4.3.5. DYNAMICS BETWEEN HUMAN ACTORS

The relations between human actors and the smart citizen kit, online platform and data took place within the project context. One of the aims was

to find out what these technological possibilities could mean for the roles of the actors involved. This resulted in many negotiations between human actors, often mediated by technologies. The project team had a central role, interacting with all actors involved, using an open approach. Within the project, citizens were configured as active or smart citizens, and this role was appropriated to a large extent. Meanwhile, this resulted in changing roles and relations between citizens and institutions, which were partially appropriated. The smart citizen kit is still under development, and citizen are configured as user, tester and experimenter. Institutions expressed to be willing to help development of the small sensor kits, but had no direct contact with the developers.

These multiple dynamics are displayed in figure 14 and further described below.

The project team & other actors

The project team took an open and equal approach towards both citizens, official institutions and the smart citizen team. This open approach allowed them to both learn from the expertise of experts (either the institutions, smart citizen team or one of the citizens) and to share their findings with other actors:

"I've the feeling that our equal approach, not making things look better than they are, works really well, especially with this type of critical people" (Interview Waag Society, July 17, 2014)

"We've tried to communicate this open attitude with citizens from the beginning. Neither we
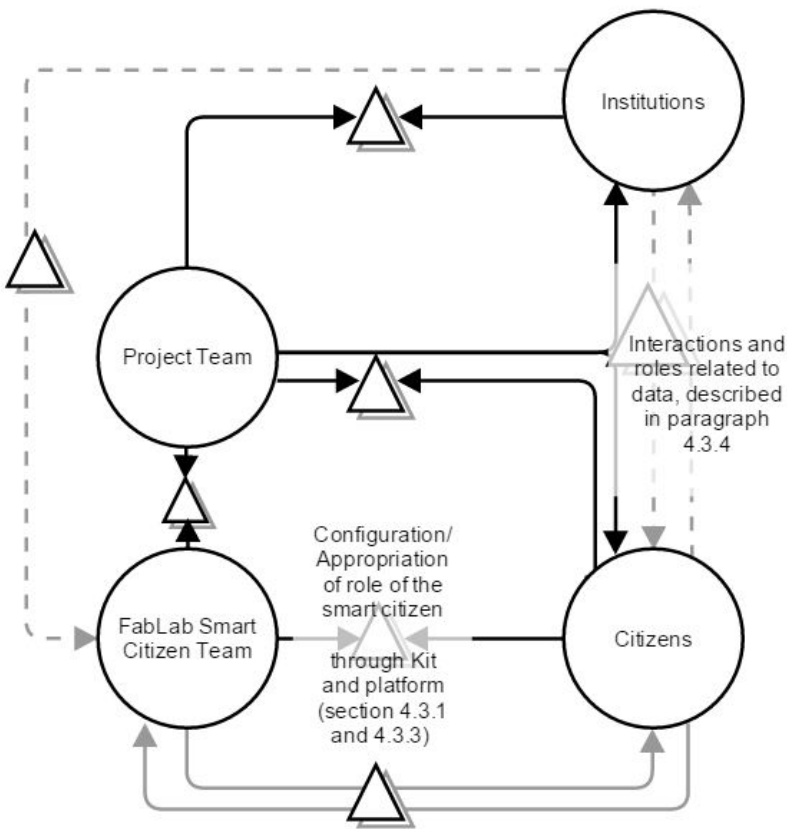
figure 14: Dynamics between human actors

nor citizen knew what we'd face, and we tried to anticipate on what we found out on the way as much as possible. We've acquired knowledge from experts, started collaborations with them and kept the conversation with the participants going on." (Van den Horn & Boonstra, 2014, p. 8)

All citizens were very positive about the role the project team had. Not only did citizens appreciate the initiative of the project, they also were very positive about the effort the project team took to help citizens overcome the installation challenges.

Next to that, the open and accessible stance of the project team was very much appreciated:

"I noticed they in the beginning were a bit hesitant towards the individual who's saying a lot, but later on they gave me more trust. It was not only my open stance towards the project, but Waag Society was open to input as well. That's impressing, since you'd rather have positive contributions than critical remarks." (Interview Citizen 1, June 26, 2014)

In this, Citizen 1 actively took part in the project by guiding the process by contributing and sharing knowledge on the topic with both the project team and the citizens. The citizen built on his background as a software engineer and extended the network by offering to invite an expert from the RIVM to one of the smart citizen meetings:

"At a certain moment in time, I noticed that amongst all present I was the one with the most experience on monitoring air quality [...]. As a holder of knowledge I suggested to invite the head of data validation of the RIVM, and Waag Society thought it to be a good idea." (Interview citizen 1, June 26, 2014)

As discussed in section 4.3.4, institutions were critical on the data produced by the smart citizen kit. By taking an open approach and taking into account the feedback of institutions, the project team managed to keep in touch with them and keep the conversation going. Institutions mentioned that the organizations of the project team are very interesting, because they have experience in participatory projects, and have the network to set up such a project. However, the skills and expertise on

monitoring air quality are expected to be limited, and institutions think openness to their expertise is essential, and expressed the wish to be included beforehand:

"I'd like to be prepared for the questions about the measurements of Waag Society, so to be able to answer them based on tests we did with the sensors they use. Now we have to tell that the sensors aren't working properly, but we don't know the details. That's a pity." (Interview RIVM, June 19, 2014)

"I don't have a clear overview of the type of expertise Waag Society has, but I'd like to help them with it, on the other hand, it's very useful for us that they already have an organization and are used to working with citizens. You have to build up something like that together." (Interview RIVM, June 19, 2014)

Being open to the feedback of institutions had a reciprocal effect, institutions were open to the contact with the project team. Both actors acknowledged a relation in which they can learn from each other. Next to that, the project team provided feedback to the FabLab Smart Citizen Team, so they could learn from the experiences in Amsterdam. The smart citizen team viewed the project in Amsterdam as an experiment and explained to hope to learn from these experiences (Interview SCT). The project team sees that the smart citizen team can learn from the project in Amsterdam and assumes that they

will use the findings from the project in the further development of the smart citizen movement.

"For such a foreign partner [the Smart Citizen Team] it becomes interesting to develop it further when they know their product is used and with what results. It's an extra stimulus for them to invest in newer versions of the kit" (Interview Amsterdam Smart City, July 15, 2014)

Building on the feedback of citizens, the project team provided feedback to the FabLab Smart Citizen Team on both the smart citizen kit and the online platform (van den Horn & Boonstra, 2014).

The open approach of the project team resulted in alignment of the configuration and appropriation of roles in relation with other actors. For example, institutions appropriated a role as knowledge contributor, and the project team appropriated an affiliated role as learner. The other way around, institutions and project team agreed that institutions could learn from the project team. In relation with the FabLab Smart Citizen Team, the project team appropriated a role in feedback provider for further development, and the Smart Citizen Team appropriated an affiliated role in learning from the project.

These successfully aligned role configurations and appropriations between project team and institutions and project team and FabLab Smart Citizen Team are displayed in figure 14 by the roles (in triangles) and single arrows towards these roles. The aligned roles between project team and citizens are a role as facilitator appropriated by the project team and a configured and appropriated role as active citizens. This role is configured by both project team and FabLab Smart Citizen Team, and discussed in the next paragraph.

Citizens and project team & FabLab Smart Citizen Team

The FabLab Smart Citizen Team sees technology empowerment as key to create smart citizens who "have learned how to have a political voice to encourage action to counterpart the existing […] big presence of the government" (Interview SCT). Similarly, Waag Society has developed several projects that investigate the relation between government and citizen, and especially the use of technology to enable citizens to take several matters into their own hands (Interview Waag). In the project, three main aspects can be identified when they characterize the expectations about active citizens: engagement and commitment in the project; taking individual action and raising a political voice based on collected data. By selecting participants based on a motivation letter, the project team aimed to create a group of engaged and committed participants:

"Participation and active involvement is obviously crucial in a project like this. You can't realize such an experiment without motivated participants who want to actively commit themselves to collecting data" (final report project team, van den Horn & Boonstra, 2014, p. 7)

Institutions monitoring air quality mentioned engagement and commitment as well. Interview respondents at the RIVM have also pointed out the importance of commitment of citizens, especially because of the complexity of monitoring air quality. While the GGD has many critiques on the technology of the smart citizen kit, they acknowledge the commitment of the citizens in the project and take it seriously. This engagement and commitment was not only appreciated throughout the project, but also in possible continuation:

"It would have been nice if a group of citizens had formed who found it so interesting that they would continue on their own. That didn't happen. But we do have a group available willing to join in further experiments" (Interview Amsterdam Smart City, July 15, 2014)

The second expectation linked to active participation by citizens is related to taking individual action and behavioral changes. The assumption of the project team was that data about the environment can raise awareness amongst citizens about the influences of their own behavior on air quality, eventually leading to actions to improve it. This has also been addressed in the newspaper article calling for participants[16]. The third expectation of active citizenship is linked to raising a political voice. Expectations about this differ for different actors. On the one hand, the project team aimed to investigate in what way citizens could use the data gathered to go to official institutions and the government. This was also expressed in the newspaper article calling for participants:

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16. 'Meten is Weten' (Lange, 2013)

"Up until now, citizens are dependent on data from institutions or the government. If citizens start to monitor themselves, this can lead them to appeal to the government on its policies." (Lange, 2013)

As described in the previous sections, citizens indeed were engaged and committed in their appropriation of technologies. For several citizens, installing the kit provided severe difficulties, but most took the effort to install it (section 4.3.1). Next to that, citizen 1 committed to the project by contributing and sharing his knowledge and inviting a representative of the RIVM (section 4.3.5). While they indeed aimed to raise a political voice, citizens were cautious in doing so because of the unreliability of data (section 4.3.4). Because most data was unreliable, most citizens did not take individual action. Citizen 3 however did so by using the app to deal with noise disturbance (section 4.3.3). Citizens thus appropriated the role of active citizen to a large extent. Throughout the project, expectations on taking individual action and raising a political voice changed, because of the unreliable data.

The role of active and smart citizens is configured by the FabLab Smart Citizen Team and the project team, and includes expectations on engagement and commitment, taking individual action and raising a political voice. This role is appropriated to a large extent by citizens. Configuration and appropriation are successfully aligned, the role of active citizen is displayed in figure 14 by the triangle in between citizens, project team and FabLab Smart Citizen Team.

Institutions and citizens

In the project aims, the project team questioned what kind of impact the project could have on the relation between citizens and institutions. In their ongoing conversations with institutions and citizens, the project team tried to address this question. The open stance of the project team in this contact had a reciprocal effect, both institutions and citizens took an open stance towards changing relations. The roles in relation between citizens and institutions are partly related to data, which is discussed in paragraph 4.3.4. In this paragraph, the dynamics related to the social interactions between citizens and institutions are described.

All actors acknowledge the legally established responsibility of official institutions to monitor air quality, and the precision with which they perform this task. The data and information provided by official institutions is thus valued for its credibility. However, citizens expressed that while they trust official institutions, these cannot solve all issues, leaving an open space for measurements by citizens. There might be a difference of interest in monitoring air quality. Institutions are interested in a broad overview of air quality for regions or the whole country, and use several monitoring stations and computational models to determine air quality. Citizens however also have an individual interest and are interested in the air quality in their surroundings and their backyard. Respondents of the RIVM mentioned that these different aims could possibly complement each other.

The respondents from RIVM indicated that they are open to this type of citizen's science projects, but are currently searching what approach is suitable. For the RIVM, the added value lies in gaining insights in the issues that society sees as important:

"I think the interesting thing is to let people decide themselves. If you let it originate from the public, you get their gut feeling with it, for free. People have the feeling something is wrong, and even if that feeling is unjustified, these are the places we want to measure, if only to reassure people" (Interview RIVM, June 19, 2014)

To do so, the RIVM wants to have an open approach towards the projects, not steering the processes. This also entails being open towards the results of the projects:

"We should be open if the results of citizen science require us to really take action […] but that also holds for citizens, they should be open an accept the outcomes of their measurements". (Interview RIVM, June 19, 2014)

In the interaction with current data produced by the smart citizen kit, citizens already took into account the feedback of institutions on the reliability of data. Their open view and motivations were appreciated by institutions (Interview GGD, RIVM). Citizens did not reflect on the changing relation with institutions in the interviews since their focus was on the individual project. The dynamics between institutions and RIVM are ongoing, and the expectations and role configurations are still fuzzy. These dynamics are displayed in figure 14

by the dotted gray arrows between citizens and institutions.

Institutions & FabLab Smart Citizen Team
Within the project, there was no direct contact between institutions and the FabLab Smart Citizen Team. This might be due to practical reasons. Institutions joined in the project dynamics later in the project, and the smart citizen team was mostly involved beforehand and in communication with the project team. Next to that, the institutions involved focus on air quality in the Netherlands, while the developers are based in Barcelona, Spain.

However, institutions expressed some expectations about developers of small sensor kits. These expectations are related to small sensor kits in general, and not limited to the smart citizen kit. Both RIVM and GGD suggested to continue testing small sensor kits, so to contribute to the development of these devices. According to the GGD, the current big question in the field of air monitoring is: Can you create precise and reliable measurements with small affordable sensors? To address this, the GGD has tested several small sensor kits, currently without any satisfying result:

"Well, that's the question that's been asked more and more over the last four years. Manufacturers approached us with a certain device either for sale or under development. Sometimes it led to a test […]. Up until now, these devices were either as pricy and large as a normal monitoring station, or the results of the measurements were very disappointing. So it [citizen science] is a very gray area

where there are many expectations, but nothing is actually proven." (Interview GGD, June 24, 2014)

The challenge institutions are dealing with is how to further contribute to these developments without compromising their current, statutory tasks. Both institutions appropriated a conceptual role in contributing knowledge to development of small sensor kits and testing them. Whether and how to include them in their statutory tasks is not yet addressed. The conceptual appropriation of this role includes a conceptual configuration for the smart citizen team, who are configured to learn from institutions. Because this configuration is conceptual and no direct interactions take place, this configuration is displayed in figure 14 by a dotted gray arrow from institutions to FabLab Smart Citizen Team. The other way around, the smart citizen team did not have expectations about the institutions within the project.

Citizens and FabLab Smart Citizen Team
The above described dynamics relate to implementing the technologies in a changing relation between institutions and citizens in measuring air quality, but the project also had aims on trying out a technology still under development. In this, citizens were configured as users, testers and co-creators of the kit. These three roles and affiliated expectations of developers were sometimes conflicting, and are further described below.
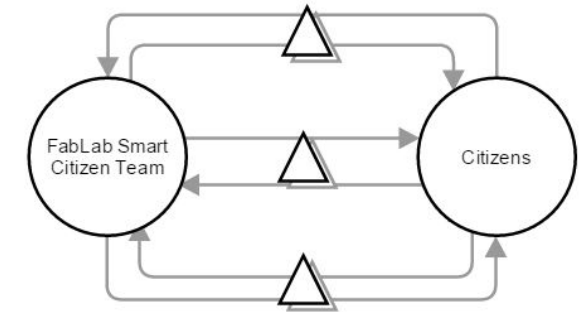
figure 15: Dynamics between citizens and FabLab Smart Citizen Team

Citizens as user of the smart citizen kit
Waag Society described in their final report that several citizens expected a "plug-and-play device" and felt "thrown back in time" with the smart citizen kit (Van den Horn & Boonstra, 2014, p. 13). When joining the project, most citizens expected a smart citizen kit which they could use to measure air quality, and to gather data about their environment. They expected a more or less finished and working product and relied on the developers' responsibility for this:

"There were several questions that I should have asked, but you hope you don't have to because they are the developer's responsibility. Essentially it's like buying a car and first checking whether the construction is correct. There's always a certain level of trust when you get a new product, if I order coffee here, I don't have to check whether it's really coffee. […] I learned that in these type of experiments you have to ask these fundamental questions about a technology." (Interview Citizen 1, June 26, 2014)

Several of the citizens mentioned a role as user of the smart citizen product (kit and platform). When asked what they used the kit for, citizen 3 explained to use the app as an instrument to check noise disturbance when she was away from home. Citizen 1 described expected use of the kit was to measure air quality, but this appeared to result in unreliable data. Here, both citizens and GGD see a responsibility for the developers. If a product is presented as a tool to measure air quality, then, according to GGD and citizen 1 and 2, it should be able to measure air quality and say something about air quality. All actors agree that this isn't possible in the current version of the smart citizen kit, and both citizens and institutions thought it to be a responsibility of the developer to either live up to this expectation of measuring air quality, or clearly take effort to alter the expectations people have about the device:

> *"In principle, the developer is responsible for delivering a good product, or not, but then you have to very explicitly state the assumptions, context and limitations. That wasn't the case, I just got a kit." (Interview Citizen 1, June 26, 2014)*

Next to that, Citizen 1 expressed the idea that the smart citizen team focused on technological development, and fell short on a reflection on the societal impact of such a movement. In that context, he suggested that the focus should have been on accurate measurements, instead of high-tech fancy visualizations. Similarly, he expected developers to think about the user experience and taken into account different operating systems:

> *"For them [in FabLab Barcelona] the Apple platform might be way sexier, and that small community of hipsters might have that, very nice. But the consequence is that it's very annoying for your target group [of citizens with mostly Windows platforms]." (Interview Citizen 1, June 26, 2014)*

Most citizens thus appropriated a role as a user, but the expectations linked to this role did not align with the configurations inscribed in the technology by the smart citizen team. The citizens who decided to keep the smart citizen kit not only hope for further developments of the kit, but also hope that the developers will allow them, the current owners of a kit, to update their kit to coming versions:

> *"I do have the hope that they further develop the smart citizen kit in Barcelona and that these developments can be plugged in on my kit quite easily" (Interview Citizen 3, July 15, 2014)*

The smart citizen team acknowledged this and wants the project to remain open to current users, and aims to make newer sensors or versions accessible for current owners of the kit.

> *"We need to move from the current version, that's a fact, and then we're going to move without compromising the users that we have already, so it means that the next iteration is going to use the same platform, the same hardware right now, but we're going to upgrade them. They use the same kit, we will be able to plug in new sensors." (Interview Smart Citizen Team, July 14, 2014)*

Citizens testing the smart citizen kit

The FabLab Smart Citizen Team and the project team also had the aim to test the smart citizen kit with a larger group of citizens (Interviews Waag, ASC, SCT). Citizens were thus configured as being part of an experiment and as testers of the smart citizen kit. The developers of the kit, who were not directly involved in the project, mentioned that their view of the project as an experiment, and thus citizens as part of the experiment, was not recognized by the involved citizens (Interview SCT). Citizens did not appropriate a role as tester.

