# Exploring the smart city mindset in small municipalities – A case study

An embedded single case study of small Norwegian municipalities

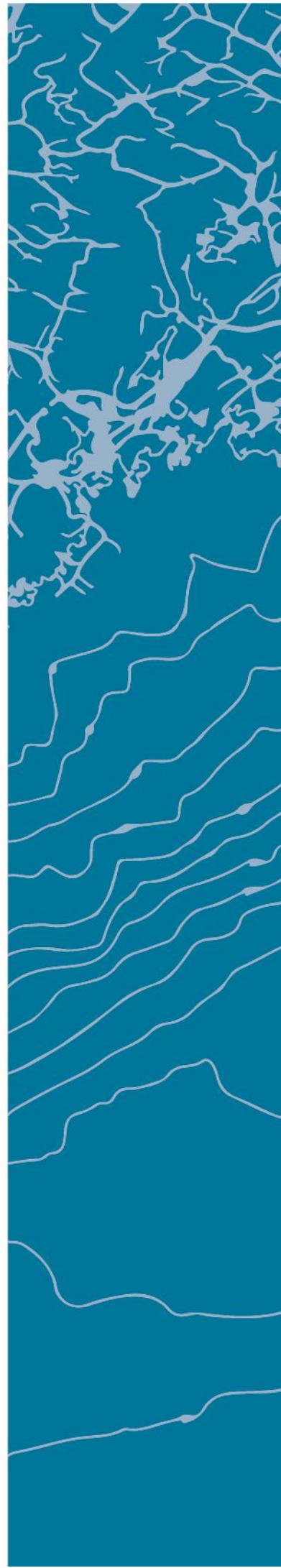Amer Karahasan & Peter Hagane

SUPERVISOR
Øystein Sæbø

**Preface & acknowledgements**

This thesis is the product of a qualitative case study conducted in the months of January through June 2018, and concludes our participation in the Information Systems programme at the University of Agder in Kristiansand, Norway.

The purpose of this thesis is to acquire a deeper understanding of how and to what extent small municipalities can adopt and apply the smart city mindset. By conducting a case study wherein we interviewed a 15 respondents from Norwegian municipalities, we have attained a better understanding of the smart city concept, the inner workings of Norwegian municipalities, and on how to undertake the process of qualitative research and analysis.

We would like to thank our supervisor Øystein Sæbø for his constructive feedback and support over the course of two semesters. We also thank our respondents for their participation – without them, you would not be reading this thesis. We would also like to thank Tom Roar Eikebrokk for helping us come up with the idea for this study.

Kristiansand, 2nd June 2018

Signed,

Peter Hagane and Amer Karahasan

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**Abstract**

The premise of this thesis is that cities and small municipalities are two closely related but different types of entities. However, with regards to making settlements smarter, the smart city has received ample attention, while the small smart municipality has been neglected enough that an investigation into its trials and potential triumphs of the is warranted.

The purpose of this thesis is to acquire a deeper understanding of how and to what extent small municipalities can adopt and apply the smart city mindset. In order to shed some light on the subject matter, we have explored the state of applied ICT and smart city initiatives where they exist in smaller Norwegian municipalities with a population of 15,000 citizens or lower.

Using a six-dimensional smart city model as a basis, we have examined which challenges, smartness interventions, and benefits are present in our selection of Norwegian small municipalities. This study has been conducted as an embedded exploratory single case study, where qualified personnel from smaller Norwegian municipalities have been interviewed on the topic of municipal smartness. In total, 12 interviews with representatives of Norwegian municipalities have been conducted, and one interview has been conducted with the representative of an organisation for intermunicipal collaboration.

After conducting a thematic analysis, we reached a number of conclusions. Our findings indicate that although few municipalities are labelling them self as smart municipalities, they are actively working on introducing ICT and smartness-enabling interventions in new and unorthodox ways. The most significant barriers to becoming smarter appear to be ICT infrastructure deficit, a lack of ICT expertise, and economic limitations – issues that can be ameliorated by combining resources through an intermunicipal cooperation. Those municipalities who engage with the smart city concept are often driven by dedicated personnel, like a project champion or an otherwise committed municipal leadership who are aware of the smart city concept.

# 1. Introduction

When the term *smart city* is used, the bustling metropolitan centre easily comes to mind. Most smart city research – unsurprisingly - concerns itself with applying method and technology to alleviate issues and challenges in the urban setting. The rationale for specifically targeting *cities* is derived from a few key developments in human societies. Of particular relevance for this thesis is the growth of populations, and the concentration of that population growth in urban centres – also known as urbanisation. More smart cities are being developed around the globe by the year, and new smart city initiatives are cropping up everywhere to deal with issues of overpopulation, energy shortages, price instability, human health concerns, and infrastructure usage (Nam & Pardo, 2011). These developments along with the sheer scale of the societal challenges contained within the city ensure that the endeavour to improve urban conditions provides the potential not just to be fruitful, but to pay significant dividends for society as a whole. The relevance this has towards our thesis is the question of whether or not similar challenges exist outside the urban context that can be met by employing the smart city concept, and the extent to which the benefits of typical smart city thinking can be realised in smaller and more rural settings.

The growth of the smart city trend (chapter 2.4) indicates that we are moving towards a future where significant focus will be placed on making cities and societies *smarter* from the lowest to the highest level of detail, whether it be transportation, homes, public services, healthcare or governance. What it means to be smart in the urban context varies by author, but it can generally be defined as becoming *efficient, sustainable, equitable, and liveable*, or as *a collection of smart computing technologies applied to critical infrastructure components and services* (Chourabi, et al., 2012).

Improving the mentioned aspects of the city may enable better ways to run a city by reducing costs, saving energy and generally improving people's quality of life (Neirotti, et al., 2014). Central to enabling these improvements is the use of ICT, with emerging technological trends like big data, open data, and internet of things being suited for dealing with urban challenges in ways that were previously out of bounds (Borgia, 2014; Batty, et al., 2012). When speaking about the various efforts, solutions, and applied technologies that can be present in a smart city or municipality, we will use the term *intervention*, or *smartness intervention* (Neirotti, et al., 2014).

It is not obvious that applied ICT and technological innovation is or should be exclusive to major population centres. Yet, in the wake of the smart city trend and its overwhelming focus on the large-scale urban context, smaller scale settlements are left neglected, and research on the application of technology in smaller municipalities and rural settings remains limited. One study that concerns itself with smaller settlements is an undergoing Czech-Norwegian collaboration (Aall, et al., 2017) where it is pointed out that *"between 20 and 40 % of European countries' population lives in small and rural municipalities, representing a significant component for the EU's landscape and economy."* For Norway specifically, that number is 30,05%, with 1,591,427 out of 5,295,619 citizens living in municipalities below 15,000 (SSB, 2018). The median municipality size is 2959.

This disparity in attention provides us with reason to investigate the state of applied ICT in small Norwegian municipalities, and there is no shortage of unanswered questions that can be addressed for the small municipal context. What potential benefits are there to be had from adopting smart city initiatives and making small municipalities smarter? Would they be facing the same challenges as larger cities? What needs do small municipalities have that could justify investing in becoming smarter? In the end of our introduction we will specify the research questions for this thesis. For our own part, conducting a study on the smart city topic would allow us to familiarise ourselves with this emerging and developing concept even further, while focusing on small municipalities allows us to illuminate an important area with potentially unique issues that is often overlooked.

Norwegian municipalities have relatively good conditions for embarking on smart city initiatives. Tim Turitto, Microsoft's global general manager of government, made the following statement on the subject at the Nordic Edge smart city conference: *"Norway is at the forefront of digital development and has very good prerequisites for creating smart communities. Digital transformation does not happen overnight, but it is important to begin with a foundation that facilitates an organic process..."* (Hansen, 2017)

Nevertheless, Norwegian municipalities are not atypical. While government policy has helped counteract urbanisation, the country is still heavily affected by it. Combined with challenges of infrastructure, a lack of skilled and educated labour, and the issue of an ageing population (Smarte Byer Norge, 2016), the local setting of small municipalities is a suitable candidate for an exploratory case study. By examining what possibilities, the smart city mindset offers small municipalities, we can attempt to identify ways by which these challenges can be met.

Finally, a potentially important aspect of the smart city vision is the involvement of citizens. Although the services provided in smart city initiatives are frequently intended to benefit citizens, citizen engagement in smart city initiatives appears to be limited. The same applies to research on the matter (Thomas, et al., 2015). One British survey from 2016 showed that residents often find the term to be distant and abstract, which may prevent them from being included in the ongoing debate on smart cities. In addition, it was noted that citizens' views on the smart city concept are inherently difficult to parse for a singular smart city vision (Thomas, et al., 2016). This leads us to our research questions.

