Practices for Smart Cities: Lessons learnt from the UK & the Netherlands

Abstract

Objective: To examine how information practices and behaviours change in relation to policing in a smart city context.

Methods: Semi-structured interviews were carried out with policymaking participants working in policing and city councils in the United Kingdom and the Netherlands.

Results: Using Cultural-Historical Activity Theory as the conceptual framework for analysing the data, it was found that collaboration and data sharing takes place between city councils and police forces, but not necessarily in light of smart city projects, but rather as part of an on-going commitment to reduce crime in cities. Challenges were identified concerning the state of the collected data, routinisation of data sharing, local solutions to local issues and privacy and ethics issues.

Conclusion: In this paper it is argued that technology use and data sharing are impacted by challenges that go further than the technological aspect alone.

Keywords: *Smart Cities, Policing, Data Sharing, Activity Theory, Policy Making, Technology Use*

Introduction

The paper reports on an engaged scholarship project, undertaken in collaboration with Thales NL, to understand the use and development of the new informational architecture of urban environments: smart cities (SC). This architecture of technology and data provides a new environment in which information behaviour and practice occurs and a new environment in which research into these two inter-twined phenomena can take place. We explore this through a study focusing on one information rich work activity which occurs in any city environment: policing. Recognising the importance of a nuanced understanding of the cultural historical context of the development of smart cities and the work activity that we wish to study we are exploring this phenomena in two countries: the UK and the Netherlands.

The is a novel research project as Smart city application for policing are not only information intensive work activities but also have been largely unexplored in the context of the development of smart cities. Additionally, in policing, an awareness of the increase of technology use in society exists and a need is felt to innovate itself and to invest and use new technologies (Manning, 1996).

The paper proceeds as follows: we discuss the relevant literature relating to SC and technology and information use in policing. The literature review will conclude with the research question: "How are technologies being deployed to support policing in the context of 'smart cities'?". It will then describe the research setting and methods of this study and the theoretical framework used. The paper concludes with the presentation and discussion of the findings.

Literature Review

The idea of a smart city has been put forward as a concept which encompasses a range of tools, technologies that create a

new digital architecture. This is an architecture which provides unparalleled amounts of information which can be used to measure and ultimately control behaviour, processes and tasks. As urbanisation has grown rapidly in recent decades, (Harrison and Donnelly, 2011) it brings new socioeconomic issues and intensifies pressure on cities' resources. It has been argued that a new way of managing cities is now called for (Cilliers and Flowerday, 2014; Hollands, 2008; Nam and Pardo, 2011; Silva Ferraz and Guimarães Ferraz, 2014). Smart cities (SC) have been coined to be a form of urban governance that will help manage these issues (Cilliers and Flowerday, 2014). This term appears across policy statements by local and central government and is used extensively by developers of new and emerging technologies. It is spoken of, in practice, as a unified and unifying concept for the future of urban spaces.

However, in the academic literature there are several definitions coined to the term 'smart cities' and no consensus has been reached on the definition (Hollands, 2008; AlAwadhi and Scholl, 2013; Dameri, 2013). The concept of SC is fuzzy and has been contested (Hollands, 2008; Nam and Pardo, 2011; Caragliu et al. 2011; AlAwadhi and Scholl, 2013; Dameri, 2013). No real understanding of what 'smartness' has been reached (Nam and Pardo, 2011), nor has a clear measurement of 'smartness' been agreed upon. Furthermore, cities have labelled themselves as smart without motivating what makes them smart by using a definition of 'smartness' (Hollands, 2008; Caragliu et al., 2011; Allwinkle and Cruickshank, 2011).

Several authors have attempted to define the term 'smart city'. Within the definitions given, a few common themes are prevalent: Quality of Life, Environmental Sustainability, and Economic Competitiveness, with a common denominator of achieving this through the use of ICT. In table one a selection of definitions is presented chronologically.