Citizens co-creating the smart citizen kit

The smart citizen team describes its role as the total drivers of the smart citizen movement. They aim to open up this process more to be a companion for partners with pilot projects (such as the smart citizen project in Amsterdam) and current owners of a smart citizen kit, by developing the smart citizen movement based on open hardware/open software, the smart citizen team hopes for communities to emerge which further take upon the development. In this citizens are configured as co-creators of the kit. For the smart citizen team "it's not about developing a product, but about evolving a movement" (Interview SCT). Opening up does not mean letting go, the smart citizen team wants to keep control over the ongoing developments:

> *"We believe that openness is great, but that you need some curation in order to have some congruence in what you are doing. So that's important to keep in the project, not just allowing everybody to do whatever they want, but keep the values aligned and keep steering the process of evolution of the smart citizen." (Interview Smart Citizen Team, July 14, 2014)*

The FabLab Smart Citizen Team as developer

The FabLab smart citizen team has a role as developer of the project. All three roles of user, tester and co-creator relate to the role of developer, but their relation to or expectations of the developer differs. A users expects a developer to take the responsibility to deliver a full functioning product, a co-creator expects freedom to cooperate and develop together, while a tester expects the developer to be open to his feedback.

A user assumes to use the product for a certain utility, in the case of the smart citizen kit, to measure air quality. This privilege, the access to the utility through the use of the product, is linked to the demand for a functioning product, or as citizen 1 phrased it: a developer is responsible for delivering a functioning product. This configuration of the developer role conflicted with the view of the smart citizen team, not aiming at developing a product, but evolving a platform, where citizens are co-creating the product. Thus, a user role is affiliated with the responsibility of the developer to deliver a fully functioning product. However, when configuring a role as co-creators it is essential to have the possibility to tinker with the technology. The open hardware/open software approach of the FabLab Smart Citizen Team allows citizens to tinker with the smart citizen kit. The configurations of user, tester and co-creator thus all have different and conflicting configurations of the affiliated role of the developer.

In the above described interaction several roles were negotiated. The project team took an open approach in project coordination which contributed to successful negotiation of roles. The role of active citizenship was configured by several actors and appropriated to a large extent by citizens. In the relation with citizens, institutions conceptually appropriated roles as data interpreter and knowledge contributor. Citizens included the feedback from institutions in their appropriation of technology.

The FabLab smart citizen team is conceptually configured to learn from institutions. The smart citizen team is unaware of this configuration. Lastly, roles are negotiated in the relation between citizens and smart citizen team. Citizens are configured as co-creator and tester but have appropriated a role as user. Configuration and appropriation are not aligned. Roles of user, co-creator and tester are related to the affiliated role of developer. However, the expectations of user, tester and co-creator differ, and thus result in role conflict for the developer role.
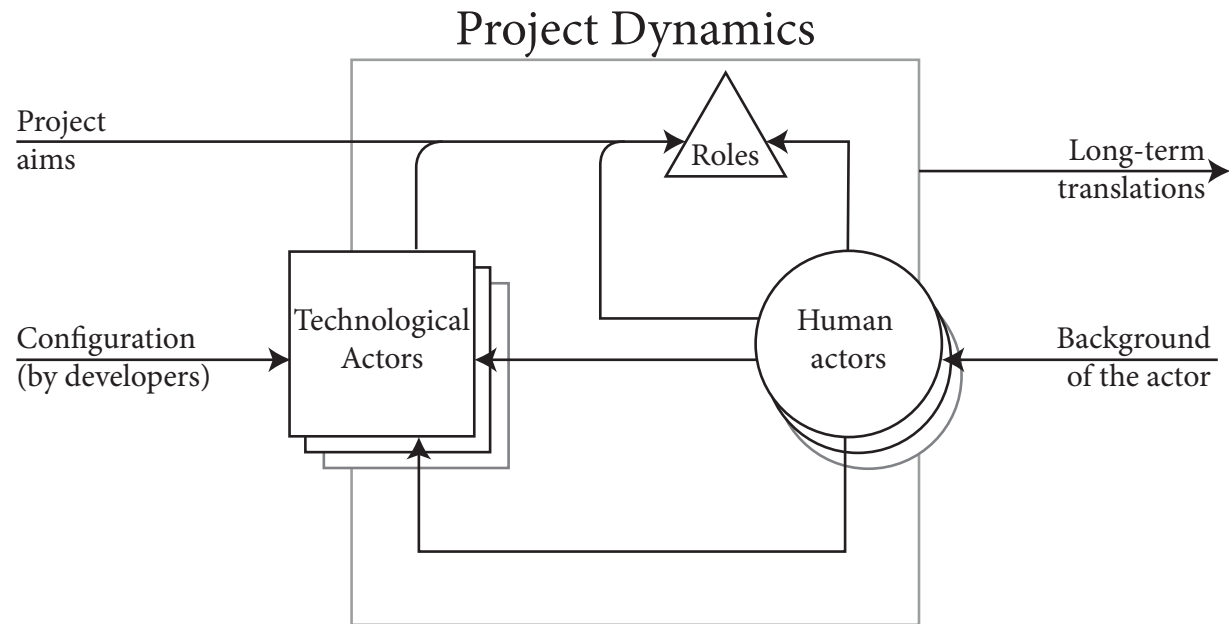

figure 16: schematic overview of configuration, appropriation and translation within project dynamics

4.4. ROLES SHAPING THE PROJECT DYNAMICS: TRANSLATIONS

In the previous section, the different dynamics within the actor network are described. As described in section 2.4, the processes of configuration and appropriation lead to short- and long-term translations. Long-term translations indicate both society-wide changes and changes on actor-network level. Within the Smart Citizen Kit project, several negotiations about roles and technology have taken place, and are sometimes ongoing. In the project, long-term translations are ongoing. The findings of the smart citizen project confirm the conceptual model of project dynamics as introduced in section 2.4. This model is redisplayed in figure 16. This paragraph describes to what extent the negotiations about roles and technology contribute to long-term translations.

The smart citizen kit project started with aims related to possible changes in the relation between institutions and citizens, and questions related to testing the smart citizen kit and online platform. The project was initiated by the project team. The project team interested several actors to join in in the actor network. The network started with the project team, the FabLab smart citizen team and the technological actors of the smart citizen kit and online platform. After preparation, the project team interested citizens to participate in the project, including them in the network. With the smart citizen kit, citizens produced data (another technological actor in the network). During the project, the actor network was expanded by inviting two institutions to join.

At the start of the project, there was no relation between the citizens and institutions on the topic of citizens measuring air quality. The distribution of roles thus had to be negotiated. These negotiations occurred through intermediation of the project team, and at the end of the project, it seems that citizens and institutions have moved towards agreement on possibilities of role distributions. This conformity remains conceptual. Roles are not currently appropriated. One of the reasons for this conceptual agreement is the unreliability of data produced. Because data is currently unreliable, these conceptual roles are not appropriated in practice. Data and the smart citizen kit producing it are thus important actors in the process of making this translation happen. The long-term translations towards these changing distribution of roles is thus ongoing, but first steps have been made in the conceptual agreement on possible roles.

The FabLab Smart Citizen Team developed the smart citizen kit with an open hardware/open software approach. The kit is currently under development. They configured citizens as testers and co-creators of the kit, while citizens appropriated a role as user. Here, the configuration and appropriation of the roles of the citizen do not match. The contact between Smart citizen team and citizens was indirect and limited, and negotiations about these roles seem to be limited, thus currently not resulting in translations. At the end of the project, several citizens decided to return their smart citizen kit, while others kept it. The project team and institutions are looking for further collaboration on the topic, and the FabLab smart citizen team continues development of the smart citizen kit, including the citizens who decided to keep their kit. New dynamics and with that new translations develop here, and negotiations probably continue.

4.5. CONCLUSIONS: TOWARDS UNDERSTANDING THE MUTUAL SHAPING OF ROLES AND PROJECT DYNAMICS

The findings presented in the previous paragraphs show that negotiations about roles and technologies in the project are ongoing. Table 5 gives an overview of the configured and appropriated roles of human actors. The table shows a large variety of roles within the project. Although several roles remain conceptual, there is a relatively large overlap between configured and appropriated roles, taking into account the multiplicity of roles and project dynamics. In the findings of the smart citizen kit project, several aspects have been identified that are of importance in the mutual shaping of roles and project dynamics, and the ongoing negotiations in this process. These aspects are described below.

4.5.1. FROM SMART CITIZEN KIT TO DATA, INFORMATION AND ACTION

The smart citizen kit is used to gather data about the environment. If reliable, this data can be interpreted and translated into information about air quality. With this information, actors (both citizens and institutions) can gain knowledge on the situation, which eventually gives them the power to act. Several translations are made in this chain from data to information, knowledge and action. The actions leading to data production and these translations are performed by different actors.

One of the roles of the citizen is being a data producer. The citizen however does not produce the data himself, it is the sensors and the smart citizen kit that produce data. By installing and configuring the smart citizen kit, the process of data production is started. The data producer is thus a role of the combination of citizen and smart citizen kit, it is a

	Project Team	Institutions	Citizens	FabLab Smart Citizen Team
(Conceptually) **Configured roles**	- Initiator - Intermediator - Bridging - Open to learn/learner	- Knowledge contributor - Monitoring air quality - Critic - *Tester of kits* - *Data interpreter*	- Active/smart citizen: • Engagement • Behavioral changes • Raising a political voice - Testers - Open for feedback/learner - Tinkerer - Little knowledge on the topic	- Developer of the product - Technology driven - Learner (from the experiences in amsterdam) - *Learner (from institutions)* - Support for current smart citizens
(Conceptually) **Appropriated roles**	- Initiator - Communicator (intermediator, open approach) - Facilitator - Smoothing technology appropriation - Tester - Re-developer SCK - Sharing findings - learner	- Knowledge contributor - Monitoring air quality - Searching for possible roles - *Tester* - *Data interpreter* - Learner (from experiences with citizen science) - Critical reflection	- Data producer - Data interpreter - User - Knowledge contributor - Networker - Helper (helpdesk) - Tinkerer/ tester - *Raising a Political Voice* - Data comparer - Guiding the process	- Driver of the smart citizen moment - Open stance towards smart citizens - Curator - learner

table 5: Roles of human actors in the smart citizen kit project

hybrid role. After data is produced, it has to be interpreted, so to translate it to information. Because of the unreliability of the sensors, at the moment data cannot be interpreted. There are several suggestions on how to do so. First of all, data is directly sent to the online platform, were it can be consulted and then be interpreted. One of the suggested roles for and by official institutions is data interpretation. How this interpretation could be done depends on the types of measurements, and is currently uncertain because of the unreliability of data. The details of the role of data interpretation (including whether it will be hybrid) are thus unknown at the moment. Data might also be interpreted by citizens through the online platform, but since citizens and institutions see possibilities in data interpretation by institutions, this seems an interesting option. The possibilities for data interpretation by official institutions is in the case of the smart citizen kit dependent on whether institutions can easily access the data, which is in itself dependent on design choices about the online platform by the smart citizen team.

Part of the configuration of citizens in the project is that they are active, and change individual behavior based on the information they get on the air quality in their environment. To do so, the interpreted data (i.e. information) has to be fed back to citizens. With the information on air quality following the data from the citizen kit, both institutions and citizens can gain knowledge on it and based on that, take action. Citizens were expected to take action by changing individual behavior and raising a

political voice. Although data was unreliable, citizens described to aim for both individual changes and raising a political voice if they can base it on reliable data.

All in all, data is produced so to eventually take action based upon it. This can only be done if data is interpreted and translated into information. Within the smart citizen project, it is suggested that citizens and smart citizen kit together produce data, while institutions contribute to data interpretation, feeding back the information to citizens.

4.5.2. ACTIVE CITIZENSHIP
In the smart citizen project, citizens are configured to be 'smart' and active. In this case, smart citizenship is understood as to be engaged and committed in the project with the aim to produce data on air quality, and based on that data to take action in raising a political voice and making behavioral changes. Within the Smart Citizen project, smart citizenship is thus not only being a data producer, but also making use of the data, eventually translating it into action. For 'smart citizens' to have the freedom to produce and use data requires the institutions to give this freedom to citizens.

4.5.3. UNCERTAIN ROLES FOR INSTITUTIONS
Official institutions are searching how to link up with citizen science projects. They see the potential and added value of citizen science in the future, but are currently hesitant because the early developments in citizen science can be time consuming

and might challenge their current responsibilities. The privilege of active citizens to act results in an obligations for alter roles to give this freedom. This conflicts with the current obligations of official institutions to monitor air quality, and especially the responsibility they feel to provide accurate and complete representations of air quality. Nevertheless, developments are ongoing and institutions are eager to contribute to this so to improve quality of data. Eventually, a role in data interpretation and knowledge contribution is foreseen for institutions. To be able to do so, data of the smart citizen kit should be easily accessible for institutions. Next to that, comparing with data of official monitoring stations can be helpful for citizens. Several actors mentioned that the online platform could provide such a possibility, but currently does not facilitate data interpretation and comparison.

4.5.4. USER, TESTER, CO-CREATOR: RESPONSIBILITIES OF A DEVELOPER
The smart citizen kit and online platform are under development. The smart citizen team expressed to aim for evolving a movement of smart citizens, instead of developing a product. In this, they expect smart citizens to be users, co-creators and testers. While the project team was aware of these configurations, most citizens expected to be user of the smart citizen kit so to be able to become an active citizen. This resulted in role conflict for citizens. A user probably expects a full functioning use product, a co-creator might expect the freedom to tinker with a product and a tester probably expects dealing with a product with the aim of giving feedback.

While all three roles are affiliated with the role of developer, their relation to or expectations of the developer differ. A user expects a developer to deliver a fully functioning product, a tester expects the developer to take into account test results and a co-creator expects freedom to cooperate in developing the product. These three different configurations of the developer role conflict. Configuring citizens as users, testers and co-creators at the same time thus results in role conflict and does not contribute to aligning project dynamics.

4.5.5.   OPEN APPROACHES

The project team had an important role in communication and intermediating between actors. As described above, there were some conflicting interests between citizens and institutions and the expectations between citizens and the smart citizen team were diverse and sometimes conflicting. Interestingly, there was little direct contact between these actors. The smart citizen team had Skype communication with some of the tech-savvy citizens during a meeting and official institutions presented to citizens during two other meetings. Besides this, all contact and communication has been accomplished through the project team. In this, the project team had an open stance. They communicated with actors in an open and equal approach, so to gain insight in the different points of view. Although at first some of the actors were hesitant towards the new roles developed in the project, the open approach of the project team had a reciprocal effect and actors opened up to the view of others.

5. Role Dynamics in ClaimJeStraat

In this chapter, the findings of the second case study, ClaimJeStraat (CJS) will be presented. The project dynamics are ongoing and complex, and are described building on the relations and ongoing negotiations between different actors involved. The project is introduced based on the initial aims and its progress (paragraph 5.1). In section 5.2, all actors involved (human and non-human) are introduced. The project dynamics are described in section 5.3. These dynamics are described following the relations and ongoing negotiations in the processes of configuration and appropriation (of both roles and technologies). The influence of these ongoing negotiations about roles on the project dynamics is addressed in section 5.4. In conclusion, several important aspects of influence in the project dynamics are identified based on these findings. These conclusions are described in section 5.5.

5.1. PROJECT AIMS AND PROGRESS

ClaimJeStraat (CJS) is developed with the aim to improve house burglary prevention by increasing social cohesion in a street. The project is developed in context of the ongoing transition towards the participation society[17] and with that a government that facilitates active citizenship (ClaimJeStraat, 2013b). The idea was that 'residents have to do more themselves' and ClaimJeStraat is a way to increase awareness amongst citizens and empower them to do things (Interview TNO).

17. The notion of 'participation society' was mentioned in the Dutch King's speech in 2013, and denotes the transition from the traditional welfare state to a society where everyone takes responsibility for their own life and surrounding environment to the best of their ability (Rijksoverheid, 2013)

For the developers the project thus aims at improving active citizenship and social cohesion in the street, so to have a positive effect on home burglary prevention. In doing so, the movement aims to adapt to the needs and preferences of residents. To do so, the 'wheel of five' is developed (figure 17), giving an overview of the different fields from which citizens can choose to act in so to improve burglary safety. (Lerend Netwerk Woninginbraken, 2012).

The idea for ClaimJeStraat originates from the Learning Network Home Burglaries[18] in 2012. The concept is further developed by TNO in 2013, and

18. Lerend Netwerk Woninginbraken, part of the Living Lab Safety (www.livinglabveiligheid.nl), a network with participants from Politie, Interpolis, VEBON, Verwey-Jonker Instituut and TNO has developed the basis for ClaimJeStraat in co-creation (ClaimJeStraat, 2013b)
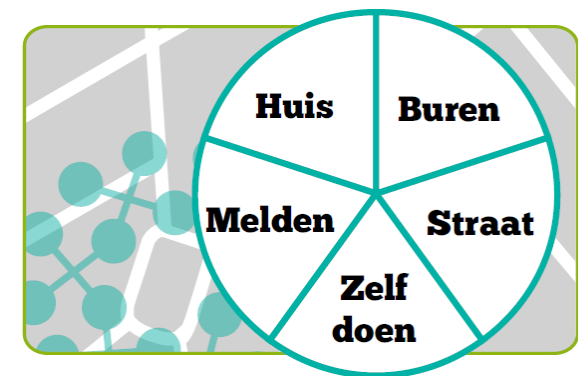
figure 17: *Wheel of Five (ClaimJeStraat, 2013b) with the sections Home, Neighbors, Street, Do it Yourself and Reporting.*

Overview of Project activities	
2012	Learning Network meetings in which the concept of CJS is developed
2013	Further development of the project by TNO
End 2013	10 small pilots
End 2013 – Early 2014	Development of CJS platform
End 2013-2014	Development CJS project in cooperation with Police Noord-Holland including monthly developers meetings
13 Feb 2014	Residents meeting Julianastraat
14 Aug 2014	Residents meeting Julianastraat

table 6: Overview of activities within Claim Je Straat on project level and in pilot Julianastraat (Groeidocument ClaimJeStraat; Interview TNO; Interview Lead resident; Interview Police profession)

several pilots have been started. Together with civic organization 'Wijkalliantie' 10 small pilots were organized. In 2014 the project continued together with Police department Noord-Holland, including 4 pilot streets. TNO has invested in the development of an online platform for ClaimJeStraat, based on ideas developed in the Learning Network. This online platform is offered to the pilot streets. In 2014, monthly meetings are held with police staff from different teams, TNO and a policy advisor of one of the involved municipalities. Incidentally, other actors, such as a victim support organization join in on these meetings. (Project meeting CJS, July 3, 2014; Interview TNO)

One of the policemen aware of the early developments of ClaimJeStraat has initiated a pilot in his own street. In this street, Julianastraat, he formed a group of self-proclaimed pioneers (Interview lead resident). These pioneers have been working on ClaimJeStraat. They have met regularly and

organized two meetings for all residents. In the first meeting, three working groups were formed consisting of both pioneers and other residents. Topics for the working groups were Burglaries & Safety, Traffic and negotiations. In the second residents meeting, each working group has presented an update or proposal to other residents. At the time of data collection, the pioneers were working on preparations for the second residents meeting. The pioneers have been in touch with local officers, both from police and municipality. The period of data collection concluded with a visit to this second meeting. Table 6 gives an overview of the activities in the ClaimJeStraat project.