## 1.1 Research questions

The smart city is a concept that has a wide range of motivational factors, potential application areas, and interventions to actuate within these areas. While cities around the globe are being developed to become smarter (Hollands, 2008), so too are IS researchers grappling with empirical research and theoretical development of technologies, methodologies, and application areas within the smart city context.

Our intention with this thesis is to explore the smart city concept with the niche of small municipalities in mind. This is not to say that research on larger cities and smart city initiatives cannot be useful to smaller municipalities but finding out to what extent smart city interventions are useful or practical to implement in small municipalities can be practical for

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future research. In this context, there are constraints that must be taken into consideration, like smaller and less dense populations, less developed infrastructure, and having potentially limited resources at one's disposal (Aall, et al., 2017). These are issues that can be investigated in an explorative and qualitative manner. As such, for our master thesis, we present the following three research questions:

**RQ1: What challenges do small municipalities face that can be met by applying smart city thinking?**

**RQ2: What smart interventions can be implemented in small municipalities?**

**RQ3: Once set in motion, how are the benefits of such smart interventions evaluated?**

Answering these questions can contribute to understanding the effect of applied ICT in smaller municipalities, and what potential or existing smart city initiatives can concern themselves with in this setting.

Our approach to answering these questions will be an embedded case study in which we intend to conduct interviews with key ICT personnel working in small Norwegian municipalities with populations below 15,000 citizens.

## 1.2 Disposition

The study is written in the traditional way as master-thesis are written. This includes literature review, research perspective, description of the case, description of results from the data collected and at the end there is a discussion and a conclusion. The following chapters consist in this master thesis, besides chapter one.

| Chapter 2 | Significant prior research | Literature review and significant prior research to the smart city topic. Presentation of the literature and background information on the topic, including smart city research, details on the six-dimensional smart city model, defining the smart city and relevant terms, describing the history of smart city research, presentation of a summary on smart city research in relation to our chosen terms, the articles we have chosen and the criteria for why who chose those articles. |
|-----------|---------------------------|------------------------------------------------------------|
| Chapter 3 | Case description | Description about the context the study is conducted in, and a description of what constitutes a small municipality. There is also an orientation for the reader about local factors and conditions that is important for smaller municipalities, and factors such as digital agenda and inter-municipal cooperation that could impact our findings. |
| Chapter 4 | Methodology | Research approach, explanation of the chosen research perspective, research strategy and research design, followed by our approach to data collection, how we analysed our data, and how we ensured methodological rigour. |

| | | |
|---|---|---|
| Chapter 5 | Findings | Presentation of the results from the data collection by four theme groups, wherein themes are categorised. |
| Chapter 6 | Discussion | The results of data collection are discussed based on research question and previous literature. |
| Chapter 7 | Conclusion | The conclusion, answering research questions, weaknesses implication for Norwegian municipalities and recommendation for further research. |

*Table 1, disposition*

# 2. Significant prior research

The goal of this brief literature review is threefold: Firstly, we intend to provide background information on the subject matter of smart cities as an explanation for why we chose the subject matter of this study; small municipalities. Secondly, we intend to highlight the literature that we consider to be most relevant to our research questions. Thirdly, by tying this literature in with our chosen terms *domains and challenges*, *smartness interventions*, and *benefits*, we will provide a suitable basis not just for formulating the method by which we will collect data, but also a general structure throughout this thesis for presenting our findings and data analysis.

| Chapter sections: | Purpose of section |
|---|---|
| Smart city research – domains and dimensions | Explanation of the current state of smart city research and how the theme smart city is explained in the literature. |
| City challenges – ASCIMER | The challenges of the smart city based on ASCIMER'S concept. This is a research project by the Polytechnic University of Madrid (UPM) that shows an approach to development of smart cities in the Mediterranean area, and where they are also showing the main challenges with the smart city concept. |
| Defining the smart city | Details on how the academia and literature defines the smart city concept. |
| The emerging trend of smart city research | Illustrates the emergence of the smart city as a subject of academic research and popular attention. |
| Summary of smart city research | An overview over challenges, smartness interventions, and benefits drawn from smart city literature, combined with ASCIMER's six-dimensional smart city model. (Detailed in chapter 2.2) |
| Existing research on small municipalities | Brief review of what research has been done on small municipalities in relation to the smart city concept. |
| The utility of this literature review | Brief explanation on what we have used the review for. |

*Table 2, overview of chapter 2*

Our approach for sourcing the review material for this chapter mainly includes locating articles in major IS publications. This approach is described in the following sections, which includes setting a few criteria for selecting review material.

### 1.Relevance

The article would have to be relevant for the subject matter. The simplest way to go about the selection phase would be to make extensive use of existing literature reviews regarding the subject. Sourcing a sufficient number of highly cited literature reviews would help create a solid basis for the topic. Note that this does not mean we intend to exclude other articles from the thesis.

### 2.Citations

In our case, we have used number of citations per year as an indication on the quality of an article, and on how accepted it is among peers. In order to reduce age bias, the application *Publish or Perish* was used to perform google scholar queries and sort the articles by yearly number of citations. When it came to the selection process, the keywords and criteria used for finding articles were the following:

| Any of the words: | Smart City Cities Issues Issue Challenges Challenge Problems Problem Solutions Solution |
|---|---|
| All of the words: | Smart City |
| Years: | 2007-2017 |

This would help us find relevant articles and help us to better understand the topic we were going to investigate. An enumerated summary of our chosen articles can be found in attachment the attachment *overview of articles used for literature review*. Note that not all of these articles have been explicitly cited in this thesis.

## 2.1   Smart city research – domains and dimensions

A recurring and often self-referential theme in smart city literature is the lack of consensus on how to define the smart city. It is a shared sentiment among IS scholars that the concept is fuzzy, with definitions varying greatly depending on the author and their focus (Angelidou, 2017), and that the topic is still being conceptualised (Chourabi, et al., 2012). This betrays a level of complexity that ensures the concept does not lend itself to any complete singular definition, which in turn produces a spectrum of different, but overlapping smart city definitions.

The source of this fuzziness is the sheer width and depth of the subject matter. The focus of scholars and professionals can be how to best to apply information technology and IS methodology to enable social sustainability, environmental sustainability, business development, public service improvement, creating urban communities with "smart citizens", or a myriad of other goals with associated benefits.

The angle from which the smart city is analysed can vary greatly. Literature on the smart city topic includes several frameworks that deal with the conceptual classification of the smart city. In order to account for the wide range of efforts and applied technologies utilised in the smart city context, urban domains and the smart city efforts meant to be employed in them are referred to by different names. Some authors focus on *factors of smart city initiatives* (Chourabi, et al., 2012), *application domains*, *contextual factors,* and *smartness interventions* (Neirotti, et al., 2014), or different presentations of *smart city dimensions* (Nam & Pardo, 2011). These terms can again be predicated by their authors on different levels of abstraction. Some choose to look at the 'low-level' minutiae of wireless sensor deployment (Zanella, et al., 2014), some try to make 'high-level' sense of the concept in its entirety by extensively reviewing smart city literature (Nam & Pardo, 2011), and some look to measure the *maturity* of smart cities (Scottish City Alliance, 2014).

It is also frequently noted by authors that the nontechnological aspects of the smart city are neglected in favour of applied information technology and infrastructure development (Hollands, 2008; Neirotti, et al., 2014; Nam & Pardo, 2011). Hollands argues that the implementation of smart city services ends up benefiting of the "creative class", while being of little service to the "service class". Fervour and a loss of perspective can lead to a chase for the high-tech ideal with inadequate consideration being given to who the technology is being implemented for, and for what purpose.

In other words, when it comes models of conceptualisation and categorisation upon which to construct our thesis on, we are spoilt for choice. One frequently-occurring format (Batty, et al., 2012; Perera, et al., 2014; ASCIMER, 2015) is the six-dimensional smart city model – or some variation thereof. Due to the ubiquity of the six-dimensional format we will use the *city challenge* model by the research program *Assessing Smart City Initiatives for the Mediterranean Region* (ASCIMER) as a basis for the presentation of our literature findings, the formulation of our chosen method of inquiry for data collection, the presentation of our research findings, and the succeeding discussion as it relates to our research questions.