Year	Definition smart cities	Author
2009	Coercively deploy IT to address social and business needs, with the goal to increase the community's quality of life, economic development, and job growth	Eger
2010	Connect the city's infrastructures, i.e. the physical, the business, the social, and the IT, to enhance the city's intelligence	Harrison et al.
2012	Local entities that uses a holistic approach to achieve a sustainable economic development through the deployment of IT and real-time analysis	IDA
2014	Improve urban performance, e.g. provide better services to its citizens, enhance collaboration between different processes, monitor the city's infrastructure, and encourage innovation, through the use of IT and data	Marsal-Llacuna et al.
2017	Seek to leverage advanced communication technologies and IS in order to improve all areas of city administration, enhance citizens' quality of life, engage citizens and provide more sustainable and resilient public services	Corbett and Mellouli
2018	An umbrella term for how information and communication technology can help improve the efficiency of a city's operation and its citizens' quality of life while also promoting the local economy	Gascó-Hernandez
2018	All about networks of sensors, smart devices, real-time data, and ICT integration in every aspect of human life	El-Haddadeh et al.
2018	"A multidimensional mix of human, infrastructural,	Ruhlandt

	social and entrepreneurial capital, that are merged, coordinated and integrated using new technologies to address social, economic and environmental problems, involving multi-actor, multi-sector and multi-level perspectives"	

Table 1: Coined definitions of smart cities throughout the years

In earlier definitions, an IT-centred approach was the dominant vision (Lee et al, 2013) where SC were seen as cities where IT was used to manage cities' infrastructure and city services (Harrison and Donnelly, 2011; Paroutis et al., 2014). However, the IT-centred approach was met with criticisms. Several researchers (Townsend 2013; Greenfield 2013) noted that while IT can be beneficial in city development, the focus should lie on delivering on the needs of the city's citizens, and on developing smarter communities based on the dynamics of the city (Hollands, 2008). In this citizen centric view, IT is not what makes the city smart, rather IT is an instrument that can be used in the pursuit of improvement (Kramers et al., 2014; Hilty et al. 2011; Nilsen, 2019).

This view on the role of IT in SC overlaps with the view that technology is the enabler of the necessary changes in policing practices. However, not much research has been done on how to conceptualise this and if an SC environment (where more IT and the deployment of technology are key) affects necessary changes in policing practices.

Policing and technology
Policing is the core focus of this paper as it aims to deal with the issues cities face in terms of public order and safety and the need for police forces to modernise their operations.

Traditionally, innovation has always played an important part in society and in policing (Nuth, 2008), with information

technologies such as facial recognition systems, DNA testing, and video surveillance being commonly deployed (Nunn, 2001). Additionally, sensor-based advanced technologies are becoming more prevalent in policing and allow for machine systems to code and decode information coming from cities and environments (Nunn, 2001). Movements of individuals and groups can be tracked and what was previously unseen can be revealed through surveillance technology (Nunn, 2001). Furthermore, big data in combination with other technologies, can benefit policing by enabling the unknown to become known by uncovering patterns from past behaviours and use this to predict potential future criminal activities (Ferguson, 2015), and particularly could enable insight into possibilities of unrest, risk, and social deviance (Leszczynski, 2016). With the rise of technology use, more data than ever is being collected and a need is felt to intelligently make sense of this data (West Yorkshire Police, 2014). However, while policing and technology is of growing interest in academia, its use has been under-explored (Custers and Vergouw, 2015; Lum et al., 2016). The aforementioned issues raise the following research question: How are technologies being deployed to support policing in the context of 'smart cities'?

Methodology
This research project is novel in that it takes an engaged approach to scholarship. This is seen as an approach which supports the development of research findings which are relevant for practice. As Van de Ven and Johnson sate:

> *'...engaged scholarship in which researchers and practitioners co-produce knowledge that can advance theory and practice in a given domain"* (2006: 803)

As PhD research the second supervisor for the work is from Thales NL. This

organisation supports the research and helped develop the initial research outline. Policing was carefully selected as the focus of the research as policing in the United Kingdom and the Netherlands have been faced with austerity and have been expected to provide the same services with fewer means (Allen et al., 2016; Custers and Vergouw, 2015; Kuijken, 2017; Lowe and Innes, 2012; Lum et al., 2016; Rowe, 2014). Technology is seen as a way of addressing their need and to increase efficiency (Lowe and Innes, 2012; Rowe, 2014; Custers and Vergouw, 2015; Lum et al., 2016). While the implementation of devices and technologies have been studied in the context of policing, a gap has been left to explore the impact of the introduction of new technologies in policing in terms of information use (Allen, 2011).