5.2. NON-HUMAN AND HUMAN ACTORS INVOLVED

In this paragraph, the human and non-human actors that are part of the project dynamics of ClaimJeStraat are described. The description of

non-human actors addresses the configuration inscribed by developers. For human actors, the background from which they joined the project is described. The relations between these different actors and their roles within the project will be addressed in paragraph 5.3.

The non-human actors involved and introduced below are an online platform, several social media and 'techno prevention'. The human actors involved are TNO, police staff, local police officers, the municipality district manager, the street community and district councils.

5.2.1. ONLINE PLATFORM

"Quite soon, there was the idea [within the learning network] that there should be some kind of website and an app so that people can use it on their smartphone. And that platform should include the Wheel of Five, so people can choose which of these aspects they find important". (Interview TNO, June 17, 2014)

Following the idea of the learning network, an online platform is developed by TNO (Interview TNO). The layout of the online platform is shown in figure 18. Before accessing the platform citizens have to register through the registration codes attributed per street. With the registration code, citizens can create an account on the online platform. Each street has its own environment, where residents of the street can interact. The main functionality of the platform focuses on organizing activities:

"The main idea of the platform was that it's about a sense of control and doing things, it's about
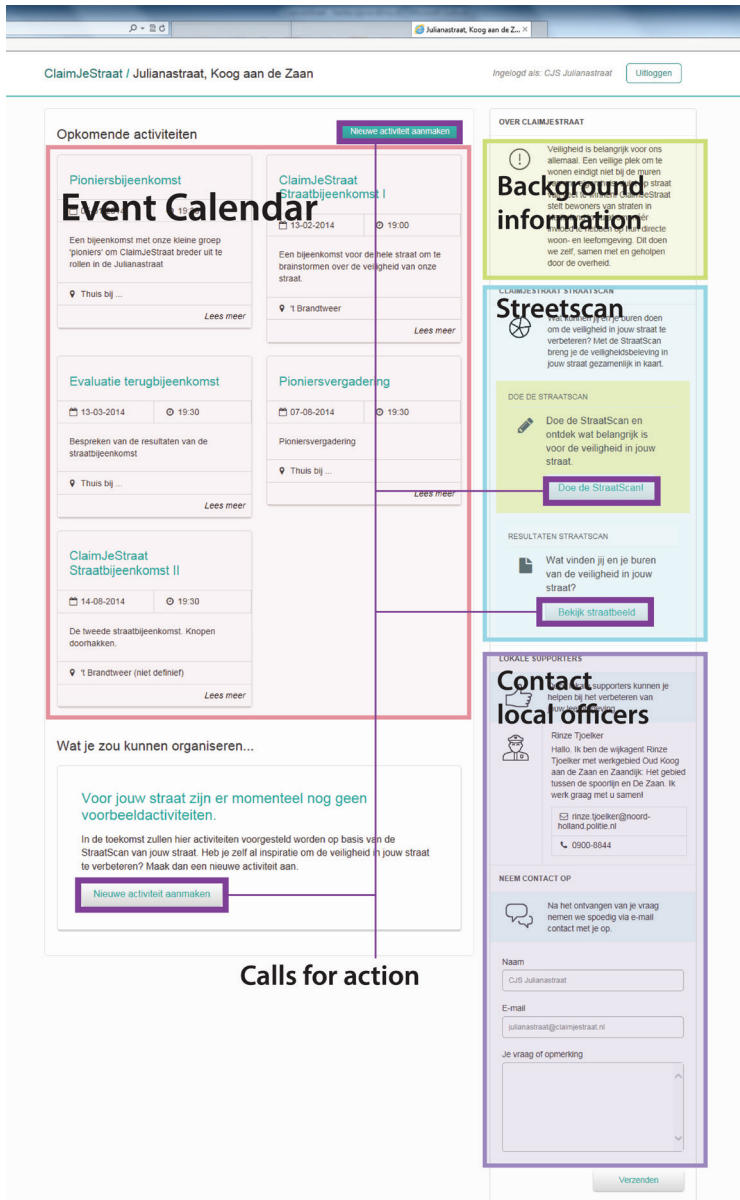
figure 18: ClaimJeStraat Online Platform (pilot.claimjestraat.nl)

activities. Based on this idea, the functionalities of the platform are defined." (Interview TNO, June 17, 2014)

The main panel shows an event calendar, with on the top a button with a call to action 'create a new event'. Each citizen registered on the platform can create and comment on events. The column on the right mainly focuses on safety and house burglaries. The top frame of this column gives some background information on house burglaries and the idea behind ClaimJeStraat, followed by information on the streetscan. The streetscan is developed based on research done by TNO and consists of 16 questions that aim to let citizens think about the status of burglary safety and social cohesion for their individual situation (Interview TNO).

Citizens can access the results of the streetscan, so to get an idea of the situation of the whole street. On the bottom of the right column, contact information of local officers is provided so to give citizens information on the local officers responsible for their area. Currently, only the contact details of the local police officer is displayed.

During the project, the concept of the platform is further developed by police staff and TNO. The further development of the platform remains conceptual and is not executed at the time of writing, and is further described in the section on dynamics around the online platform (section 5.3.1). (Project Meeting, July 3, 2014; Interviews TNO, Police P, Police IB).

5.2.2. SOCIAL MEDIA

There currently is a wide variety of online communication tools available. Communication by email and cell phone is more than common and many people have access to different social media platforms. Online platforms such as Twitter and Facebook are commonly used, and the range of platforms is complemented with smaller platforms such as Buurtlink[19], focusing on local communities. Besides these online platforms accessible through computers and apps on smartphones, the app WhatsApp is available on smartphones to send messages. These messages can not only be sent to individual people, but also in group conversations.

5.2.3. TECHNO PREVENTION

Several interview respondents mentioned 'techno prevention' as possible implementation of technologies in the context of burglary prevention. Examples of techno prevention are security strips for doors, security cameras, alarm systems, adaptive alley lights or the possibility to turn lights on and off at a distance. Within the ClaimJeStraat project there is no conformity on the use of specific applications of techno prevention, but possibilities are explored.

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19. www.buurtlink.nl is a platform that aims at improving social cohesion in the neighborhood so to improve the quality of living. It does so by bringing citizens together, and offering a platform to communicate about neighborhood initiatives and activities.

5.2.4. TNO

TNO is the Dutch organization for applied scientific research and works in many different fields. When referring to TNO in this chapter, I refer to the project team working on ClaimJeStraat, originating from the department Networked Organizations. TNO was one of the five partners in the Living Lab Safety, from which the idea for a 'learning network home burglaries' originated. TNO has developed a format for this learning network, and facilitated the sessions. Within these sessions, the concept ClaimJeStraat is developed. At the end of the learning network sessions, TNO has taken up the ideas to further develop the project (Interview TNO).

Through previous research, TNO had developed knowledge on amongst others influencing behavior, self-reliance and identifying suspicious behavior and responding to it (Interview TNO). Building on this knowledge, the ClaimJeStraat project was developed further.

5.2.5. POLICE STAFF

The National Police is a large organization. Police officers involved in ClaimJeStraat come from different levels in the Police department Noord-Holland. Officers from these different levels have a different role in the project dynamics. Therefore, a distinction is made between the local policemen on the street, and police officers in the district staff, who work on district level. The police staff involved in the project are the innovation broker and police profession. The innovation broker focuses on boosting and stimulating innovation within the police department. The police profession works on translating policy of the department into practice.

Research of the police showed that the problem with home burglaries is that citizens are only willing to do something after the occurrence of two burglaries close by, and this willingness and awareness only last for a short period of time. There is a question on how to change this and get citizens more aware of the importance of burglary prevention. (Interviews PoliceIB, PoliceP). Next to that, citizen participation is part of the plans of the national police, but how to achieve it is little addressed (interview PoliceP). From a police perspective, citizen participation has two main aims: (1) to get citizens in a position where they undertake activities to improve safety in their street and (2) to improve the information position of the police (Interview Police P).

The police staff joined in in the ClaimJeStraat project through a contact of TNO and a flyer of ClaimJeStraat. The Police innovation broker took up the idea and from that, TNO and Police Noord-Holland decided to start the pilot project.

5.2.6. LOCAL POLICE OFFICERS

On a local level, for each city district a local police officer[20] is responsible. The local police officer follows the developments in his/her district, and is a first point of contact for citizens in case of non-urgent matters. Each local police officer gives his own interpretation of his task, because responsibilities are broad:

> "Well, I know what a local police officer is facing […]. They have a double task, they are service providers, but on the other hand they have to catch criminals as well. And each officer fulfills this role in his own way." (Interview PoliceP, August 6, 2014)

The local police officer responsible for Julianastraat expressed his doubts about his job becoming more and more located in the office behind a computer instead of on the streets. While this local police officer is little involved in social media and online technologies, other police officers actively use twitter or develop participation projects (Interview PoliceLO, PoliceIB, PoliceP).

5.2.7. MUNICIPALITY DISTRICT MANAGER

The municipality of Julianastraat is not actively involved in CJS, but the residents have been in touch with the district manager of the municipality, he is a first contact for citizens with initiatives and a link between citizens and municipality:

> "A district manager for this municipality is a kind of link between the citizens, civil servants and local politics, to put it short. This means I have to deal with police, youth workers, housing corporations, entrepreneurs and residents. I'm a link between citizens and the civil service, so I bring policy from here to the citizens, and the other way around I'm a lobbyist for citizens within the municipality." (Interview ZDM, July 22, 2014)

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20. In Dutch: 'wijkagent'

5.2.8. STREET COMMUNITY

The residents of the Julianastraat are a diverse group, involved in the project in various ways. Based on the interview data, a distinction is made between the group of (self-proclaimed) pioneers and the other residents. The group of pioneers includes a resident with a central role, he can be understood to have a role as a 'lead resident' (following the concept of 'lead user' of Von Hippel as described by Verhaegh, et al. (forthcoming)), the configurations and appropriations of the role of the lead resident within the project are further addressed when describing the project dynamics (section 4.3). The lead resident works as a liaison for the police in the safety house for the region, a cooperation of several partners (including police and municipality) on crime and safety. The lead resident was one of the victims of a set of burglaries a year ago. Next to that, he is enthusiastic about innovation and pioneering in new projects (Interview lead resident).

Most of the residents of Julianastraat are home owners that have lived in the street since a long time. Residents are generally of middle to older age, ranging from around 40 to residents in their eighties. The contact between residents in the street has been quite good, but residents feel the need to cooperate more regarding several current issues in the built environment of the street, such as the need for foundational repair and restructuring plans by the municipality (Interview Residents).

The contact between residents is influenced by the lay-out of the street where they live. The Julianastraat consists of about 50 houses, most of them private property, and is split up in two sides by a road crossing it. Houses are semidetached and have adjacent gardens, also accessible by alleys. The view of the street is set by many forty-year old trees on both sides. The deep sewage in the street is going to be replaced soon, due to tree roots damaging the current sewage system. The municipality has planned the replacement of the deep sewage and at the same time restructuring the street. (Interviews Lead resident, Residents). Residents expressed that they regularly talk to neighbors when they meet each other in the street, for example when walking by or working in the garden.

5.2.9. DISTRICT COUNCILS

District councils are not involved in the pilot in Julianastraat, but are mentioned by police staff, local policemen and the municipality. In several neighborhoods in the municipality where Julianastraat is located, district councils (or district organizations) aim to serve the interests of residents, and to improve the quality of living in their district. District councils are formed by residents who are involved on a voluntary basis[21]. The district manager of the municipality sees the district council as "a type of link between citizens and the municipality" (interview ZDM). A district council focuses on a whole district (in contrast to the street in CJS), and for

the district of Julianastraat, the council is currently less active (interview ZDM). In a pilot in a different municipality, the police staff is currently in touch with a district council to set up the pilot (Interview PoliceP).

The local police officers mentioned contact with district councils as possible actor in citizen participation as well. The district council is thus not involved in ClaimJeStraat Julianastraat, and will not be further included in describing the project dynamics. It is however noteworthy that several actors see a possibility for district councils to be involved as a driving force in citizen participation.

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21. Source: https://www.zaanstad.nl/mozard/!suite86.scherm 0325?mPag=471&mVrg=907&mLok=1

5.3. SHAPING ROLES IN PROJECT DYNAMICS

The different (human and non-human) actors span up the actor-network of the project. Within this network, actors are related, and processes of configuration and appropriation take place between actors and influence the project dynamics. Within these processes, roles are constructed. In this section, the project dynamics are described building on the theoretical framework (chapter 2). The processes of configuration and appropriation of both roles and technologies take place in relations between different actors. The different relations in the actor networks are complex, and the network is analyzed building on five smaller networks. These smaller networks together give an impression of the total project dynamics. The networks are schematically displayed, building on the schematic overview of project dynamics in section 2.4. The different types of configuration and appropriation have been introduced in section 3.4.

To address the non human actors and technological agency that is central in actor network theory, the first three networks are centered on the different non human actors. The first three sections focus on dynamics around the online platform; social media; and techno prevention. Next to these socio-technical dynamics, several social dynamics take place within the project. The fourth network addresses dynamics in daily practices in the street and the dynamics on project level are addressed in the last network. For each sub network, the dynamics are shortly introduced, followed by a schematic

overview of the network. The details of dynamics are described afterwards, including the configured and appropriated roles.

5.3.1. DYNAMICS AROUND THE ONLINE PLATFORM

Figure 19 displays the dynamics related to the online platform. In short, the network describes the development of the online platform by TNO, aiming at the street community as users. The street community was thus configured, but did not appropriate the platform. The street community however did have some ideas of what a platform could be, and the lead resident took part of this feedback to a project meeting with TNO and police staff (project meeting, July 3, 2014). TNO and police staff

continued conceptual development of the platform, but this was not executed at the time of writing. Within the ideas about the platform, also local police officers and the district manager are configured as possible users of the platform. However, local police officers and the district manager seem not to appropriate the idea of the platform and their role related to it. The details of these dynamics are described below.

TNO AND ONLINE PLATFORM

Following the development of the ClaimJeStraat project, TNO commissioned the development of the online platform (indicated in figure 19 by the arrow from TNO to online platform). In a brainstorm session with a design studio, TNO decided
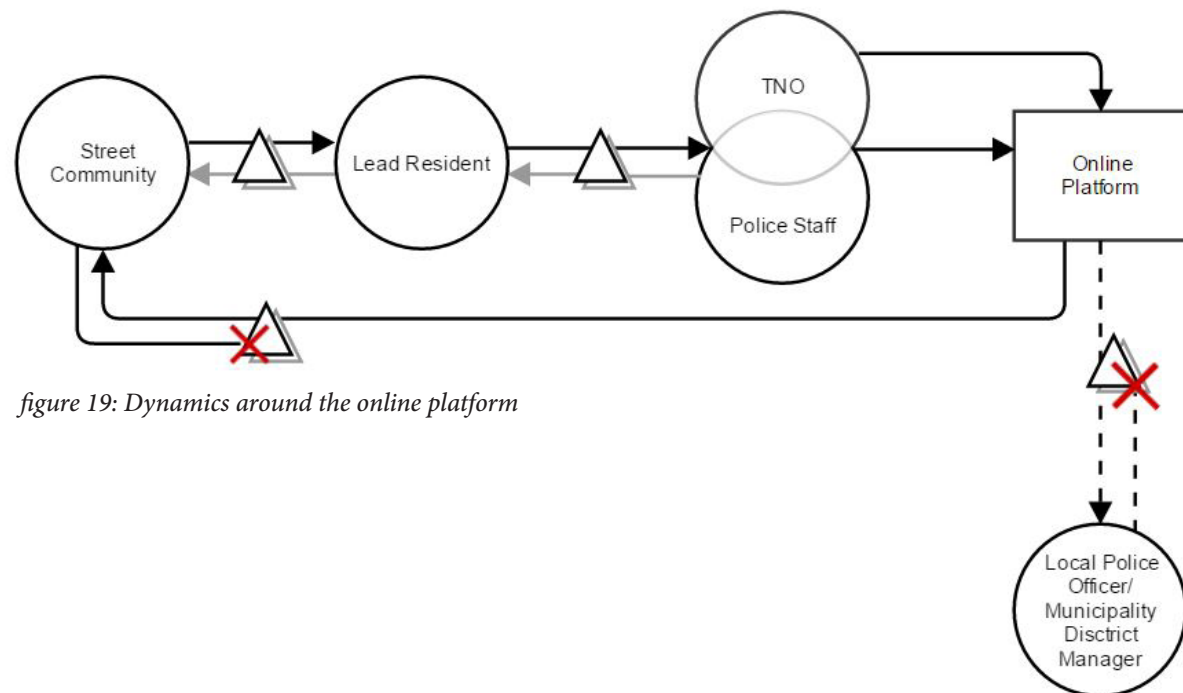

figure 19: Dynamics around the online platform

upon the main functionality of the platform, configuring the street community through the platform. The street community is thus configured as *user* of the platform. With the platform, citizens are expected to *organize activities* in their street and do so *together*. Working together is of importance, because it increases social cohesion, and by that improves burglary safety (Interview TNO).