The reason for opting for the six-dimensional smart city model is, as mentioned, its prevalence in the literature and in smart city discourse. We argue that it presents a commonly-accepted way to delineate the concerns of a city and the ways in which these concerns can be addressed by applying various interventions and solutions. By transferring these dimensions from the city to the small municipality, we are able to explore the concerns and potential smart interventions for small municipalities, but in relation to an established smart city format.

## 2.2  City challenges – ASCIMER

There exists a myriad of explanatory models and definitions of the smart city concept (Batty, et al., 2012; Perera, et al., 2014; Khatoun & Zeadally, 2016; Quadrant Knowledge Solutions, n.d.; Jadoul, 2014). Common to these models is that they typically include the same component categories and dimensions that are described in the *city challenges* model. Some variance occurs, but the principal difference between many smart city models lie in what level of abstraction they display, how they choose to subcategorise smart city components, and what slant their focus area causes.

ASCIMER is a research project conducted by the Polytechnic University of Madrid (UPM) which concerns itself with offering a multidisciplinary vision of cities that allows an integrated approach to the development of smart cities (ASCIMER, 2015). The project has produced a conceptual model for the smart city that revolves around six defined dimensions of the smart city, and the city challenges associated with them.

We consider these smart city challenges to cover the most important general dimensions of the smart city issue. It is important to keep in mind that these are *city challenges*; they are categories of common issues that can be addressed using technological or otherwise *smart* solutions. Some researchers choose other categorisation paradigms, such as the smart city factors defined by Chourabi et al (2012) – or the dimensions defined by Albino et al (2015). However, most of them concern themselves with the six mentioned dimensions – sometimes with a focus on solutions rather than challenges.

Chourabi et al (2012) notes that technology may be considered a meta-factor in smart city initiatives, since it heavily influences and enables all other aspects of the smart city. As such, the *tools* of applied infrastructure -- the technological and methodological solutions for these problems -- are not present in this table.

| Dimensions | Subcategories |
|---|---|
| Environment | Climate change effects, scarcity of resources, water scarcity, rapid growth, pollution, urban sprawl, climate change effects, energy saving, environmental issues, urban ecosystems under pressure |
| Mobility | Pollution, lack of public transport, high infrastructure deficit, sustainable mobility, inclusive mobility, non-car mobility, multimodal public transport system, traffic congestion |
| Economy | High infrastructure deficit, limited urban based industries, economical weakness, unbalanced geographical development, ICT infrastructures deficit, economic decline, sustainable local economies, mono-sector economies, shrinking cities |
| Governance | Shortage in access to tech, low urban institutional capabilities, instability in governance, urban youth problems, gap between govt and governed, territorial cohesion, flexible governance, formal/informal government |
| People | Urban poverty and inequality, low educational level, threats to cultural identity, unemployment, innovation, social cohesion, ageing population, cyber security |
| Living | Urban violence and insecurity, health problems, safety and security, emergency management, affordable housing |

*Table 3, summary of ASCIMER's city challenge model*

## 2.3 Defining the *smart city*

As mentioned, smart city literature frequently points out the overabundance of definitions on how to define a smart city. On this conundrum, Townsend makes the following remark:

*People often ask me, "What is a smart city?" It's a hard question to answer. "Smart" is a problematic word that has come to mean a million things. Soon, it may take its place alongside the handful of international cognates – vaguely evocative terms like "sustainability", and "globalisation" -- that no one bothers to translate because there's no consensus about what they actually mean. When people talk about smart cities, they often cast a wide net that pulls in every new public service innovation from bike sharing to pop-up parks.*
(Townsend, 2013)

Despite this lack of consensus, we find it prudent to utilise one definition of the smart city for this thesis in order to minimise ambiguity. We then have a choice between either deferring to one of many existing definitions or adding our own definition to the growing pool. Before making this decision, we should go provide some viable, existing alternatives, and illustrate the issue with settling for any one of them.

Before presenting a selection of definitions that have made an appearance in the literature, (Chourabi, et al., 2012) that the smart city concept is still emerging, and that the work of defining it is an unfinished task. They continue: *"Although there is an increase in frequency of use of the phrase "smart city", there is still not a clear and consistent understanding of the concept among practitioners and academia.".*

Chourabi et al continues to describe the smart city: *"The new intelligence of cities, then, resides in the increasingly effective combination of digital telecommunication networks (the nerves), ubiquitously embedded intelligence (the brains), sensors and tags (the sensory organs), and software (the knowledge and cognitive competence)."*

On the subject matter, Kitchin (2014) makes the following remark:

> *'Smart cities' is a term that has gained traction in academia, business and government to describe cities that, on the one hand, are increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people.*

Due to the complexity and scale of the topic, it is unlikely that we will see a single commonly accepted definition of the smart city any time soon. Two compounding factors for this are the multidisciplinary and multi-stakeholder nature of the concept. Results from a study by Thomas et al (2016) indicate that citizens have complex and high expectations of what the smart city should provide, with respondents envisioning a technologically enabled city that provides personalised services, and simultaneously requiring that their privacy is respected and *"sense of community enhanced"*. It is noted that "*Such multi-faceted views reinforce the notion that cities and their inhabitants negotiate a vastly complex reality that likely cannot be simplified to one experience, let alone one vision of a 'smart' city."*

In smart city discourse, a focus on the application of technology also tends eclipse other concerns: "*…the large-scale visions for smart cities expressed in academic papers, marketing*

*materials, and government publications tend to simplify this context by placing technologies at the heart of the smart city, with a particular emphasis on efficiency over other outcomes."* (Thomas, et al., 2016) In smart city discourse, a focus on the application of technology also tends eclipse other concerns and contributes to presenting a simplified smart city concept: *"…the large-scale visions for smart cities expressed in academic papers, marketing materials, and government publications tend to simplify this context by placing technologies at the heart of the smart city, with a particular emphasis on efficiency over other outcomes."*

Being able to effectively perform tasks and improve performance is noted in the literature as relevant for the smart city: *"The Natural* Resources *Defense Council defines smarter in the urban context as more efficient, sustainable, equitable, and livable."* (Chourabi, et al., 2012), while Nam & Pardo (2011) says that *"A smart city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively"*

For our purposes, the key term *smart* is of primary importance. If left untouched, it could introduce some unnecessary fuzziness into to the thesis. Nam & Pardo (2011) views the term *smart* from a few different perspectives: Marketing language views the term from a user perspective, where smart refers to *user-friendliness* rather than *intelligence*, which is more related to high cognitive performance. In urban planning, being *smart* refers to "achieving policy success" with regards to sustainable development, economic growth, and quality of life. Finally, *smart technology* is said to imply the presence of automatic computation principles, like self-configuration and self-optimisation through interconnected devices, sensors, and actuators.

Many terms used in relation to the smart city concept appears to fully or partly describe the same phenomena or concepts. These concepts usually concern themselves with relevant ICT solutions, and the domain in which ICT is applied. With ICT in the eye of the storm, facilitators are used like internet of things, communication infrastructure, or big data analysis (Zanella, et al., 2014)to enable services or operations such as feedback on local air quality, mobile application for tourists (Kitchin, 2014)or surveillance – amongst many others. These concepts are rarely exclusively technological in nature; (Albino, et al., 2015) remarks that the smart city concept is no longer limited to the diffusion of ICT, but also looks at people and community needs. These smart city measures serve to solve urban problems ranging from city logistics, to healthcare, to digital education – to name a few.

Another term featured in the literature that benefits from some elaboration is the "alignment" of stakeholders (Angelidou, 2017). In the context of the smart city, it refers to achieving a level of coordinated interaction between various actors involved in the smart city concept, whether they are business owners, politicians, urban planners, maintenance workers, or citizens. For this study, the term "alignment" refers particularly to the interaction between the smart city leadership, and the citizens whose interests they are trying to fulfil. Breuer et al (2014) for example, notes that the smart city should "*involve or engage citizens in innovative experiences with the goal of increasing their quality of life in meaningful ways.*"

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It is also said that municipalities should try to adopt tools and strategies for enabling sustainable engagement of stakeholder in governance and strategic planning*: "It is important to combine formal and informal platforms for collaboration and support information exchange and collaboration between organizations and informal groups in the city."* - (Aall, et al., 2017)

In order to make sense of these concepts, we find it prudent to elaborate on which terms we have chosen to operate with, and why they are appropriate for our use. This will be summarised in Table 4 below and explained further.

| Chosen terms | Synonyms | Meaning |
|---|---|---|
| Domain (Zanella, et al., 2014) Challenge (Monzon, 2015) | Application domain, subdomain, challenge, problem area, issue, dimension | An urban area or constituent phenomenon in which an improvement can be made and/or ICT can be applied. |
| Smartness intervention (Neirotti, et al., 2014) | Efforts, measures, services, solutions, applied technology | Various measures, solutions, and applied technologies that can mitigate or solve challenges. |
| Benefit | Return, yield, value, result, effect | The usefulness of a smart city investment or applied ICT. |

*Table 4, summary of chosen terms*

### "Challenge":
Commonly used terms for an area or constituent phenomenon or challenge in which an improvement can be made. Kitchin (2014) describes urban domains such as work, travel, and consumption. Zanella et al (2014) mentions, among others, the domain of waste management. Neirotti et al (2014) lists the application domains of *natural resources and energy, transport and mobility, buildings, living, government*, and *economy and people*.