To gain an initial insight into how smart cities influence information use and work activities, a set of 8 extended semi-structured interviews were conducted with senior organisational actors responsible for developing, exploring or implementing new approaches to policing in a SC context in the Netherlands and in the United Kingdom as part of a qualitative study. Six participants work in policing organisations and two work in city councils. For this study participants involved in policy making and in IT developments were interviewed to gain an understanding of the types of technologies used and the activities they are used for, the rules and norms surrounding implementioin and use of

certain types of technologies and data, the challenges the organisations are faced with when using smart city technologies, and to gain insight into how data sharing between organisations takes place.

Third generation Cultural-Historical Activity Theory (CHAT) (*figure 1*) is used as the conceptual framework to address the research question. CHAT will be used to provide a descriptive narrative aiming to gain a thorough understanding of what is happening in cities and police forces as the transformation to a smart city is being made, and how the activates interlink. Ove the past 20 years, the framework has gained interest in the field of information studies (e.g. Karanasios et al.; Kuutti, 1999; Allen et al., 2014). Using the framework in the context of cities, promises insights that will be gained in local activities and placed in the context of cultural resources common to the society they are in and the historically formed mediating artefacts (Engeström and Miettinen, 1999).

Within and between activity systems contradictions may exist (Engeström, 1987; Engeström, 2000; Karanasios et al., 2017). Contradictions expose the dynamics, inefficiencies, and opportunity for change in the activity (Blackler, 2009). In this research, tensions and contradictions are used as a means to identify areas of change and problematize smart city technologies in policing (Karanasios and Allen, 2014). This is done through examining the working
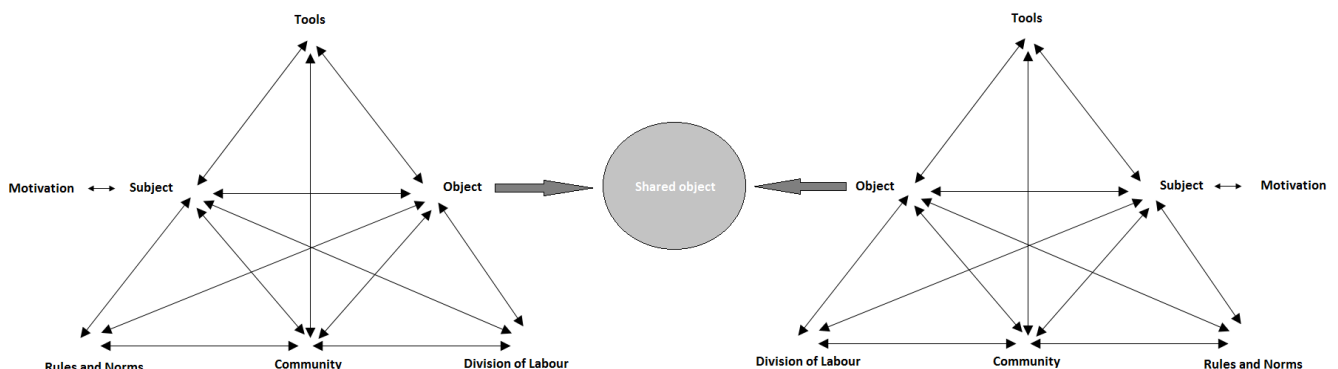

Figure 1: Third generation Activity Theory (Developed by Engeström (2001))

activities in which the technologies are deployed.

Findings

The initial premise of the research was that smart cities, in some form were developing and that policing organisations were in a co-ordinated fashion engaging with the development of this new digital architecture. The development of SC in practice was found to be amorphous and a lack of a clear strategy was identified. The immaturity of smart city projects was cited by participants, as well as the immaturity of the technologies needed to enable smart city development. Participant six noted:

"There are not that many smart city concepts yet. It is being talked about a lot, but not much is happening yet. If you talk to people about smart cities, they often talk about IoT. ...We use many sensors for this, and at times we make them ourselves. But I wouldn't present this as a smart city concept, but as smart policing." (Participant 6)

An issue raised was that the data collection process in the UK has not advanced to a level where meaningful data analysis can be done. With Participant 7 stating that:

"The data is unexploited now. We haven't got the data collection right, and therefore we can't do the analytics effectively enough, and extent of the data." (Participant 7)

However, despite some of the challenges mentioned, big data and sensors are being used in policing and city councils. With 4 participants from the Netherlands highlighting the use of the CAT system (Criminalitiet-Anticipatie-Systeem, Eng: *Criminality-Anticipation-System*) as a means to layer data coming from different organisations, e.g. policing records and data coming from the Centraal Bureau voor de Statistiek (Eng: *Statistics Netherlands*) to estimate crime levels per square meter.