Street Community and online platform
The street community has not appropriated the platform. In figure 19, the configuration of the street community as users is indicated by the arrow from online platform to street community, the street community did not appropriate this role, indicated by the red cross. An important aspect in them not appropriating the online platform is the environment in which residents interact. The project is focused on bringing the residents of one street together. Residents highlighted that when walking around in the street or working in the garden, people often make some small talk. The online platform focuses on citizens organizing activities and communicating with each other. The interviewed residents of Julianastraat mentioned that they already talk to each other in the street, not needing a platform for it. Next to that, the pioneers explained that they aim to reach as many residents as possible. Using the online platform makes them dependent on whether individuals in the street will appropriate the platform and make a routine of checking it (Interview Residents). The pioneers do thus not prefer the platform for communication:

Verbal communication in the street is way better. It's more direct, but you can also see the reaction of people. You can put something on the website, but people won't check it. It's a street, you know, not a factory. You walk by and people regularly ask you about ClaimJeStraat. We even have to watch out not to look at neighbors houses too much, or they'll start talking again [joking]". (Interview residents, July 22, 2014)

The direct communication within the street and dependence on other residents logging on on the platform is however not the only reason for the street community not appropriating the platform. When the pioneers in the Julianastraat wanted to start with ClaimJeStraat, the platform was not available yet. TNO was still developing the platform and streetscan. The street community of Julianastraat wanted to start, and found their own alternatives for communicating, organizing activities and prioritizing:

"We decided not to use the platform and streetscan because it wasn't ready in time. That's when we took a different path, one of the pioneers made an email address for the street, and he made a Facebook group." (Interview lead resident, July 3, 2014)

Lead Resident and Street Community, TNO & Police Staff
Residents did not appropriate the platform, but did have several suggestions for improvement. Pioneers expressed these suggestions in the interview, but did not actively communicate these with the police staff or TNO. Communication with other human

actors all takes places via the lead resident. In general, the lead resident has a networking function, he aims to connect with the district manager, the local police officer and the project team of TNO and the police staff: "I also see that I have a sort of liaison function here. So for the others it's nice that I go out there and connect with others" (Interview lead resident). In this, lead resident appropriated *an intermediating role*, staying in touch with the other actors involved. This role is partly a result of his double background as both citizen and working for the police. During the project meeting the lead resident mentioned some of the options that the pioneers mentioned in the interview (Project meeting, July 3, 2014). In this, the street community and lead resident configured roles for TNO and police staff in *re-development of the platform*. These role dynamics are indicated in figure 19 by the roles and arrows between street community, lead resident and TNO and police staff.

Pioneers expressed a wish to communicate with others, to get information on possible activities to undertake as a street, to get in touch with other claimed streets and to have an overview of the facilitating officers. They currently have the feeling to have to do it all alone, and to constantly reinvent the wheel:

"Well, we heard that there are about 5 streets in the country that have ClaimJeStraat. And actually it's a pity that we have no contact with them, because you try to do something, to find something out, but you should try to reinvent the wheel." (Interview residents, July 22, 2014)

Police Staff & TNO and online platform

In the project meeting with police staff and TNO (July 3, 2014) the concept of the platform was further developed (indicated in figure 19 by the arrow from TNO and police staff to online platform). In this, the police staff and TNO took into account some of the suggestions of the street community. The effect of their suggestions is little, it seems that much is lost in the communication of these suggestions via the lead resident. TNO and police staff thus partially appropriated a role in re-development (indicated in figure 19 by the gray arrows from TNO and police staff to lead resident and street community). Whether these new functionalities will actually be developed depends on further continuation of the project (personal communication with project team TNO, September 30, 2014).

The current platform is hardly used by the police staff, and thus not appropriated. They do see the possibilities of the platform and in project meetings aim to contribute to the development of the platform. In this, the police staff sees the citizen as main user of the platform, incorporating the platform in the tasks of the police is not seen as a possibility. The police wants to stay at distance in the use of the platform, because there is not enough capacity to actively use it. (Interviews Police P., Police IB). Although not interested in being actively involved on the platform, the police can contribute information on for example burglary hot-spots and hot-times, so to inform the citizen. Another option is to include tweets of local police officers in the platform. Each local police officer is supposed to be twittering about their work to share this with citizens. In the meantime, data gathered on the platform can be analyzed by data analyst within the police organization (Interview Police IB). In re-development, police staff thus conceptually appropriated roles as *data-user* and in *information sharing*.

Local officers and online platform

In development of the platform, police staff and TNO see that the information gathered on the platform can help local police officer and municipalities to *facilitate active citizens*. This idea is not included in the current version of the platform, and is currently limited to plans including a 'residents' counter', where residents can get in touch with local officers and are provided with examples of activities to organize (Project meeting, July 3, 2014). This functionality is currently not appropriated by these local officers, because it is still conceptual. However, they also do not appropriate the idea of a residents counter. The local police officer expressed to not see the need for such a platform, because he feels to be informed enough by his personal contact with the lead resident and other communication channels (Interview Police LO). The district manager also expressed not intending to actively use the platform, although for different reasons. He expressed to want to leave the initiative up to citizens and not to interfere:

> *"Well, I haven't looked at the platform […]. I don't intend to take active part in it, so I prefer leaving it up to themselves. If they think they're doing well, I believe that. They can always contact me, so I don't need to be part of a platform or group to check them. […]. It is however interesting to have a look at it, to see what's happening, but I want to leave it up to the residents. I want to stay informed, but I don't want to be part of the initiative." (Interview ZDM, July 22, 2014)*

Local officers thus were conceptually configured in re-development of the platform (indicated in figure 19 by dotted arrow from online platform to local officers), but did not appropriate this conceptual role as user or facilitating officer (indicated by the red cross in figure 19).

Concluding: roles related to dynamics around the online platform

In the current online platform, only the street community is configured as users, but the street community did not appropriate this role. The reasons for this and suggestions for improving the platform have been communicated to TNO and police staff by the lead resident, configuring a role for them in re-development. This role was partly appropriated by TNO and police staff. In this, the lead resident appropriated a role as intermediator.

In conceptual redevelopment also local officers have been conceptually configured in a user-role. They however expressed not to see use for the platform. From these processes of configuration and appropriation, it can be concluded that several actors have appropriate a role in design of the platform, constantly configuring the intended user roles. The online platform is however not

appropriated by these intended users, negotiations about the platform are ongoing.

5.3.2. DYNAMICS AROUND SOCIAL MEDIA

While the online platform was not appropriated, human actors appropriated different types of online communication. The street community uses e-mail, Facebook and WhatsApp, while the police organization and local police officers appropriated twitter as online communication. TNO is not involved in these dynamics around social media. These dynamics are displayed in figure 20 and described below.

Facebook & WhatsApp and Street Community & Local Officers

Because the online platform wasn't finished in time, the street community developed other alternatives for online communication (Interview lead resident). The by the residents appropriated alternatives are a combination of different (social) media. First of all, the residents created an email address for the street, and gathered all email addresses of residents. This way, residents can always contact the group of pioneers (Interview Residents). For
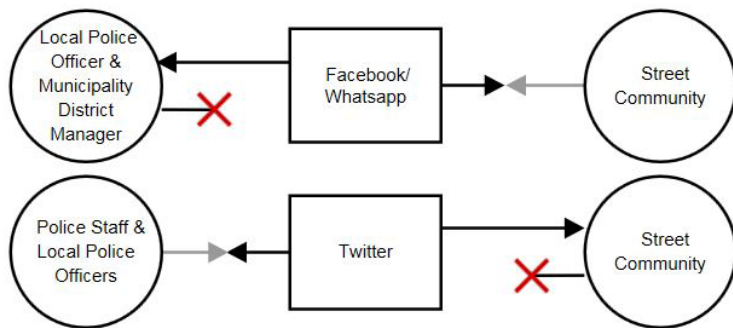
figure 20: Dynamics around social media

communication with the other residents, the pioneers explained to use this email address, but also distribute printed flyers and invitations in the street. This allows to inform all residents at the same time, including the ones without email addresses:

> "Well, we keep informing everyone, in personal communication and in information flyers in mailboxes. We put all kind of information in the mailboxes." (Interview residents, July 22, 2014)

For less formal communication, one of the pioneers created a Facebook group where not only the pioneers, but all residents in the group can contact each other. The Facebook group has about 20 members, which is only a part of the total residents (Interview Residents). The municipality district manager does not appropriate Facebook as communication tool (indicated in figure 20 by the red cross between municipality district manager and Facebook/WhatsApp), although he sees the added value for residents:

> "I think Facebook is another nice tool, as long as they have a closed group. If they want to, I could join these groups as a district manager. But I don't intend to take active part in it, so I prefer leaving it up to themselves. If they think they're doing well, I believe that. They can always contact me, so I don't need to be part of a platform or group to check them." (Interview ZDM, July 22, 2014)

Another medium used by the street community to communicate is a WhatsApp 'alarm' group, where residents in the group can contact each other when they notice suspicious behavior or mention when

they will be away on holiday. In practice, WhatsApp is not actively used because most informal communication takes place on the street:

> "We also have a WhatsApp group where we would notify each other when we're on holiday and that sort of stuff. But in practice we tell it when we see each other in the street. I already know when my direct neighbors are on holiday."(Interview residents, July 22, 2014)

On the other hand, the pioneers mentioned that through people joining the meetings, the WhatsApp group or the Facebook group, they got to know people who live on the other end of the street, and have more contact with them (Interview Residents).

The use of WhatsApp groups and social media is also noticed by the police staff and local policemen. Policemen are however not involved in WhatsApp groups, since the smartphones they use do not support WhatsApp. They thus cannot appropriate WhatsApp with the means provided by the police organization:

> "There are many streets that started WhatsApp groups or other things. I know little of the local police officers are part of these groups, but they do that with their private smartphones. The police has blackberries, and you can't use WhatsApp on them." (Interview PoliceP, August 8, 2014)

Twitter and Police & Street Community

Currently, data analysts of the national police analyze twitter data (Interview PoliceIB). Next to that, many local police officers are visible on twitter.

Within the Police Noord-Holland, it is intended that every local police officer will use twitter in the future. Currently, the appropriation of twitter by the police organization depends on the individual appropriation of local police officers (Interview PoliceP). The local police officer for Julianastraat has not appropriated twitter, because he is not fond of digitalization:

"I myself am not into that digital stuff. I also don't tweet. I've heard what some people tweet and it's complete nonsense, or you send a wrong tweet and get a lot of questions. So twitter is not my cup of tea." (Interview PoliceLO, August 12, 2014)

On the other hand, one of his colleagues actively uses twitter for citizen participation purposes:

[About an initiative in a different street, and not being able to communicate with the resident involved through WhatsApp:] "I do have personal contact with the resident, and he is following me on twitter, so he shares some of that information within the WhatsApp group" (Interview Police LO, August 12, 2014)

Twitter is thus partially appropriated by the police for communication purposes with citizens, indicated in figure 20 by the gray arrow between police and twitter). In this, the police expects citizens to read the information they share on Twitter. The police staff expressed doubts about the number of citizens on twitter, according to the deputy police profession, twitter users seem to be mostly professionals, and he questions whether most residents are reached through twitter (Interview PoliceP). For Julianastraat, this image was confirmed by the interviewed residents who all expressed not to use twitter. Thus, the configuration of the street community as *twitter readers* is not appropriated.

CONCLUDING: ROLES RELATED TO DYNAMICS AROUND SOCIAL MEDIA

Both the police and street community have appropriated different types of social media for communication purposes. Not only the type of medium is different, also the aims differ. The police aims at communication between police and residents, while the street community aims at communication within the community. These aims not necessarily conflict, communication within the street community can go together with communication between police and residents, depending on the medium appropriated for communication.

For communication within the street community, the pioneers have appropriated WhatsApp and Facebook groups (indicated in figure 20 by gray arrow between street community and Facebook/ WhatsApp). These media are only used additionally, since several of the (older) residents do not have Facebook accounts or smartphones. The police is however not involved in these social media (indicated in figure 20 by the red cross between police and Facebook/WhatsApp), and uses twitter as a medium to communicate with citizens. The street community however has not appropriated twitter. The street community has appropriated social media that match their aims. The police has appropriated twitter, but is dependent on the appropriation of twitter by citizens to match their aims (indicated in figure 20 by the red cross between street community and twitter). To reach the aim of communication between police and residents means to align technology appropriation by residents and police. This either requires residents to appropriate twitter, the police to appropriate social media used by residents or to appropriate a different medium that suits both aims. These changes in technology appropriation might include renegotiating the configuration of the technology. These possible dynamics do currently not occur, and there is a mismatch between the social media appropriated by street community and police. Therefore, social media are currently not used to contribute to communication between police and citizens.

5.3.3. DYNAMICS AROUND TECHNO PREVENTION

Techno prevention is understood as the implementation of technologies to improve burglary security. Different human actors have different interpretations of what is understood as techno prevention. TNO developed several smart sensor concepts. Together with other residents, the lead resident is implementing techno prevention in Julianastraat and the police staff is investigating possibilities with techno prevention. In the meantime, the pioneers expect the police staff to help them in finding out possibilities for techno prevention. The local police officers and the municipality are not involved in the dynamics around techno prevention. These different dynamics are displayed in figure 21 and described below.
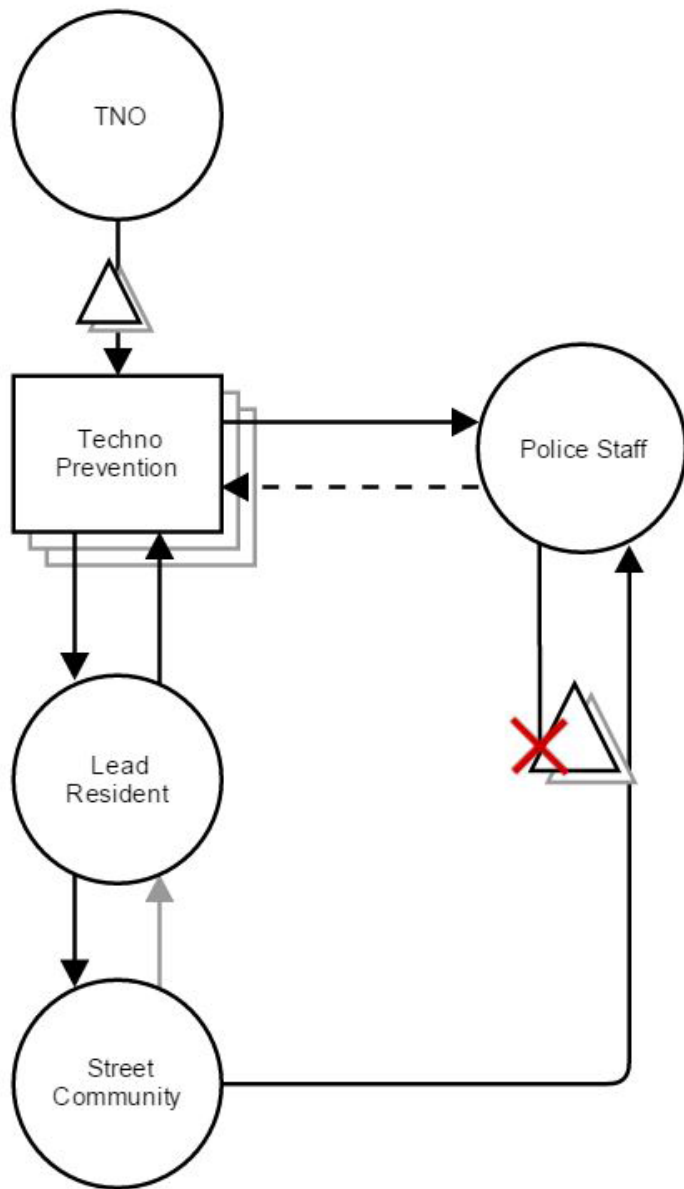
TNO & Techno Prevention

Together with small and medium-sized enterprises (SMEs) and the national police, TNO investigated the possibilities of smart sensor concepts in preventing burglaries, and developed five smart sensor concepts, presented in a poster (ClaimJeStraat, 2013a) . Some of these concepts are further developed by SMEs (Weima, 2014). At the time of data collection, these concepts are not implemented or communicated with the street community of Julianastraat (Interviews TNO, Lead resident). TNO thus appropriated a role in conceptual development of techno prevention, indicated in figure 21 by the triangle between TNO and techno prevention. Further development is taken up by SMEs.

Lead Resident, Techno Prevention and Street Community

During the first meeting with the whole street community the lead resident presented some information on techno prevention, and invited the local locksmith who sold high quality locks to several residents (Interview Lead Resident). During this first meeting, the street community together decided the topics to focus upon in their street. One of these topics was burglary safety. The lead resident was involved in this working group, taking up the topic together with some other residents. The working group investigated several options for techno prevention, and proposed several options to the street community. In this, the working group and lead resident appropriated a role in *investigating possibilities for techno prevention* and *sharing their findings* with the street. Several people opted-in for

alley lights and affordable alarm systems (second residents' meeting, August 14, 2014), thus adopting several forms of techno prevention. The dynamics around techno prevention and the street community all took place via the lead resident, as indicated in figure 21. Only part of the street community is involved in implementing techno prevention in Julianastraat, indicated by the gray arrow between street community and lead resident.

Police Staff and Techno prevention

The pioneers see many more options in techno prevention, but feel that they are alone in developing them. Here, they see a role for the drivers of the project *in coordinating this development* (At the time of writing, this driver is the police staff, further discussed in section 5.3.5):

> "There are ideas, we certainly have ideas about techno prevention and these fit with the ideas of ClaimJeStraat, but these developments should be led externally, not from within the streets. The coordinators of the project should approach external parties within our network with the question to investigate these options." (Interview lead resident, July 3, 2014)

The police staff mentioned possibilities with techno prevention, and is looking at possibilities with it, but currently not implementing them (Interview PoliceIB). The police staff thus has appropriated the idea of techno prevention, but not implemented it yet. This is indicated in figure 21 by the dotted arrow between police staff and techno prevention. These investigations are however not directly

linked to the CJS project. The police staff thus has not appropriated the supporting role that is configured by the expectations of the pioneers (indicated in figure 21 by the role and red cross between street community and police staff).