Similarly, the aforementioned ASCIMER model of smart city dimensions contains various *city challenges*. The granularity of this term varies; the highest level of abstraction being represented by – for example - the application domains of Neirotti et al (2014), or the challenge dimensions of ASCIMER. For this study, we will make use of the terms *domain* and *challenge*. *Domain*, as it is analogous to the *dimensions* of ASCIMER, and *challenge*, as the term helps us both formulate and answer research question 1 (**RQ1**).

### "Smartness intervention"
As detailed in section 2.2, there are numerous ways to describe the various efforts, solutions, and applied technologies that can be present in a smart city or municipality. We find *Smartness intervention* (Neirotti, et al., 2014) to be appropriate for our purpose: It describes something smart that can be done or implemented in a city or municipal setting to handle the previously mentioned challenges, and it is a term that has use precedence in IS literature. This relates to research question 2 (**RQ2**), for which an inquiry must be made into which smartness interventions can be and are present in a small municipality.

**"Benefit"**

The terms *benefit* and *value* have significant precedent use in IS research where the goal is to assess the usefulness, effect, or return of ICT investments. This is particularly relevant for IS topics such as change management and e-governance (Hellang & Flak, 2012; Hellang, et al., 2012). This term relates to research question 3 (**RQ3**). Naming the various benefits of introducing smartness interventions into a small municipality will allow us to either observe how knowledge of these benefits was acquired, or if not explicitly written, infer it based on our own knowledge of information technology and information systems research.

## 2.4  The emerging trend of smart city research

For the last two decades, the smart city concept has emerged in parallel with the development of communications infrastructure and the continued maturation of applied ICT as a way to address the growing challenges of urbanism. This growth was predicted as far back as 1997, where the World Forum on Smart Cities suggested that around 50,000 cities and towns would develop smart city initiatives in the coming decade (Hollands, 2008). Furthermore, Neirotti et al (2014) makes the following comment:

> *"...a debate has emerged on the way new technology-based solutions, as well as new approaches to urban planning and living, can assure future viability and prosperity in metropolitan areas. In this discussion, the concept of Smart Cities (SCs) has been the subject of increasing attention and it now appears as a new paradigm of intelligent urban development and sustainable socio-economic growth, whose origin can be traced back to the Smart Growth Movement of the late 1990s."*

Kitchin (2014) states the following:

> *"For the past two decades, urban analysts and theorists have been charting the evolution of cities during an era where information and communication technologies(ICTs) have been exerting a growing and pervasive influence on the nature, structure and enactment of urban infrastructure, management, economic activity and everyday life".*

In order to further illustrate these points, we have gathered two sets of data that indicate the growth of the smart city as a research topic, and its presence in the public consciousness.

**Figure 1** displays the following data: 500 smart city academic articles were sampled from the period of 1998 to 2018. The data was collected using the citation management tool *Publish or Perish*, and only *Google Scholar* was queried. The graph shows that the occurrence of smart city research articles significantly increased from 2008 and onwards but has plateaued in the last two years.
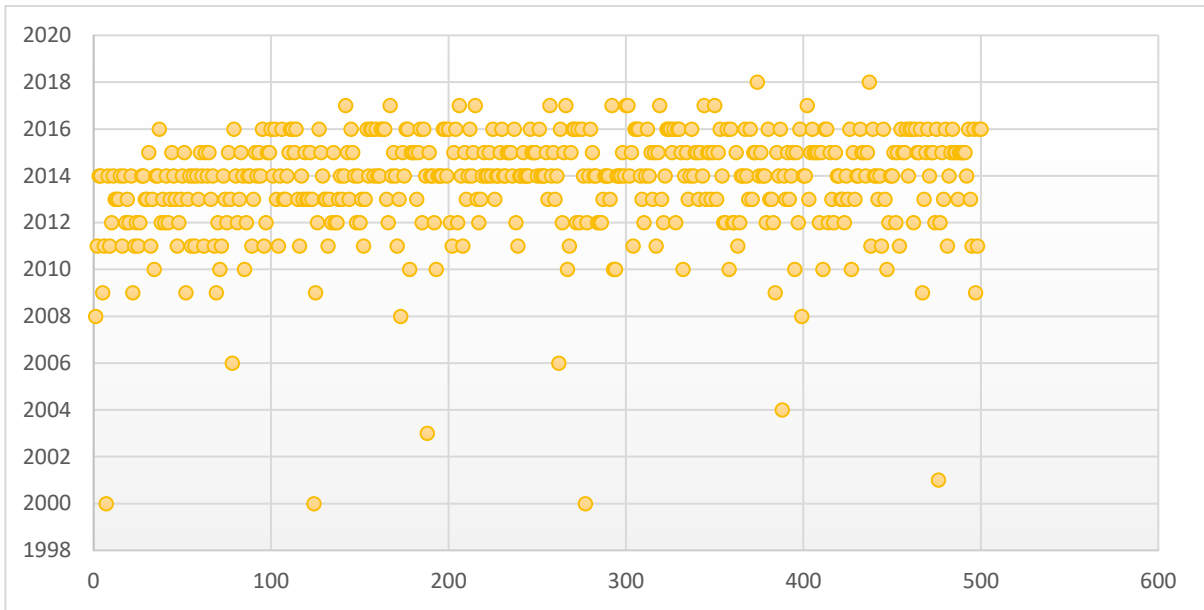
*Figure 1, Occurrences of smart city literature since 1998  (Source: Google Scholar, n = 500)*

**Figure 2** displays the following data: Taken from Google Trends, we can observe an indication on how much public attention towards the topic has increased since 2004. Queries through Google's search engine grew significantly in the years 2014 to mid-2015, and search traffic on the smart city topic peaked specifically in the summer of 2015.
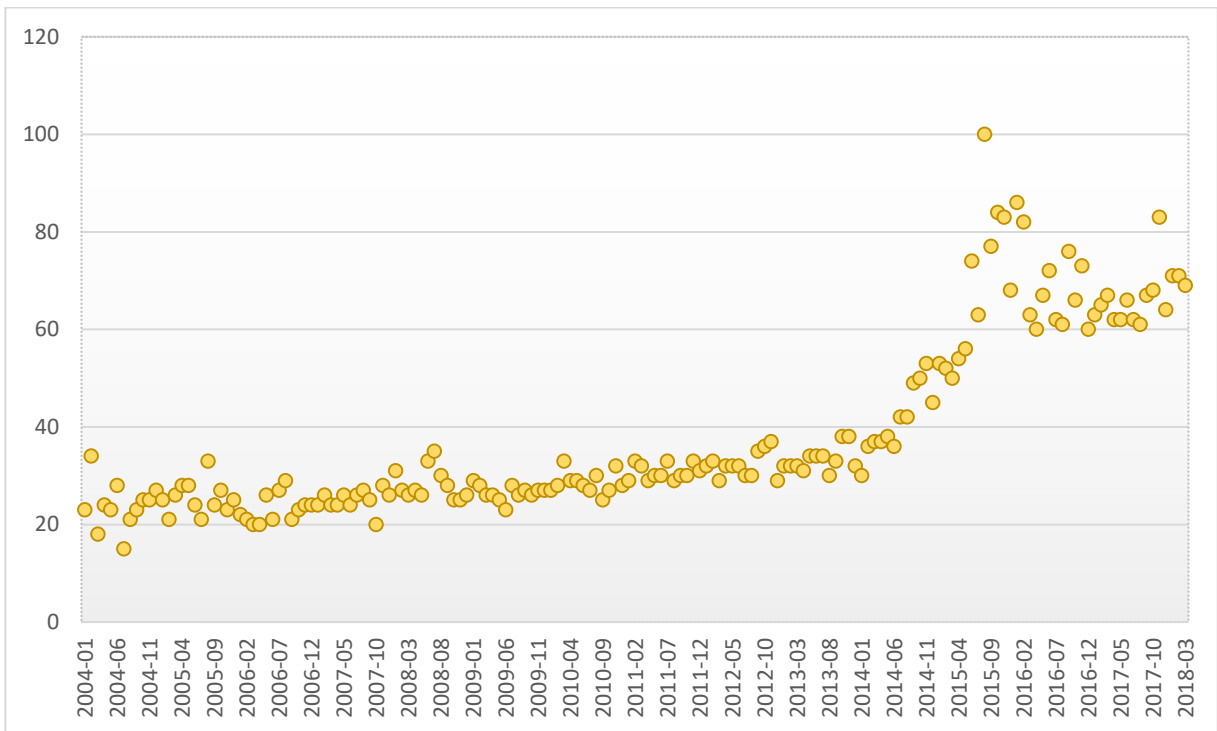