However, in the United Kingdom connecting different IT systems to enable data sharing was mentioned as a challenge. Furthermore, participant 7 said that, if information is being shared the state of the data and whether the data is available in near real-time or retrospectively only is a challenge. Furthermore, it was found that smart city technologies often cited in literature, such as crowd monitors are used in experiments, but are not deployed as common practice or by all city councils or police forces.

A disconnect was found in information sharing between the police and city councils. Participants from both countries stated that collaboration and information sharing takes place and that there is a requirement in both countries to share information. However, it was pointed out that data sharing is not necessarily done systematically and that the technology is still to be developed further:

"What we are doing, we always work with safety regions. So that is the fire brigade, police, city council, and the mayor is the head of the safety region. There is also an information manager in the safety region, whose job it is to ensure all information is ends up with the right people. There is a whole decision tree on who has to be informed on what and who is allowed to make which decision." (Participant 2)

This lack of co-ordination was, however, in stark contrast to rules in place which, in the UK mandated information sharing:

"There is a statutory requirement, a piece of legislation called the Crime and Disorder Act 2000. Where there is a statutory responsibility for the local authority to share data with policing and other partners in order to reduce crime, and therefore provide safety. So, it should be happening, but it is not in a particularly systematic way. It should be automated. Every year they should produce an

assessment based on that data. So that is at the strategic level. And that leads to tactical data-sharing around particular problems or threats. I don't think that has matured into a smart city environment yet, but that might be because smart cities are still relatively new, and infrastructures are developing. You know, IoT is a bit fragmented in that environment. You know, it is still very young and pretty immature." (Participant 7)

Indeed, the current approach to information sharing seemed to be far from the vision envisaged in the concept of smart cities:

"Of course data is being shared, in all sorts of ways, but often through human action. The police and city councils work closely together, so there are many occasions where people could meet. And then they do talk about these type of topics. But I don't believe it is done structurally. [...] and if we look at police processes themselves: if there is a need or a wish to share data, then bilateral contact is established, they get in touch and say: "we have a problem with this and that, and you do too, shall we work together?" This happens on a daily basis. But to develop smart cities on a structural level, the police plays no part in that." (Participant 6)

Collaboration between the police and city councils was undertaken on a local basis and a lack of national coherence was found. Participant 7 stated that:

"Yes, so it is being done on a local basis. [...] To what extent that transcends into a technical domain, I don't know. In the UK there are a number of so-called smart cities. [...] [On police involvement] I think that would be optimistic to say that there is very coherent engagement, but there will be organic and localised engagement from the police. There is very little on a national coherent basis." (Participant 7)

Tools
- Crime reporting systems
- Police National Legal Database (UK)
- CAS system (NL)
- Saftey cameras
- Social media platforms
- Mobile handheld devices

Police organisations

Rules and Norms
- Adhere to requirement to share data to reduce crime
- Adhere to the General Data Protection Regulation
- Adhere to the force's code of ethics

Community
- Criminal investigation unit
- Basic command unit
- Forward intelligence team
- Road policing unit
- IT department
- Support staff
- Neighbourhood support team
- Neighbourhood watch
Control room operators
- Other public service partners

Division of Labour
- Crime prevention and deterrence
- Crime investigation
- Respond to the public
- Protection of vulnerble children
- Share data with public service partners to ensure safety

**Shared object
To make the city smarter**

Tools
- Data bases
- Historical local data
- Sensors
- CCTV
- ANPR
- Social media
- Sound monitors
- Crowd monitors
- City council website
- Traffic monitors

City councils

Division of Labour
- Manage local infrastructure
- Lead community planning process
- Identify local public safety needs
- Develop SC projects
- Collect and analyse data
- Share data with policing and other partners to reduce crime
- Set-up data sharing/data usage policy
- Develop staff's ICT skills