CONCLUDING: ROLES RELATED TO TECHNO PREVENTION

Configuration and appropriation centering on techno prevention take place in three separate dynamics. TNO developed smart sensor concepts; part of the street community appropriated new locks and plans to implement alley lights and affordable alarm systems and the police staff is investigating possibilities. These different dynamics don't conflict and take place next to each other. However, the pioneers expressed to prefer to align these different dynamics, so not to constantly re-invent the wheel. Within CJS, techno prevention is a fuzzy concept and a repository of many different ideas that are not aligned with each other. These different dynamics are indicated in figure 21 by the multiple blocks of techno prevention.

Within these dynamics, TNO (in cooperation with SMEs) appropriated a role as *developer*. Both street community (including lead resident) and police staff appropriated a role as *investigator of possibilities*. The street community also implemented some of these possibilities. The street community configured a role for police staff as *coordinator of development of techno prevention*. This role was not appropriated by the police staff.

5.3.4. DYNAMICS IN THE DAILY PRACTICES IN THE STREET

The previous sections described the dynamics around the online platform, social media and techno prevention. These dynamics have highlighted relations between human and technological actors, but interview respondents expressed several role dynamics that are not directly related to technologies. In this paragraph, the relations between the actors involved in the daily practices of Julianastraat are described, these relations are displayed in figure 22. Building on the project aims of TNO, the police staff configured the street community as 'active citizens'. The street community appropriated a role as active citizen, but the interpretation of this role differs. Local police officers do currently not appropriate the role conceptually configured by the police staff. The street community has several expectations of the local police officer and municipality district manager, but communication with them takes place via the lead resident. The other way around, soft configurations of the street community by local police officers and the district manager are also communicated via the lead resident. These relations are described below. After discussing the processes of configuration and appropriation via the lead resident, the relations between police staff and local police officers are discussed. TNO is not involved in the dynamics in the daily practices in the street.

POLICE STAFF & STREET COMMUNITY

Within the platform, TNO configured the street community to organize activities in their street
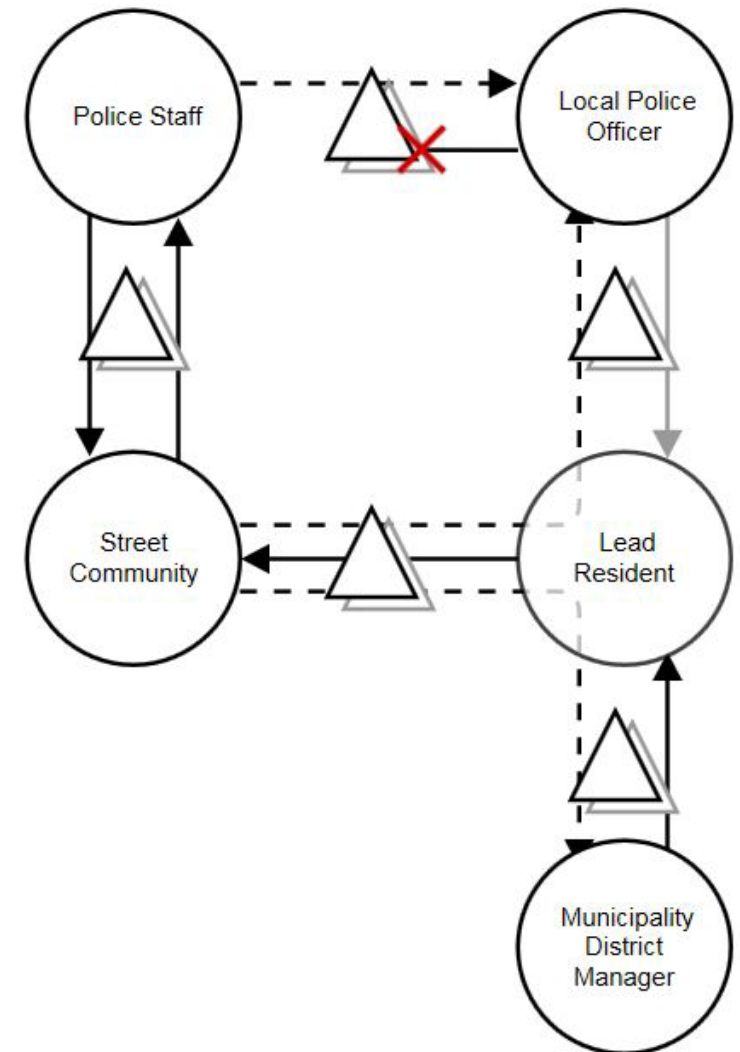

figure 22: Dynamics in the daily practices in the street

together. The platform (including this configuration) was not appropriated by citizens (see 5.3.1). The expectations of the street community by the police staff support the hard configurations inscribed in the platform, but have a broader range.

Building on research on and experience in the effects of home burglaries, the police staff concluded that citizens do not see the importance of burglary prevention. Thus, the police sees possibilities in focusing on social cohesion, something that improves burglary prevention, but can have other positive outcomes for the citizen. In this, the police is searching for what citizens want, so to adapt to the wishes of citizens, and linking that with their aims on improving safety. Here the police experiences struggle in finding out what citizens want:

> *"Our interest of course lies in reducing burglaries, but we noticed that you can't control the interests of the citizen." (Interview Police IB, August 12, 2014)*

> *"We had a residents meeting [for a different pilot street], and we started with the question what citizen wanted, but in reply, we got back a big question mark because the meeting was our initiative. So they asked what we wanted. Well, we want to know what they want, but they don't know. So, we can introduce ClaimJeStraat, but the difficulty is that people don't know what they*

can and want to do." (Interview Police Profession, August 6, 2014)

The struggle of the police staff to adapt to what citizens want can also be found in the procedure the police staff defined for citizens claiming their street. This procedure is rather vague and open for further interpretation by citizens: "Form a core team, distribute flyers together with local officers, determine your priorities through the streetscan, digitally claim your street and make it your own street." (Groeidocument ClaimJeStraat)

While the police staff supports and sees the importance of the expectations on residents working together, they have a main focus on the safety aspect. With ClaimJeStraat, the police not only expects citizens to improve social cohesion so to improve burglary prevention, but also hopes for a raised awareness on safety issues. One of the main expressed expectations by all interviewed policemen, both local officers and staff, is that citizens start *reporting suspicious observations* more:

> *"What they can do for me? Well, when they're out on the street, that they start calling when they have a weird feeling about something. They know their neighborhood, they know who lives there, who are strangers. But it is only when you have an incidental conversation with them that they mention things they noticed a while ago. I ask why they didn't call, you want to stimulate them to call*

the moment they see something." (Interview Local police officer, August 12, 2014)

The street community is thus configured by the police to *take initiative, organize activities together* and *report suspicious behavior*. These roles are indicated in figure 22 by the triangle between police staff and street community. Because the street community consists of many residents and pioneers, the appropriation of these configured roles is shaped by dynamics within the street community, discussed in the next paragraph. Next to the above described soft configurations, the police staff expects the street community to *keep local officers involved*. This role is appropriated by the lead resident, and discussed in later on.

DYNAMICS WITHIN THE STREET COMMUNITY

The lead resident initiated the pilot in his street after he joined in the project through his work for the police:

> *"I joined in via the innovation broker of the police. She was talking about ClaimJeStraat, and I thought it was interesting. So I asked further and it made me enthusiastic to join in. (Interview Lead resident, July 3, 2014)*

Within the street community, the lead resident appropriated a *coordinating, driving and structuring* role in the process. These roles are displayed in figure 22 by the triangle between street community and lead resident. He calls himself a "driver, convening, time guarding. That's what I'm doing, I just want to get it done." (Interview Lead Resident). The

lead resident started the pilot based on a personal approach and gathered a team of residents to start the project, the 'pioneers'. The lead resident is part of the group of pioneers, and they together experience an equal approach between them, *cooperating, consulting and informing each other*:

> "We keep each other posted. That's why we knew that you wanted to interview all of us, and wanted to combine it. It's easier for us, and for you. But it's also because we see each other regularly and know what's going on. We're a team and work together." (Interview residents, July 22, 2014)

The pioneers explained to organize themselves through several meetings, in which they discussed possible topics for the street. The pioneers are committed, but their tasks and roles are dynamic, and develop throughout the process: "We found out what we would do throughout the first months. We expected each other to take effort to develop ClaimJeStraat" (Interview residents). The lead resident explained how the street converged to several topics to focus upon. Ideas were proposed by the pioneers:

> "Ideas for topics were burglaries and safety, traffic, negotiation, a neighborhood barbecue and a network, building a Wi-Fi network that was very easy to use for everyone, so you could immediately log on to Wi-Fi in the whole street. Well, these type of things were ideas for the working groups. These ideas came from the pioneers, so they already committed to the ideas." (Interview lead resident, July 3, 2014)

The ideas of the pioneers have been proposed to the other residents during two residents meetings. Here, the full street community was given the opportunity to ask questions about the process and proposals and to vote upon these. The pioneers in the street configure and appropriate an equal collaboration amongst them. Other processes of configuration and appropriation of roles within the street community are vague and dynamic.

Lead resident between street community and local officers

The street community is expected to keep involved officers up to date. As well the municipality's district manager, the local policeman as the police staff expect the residents taking the lead to keep them updated on what's going on. Thus configuring a role in *informing and including the network*. It seems that in this role, the lead resident mostly is giving information about ongoing developments in the street:

> "Now and then I update the district manager, and I've asked him to organize a place for our resident meeting. That's the most important for now". (Interview lead resident, July 3, 2014)

The lead resident represents the street community towards other human actors involved in the street. This representation and giving information is related to the *intermediating role* also discussed in the dynamics around the online platform (section 5.3.1). The police staff acknowledged this role:

> "Of course, the lead resident is the portal towards the police, and maybe towards the municipality as well. I don't know what he shares there. In

> our project he shares some things, about that he's working on foundation hassle. But I have no idea what they expect about the police and municipality". (Interview Police P, August 6, 2014)

Dynamics within the police organization

Different actors mention little enthusiasm about CJS within the police organization, except for some individuals who are currently working on it (Interviews PoliceP, lead resident). Facilitating active citizenship and developing such a movement takes time from both the police staff working on the project as well as from local officers. The lead resident (also working for the police) mentioned that to be able to deal with increased reporting that is expected from citizens, local officers need more time to perform the tasks expected of them. This requires the police organization to make adjustments in the task descriptions of local police officers. To reach this situation, the police staff and project team are expected to point out the importance of these issues within the organization, thus configuring a role for the police staff in *promoting CJS*. Police staff see this as their responsibility as well, but still have to undertake action, thus conceptually appropriating the role:

> "What I expect from the police organization? Time. Just time. […] If the monitoring station gets ten calls from ten claimed streets in one night, then we're organizing our own problem. So we have to prepare the police organization for this situation, but that's out of my sphere of influence" (Interview Lead resident, July 3, 2014)

"I want to put ClaimJeStraat to the light internal in the organization. I think I'll do so by a top-down approach, starting at the top and ending with local policemen. At least it has to be communicated more. And externally, I'm trying to get others involved, such as victim support organizations or municipalities." (Interview Police Profession, August 6, 2014)

Several conflicting expectations are expressed about the role of local policemen. On the one hand, the police describes involvement of the local police officer by "facilitating through […] distributing flyers together with the local police officer […] and a street inspection with the local police officer" (Groeidocument CJS, p. 3). On the other hand, it is expected that local policemen do not have time to implement ClaimJeStraat, and their participation depends on their personal interests (Interview PoliceP). The deputy police profession acknowledges that he has to include local police officers more in the project, and is planning to do so. At the time of data collection, the expectations of local police officers by the police staff were vague and not communicated with the local police officers involved, indicated in figure 22 by the dotted arrow between police staff and local officers. Local police officers are thus unaware of these soft configurations, and have not appropriated the role of *facilitating professional* suggested for them by the police staff, indicated by the red cross.

Part of the initial project aims is that active citizenship should be facilitated by 'facilitating professionals'. Building on this initial aims, the street community expects to be taken more seriously by local officers because they live in a claimed street:

"That was what we heard, if you use ClaimJeStraat, than you'll be taken seriously by officers. Well, you can forget it. Within our street people are familiar with ClaimJeStraat, but when you call the police or municipality, they don't know about it. […] And that is what they presented to us, there are only five claimed streets in the Netherlands, and that these would be given priority from police, municipality and all other institutions are aware as well." (Interview Residents, July 22, 2014)

The street community expects local police officers to be informed about CJS and to act upon that, thus expecting a *facilitating role* from local officers. However, as described in the previous paragraph, local policemen are currently unaware of the developments of the project on district level, and cannot appropriate the role configured by the street community, their only involvement in the project is through the updates from the lead resident (Interview Police LO).

The same holds for the district manager of the municipality. He sees ClaimJeStraat as a citizen's initiative, and thus has no specific expectations on what residents should do. He expects the street community to *take initiative*. If in need for support, it is up to the street community itself to *ask for support* (Interview ZDM). The district manager mentioned

to be available to support their initiatives if necessary, but not to have received any requests, except for organizing a meeting place for the residents meetings (Interview ZDM). When asked what types of support the district manager could provide, the district manager came up with examples of 'greenery adoption', where citizens do greenery maintenance, and if necessary, the municipality can provide hoes or wheelbarrows; or as a lobbyist for citizens to present their plans within the municipality (Interview ZDM). The district manager thus appropriated a role in *supporting based on demands* of citizens.

Both the municipality district manager and the local police officer are only involved in the project through the lead resident's updates. This is indicated by the arrows between street community and local officers going via the lead resident. Because expectations by the street community are not directly communicated with municipality and local policemen, these are displayed as dotted arrows. The lead resident expressed to keep these updates short and not to ask too much from these local officers. He does so either because he feels that the local police officer does not have the time to take action, or because he feels no support from the municipality at all:

"Now and then I update the district manager, and I've asked him to organize a place for our resident meeting. That's the most important for now, because I feel I don't get any support, no interest at all from people of the municipality". (Interview lead resident, July 3, 2014)

This view of the lead resident conflicts with the view of the municipality district manager, who mentioned to have received little requests for support, and to be open to facilitate if asked to. All in all, the ClaimJeStraat project is developed building on the idea of 'facilitating professionals' but there is no general understanding of what this role entails. The expectations of the street community do not match with the ideas of the local police officer and district manager.

The ClaimJeStraat project is initiated with ideas related to active citizenship and citizen participation. Other actors expect different things from the street community, and there is no general understanding of what active citizens are expected to do within this project. Roles configured for the street are initiator, collective organizers of activities and reporters of suspicious behavior. Next, they are expected to keep local officers up to date and ask for support if needed. The pioneers (including the lead resident) indeed take initiative and organize activities with support of their fellow residents. However, the street community does not appropriate a role in reporting suspicious behavior within the project.

Next to 'active citizenship', the project is developed with ideas on the 'facilitating professional'. There are no clear configurations of a facilitating role, and the vague expectations that are expressed are not communicated with the local officers involved in the street dynamics. The district manager and local police officer are thus only involved through their interaction with the lead resident. In this, the lead resident based his communication on his personal view of the human actors involved and his experiences in the project dynamics. This results in limited communication between the street community and professionals (as well local policemen as district manager).

5.3.5.   DYNAMICS ON PROJECT LEVEL
Next to the relations in daily practices, several dynamics take place on a more abstract project level. TNO started the project and felt ownership over it, but is looking to transmit this ownership to the police staff. The police staff took it up, but in turn aims to transmit it to municipalities. Municipalities have not appropriated this role.

While taking up ownership over the project, the police staff expects TNO to keep supporting it, or as TNO named it 'facilitating the facilitating professional'. On project level, the police staff has several aims with the project, in which they soft configure the street community in the role of active citizens. These dynamics come to fore in the daily practices in the street. TNO also configures the street community in their project aims and expectations. These expectations have been translated and inscribed in the online platform, but as described in section 5.3.1, this is not appropriated by the street community.

These different relations introduce the dynamics on project level, displayed in figure 23 and further described below.

TNO, Police Staff and Municipality
Both TNO and police staff feel responsible for coordination and organization of the project, thus having appropriated a role as *driver* of the project. While they currently feel responsible, both actors expressed not wanting to fulfill this role, and wanting to transfer this role to other actors.

The CJS project was initiated by TNO, following the outcomes of the learning network. Building on previously developed knowledge, the ClaimJeStraat project was developed further. TNO expressed aims to further disseminate this knowledge in projects for professional clients, who in turn can further spread it to the general public:

> *"As TNO we draw quite a clear line of what we're supposed to do, applied research. […] We have professional clients for which we work, and generally, we don't directly communicate with the lay public". (Interview TNO, June 17, 2014)*

TNO started with a role as *initiator* and *driving force* of the project, including the feeling of ownership and responsibility for the project. It does not fit with the background and tasks of the organization to continue this ownership in the practical roll-out of the project. TNO expressed the wish to transfer this ownership to the police staff. TNO thus soft configured a role as *driver* and *owner* over the project process for the police staff.

The police staff has appropriated this role as driver of the project. They expressed to be a driving force in starting up the pilot streets and boosting the CJS movement (Interview Police IB, Police P). The

deputy police profession sees that this boosting and directing role entails *extending the network* as well internally in the police organization and with external partners on a project level and identifying and mobilizing the networks in the pilot streets.

However, the police expressed not to be able to continue this ownership in the long run:

"At this point, we have a directing role, within our department, we're responsible for the introduction of ClaimJeStraat, communicating about it and giving meaning to the actions around CJS. In all aspects, the directing role is with the police, and

it's a pity that it is like that. […]The police can't pay for citizen initiatives. We simply don't have the means for it, because that's not part of our task description. We can try to support pilots and put some capacity on it, and that might cost some money, but we have to end that somewhere. " (Interview Police IB, August 12, 2014)

In this, the police staff is looking to transfer the initiatives in the project to other actors. They eventually want to become a facilitating and receiving actor. Who to transmit this role to is still uncertain. The police staff has been looking for

contact with municipalities, but neither individual municipalities nor the Association of Netherlands Municipalities (VNG) have appropriated this role (Interview PoliceIB). Other mentioned options are transferring this role to district councils:

"I'm currently in touch with a district council in another municipality, and they are willing to take over the initiative, they are willing to be a driving force and be in between residents and the professionals. In that way, you've organized the role of driving force and initiator away, because it can't be that it's constantly the government who is doing that". (Interview police P, August 6, 2014)

For Julianastraat, the lead resident and TNO have contacted the municipality, but they expressed not to want to take an active role in the project (Interview Lead Resident; personal communication project team TNO, July 3, 2014). The municipality district manager expressed to understand the project as a true citizens' initiative (Interview ZDM).