*Figure 2, prevalence of "Smart City" as a search term since 2004 (Source: Google Trends, 100 = peak)*

These statistics show us that while the smart city hype might be cooling down, both public and academic interest in the topic is still present. We suspect that this is due to the scale and width of the concept, the maturation of the concept, and its potential for addressing the ever-

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growing challenges of urbanisation. As the smart city concept matures, we find it prudent to explore the possibilities produced by this field of research that can be extended to areas of human settlement that aren't traditionally considered in smart city research. This can contribute to bringing potentially cost-saving, service-enhancing, and environmentally beneficial smartness interventions to settlements that constitute a significant minority of the population.

## 2.5  Summary of smart city research in relation to our chosen terms

The literature basis for this review – aside from being drawn from the aforementioned city challenges - is drawn from a selection of prolific smart city articles published in the last ten years that concern themselves with Smart Cities, with the addition of the ASCIMER project's city challenge framework – represented by Monzon (2015).

In the following tables 5, 6 and 7, we will display the city challenges of six smart city domains (Monzon, 2015). Together with these challenges, we will tap into smart city literature to display smartness interventions that can be used to deal with these challenges, and some of the stated benefits of implementing these interventions. These summaries will serve as a basis for comparing the challenges, interventions, and benefits of the smart city and the smart municipality in our data analysis. This data analysis is detailed further in chapter 4.

**Format example**

The format for presenting the domains, challenges, smartness interventions, and benefits is illustrated below, with the example challenge *health problems.* Behind each citation is a number that refers to the corresponding article in the attachment *Table 19, overview of articles used for* literature review. The format below is just an example of how we will fill out the tables in next section.

| i | Scope of action (RQ1, RQ2) | | Benefits (RQ3) |
|---|---|---|---|
| ii | Domains and challenges | Smartness interventions | Benefits |
| iii | Pollution | Waste management | *Waste management processes help to save money that can be used to address other challenges that SC need to deal with [11]* |

| i | Relation to research questions RQ1, 2, 3. |
|---|---|
| ii | Chosen term categories |
| iii | Literature findings, with source reference |

The challenge domains are colour coded according to the dimensions of ASCIMER:

| Environment | Mobility | Economy | Governance | People | Living |
|---|---|---|---|---|---|

| Scope of action (RQ1, RQ2) | | Benefits (RQ3) |
|---|---|---|
| Domains and challenges (Monzon, 2015) | Smartness interventions (Zanella, et al., 2014) | Benefits |
| Scarcity of resources, Climate change effects, Water scarcity, Energy saving, Holistic approach to environmental issues, Rapid growth, Urban ecosystems under pressure, Pollution | Smart grids | *"Efficient delivery of sustainable, economic, and secure electricity supplies" [2]*<br><br>*From the experience of several industrial trials on smart grid with communication infrastructures, we expect that the traditional carbon fuel based power plants can cooperate with emerging distributed renewable energy such as wind, solar, etc, to reduce the carbon [5]*<br><br>*A smart grid is expected to be a modernization of the legacy electricity network. [5]*<br><br>*The smart grid is defined as an intelligent electrical distribution system that delivers energy flows from producers to consumers in a bidirectional way. [13]* |
| | Public lighting | *while providing a simple but accurate mechanism to check the correct operation of the public lighting system by measuring the light [2]*<br><br>*aim of reducing costs and increasing reliability and transparency of energy supply systems Managing public lighting and natural resources.[5]* |
| | Green/renewable energies | *Green/renewable energies Waste management Water management Food and agriculture [5]*<br><br>Energy management will also be optimized by using a smart grid for monitoring and modify consumes in town and buildings through actuators and by using renewable energies for the production [13] |
| | Waste management | *A shared waste management vehicle fleet was recommended as a particularly good policy intervention [20]*<br><br>*waste management processes help to save money that can be used to address other challenges that SC need to deal with [11]* |
| | Water management | *water management and agriculture), and where there are few best practices to finance their investments through public/private partnerships. [5]* |
| Pollution, Lack of public transport, High infrastructure deficit, Sustainable mobility, Inclusive mobility, Non-car mobility, Multimodal public transport system, Traffic congestion | City logistics | *City logistics Info-mobility People mobility*<br><br>*Buildings [5]* |
| | Info-mobility | *City logistics Info-mobility People mobility [5]* |
| | People mobility | *City logistics Info-mobility People mobility [5]* |

*Table 5, overview of challenges, smartness interventions, and their benefits within the dimensions Evironment and Mobility*

| Scope of action (RQ1, RQ2) | | Benefits (RQ3) |
|---|---|---|
| Domains and challenges (Monzon, 2015) | Smartness interventions (Zanella, et al., 2014) | Benefits |
| High infrastructure deficit, Limited urban based industries, Economic weakness, Unbalanced geographical development, ICT infrastructures deficit, Economic decline, Sustainable local economies, Mono-sector economies, Shrinking cities, Waste Management, | Innovation and entrepreneurship | *From this perspective, a smart city is one whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people. [3]*<br><br>*Their operational definition of a smart economy includes factors all around economic competitiveness as innovation, entrepreneurship, trademarks, productivity and flexibility of the labour market as well as the integration in the national and global market. [4] Approaches towards education and leadership in a smart city should offer environments for an entrepreneurship accessible to all citizens. [8]*<br><br>*Economical entrepreneurship and entry barriers It will open up opportunities for thousands of new businesses. [11]* |
| | Food and agriculture | *Further, smart agriculture makes indirect impact on sustainability towards the smart cities. [11]*<br><br>*Agriculture is an importation part of SC as it contributes to the food supply chain that facilitates a large number of communities concentrated into cities. [11]* |
| | Waste management | |
| Shortage in access to tech, Low urban institutional capabilities, Instability in governance, Urban youth problems, Gap between govt and governed, Territorial cohesion, Flexible governance, Formal/informal government, | E-government | *Finally, cities in countries with a lower degree of transparency in public administration processes are more likely to sustain e-government initiatives, which shows that SC trends are exploited in some domains to invert their structural attitude [5]*<br><br>*the Smart City Hall where mobile e-government services are delivered. [18]* |
| | E-democracy | *Components of a smart city smart economy smart people smart governance smart mobility smart environment smart living Related aspect of urban life Industry education e-democracy….. [8]* |
| | Procurement | *using innovative procurement policies to align technology development and societal challenges; and establishing open innovation models to create sustainable cooperation. [18]* |
| | Transparency | *ween suppliers and consumers using two-way digital technologies. It controls intelligent appliances at consumers' home or building to save energy, reduce cost and increase reliability, efficiency and transparency [6]*<br><br>*ICT will be central but so will issues of responsibility, openness, transparency, access to public data and the regulations that extra national government agencies may impose on what and how and where and why citizens are able to influence the governance of their cities [10]* |
| | Facility management | *Similarly, Smart Santander focuses on creating an experimental facility for a smart city in order to research and test architectures, key enabling technologies, services and applications [13]* |
| | Building services | *An urban IoT, indeed, may bring a number of benefits in the management and optimization of traditional public services, such as transport and parking, lighting, surveillance and maintenance of public areas, preservation of cultural heritage, garbage collection, salubrity of hospitals, and school [2]*<br><br>*The use of Smart Computing technologies to make the critical infrastructure components and services of a city which include city administration, education, healthcare, public safety, real estate, transportation, and utilities more intelligent, interconnected, and efficient" [4]*<br><br>*The perception of technology in smart city initiatives stresses integration of systems, infrastructures and services mediated through enabling technologies. Technological innovation is a means to smart city, not an ends. [9]* |