Community
- City mayor
- Policy makers
- IT department
- Admin staff
- Policing
- Other public service partners
- Local businesses
- Residents

Rules and Norms
- Ensure quality of life for citizens
- Maintian safety for citizens
- Promote well-being of the city
- Share data with other public service partners to ensure safety according to national legislation
- Adhere to the General Data Protection Regulation
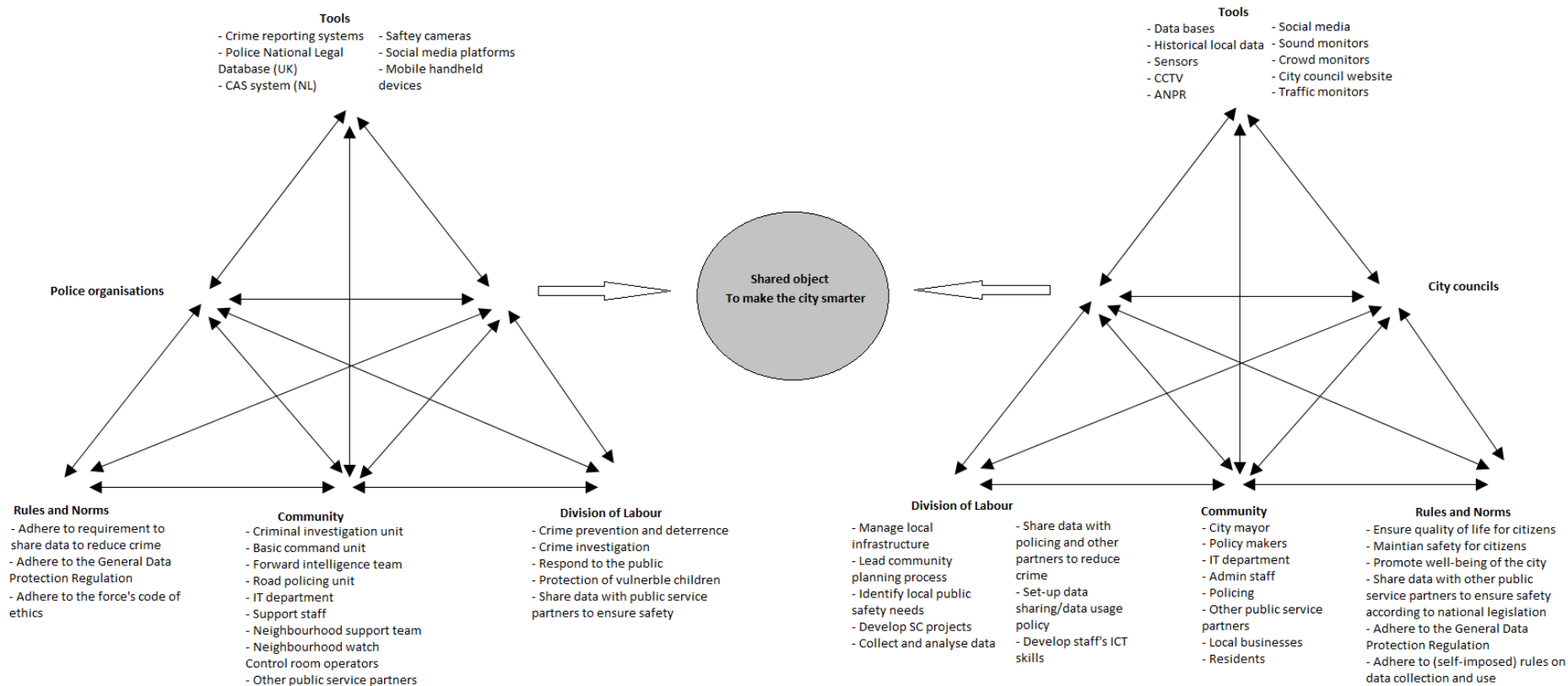- Adhere to (self-imposed) rules on data collection and use

Figure 2: smart city technology implementation and use in police forces and city councils as a network of activity systems.