The dynamics related to roles of project ownership are displayed in the top part of figure 23. All in all, TNO has transferred the driving role and ownership to the police, but the police is still searching for what role they want to have in ClaimJeStraat (indicated by the arrows between TNO and police staff). They currently appropriated a role as driving force, but aim to transmit this to another actor and have a facilitating role. Both TNO and police staff configured a driving role for the municipality, but this role is not appropriated by the municipality (as indicated by the red cross in figure 23).
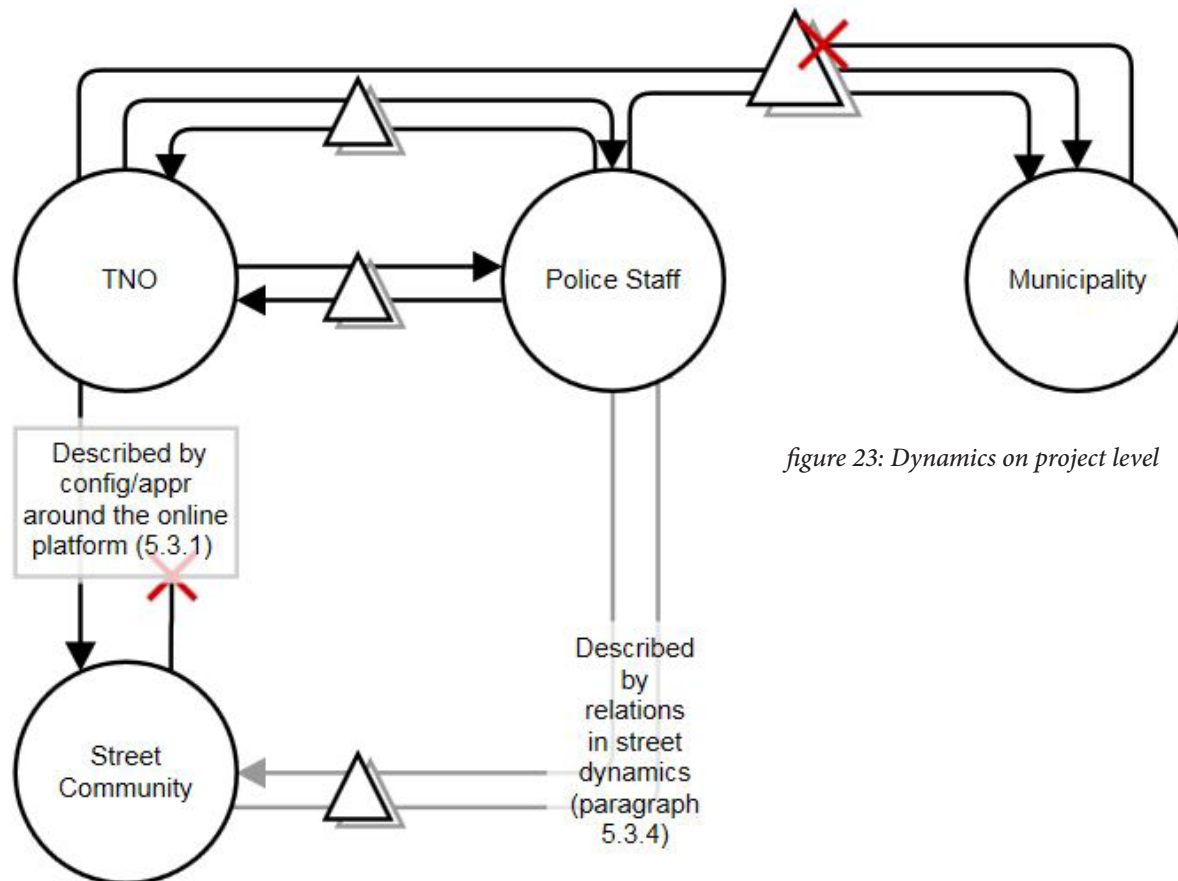

figure 23: Dynamics on project level

TNO and police staff

The police staff appropriated the role of driver of the project, but did so under certain conditions, expecting TNO to both *facilitate the process* and *roll out the network* to municipalities and to *further develop of the online platform* and technologies involved in the project:

> *"TNO of course has the responsibility for the project, at least for the technology." (Interview Police Profession, August 6, 2014)*

> *"About the role of TNO, to follow and move with the developments of the projects. They put themselves in the position of developing the platform and bringing it to professionals and citizens as a tool. […] In the meantime I guess that they've continuously changed their project aims and process." (Interview Police Innovation Broker, August 12, 2014)*

TNO described a similar role themselves in "facilitating the facilitating professional". This can be understood as facilitating police and municipalities to activate citizens in the CJS movement:

> *"Ideally, I see a role for TNO were we facilitate the professionals, and we can do that in two ways. We keep facilitating them in the process of activating citizens and how to deal with that within the organization, but we also can facilitate by providing actual tools, to give professionals actual tools to approach the citizen." (Interview TNO, June 17, 2014)*

While the soft configuration and appropriation of the role seem to match, TNO and the police staff have slightly different aims with the project. For TNO, the aim of the project was to improve burglary prevention by increasing social cohesion, and in this gaining insights in facilitating active citizenship. The police staff subscribes to these aims, but has a different focus. The police expects to enhance communication between citizens and police by making it more direct through an online platform. By improving the communication, police expects to gain more trust of citizens, eventually leading to more reports, improving the information position of the police (Interview PoliceIB, PoliceP). The expectations on increased reporting and an improved information position are not included in the project aims and expectations of TNO.

TNO & Street Community

The dynamics between TNO and the street community only take place in relation to the online platform, described in section 5.3.1. TNO has no intention to directly interact with the street community, following the background of the organization. However, TNO configures the street community as 'active citizens' through the project aims, their interaction with the police staff and the online platform.

The street community expressed not to be aware of the involvement of TNO in the project, and only link the project to municipality and police (Interview Residents). The lead resident however has been in touch with TNO through his involvement in the project meetings. He expressed to expect more concrete tools from TNO. Other residents also expressed to expect these tools, but this might also be provided by the 'facilitating professional':

> *"What I hope for is TNO to ease up and start committing, not constantly delimiting their responsibilities. I get that they are in it for research, but I expect that it in the mean time they facilitate us, and I haven't experienced that. They could for example provide templates for flyers or invitations, something practical, not gobbledygook[22]" (Interview lead resident, July 3, 2014)*

As described in section 5.3.1, the online platform is not appropriated by the street community (indicated in figure 23 by the red cross between TNO and street community), the configurations of the street community inscribed in the online platform do not match with their interests. It seems that the indirect negotiations do not benefit the alignment of configuration and appropriation.

Police Staff & Street Community

Dynamics between police staff and the street community are indirect, and take place via various actors. There are relations via the online platform and social media, but these interactions do currently not occur and are conceptual. The redevelopment of the online platform by police staff and TNO is conceptual (see 5.3.1) and there is a mismatch in the appropriated social media by police

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22. Author's translation of the informal Dutch word 'hemelfietserij'.

and street community (see 5.3.2). Next to these conceptual interactions, police staff and street community indirectly interact in the dynamics in daily practices, via the lead resident and conceptually via the local police officer (see 5.3.4).

Section 5.3.4 described the dynamics in daily practices. The configurations of the street community by the police staff are to be 'active citizens', organize activities together and to report suspicious behavior. These soft configurations are either communicated via other actors (the lead resident), or not at all and therefore not appropriated. On the other hand, the street community is looking for support from police in their activities, but this facilitating role is not appropriated by either local officers or police staff. Because the interactions between police staff and street community are indirect, the processes of configuration and appropriation of roles are not aligned.

Concluding: roles related to dynamics on project level

In organizing the project, TNO, police staff, municipalities and district councils are negotiating who has ownership over the project. All actors see the added value of the project to a greater or lesser extent, but none want to have the responsibility for the project. Because the police staff sees the importance of the project, they currently have appropriated a role as driver of the project, but they are looking to transfer this to other actors. The police staff pointed out that this is part of innovation processes, and because they see the possibility

with the social innovation of ClaimJeStraat, they currently continue the project, with support from TNO on the technological aspects (Interview PoliceP, PoliceIB).

The project centers around expectations on 'active citizens', but the street community is only involved in the dynamics on project level through indirect interactions with police staff and TNO. Within these indirect interactions, there are many mismatches between processes of configuration and appropriation. As a result, the appropriation and configuration of roles by the street community are not aligned with the appropriation and configuration of roles by police staff and TNO.

5.4. ROLES SHAPING THE PROJECT DYNAMICS: ONGOING NEGOTIATIONS

In the theoretical framework, the relations between configuration and appropriation were presented in a schematic overview (figure 4 on page 19). In the ClaimJeStraat project, the processes of configuration and appropriation are ongoing and often not aligned. This results in different project dynamics, displayed in figure 24.

As described in section 2.4, the processes of configuration and appropriation lead to short- and long-term translations. Long-term translations indicate society-wide changes or changes on actor-network level. Within ClaimJeStraat, negotiations about roles and technology are ongoing, and therefore, long-term translations are ongoing. This paragraph describes to what extent the negotiations about roles and technology contribute to long-term translations.

Within ClaimJeStraat, three different dynamics take place: the dynamics around initiating the movement, the dynamics on project level and the dynamics within the street. The ClaimJeStraat project originates from TNO and the learning network, who developed the ideas of ClaimJeStraat, identifying 'government, businesses and citizens' as actors to be involved. TNO included the police staff in the network, and commissioned development of the online platform to provide something for citizens. The police staff joined in in the project, and appropriated a directing role, initiating the project
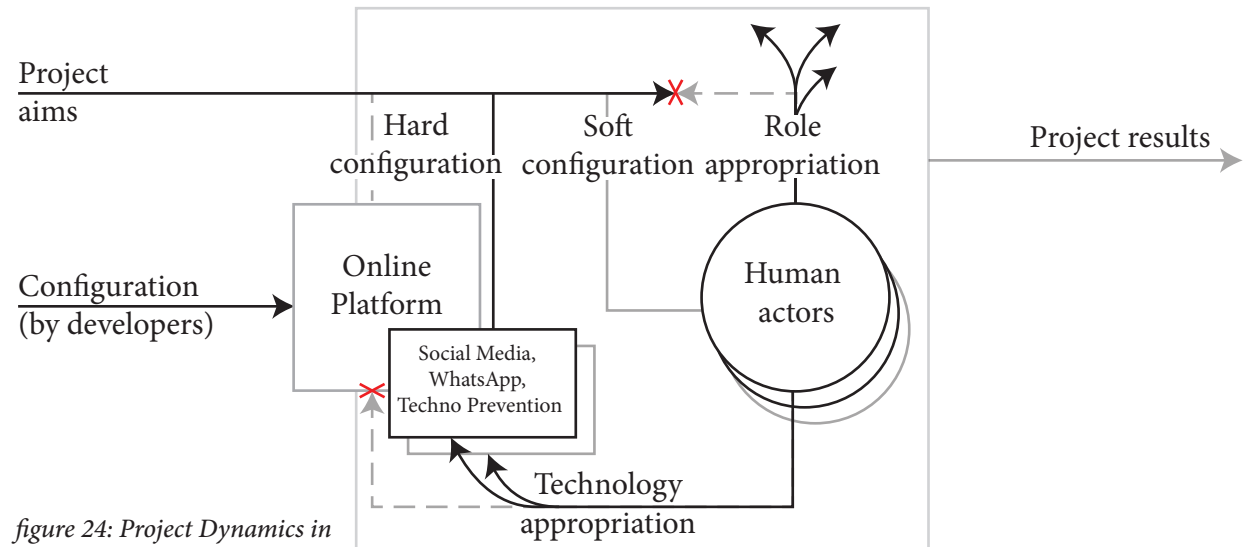

figure 24: Project Dynamics in ClaimJeStraat

for the police. The police staff further developed the project, and identified actors interested in the project. On project level, the police staff is currently looking how to include more actors in the project and eventually having a facilitating role, instead of directing. Through professional contact, the lead resident in Julianastraat became interested in the project, and joined in.

The lead resident aimed to develop the network for Julianastraat, and identified his fellow residents, the district manager and local police officer as important actors to include. He included them through personal communication, and a group of pioneers joined in in the project. Together with the pioneers, the lead resident approached fellow residents, who joined in in working groups and during meetings.

These three different dynamics (initiated by TNO, the police staff and the lead resident) are interrelated, but the linkages between these different levels are weak. The pioneers for example are not actively included in the project of TNO or the police staff and the other way around, TNO and police staff are not part of the dynamics in Julianastraat. They however are interested in these developments. Because the different dynamics are not aligned and negotiations about roles and technology are ongoing, long-term translations cannot be identified at the time of writing. It is noteworthy that within the different dynamics, several actors take up the initiative on different levels (TNO, the police staff and the lead resident). Although the three dynamics are not aligned, the three different initiators are keeping each other posted over time, for example in one of the project meetings (July 3, 2014). These three different initiatives result in ongoing project dynamics, even though the different levels are not aligned.

5.5. CONCLUSIONS: TOWARDS UNDERSTANDING MUTUAL SHAPING OF ROLES AND PROJECT

The findings presented in this chapter show that processes of configuration and appropriation are not aligned, resulting in ongoing negotiations. Table 7 gives an overview of the configured and appropriated roles per human actor. The table highlights the multiplicity of roles within the complex project dynamics, and shows many differences between configured and appropriated roles. Based on the findings on configuration and appropriation of technology and roles, several important aspects for aligning the project dynamics have been identified. Below, these aspects are described. Combined with the findings of the first case study (described in chapter 4) these six aspects form the basis for the concluding chapter of this thesis (chapter 6).

5.5.1. INCLUDING NEW TECHNOLOGIES IN THE PROJECT DYNAMICS

Within the project, there is no accordance about involved technologies, negotiations about interactions with technological actors are ongoing. The current online platform is not appropriated by the street community, and negotiations about reconfiguring the online platform are ongoing. Several human actors have appropriated other technologies: social media and techno prevention. The appropriation of these technologies by different actors is not aligned. For example, street community, police staff and TNO all interact with different types of techno prevention. Interestingly, these appropriated technologies are not included in the dynamics on project level, while they potentially can strengthen

	TNO	Police Staff	Police Local Officer	Municipality District Manager	Street Community	Lead Resident
(Conceptually) **Configured Roles**	- (Re)developer of technologies - Facilitator of process - Roll-out the network	- (Re)developer of online platform - Support investigation of techno prevention - Promoter of CJS within police organization - driver	- sending tweets - facilitator of active citizenship - *user of platform*	- facilitator/ support the street community - driver	- user of platform - organizers of activities - reader of twitter - initiative taker - ask for support - reporter of suspicious behavior - inform local officers	- networker/ communication
(Conceptually) **Appropriated Roles**	- Developer of the platform - Developer smart sensor concepts - Initiator - Driver - Facilitator of the facilitating professional	- *Information sharer* - *Data analyst* - Driver/directing role - *Extending the network* - *Facilitating professional*		- Demand-based support - Lobbyist within municipality	- WhatsApp user - *User of techno prevention* - Working together (equal cooperation) - Involved with street dynamics	- Intermediator - Investigating & sharing techno prevention possibilities - Coordinator, structuring & driver of street dynamics

table 7: Overview of roles of human actors in ClaimJeStraat

links between the different dynamics[23]. The police staff and TNO seem to keep focusing on the online platform as main technology in the project.

5.5.2. PROJECT PROCESS OR CONTENT?

Many of the dynamics on project level are related to TNO and police staff transferring the directing role in the project to other actors. In the meantime, dynamics between the street community and police staff and TNO are indirect and there are many mismatches between configuration and appropriation in these dynamics, while the aim of the project is related to facilitating active citizenship. TNO and police staff focus on organizing the project process, and do not directly interact with the street community. This is not beneficial for the interactions between street community and TNO and police staff.

5.5.3. MAN IN THE MIDDLE: THE LEAD RESIDENT

All interactions between the street community and other actors take place via the lead resident. The lead resident stays in touch with the police staff, local police officers and district manager, and with TNO during project meetings. The online platform was also introduced to the lead resident, who in turn was responsible for bringing it to the street community. In this, the lead resident takes initiative and constantly keeps actors involved in the network. In the meantime, he also limits the

23. Callon (1986) describes technologies placed in an actor-network to strengthen or loosen links between actors as interessement devices

interactions between actors by selectively communicating issues (for example in the interaction with the municipality district manager, whom he deliberately keeps at a distance). This does not benefit negotiations about roles and technology between the street community and other actors

5.5.4. NEGOTIATING THE DISTRIBUTION OF ROLES: CONDITIONAL INTERACTIONS

Many of the negotiations about roles are limited in the project dynamics. In some of the ongoing negotiations, it appears that negotiations are conditional, having a following structure: Actor A configures a role for actor B. Actor B is willing to (partly) appropriate the role, under the condition that actor A does something in return. This can for example be found in the police staff appropriating the driving role for the project. In doing so, they expect TNO to keep supporting them in development of the technology. One of the reasons for these conditional negotiations is the match between role configurations and the background of the actor. Human actors join in in the project with a certain background and expectations about the project. If configured roles do not fit with their background, actors will further negotiate these roles. For these conditional negotiations to take place, it is important that negotiations are ongoing, eventually leading to aligning configuration and appropriation.

5.5.5. ARTICULATING AND COMMUNICATING ROLE CONFIGURATIONS

Many of the configured roles have not been appropriated by actors. This is partly due to ongoing negotiations. However, several roles have not been appropriated because actors are not aware of the configurations. For example, the local police officer is not aware of being configured as a facilitating professional, and the street community is unaware of the configuration in reporting suspicious behavior. These actors are unaware of these configurations because the configurations are not communicated with them (either through inscriptions in technological actors or via soft configurations). Next to communicating these expectations, the articulation of configuration is important in role negotiations. It appeared that several role configurations are vague. For example, it is still uncertain what the tasks and responsibilities of a 'facilitating professional' are. To align configuration and appropriation of roles, i.e. to result in successful negotiations, it is important that role configurations are both communicated and clearly articulated.