*Table 6, overview of challenges, smartness interventions, and their benefits within the dimensions Economy and Governance*

| Scope of action (RQ1, RQ2) | | Value (RQ3) |
|---|---|---|
| Domains and challenges (Monzon, 2015) | Smartness interventions (Zanella, et al., 2014) | Benefits |
| Urban poverty and inequality, Low educational level, Threats to cultural identity, Unemployment, Innovation, Social cohesion, Ageing population, Cyber security, | Cultural heritage management | *benefits in the management and optimization of traditional public services, such as transport and parking, lighting, surveillance and maintenance of public areas, preservation of cultural heritage, garbage collection, salubrity of hospitals, and school. [2]*<br><br>*In the case of culture, public involvement could be aimed at improving the exploitation and attractiveness of a city's cultural heritage [5]* |
| | Digital Education | *a smart city is a centre of higher education, better-educated individuals, and skilled workforces. [8]*<br><br>*Key dimensions of a smart city; IT education [8]* |
| Threats to cultural identity, Health problems, Cyber security, Safety and security, Urban violence and insecurity, Emergency management, Slum proliferation, Affordable housing, Urban sprawl, | Entertainment | *These include automatic doors, lighting and heating systems, security alarms, wifi router boxes, entertainment gadgets, television recorders, and so on. [3]*<br><br>*Additionally, future services will include the possibility to book charging slots in advance and to enjoy entertainment services integrated into e-stations.[13]* |
| | Hospitality | *Housing quality Living Entertainment Hospitality Pollution control Public safety Healthcare Welfare and social inclusion Culture Public spaces management Government E-government E-democracy Procurement Transparency [5]* |
| | Pollution control | *It includes pollution control Optimising logistics and transportation in urban areas by taking into account traffic conditions and energy consumption .[5]*<br><br>*Wireless identifiable devices are used in different areas to increase safety and security. Some of these are: Environment surveillance: earth quakes, tsunami, forest fires, floods, pollution (water and air). [15]* |
| | Public safety | *Public safety and environmental monitoring Local and national governments aim at creating secure society, by guaranteeing public safety and by planning emergency management accurately. [13]* |
| | Healthcare | *This paradigm indeed finds application in many different domains, such as home automation, industrial automation, medical aids, mobile healthcare, elderly assistance, intelligent energy management and smart grids, automotive, traffic management, and many others [2]* |
| | Welfare and social inclusion | *``soft'' urban living domains wherein ICT plays a more limited role in enabling sustainability and handling ``transactions'', which is thus related to welfare and social inclusion policies [5]* |
| | Culture | *In the case of culture, public involvement could be aimed at improving the exploitation and attractiveness of a city's cultural heritage. [5]* |
| | Public spaces management | *Smart grids should be self-healing and resilient to system anomalies Illumination of public spaces with street lamps that offer different functions, such as air pollution control and WiFi connectivity [5]* |
| | Housing quality | Housing & Housing Quality Housing and housing quality described as an important factor for smart city houses [5][9][10] Juj |

*Table 7, overview of challenges, smartness interventions, and their benefits within the dimensions People and Living*

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## 2.6 Existing research on small municipalities

The context and application area of smart city research is, as the name of the concept implies, cities. The motivation for such research is somewhat self-evident; large cities, densely populated urban areas often have both the need and potential to optimise the use of resources, energy, and time, and to improve education, health, living, environment and economic development. Furthermore, the city is an arena in which information technology can be applied in a multitude of ways to help face the previously mentioned city challenges.

However, in favour of this large-scale society-improving concept, it appears that small settlements are often overlooked as research subjects in smart city literature. This may not be entirely surprising, considering the potential for improvement in constantly growing large cities (Chourabi, et al., 2012). Nevertheless, having been offered meagre attention by IS researchers in comparison to its larger cousin, the small municipality remains an area that deserves exploration.

While limited research has been made on the topic, one such study is an undergoing Czech-Norwegian collaboration (Aall, et al., 2017) where rural cities with a population between 1000-15,000 are studied in order to map the state of smart solutions, observe best practices, and present recommendations for the public sector. Challenge classifications were both technological, such as electromobility and e-health - and related to governance, including the management of human resources and stakeholder engagement. The population range of 1000-15,000 citizens as "small cities" has been applied by several Nordic research institutes and universities, e.g. SINTEF, WNRI, Linköping University, VTT and Helsinki University. It is pointed out by Aall et al that *"between 20 and 40 % of European countries' population lives in small and rural municipalities, representing a significant component for the EU's landscape and economy."* Furthermore, it is noted that *"the gap between needs and resources could endanger sustainable development and adoption of new technologies."*

One collection of research articles exists that focuses specifically on the urbanism of the small and medium-sized cities and island communities in the Mediterranean (Stratigea, et al., 2017). It is noted therein that the southern and northern Mediterranean urban regions possess significantly different key characteristics:

| North Mediterranean (EU states) | South Mediterranean (Arab states) |
|---|---|
| **Urban and industrialized societies** | The globe's highest urbanization pace |
| **High to medium income levels** | Low-medium income levels |
| **Low population growth** | High population growth rates |
| **Decreased rural population** | Relatively high population density in rural areas |
| **Intensifying agricultural production** | Dependent on natural resources |

## 2.7 The utility of this literature review

The purpose of this literature review has mainly been to elaborate on two components that shaped how this study was conducted. The first component is the six smart city domains.

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These domains provide a literature background against which we can juxtapose the second component, which is the trio of challenges, smartness interventions, and benefits.

The scaffolding that these two components provide can then be shifted away from the *city*, and onto our research subject, the *small municipality*. The transposition of these challenges, interventions, and benefits within six smart city domains gives us a stable platform on which we can explore the smart city mindset in small municipalities.

# 3. Case description

The purpose of this chapter is to provide a brief overview of the context the survey has been conducted in, and to orient the reader on local factors and conditions that might be prudent for us to account for in our data analysis, and for other researchers who might choose to perform similar research on small towns in different settings. To this end, we will cover the following topics:

| Chapter sections: | Purpose of section |
|---|---|
| The "Digital Agenda" ICT program | Description of digital agenda for Norway and Norwegian municipalities, and why this is relevant to our thesis. |
| Guidelines for formal intermunicipal cooperation | Description of intermunicipal cooperation in Norway, and what that cooperation consists of. |
| Greenhouse gas reduction | Brief description of national goal set to reduce GHG emissions by 40%. |
| Key Norwegian rural challenges | Norwegian rural challenges, and how those challenges are relevant to other smart city challenges from the academia and found literature. |
| Economy, geography, and demographics | Other conditions of Norwegian municipalities that can affect our results. |

*Table 8, overview of chapter 3*

## 3.1 The "Digital Agenda" ICT program

*The digital agenda,* detailed in *Parliamentary Whitepaper No. 27* (KMD, 2015) is an overarching national digitalisation plan worked out by the Norwegian parliament. The digitalisation of Norwegian municipalities is considered to be an important step for the further development of the municipalities. It is therefore difficult to avoid the mention the digital agenda for Norway and Norwegian municipalities as this is a potentially significant influence on municipalities to become smarter, more efficient, to reduce costs, and to cope with the future challenges through the use of ICT. It is stated in the whitepaper that:

> *"Digitalisation will play a central role in making cities sustainable and attractive to live in. ICT has gradually become synonymous with the term "smart" because ICT allows us to solve many challenges in new and more efficient ways. The term "smart cities" has been rooted internationally as a collective term for innovative, ICT-based ways to organize small and large parts of life in cities. The purpose of "smart cities" is to renew, simplify and improve cities, both from the citizens, business and public sectors."*

*The digital agenda* incentivises municipalities within Norway to adjust and make sure that they are participating in this trend.

The Norwegian government has set some high ambitions to renew, simplify and improve the public sector while at the same time meeting the expectations businesses and citizens. The use of ICT and the conscious pursuit of the possibilities of digitization would enable them to achieve both. The digitalisation process poses challenges that the sectors cannot solve individually. The Government therefore sees the need to address cross-sectoral issues related to digitalisation as there is an added social value to having an overall and coordinated approach.

From this perspective we can see that digitalisation taking place in Norway has a direct link with the term smart city, and how digitalisation will play a central role in making cities sustainable and attractive to live. As such, it is difficult in our case to separate digitisation from the smart city concept – which makes it prudent to point out that the national digitisation plan might affect the results of our study.