Another factor found was that projects were undertaken on a local level. This was mentioned in two views: in one view the local needs was highlighted and in the other view a need for standardisation was expressed. Participant 7 said:

"We have recognised the opportunities at governmental level to set some frameworks. This is all new. So, for example a smart city that uses, I don't know, Piezo floor tiles to generate electricity in heavy footfall areas, as an equal way of generating electricity. Great, we really like that data, because that could really help out in useful purposes. But that would be true for every smart city, so it is pointless to do that locally. Why don't we

Furthermore, privacy and ethics were regarded as concerns when developing smarter cities, with all participants raising it as a challenge. Some of the issues mentioned were around to what degree (routinised) data collection is legally permissible and the socially responsible amount that can be collected.

"It is clear that privacy is obviously very important. [...] I would see it as a precondition to be able to do it. You need to take care of it neatly and you need to ensure you have an in-depth knowledge of it. I wouldn't see it as a challenge as such. It just has to be taken care of." (Participant 2)

Participant 1 saw ethics as a constraint when deciding what data and technologies to use in policing:

"I think that technology-wise we can do it, because we have quite a lot of data already, and I think the challenge is to continuously discuss the legal and ethical issues. Of course there is a wider debate around the legal element already, but also, if legally there are no constraints, to consciously look at, is this a thing we want to do ethically? Even though it is allowed, is this a thing we want to do? Is this the type of

do that centrally? And create a data sharing framework? But that is not happening yet." (Participant 7)

At the same time it was highlighted by the same participant that development needs to be done with the local environment in mind:

"Build algorithms that mean something locally. I don't think you can have an ubiquitous algorithm I think it needs to be built around that environment. So, the algorithms for Leeds would be different than for the algorithms for Bristol potentially, to start with. Start to build data up and you can probably standardise but, again, huge potential." (Participant 7)
society we want to be? [...] I think this is a thing we are becoming increasingly aware of within the police. Yes, I think that it often is a boundary to not do things" (Participant 1)

Discussion and conclusion
The findings of this study stand in contrast to the initial expectations of the research. The concept of smart cities has been put forward as a concept where a range of tools and technologies are used to generate more data than ever before which can be used to measure and ultimately control behaviour, processes, and tasks (El-Haddadeh et al., 2018). The process of policing was chosen as a focus of this study as it aims to deal with the issues cities face as a result of the growth of urban populations in the recent decades in terms of public order and safety (Cilliers and Flowerday, 2014) and the need for the police in the Netherlands and the United Kingdom to modernise their operations (Manning, 1996).

While the definition of the term 'smart cities' has been problematized in academic literature (Hollands, 2008; Alawadhi, and Scholl, 2013; Dameri, 2013), in practice, the term is being used widely in policy statements by governmental bodies and developers of technologies as a unified and unifying concept for the future of urban

areas. The usage of the term in practice led to the initial premise of the research to be that smart cities were developing in some form and that policing organisations were engaged in the development. However, it was found that in practice the development of smart cities is amorphous and there to be a lack of a clear SC strategy.

Challenges identified by policymaking participants working in policing and city councils in the United Kingdom and the Netherlands are around the immaturity of the SC projects and the immaturity of the technologies needed to enabled SC development. Additionally, issues around the level of advancement of the data collection process have been raised which impact the degree to which meaningful data analysis can be done. While big data and sensors are being used in policing and city councils, e.g. through the use of the CAT system in the Netherlands, other technologies such as crowd monitors are not being deployed as common practice but are used mostly in experiments. Challenges identified in the United Kingdom concern connecting different IT systems to enable data sharing and the quality and speed of which the data can be made available.

It is obligatory for city councils and the police of both countries to share data, however, participants noted that while data sharing does indeed take place, it is not necessarily being done systematically and that the technology that enables data sharing is still to be developed further. The current approach to information sharing is done in various ways, but often done through human action, showing a disconnect between the vision of the concept of smart cities and current practices. Furthermore, a lack of national coherence in collaboration between police forces and city councils and lack of structural involvement of the police was found when it comes to the development smart cities. Privacy and ethics were highlighted as concerns to utilising the potentials (routinised) data collection and data analysis could bring. These points highlight that technology use and data sharing are impacted by challenges that go further than the technological aspect alone.

Building on the work conducted here, future research will focus on potential small-scale embryonic implementations of smart city developments.

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