5.5.6. GUIDING ACTIVE CITIZENSHIP?

Within the project, citizens are expected to be 'active citizens'. The police staff experienced that interests of citizens cannot be steered. In the meantime, they configured a role for citizens in reporting suspicious behavior, a role not appropriated by the street community because the community focuses on different topics. Because many interactions are conditional, configuring the street community to

file more reports might result in conditional configurations of the police. To get citizens to appropriate a role in filing more reports thus might require additional tasks from the police. These conditions require *flexibility* from the police. However, before being able to negotiate these new role distributions, it is important that police and street community interact. These interactions are currently limited by the lead resident, the man in the middle.

'Light Trails at Oxford Circus' by Sophie Carr Photography. Retrieved from https://flic.kr/p/pWD1wB

6. CONCLUSIONS

This research focused on the mutual shaping of roles and project dynamics within specific smart city projects, so to gain insight in the dynamics of smart city development. These insights can contribute to aligning smart city applications with actors involved. In chapter 1, the following research question was formulated: *How are roles of actors in specific smart city projects shaped within project dynamics, and how do these roles in turn influence the project dynamics?*

As described in the theoretical framework (chapter 2), the project dynamics include relations between human and technological actors and roles of these actors. The concepts of configuration,

appropriation and translation are used to describe the construction of roles in the project dynamics. The two previous chapters presented the findings of the two case studies conducted for this research. As addressed in chapter 1, several authors have called for including people in the smart city (e.g. Chourabi, *et al.*, 2012; Giffinger, *et al.*, 2007; Hollands, 2008; Nam & Pardo, 2011), but how to include them is little addressed. The empirical results of this research show that people are included within specific smart city projects. The next three paragraphs address in what roles different actors are included and how these roles in turn influence the project dynamics. In paragraph 6.1, roles of citizens and public actors are described, relating to blurring

boundaries between government and citizen. Next, roles related to technology development and the blurring boundary between design and use are discussed in paragraph 6.2. Next to the roles and dynamics related to these blurring boundaries, several crucial factors and roles related to the project process have been identified, which are described in section 6.3. In paragraph 6.4 these conclusions and the cases studied are placed in context of the smart city concept. In section 6.5 these conclusions are translated into six practical lessons for setting up smart city projects where citizens are included in the project.

6.1. BLURRING BOUNDARIES: ROLES OF CITIZEN & PUBLIC ACTORS

Within smart city projects different actors work together in new collaborations. Projects are initiated both top-down and bottom-up, and the studied projects both included citizen participation in the project aims. Public actors and citizens collaborate on specific topics. These collaborations result in ongoing negotiations about new roles for these actors. The blurring boundary between public actors and citizens in smart city projects results in new roles for actors in smart city projects such as the data producer, the facilitating professional and in taking action. These roles are all shaped within the project dynamics including the technological actors; in this case specifically the accessibility of data and information. Human actors do not have experience with these new roles yet, resulting in uncertainty about these roles within the project dynamics. These

three roles and the impact of technological actors are described below. The paragraph concludes with how these roles and technology contribute to blurring boundaries between public actors and citizens, and how this shapes project dynamics of smart city projects.

6.1.1. THE DATA PRODUCER

The smart city is understood as a city in which information and communication technologies (ICTs) are applied to improve quality of life. ICTs are inherently linked to data and data is thus an important actor in smart city projects. As the empirical results show, one of the roles configured for citizens is a role as data producer. This role is not appropriated by the citizen alone; they use devices to produce this data. The role of data producer is thus a *hybrid* role, appropriated by a collective of human and technological actors. For example, in the smart citizen kit (SCK) project, citizens cannot produce data about their environment without their smart citizen kit, and the smart citizen kit cannot produce data without citizens installing and maintaining it. Within ClaimJeStraat (CJS), the police staff configured citizens to file reports so to improve the information position of the police. Citizens have not appropriated a role as data producer within that project. Within CJS, there are no technological actors included in the project that can fulfill the 'technological' part of the hybrid role. If citizens would have appropriated the role of data producer in this project, they themselves would have to include technological actors to fulfill this technological part of this hybrid role.

6.1.2. TAKING ACTION

Citizen participation or active citizenship entails more than the citizen as data producer. Within the studied projects, the active citizen is configured to be engaged and committed and to take initiative and action based upon the data in the project. To be able to act upon the data produced in the project, it is important that this data can be translated into information for the citizen. This way, citizens can develop an understanding of this information and act upon it. In case of the smart citizen kit, the configured actions range from taking individual actions to raising a political voice. In practice, this role in taking action is not appropriated by most citizens, since most data is unreliable. Within ClaimJeStraat, citizen take initiative and action, but their actions are not directly linked to the project aims. There is no conformity within the project about data or information to act upon. The actions of citizens are thus not related to data or information that is included in the project set-up.

6.1.3. THE FACILITATING PROFESSIONAL AS DATA INTERPRETER AND KNOWLEDGE CONTRIBUTOR

In producing data and taking action, citizens appropriate new roles, which require a certain knowledge and expertise. Both case studies show that public actors are willing to facilitate the citizen in producing data and taking action. What this role of public actors as a 'facilitating professional' entails and how to appropriate it is however uncertain. The empirical results show two facilitating roles for public actors, that of data interpreter and knowledge contributor.

One of the challenges in taking action based upon data is to translate the data into information. Public actors can facilitate citizens by data interpretation and by providing citizens with information that follows from the data produced. In this, public actors share their knowledge and expertise with citizens, so to enable them to take action and become active.

In the studied projects, the facilitating role is loosely configured and the understanding of the role is based on expectations and suggestions. The role is only partially appropriated in both projects. Nevertheless, public actors acknowledge the possibility of appropriating such a role, and seem open to it. A possible reason for the non-appropriation of this role is that it requires different or new skills from public actors, since communication becomes more and more important in such a facilitating role.

6.1.4. ACCESSIBILITY OF DATA & INFORMATION

Data and information are important aspects in the above mentioned roles. In appropriating these roles, citizens and public actors collaborate in producing data, translating it to information and acting based upon that. To be able to collaborate in these roles, each actor appropriating such a role needs access to the data and information. Without access to the data, a data interpreter cannot translate the data into information, and without access

to this information, the 'active citizen' cannot take action based upon it.

In both cases studied, an online platform is developed to gather or share data and information. The configurations inscribed in this platform allow or inhibit access to data and information for different human actors. Public actors and citizens can only cooperate in data production, interpretation and taking action if they both have access to the data and information. In the case of the smart citizen kit, the public actors involved did not have direct access to the data produced, data was only accessible by the restricted display on the online platform. Within ClaimJeStraat, public actors expressed the possibility to share information, but they did not do so within the project. In CJS, citizens could thus not act based upon the information within the project. To allow citizens and public actors to cooperate in the roles of data producer, data interpreter and taking action on data thus requires open accessibility of data and information for both citizens and public actors.

6.1.5. CONCLUDING: BLURRING BOUNDARIES BETWEEN PUBLIC ACTORS & CITIZEN

In smart city projects that address active citizenship or citizen participation, the boundaries between public actors and citizens become blurry when public actors and citizens collaborate on specific topics. Using ICTs, data has a central place in this collaboration.

In figure 25 I present a schematic overview showing how public actors and citizens can collaborate within smart city projects. Together with technological actors [II], citizens appropriate a role as data producers. This data has to be interpreted to become information. This data interpretation can be facilitated by public actors, using their knowledge on the topic and the technologies they developed to do so [IV]. To do so, public actors need access to the data produced by citizens, this can be shared using technologies [III], such as an online platform. This data can be combined with the data

institutions produce themselves (in a collective with technological actors [I]).

Several human actors have configured citizens as 'active' or participating citizens, who act based on the data and information gathered. To do so, citizens have to have access to this information and data. When public actors contribute to data interpretation, their findings have to be fed back to citizens using technologies [V] (for example, an online platform). This information will likely be accessed using other technologies [VI]. Expert
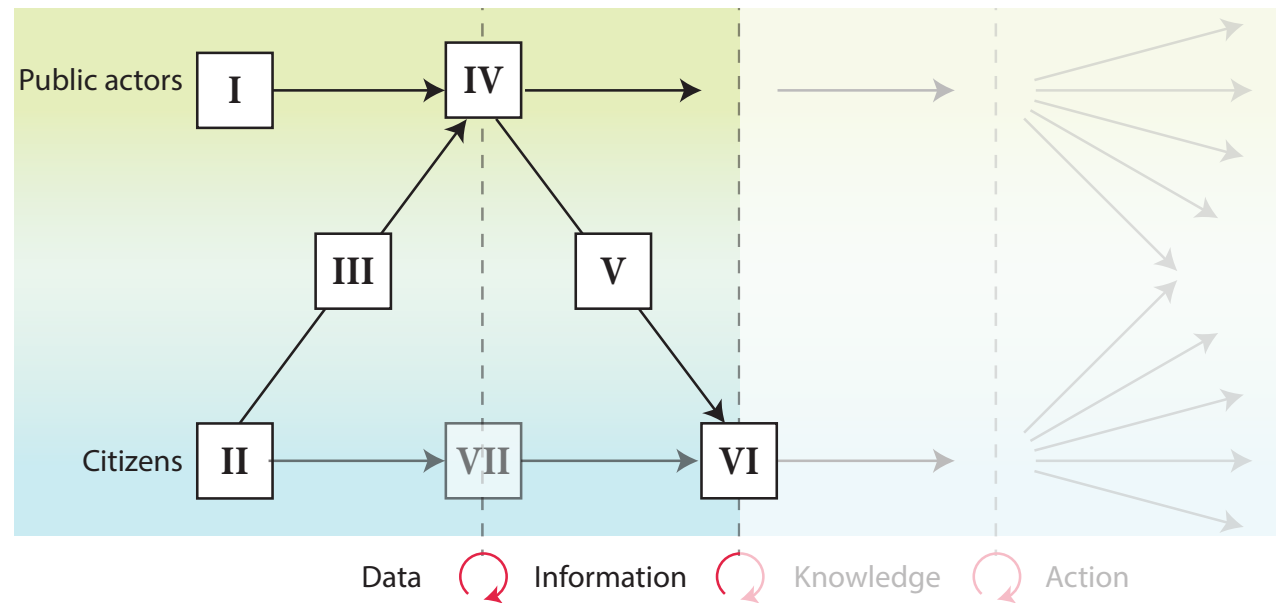

figure 25: Blurring boundaries between public actors & citizens: data production & interpretation

citizens might also interpret data themselves (via [VII]). To increase openness and accessibility of data and information, a single technological actor can be used for sharing it. In both cases studied, an online platform is suggested for this. An online platform could thus fulfill the function of technologies [III], [V] and [VII].

Active citizens are configured to take action based on the information they gather. Because both cases studied are in pilot phase, the translation from information to action is little. For the SCK project, this is due to unreliable data, and within ClaimJeStraat, public actors have not shared information within the project. The collaboration between citizens and public actors can become even more interesting if the action taken by public actors and citizens are aligned as well. Because the role in taking action based on data was not or only little appropriated in the case studies, this aspect could not be studied within these projects. The blurring boundaries between public actors and citizens studied in this research are thus related to data production and data interpretation. I suspect that this could be extended in collaborations in taking action, but this requires further research and is beyond the scope of the studied projects.

All in all, in these smart city projects the boundaries between public actors and citizens indeed became blurred, resulting in new roles for these human actors. These new roles contribute to the smart city in the aspects of smart people and smart governance (as defined by Giffinger *et al, 2007*).

However, human actors have no experience with these roles yet, resulting in uncertainty about not only their own role, but also about what to expect of other actors. The different configured roles for citizens and public actors do align with each other, but the appropriation of these roles in project dynamics is in early stage.

6.2. BLURRING BOUNDARIES BETWEEN DESIGN AND USE: ROLES IN PRODUCT DEVELOPMENT

In the studied smart city projects the technologies are in pilot phase or under development. Technologies often had an open character, allowing human actors to reconfigure them. Several human actors are involved in further product development, resulting in blurring boundaries between design and use. The roles of user, tester and co-creator are configured for citizens. These roles all are related to the role of the developer, but the different roles result in different expectations of the developer. Roles of developer, user, co-creator and tester all are inherently linked to the technology under development. With blurring boundaries between design and use, new roles are shaped for human actors. Below, these roles and the relation with technologies are described. This paragraph concludes with how these roles and technology impact the project dynamics.

6.2.1. CITIZENS: USER, TESTER OR CO-CREATOR?

Within the studied smart city projects, several roles were configured for human actors in relation to the technological actors. In these cases these roles were specifically configured for citizens, but they are not automatically limited to citizens. Citizens have appropriated several different roles related to technology development actors as well. Three roles can be distinguished, that of user, co-creator and tester.

A *user* of a technology uses it for a certain purpose, related to the functionality of the technology. A user expects a certain utility. As expressed by several citizens who appropriated a role as user, they expect a technology to work, to function properly according to their expectations. Citizens in the smart citizen kit for example expected plug-and-play devices, and to measure air quality with the smart citizen kit. A second role configured for citizens is a role as tester. While a user expects a specific utility, a *tester* has the aim to test the product and help the developer in finding out what should be further addressed. While a tester might expect specific functionalities and utility (as a user does), these are not the main aim of his interaction with the technology. A tester aims to test whether these expectations are lived up to, so to further improve the technology under development. The role of tester was especially configured for citizens in the SCK project. In this project, citizens did not recognize and appropriate this role. Citizens expected to be a mere user of the kit. Next to roles of user and tester, the role of *co-creator* was configured for citizens in

the Smart Citizen Kit project. A co-creator expects a certain utility similar to the expectations by a user. However, a co-creator both negotiates the configuration inscribed in the technology and reconfigures the technology with the aim to achieve the expected utility. Co-creation is not an individual process, it should be understood in the network including the citizens configured as co-creator, technology and developers. A co-creator aims to improve the technology in collaboration with developers and other co-creators. The role of the co-creator encompasses aspects of the roles of user and tester, expecting both utility and to improve the technology under development. However, the role of co-creator encompasses more than the combination of using and testing, since a co-creator actively re-configures the technology under development. The role of co-creator was conceptually configured for citizens in the SCK project, but citizens did not appropriate this role. The role of co-creator was not configured for citizens in ClaimJeStraat. Here citizens were only configured as users. Even though the project was in pilot phase, citizens were not configured as testers of the platform. Nevertheless citizens did provide feedback including suggestions of re-development of the platform.

6.2.2.   CORRESPONDING RESPONSIBILITIES OF A DEVELOPER

User, tester and co-creator all interact with a technology which is configured by the developers. The roles of user, tester and co-creator are thus related to the role of developer, this relation is mediated by technological actors. The configurations of the role of developer differ for each of these three roles. As described above, the user expects utility, thus configuring the developer to deliver a fully functioning product. A tester aims for improvement of the technology, thus configuring the developer to include his feedback in further development. Lastly, a co-creator aims to further develop the technology in collaboration with the developer, thus configuring the developer to give freedom to and cooperate in co-creation.

These different configurations of the developer by user, tester and co-creator conflict. For example the role expectation to develop a fully functioning product conflicts with the expectations in redevelopment. Because of these conflicts, the roles of user, tester and co-creator eventually conflict too. Provided that the aim is to align the different project dynamics, one cannot configure the role of user, tester and co-creator at the same time within a single project.

6.2.3.   OPEN TECHNOLOGIES

The relation between the roles of user, tester or co-creator and developer is mediated by a technological actor. Technology shapes the roles of developer and user, tester and co-creator. Taking into account the mutual shaping between human and technological actors, Verhaegh, *et al.* (forthcoming) claim that openness and fluidity of technologies is key in community innovation. In community innovation, users collectively contribute to the development of technologies. The importance of openness and fluidity of technology as identified by Verhaegh *et al.* also applies to co-creation. In the case of the smart citizen kit, the open software/ open hardware approach allowed citizens to tinker with the kit. For ClaimJeStraat, citizens provided feedback on the platform but could not reconfigure it because of its closed characteristics. Thus, in the case of the smart citizen kit, the open character of the technology allowed citizens to tinker with it, while in ClaimJeStraat, the 'closed' online platform inhibited citizens to improve it.

6.2.4.   CONCLUDING: BLURRING BOUNDARIES BETWEEN DESIGN & USE

In the studied smart city projects, boundaries between design and use indeed became blurred. Citizens were configured as co-creators or appropriated a role in providing feedback for re-development. Within ClaimJeStraat, citizens' feedback was included in brainstorm sessions on further development of technologies and within the Smart Citizen Kit Project, the developers expressed to take into account the feedback provided throughout the project. Since the development of smart cities is ongoing, smart city projects often include pilots and technologies under development. Blurring boundaries between design and use can actually contribute to aligning the project dynamics. Because technologies are under development and in pilot phase, it is likely that the user configurations not always align with the background of the human actors configured as user. This might result in non-appropriation of technology and the user-role. If actors are not only configured as users, but also

as co-creators, these actors can have the freedom to reconfigure the technology. This contributes to the alignment of configurations and their background.

Several key aspects can be identified when dealing with blurring boundaries between design and use. First, it is important to have clarity whether citizens are configured as user, tester or co-creator. These roles include different and conflicting configurations of the role of developer, and uncertainty about these roles thus can result in role strain for the developer. This does not contribute to aligning the project dynamics. Secondly, the hard configurations inscribed in the technology should correspond with the (soft) configured roles. The role of co-creator requires open technologies that can be reconfigured, while a user expects a fully functioning product. Lastly, when boundaries between design and use are blurring, the interaction between design and use becomes important. If technologies are under re-development by different actors (both in the roles of developers and co-creators), the dynamics initiated by different actors have to be aligned. Otherwise, different actors are reconfiguring the technologies, and different versions of a technology develop next to each other. Sauer (2013) has studied user innovativeness in living lab practices, building on three case studies focusing on users as designers, users as testers and users as co-creators. These three user-configurations are related to what in this thesis has been addressed as blurring boundaries between design and use. Hence, I suggest that Sauer's conclusions and suggestions for dealing with user innovativeness in

living labs also contribute to dealing with blurring boundaries between design and use in smart city pilot projects.