## 3.2  Guidelines for formal intermunicipal cooperation

Since we have chosen to study small municipalities, it is prudent to shed some light on inter-municipal cooperation, and how this benefits smaller municipalities. The Norwegian Association of Local and Regional Authorities (2013) published a set of guidelines regarding formal collaboration between Norwegian municipalities. Usually such collaborations occur between municipalities who are located in the same region. Smaller municipalities have especially taken great advantage of the opportunity to work with other municipalities and benefit from mutual knowledge sharing, ICT, and other initiatives.

The municipalities in Norway have throughout the years collaborated in order to solve specific joint tasks over administrative boundaries. This applies to both formal and informal cooperation. With increasing cooperation between the municipalities, the need for better adapted legislation has also increased. *"In total, there are about 850 formal collaborations in Norway"* (The Norwegian Association of Local and Regional Authorities, 2013, p. 4). It is further stated that:

> *"Through inter-municipal collaboration, smaller municipalities (under 3,000 inhabitants) can achieve more significant savings than larger municipalities (over 6,000) residents… Inter-municipal cooperation appears to have a coordinating function which supports other tasks being taken care of by the parent municipality."*

As will be shown in our analysis, this can prove beneficial for smaller municipalities in practice.

## 3.3  Greenhouse gas reduction

Another factor that can affect the smartness of Norwegian municipalities specifically is a national goal to reduce greenhouse gas emissions by 40% by 2030 (International Energy Agency, 2017). This presents the authorities with a challenge:

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*because both the country's electricity supply and its energy use in buildings are already essentially carbon free. Norway is determined and, with its large oil and gas revenue, well placed to invest in developing new solutions for a low-carbon future.* (International Energy Agency, 2017)

## 3.4 Key Norwegian rural challenges

The setting of our research is not significantly different from the northern Mediterranean rural context mentioned in chapter 2. The following key Norwegian rural challenges are noted by Nordregio (2011):

| Key Norwegian rural challenges |
| --- |
| Centralisation of the settlement pattern (Less attractive nature of 'small places') |
| Narrow economic basis of the small labour market |
| Low growth rate |
| Youth moving out in favour of urbanised areas |

However, Norwegian rural policy sets itself apart from its Nordic neighbours; it is a nonpartisan stipulation that all citizens should have the freedom to settle wherever they choose. This is treated as a value both intrinsic and practical, in that it enables the utilisation of resources from all over the country. National policy also specifically targets local needs in the coordination of sectoral policies. These are: Agriculture, forestry, fishing, transport, ITC, research and innovation, regional higher education, health services, localisation of national institutions, nature, and cultural heritage. As such, it may be the case that small Norwegian municipalities are better equipped than small municipalities in other nations to handle the challenge of becoming smarter.

Centralisation and globalisation are identified as the most important challenges faced by rural and small municipalities. It is noted by (Nordregio, 2011) that they "are seen to be at the root of the growing regional disparities." In specific terms, the ongoing centralisation of the settlement pattern which is seen to be a result of the less attractive nature of 'small places' is addressed.

Looking at the challenges of small municipalities from a smart city perspective, we will be able to compare them to the challenges that are produced by our findings.

## 3.5 Economy, geography, and demographics

Examining difference between the *smart city* and the hypothetical *smart small municipality* is part of our inquiry. For this reason, we will name three conditional factors that we believe to be important when answering our research questions RQ1-3.
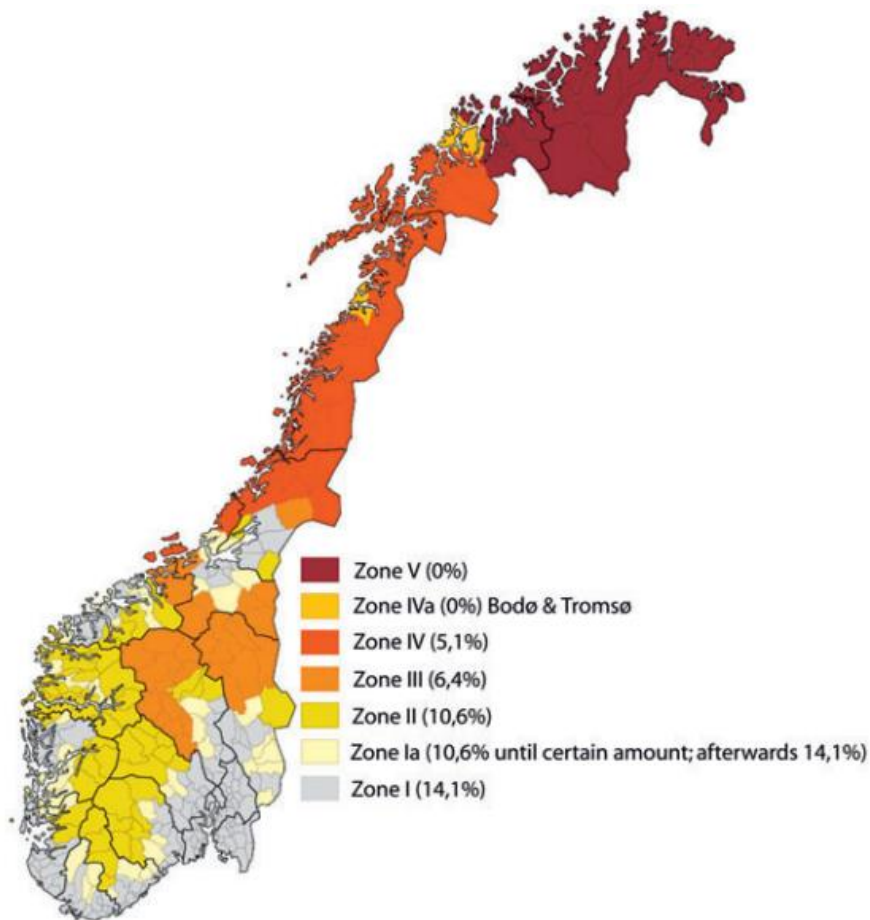
*Figure 3,classification of areas in Norway based on geography, labour market, business, and standard of living.*

These conditions are economy, geography, and demographics. The map in Figure 3,classification of areas in Norway based on geography, labour market, business, and standard of living., courtesy of The Norwegian Ministry of Finance (Nordregio, 2011), shows the differentiated payroll tax where the zones are classified according to the scores on the following four main indicators of economic strength: Geography (accessibility and population density), demography, labour market and business, standards of living.

RURAL REGIONS

- ○ Small rural towns
- ◯ Big rural towns

☐ Urban regions
■ Rural region including big towns
■ Rural region including small towns
■ Rural region without urban centres
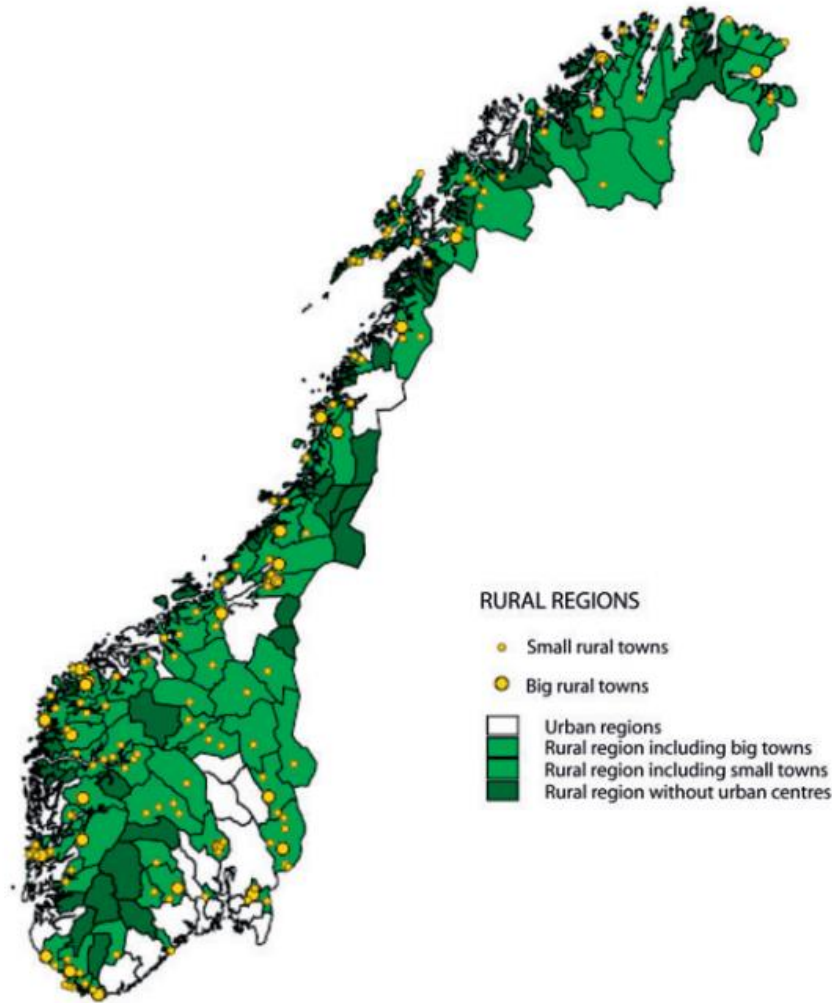
*Figure 4, classification of rural areas and towns*

The map in figure 4 shows how this economic strength compares to rural and small-town status. Judging by these statistics, detrimental conditions tend to converge in small municipalities. These conditions might in turn prove to be a barrier for launching smart city initiatives or implementing smart interventions in these locations.