All in all, boundaries between design and use become blurry in these smart city projects, and this can benefit the development of technologies in pilot phase. It is important to be aware of the heterogeneity of configured roles for citizens; to align the hard configurations inscribed in the technology with these configured roles and to align the dynamics in reconfiguration by different actors.

6.3. PROCESS ORIENTED ROLES

Next to roles related to blurring boundaries between design & use and public actors & citizens I have identified several process-oriented roles and aspects that are of importance in the mutual shaping of roles and project dynamics in smart city projects. These below described aspects at first seem to consist of contradictions, but if they are approached as complements instead of contradictions, these can actually contribute to aligning the dynamics of smart city projects.

6.3.1. PROJECT AIMS: CONTENT AND PROCESS

The aims of a project have impact on the project dynamics. This is also shown in the schematic overview of project dynamics as presented in figure 4 on page 19. The aims of smart city projects can be process oriented or focused on content. In the case studies, the SCK project had both process and

content oriented aims, focusing on learning about the process and content, so to further develop the dynamics on the topic. Within ClaimJeStraat, the aims were content focused, the project aimed to improve safety. Within the latter project, these aims are currently not achieved, because the initiators faced many process-related challenges.

Smart city projects deal with uncertain dynamics because technologies are under development or in pilot phase and boundaries between both public actors & citizens and design & use are blurry. Aligning these different dynamics requires not only focusing on the content of the project, but on the structure of the process as well. Including both content and process oriented focus in the project aims will benefit the project dynamics.

6.3.2. A CENTRAL ACTOR AND AN OPEN APPROACH

To align different actors and roles in project dynamics includes many negotiations between different actors. In both cases studied, one of the actors took a central role, being the contact between different human actors. Such a central role can help bring others together, having a positive effect on the alignment of these different actors. These benefits are dependent on how the actor appropriates this central role. In the case of ClaimJeStraat, the man in the middle limited interactions between others due to selective communication based on his personal preferences. On the contrary, the project team in the smart citizen kit project appropriated an open approach in their central role in the network.

For an actor with a central role in network it is essential for aligning the project dynamics that this central role includes an open approach. This open approach entails an open stance towards new and current actors in the network, both human and technological. With an open approach, new actors can be included in the project dynamics, such as institutions in the smart citizen kit project and local officers and techno prevention devices in ClaimJeStraat. Next to being open to new actors, an open approach includes an open stance towards current actors in the network and their background. Being open to the background of human actors allows identifying existing mismatches between configurations and appropriations, and allows further negotiation of roles and technology, thus contributing to aligning these processes. The Smart Citizen Kit project shows that such an open approach has a reciprocal effect. If an actor with a central role is open towards the background of other human actors, these actors also open up to the project dynamics and backgrounds of others. This creates an open dynamic in which roles and technologies are more fluently negotiated, thus contributing to aligning the project dynamics.

6.3.3. CONFIGURATION, APPROPRIATION AND RE-CONFIGURATION OF ROLES

Role negotiations are ongoing in smart city projects, especially for roles related to the blurring boundaries. In this negotiation, it is important to articulate role configurations. If role configurations are not clearly articulated, other actors cannot appropriate the configured roles. When roles are appropriated, they are often appropriated under certain conditions. These conditions consist of expectations of the other actor, thus reconfiguring his role – leading to a mutual re-configuration (i.e. actor A configures a role for actor B. Actor B appropriates this role, under the condition that actor A changes his role, thus actor B reconfigures the role for actor A). To align the project dynamics means to continue role negotiations so to reach conformity about roles. This negotiation requires to articulate (re)configurations. On the other hand, it requires actors to be open to the (re)configurations by other actors. These (re)configurations can result from either (conditionally) appropriating the configure role, or from appropriating a different role. If configurations are not articulated and actors are not open to configurations, the different processes of configuration, appropriation and re-configurations of roles in the project dynamics cannot be aligned.

6.4. THE CASE STUDIES IN CONTEXT OF THE SMART CITY

In the previous paragraphs, I concluded that the boundaries between public actors & citizens and design & use are blurring within smart city projects and that this leads to several new roles for actors involved in smart city projects. These conclusions are based upon the empirical results of two case studies of smart city projects. In chapter 1, smart cities are described by three levels: the smart city concept, initiatives and projects. How do the studied projects relate to the broader smart city development?

Giffinger, et al. (2007) characterized the smart city by the six aspects of smart governance, people, economy, living, mobility and environment. Individual smart city projects contribute to part of these aspects. Both projects studied address active citizenship and citizen participation, part of the aspect of smart people. By addressing the roles of public actors in relation to this active citizenship, the aspect of smart governance was addressed. Both projects contributed to the aspect of smart people and governance in different contexts, the Smart Citizen Kit project focused on monitoring air quality, by that linking to the aspect of smart environment; ClaimJeStraat focused on safety and social cohesion, both part of smart living. The idea to include SMEs in ClaimJeStraat can link to the smart economy aspect, but this idea is currently not implemented in the project. Thus, the studied projects touch upon most of the aspects identified by Giffinger et al., the aspect of smart mobility has not been addressed within these projects. It would however be too blunt to say that the case sample comprise all these different aspects, since these aspects consist of many more different factors than the factors addressed within the cases.

Central in smart cities is the application of ICTs to improve quality of life. ICTs are central actors within the smart citizen kit project, data about air quality is presented in an online platform. The main ICT application in ClaimJeStraat is an online platform as well, but this was not appropriated by several human actors, large part of the dynamics in the street were not related to ICTs. Although social

media and e-mail was included, most communication took place face-to-face or through leaflets distributed in the street. The non appropriation of the online platform is partly related to the target group of the CJS project, citizens in one street. When citizens live close together, there is less need for online communication. While ICTs were thus not appropriated in the street dynamics in CJS, future intentions of actors involved do include ICTs in the form of the online platform, techno prevention and social media. Whether and how these ICTs will be included in the project in the future is unknown, since dynamics are ongoing.

This thesis focused on blurring boundaries in smart cities. The blurring boundary between public actors and citizens is inherently linked to active citizenship and facilitating public actors, since these two types of actors form new collaborations. Because active citizenship and facilitation relate to the aspects of smart governance and smart people, the blurring boundary between public actors and citizens is inherently linked to smart city projects that address these aspects. The blurring boundary between design and use is linked to technology development. The smart city concept comprises ICTs applications and the development of smart cities is ongoing, and it can thus be assumed that this includes the development of new technological applications. The blurriness of the boundary between design and use is dependent of the project set-up and the development stage of the technologies involved. As I concluded in paragraph 6.2, blurring boundaries between design and use can benefit the development of technologies, provided that they are handled well.

6.5. LESSONS FOR SETTING UP SMART CITY PROJECTS

In the previous paragraphs, I concluded that the blurring of these boundaries can actually contribute to smart city projects, by contributing to aspects of smart governance and smart people and by benefiting the development of technologies in pilot phase, provided that they are handled well. How to deal with these blurring boundaries? The conclusions are translated in six lessons for setting up smart city projects and dealing with blurring boundaries in practice. These lessons are based on the findings on process oriented roles and the blurring boundaries between public actors & citizens and design & use.

1. Before starting the project, take the dynamic interactions in the process into account. The blurring boundaries lead to ongoing negotiations about roles and technologies under development. Acknowledge and allow for these ongoing negotiations in the set-up of the project and the development of the technology, by including the process in the project scope.
2. Adopt an open approach when taking a central place in the network, being open to new actors and the individual background of existing actors. This open approach has a reciprocal effect that benefits alignment of project dynamics.
3. When focusing on smart, active or participating citizens, include these citizens in the project set-up. Take into account the background and interest of the citizen when expecting certain roles of the citizen, and expect ongoing negotiations with citizens about roles.
4. Relate roles to their complementing role. Roles always come in sets or pairs, the expectations about a role for an actor should thus be understood in relations to the complementing role of another actor (e.g. relate expectations about the role of active citizen and facilitating professional to each other, and relate roles of data producer and data interpreter to each other).
5. Clearly articulate roles, both the expectations about roles (configuration) and how roles are taken up by actors (appropriation). If specific configurations or appropriations are uncertain or unclear, acknowledge to be searching for possible roles.
6. Align the functionality of a technology with the expectations of human actors who interact with it. When expecting roles such as co-creator or tester (i.e. in the case of blurring boundaries between design and use), include open and fluid technologies in the network that allow co-creators and testers to tinker with it. Think about the capacities needed of actors to be able to appropriate these roles.

7. DISCUSSION

'Goodbye Tokyo' by Alex Robertson. Retrieved from https://flic.kr/p/dacFna

This chapter reflects upon the decisions and assumptions made within this research. Section 7.1 discusses the limitations of the research, and especially the case selection. The theoretical framework is reflected upon in section 7.2. Throughout the research, several issues emerged that where beyond the scope of this thesis and require further research. The first is related to the question whether data should be understood as an actor within the network (section 7.3). Secondly, several ethical issues related to the development of smart cities emerged in interviews with human actors involved in the case studies. These issues are addressed in section 7.4.

7.1. LIMITATIONS OF THE RESEARCH

The selected cases resulted in several findings on the mutual shaping of roles and project dynamics. These findings were translated into several lessons for setting up smart city projects. Since the studied cases are in pilot phase, it is hard to generalize these findings. The dynamics in both case studies are ongoing, and the impact on the long-term development of smart cities could not be addressed. Related to the blurring boundaries between government and citizen, several roles have been identified. These roles are however limited to early phases in collaboration related to translating data into information, and taking action based upon

data. Identified roles and dynamics focus on data production and interpretation. Dynamics related to collaboration on taking action could not be identified within the case sample.

The case sample consisted of specific smart city projects. As described in the introduction (section 1.1), a distinction can be made between three levels: the concept of smart cities, smart city initiatives and specific projects. The studied cases cover a small part of the total concept of smart cities, addressing only the project level and addressing part of the characteristics of a smart city as defined by Giffinger *et al.* (2007). Meijer and Bolívar (2013) call for conceptualizing the smart city as a socio-technical system. In this research the socio-technical nature of smart cities is addressed on project level. To what extent do the findings of this research contribute to conceptualizing the socio-technical nature of smart cities in general?

Ojo, *et al.* (2014) introduce the conceptualization of a smart city as a socio-technical system of systems. Specific smart city projects are, as separate socio-technical systems, interconnected in the bigger socio-technical system of the smart city. However, next to these dynamics on project level, several dynamics take place on city level. Examples are social, political and economic processes, or technological applications such as data analysis on city level. Smart cities cannot be understood by focusing on the projects alone. To cite Aristotle: the whole is more than the sum of its parts. Thus, to conceptualize the socio-technical nature of smart

cities in general requires to combine research on the socio-technical dynamics on project level with research on the dynamics on city level. While the case sample in this research contributes to the first, the latter is not addressed. The smart city however includes many different aspects. In the introduction, the six smart city characteristics of Giffinger, *et al.* (2007) were described: smart governance, people, environment, mobility, living and economy. To address the full socio-technical dynamics on project level requires to include projects on all these different aspects. All in all, to conceptualize the full socio-technical nature of smart cities thus requires to study the dynamics of projects in all different fields of smart city development and to research the socio-technical dynamics on initiative- and city level.

7.2. COMBINING ROLE THEORY & STS

This research is based upon a theoretical framework building on actor-network theory and role theory. Many insights building on ANT have focused on user-technology relations, resulting in challenges when studying practices where boundaries between design and use are blurred (see paragraph 2.3). The theoretical framework combines actor-network theory and role theory, so to be able to study heterogeneous networks without framing actors within specific roles. Role theory provided useful concepts in studying roles within actor-network theory. Central in actor network theory is to acknowledge the agency of technologies and

include them as technological actors in the network. Within role theory, roles are taken by people, human actors. Combining role theory and ANT thus raises the question whether technological actors can appropriate roles.

In general, roles are described as a pattern of expectations about behavior and attitude. When people appropriate roles, they behave according to these expectations. In this sense, a role of a technology relates to the functions it performs, and would be inscribed by the designer. Essential in role theory is that roles are not prescribed to specific actors, a role can be appropriated by different actors, and an actor can appropriate different roles. However, changing the role of a technological actor means changing its functionality inscribed, and with that changing the technological actor itself. This would mean that technological actors are inextricably linked to a specific role and can in itself not appropriate roles. This research showed that technologies can be essential when human actors appropriate roles. Hybrid roles (such as data producer) can only be appropriated by a collective of human and technological actors. This is dependent of the functionality inscribed in the technological actor.

It would however be too simple to conclude that technologies cannot appropriate roles, but have a specific role inscribed in them. This is the case for the technological actors involved in the case sample of this research, but the situation might be different when talking about for example robots and artificial intelligence. This is an emerging field, and

answering the question whether technologies can appropriate roles would require further research in at least the fields of robotics and artificial intelligence. Nevertheless, technological actors have a specific functionality or role inscribed. With that, technological actors configure certain roles for human actors within project dynamics. Within actor network theory, no a priori distinction is made between human and technological actors. The ANT perspective thus allows to let it come to fore when technological actors appropriate roles.

7.3. DATA AS ACTOR?

Within actor-network theory, both human and technological actors span up a heterogeneous network. In this network, technologies are an active agent, i.e. a technological actor. In a smart city, ICTs are applied to improve the quality of life in the city. ICTs are inherently linked to data. This raises the question whether data should be understood as an individual actor in smart cities.

This question cannot be answered without considering whether data in itself should be understood as an individual actor. This is a complex issue, since data is at the same time specific and indefinite. It is specific because data always concerns a specific topic or a piece of information. It is indefinite because it is omnipresent through ICTs and easily shared and accessible. This tension between the indefinite and the specific characteristics of data complicates defining the place of data in a network. Next to that, data can be understood as both a

resource and a product. Data is a resource for ICT applications, an online platform or the software in the smart citizen kit is 'built' from data; on the other hand, using this software, the kit produces new data, in this case, data about air quality. Despite these difficulties, it is undeniable that data influences the dynamics in a network, for example the impact of the unreliability of data on the dynamics as seen in the Smart Citizen Kit project. Data should be included in actor-network research concerning ICTs, but whether and how data can be understood as an individual actor requires further research, and might differ for different 'types' of data.

7.4. MORAL RESPONSIBILITY IN THE DEVELOPMENT OF SMART CITIES

New developments can raise new ethical issues. The same holds for the development of smart cities. Therefore, the developers of smart cities have a moral responsibility to address these issues. Identifying these issues is beyond the scope of this research, but several have emerged. Within the smart citizen kit project, questions emerged about the ownership and accessibility of data. Related to these questions are issues regarding privacy. Martínez-Ballesté, Pérez-Martínez, and Solanas (2013) discuss several aspects of privacy in smart cities. They suggest several measures to protect citizens' privacy within smart cities.

A second moral issue that emerged in the case studies is related to the digital divide. The digital divide in smart cities is for example discussed by Partridge (2004). The digital divide describes the gap between people who can use ICTs and people who cannot. Because the application of ICTs is inherent in smart cities the digital divide can raise ethical issues concerning equality between the two groups. The issue of the digital divide emerged in the case-study of ClaimJeStraat. Elderly people in de street community did not use the internet and e-mail, and were excluded from the online platform. Other residents included them by distributing information both through e-mail and flyers in mailboxes.

Privacy and the digital divide are two examples of ethical issues in smart cities. Many more possibly exist, especially when addressing specific smart city applications. These issues should be mapped and addressed in order to include them in smart city development.

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APPENDICES

A. INTERVIEW PROTOCOL

The interview protocol has been approved by the ethics committee of the faculty of behavioral sciences of Twente University and the first supervisor. Interview respondents were informed beforehand about the topic of the research and data handling. Research is conducted based on in-depth semi-structured interviews. The following interview questions were used as a guideline throughout the interview, depending on the background of the interview respondent, specific questions were elaborated upon or only shortly addressed.

As described in section 3.4, the concepts of the theoretical framework are translated into 25 interview questions. The background of human actors is addressed in questions 1-4. The project aims are addressed in questions 4 and 5. Relations with non-human actors are divided into technology appropriation (Q14-16, 24) and hard configurations (Q 13-15, 17, 19). The soft configuration of roles is addressed in questions 7, 8 and 18-20. Questions 3, 6 and 8-11 address the appropriation of roles. The last topic addressed in the interviews is translations within the project, addressed in questions 12, 17 and 21-25.

Acquaintance

1. Can you describe the background of [your organization/your function/your interest in the project]?
2. To what extent are you involved in the project?
3. How did you get started with this project?
4. Why did you start/join the project?

Project & process related questions

5. What do you hope to achieve with this project?
   – How do you contribute to achieving this?
6. What do you do in this project?
7. What do you think of this project in terms of:
   – Process (possibilities/difficulties)
   – Project
8. How did you expect to be involved in the project, what role?
   – E.g. inform, facilitate, developer, innovator, engaging, …, …
9. How would you describe your role?
10. What does the project mean in your organization/background/life?
11. Do you feel responsible for, or ownership over…
    – The project
    – Process

– The topic of the project
12. Do experiences match with your expectations? What has changed?
    – Aims/Goals
    – Project
    – Your role
    – Process

Technology (specified per technology)

13. What did you expect/aim for from the [technology] (functionality; possibilities/difficulties)?
14. What are your experiences with [technology]
    – Installation/first use
    – When/how often do you use it
    – What do you use [technology] for
    – Did you make adaptions to [technology]
15. Did the technology change something in your environment/context?
16. Do you feel responsible for, or ownership over [the technology]?
17. Do experiences with [technology] match with your expectations? What has changed?

Others involved

18. Can you describe the cooperation and communications with others involved?

- Are you personally in touch with others actors?
- If yes: can you describe it? What's the aim, what do you get from and contribute to this contact

19. What do you expect from [others] involved? What do you expect them to do?
    - What do you want/expect others (in this project) to do with the technology?
    - [For developers:] how have you incorporated it in the design/development?
    - Have these expectations of others changed?
20. What do others ask from you? How do they communicate that?
21. Do experiences match with your expectations? What has changed?
    - Other actors

Future Intentions
22. What does this project (and similar projects) mean for [you/your organization]?
23. What are your ideas for continuing this type of projects?
24. Do you have plans with the [technology] in general?
25. (How) do you plan to contribute to these projects/development etc.?