# 4. Methodology

The purpose of this thesis is to acquire a deeper understanding of how and to what extent small municipalities can adopt and apply the smart city mindset. As mentioned in chapter 2.6, existing research on the topic appears to be limited. As such, we have explored the state of applied ICT and smart city initiatives where they exist in smaller Norwegian municipalities in order to shed some light on the subject matter. In this chapter we will elaborate on the means by which we have done so. We will present our chosen research design and perspective. As a part of this, we will present how we ensure validity, reliability, generalisability, and elaborate on potential weaknesses and ethical concerns. Furthermore, we will explain the approach we have chosen for collecting data, and our method of conducting the subsequent analysis.

Before elaborating on the specifics of research approach, we will take the opportunity to reiterate our research questions:

**RQ1: What challenges do small municipalities face that can be met by applying smart city thinking?**

**RQ2: What smart interventions can be implemented in small municipalities?**

**RQ3: Once set in motion, how are the benefit of such smart interventions evaluated?**

Keeping these research questions in mind, we tasked ourselves with finding an appropriate approach to answering them. This approach is presented in the following sections:

| Chapter sections: | Purpose of section |
|---|---|
| **Research design** | The chosen research design for the thesis and chosen case study. |
| **Research perspective** | Explanation of the research perspective, and what perspective have been chosen. |
| **Data collection** | How the data was collected, and the interviews were done. |
| **Data analysis** | How the data was analysed. |
| **Ensuring methodological rigour** | Reviewing the literature, |

*Table 9, overview of chapter 4*

## 4.1  Research design

The overall design for the study is a case study design borrowed and adapted from (Dubé & Robey, 1999). Our adapted version is pictured below in Figure 5, research design.



*Figure 5, research design*

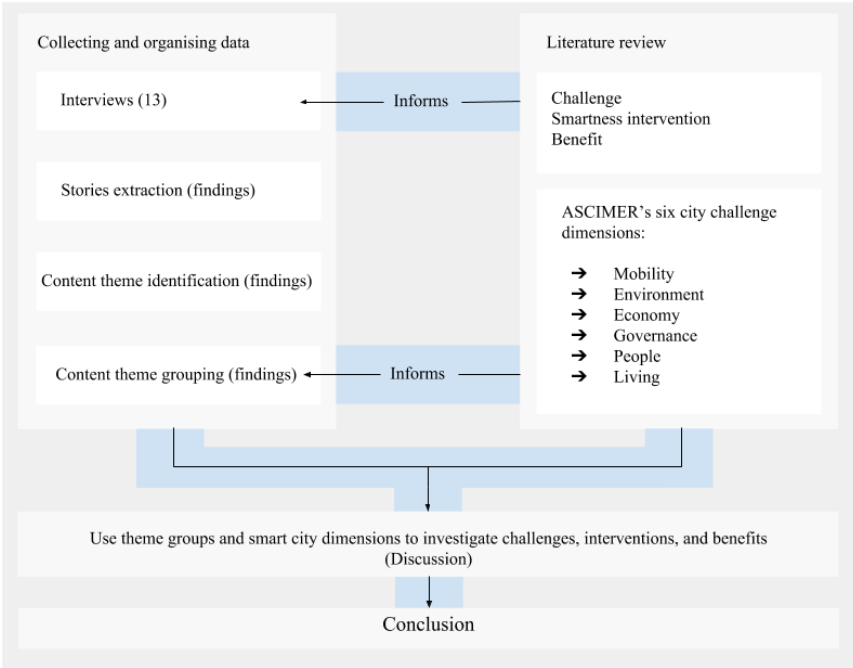To the left, this adaptation represents the contents of the sections that are detailed in this chapter:
- Data collection: Create interview guide, select respondents, conduct interviews, transcribe interviews (extract stories).
- Data analysis: Theme identification, theme grouping, discussion.
- Conclusion

To the right, it represents the two main components of our literature review, as detailed in chapter 2.7. The six smart city domains, juxtaposed with the concepts of challenges, interventions, and benefits helped shape the structure of the interview, and in part chapters 5 and 6.

## Single case study

For this thesis, we elected to conduct a single case study. Choosing the case study approach was a natural choice due to both the under-researched status of our subject matter, and its nature as an IS subject. Indeed, the case study has seen significant use in studying IS phenomena, from system development, to IT management, or the impact of IT on organizations and markets (Paré, 2004). Yin (1994, p. 13) states that the case study is: "A*n empirical inquiry that: investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident».* In our case, the phenomenon is *smart city thinking*, while the real-life context is the *small Norwegian municipality*.

Paré (2004) details five issues of designing a case study. These are,

- The initial definition of **research questions**
- The **a priori specification of constructs or theory**
- The definition of the **unit of analysis**
- The **selection and number of cases**, and
- The **use of a case study protocol**

With regards to **research questions**, Yin (1994) makes the remark that case studies are preferred when "How" or "why" questions are being posed. At first glance, this appears to confound our research questions RQ1 and RQ2, where we made use the *"what"* formulation. However, they are swiftly vindicated:

> *If research questions focus mainly on "what" questions, either of two possibilities arises. First, some types of "what" questions are exploratory, such as this one: "What are the ways of making schools effective?" This type of question is a justifiable rationale for conducting an exploratory study, the goal being to develop pertinent hypotheses and propositions for further inquiry.*
> - Yin (1994, p. 5)

The **a priori specification of constructs and theory** is handled by including a literature review, as we have done in chapter 2. This review also helps form a basis for presenting both findings and discussion in successive chapters, and for formulating an interview guide, as we elaborate on in section 4.3, Data collection.

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When it came to decide on what *type* of case study to conduct, we were more apprehensive. On the surface, our subject matter appears to lend itself more to a multiple case study than a single case study. This is deceptive. In the context of *the small Norwegian municipality* (note the representative singular), we wanted to examine the phenomenon of *smart city thinking in the small Norwegian municipality*, where *individual instances of the small Norwegian municipality* constitute our **unit of analysis**. This qualifies as an embedded single case (Yin, 1994). Compare with Paré's description of a fictitious embedded case study:

> *For example, a case study of a system implementation in an organization might include… a qualitative analysis of the implementation strategy in place, to draw conclusions about the success of the project. In this fictive example, the project would be the "case," and conclusions drawn about it would still reflect a single data point; the users would represent a lesser or embedded unit of analysis.*
> - Paré (2004)

One could go either way by adjusting the unit of analysis, but in order for this to be a multiple case study, we would have to change the above sentence thusly: *In the context of Norway, we wanted to examine the phenomenon of smart city thinking in a selection of small Norwegian municipalities, where the small Norwegian municipality (representative singular) constitutes our unit of analysis.* We have chosen not to take this route as we wanted to sample a broader selection of municipalities. This brings us to our next point.

When **selecting a case**, there are multiple types to choose from (Gerring, 2008). Due to the embedded, single case nature of our study, the most natural option is the *typical case*: *"The typical case study focuses on a case that exemplifies a stable, cross-case relationship. By construction, the typical case may also be considered a representative case, according to the terms of whatever cross-case model is employed"* (Gerring, 2008). If this seems counterintuitive, keep in mind that our single case is *the small Norwegian municipality*. Any single municipality might be atypical, but potentially capturing atypical examples is part of the purpose behind embedding a broad sample of municipalities and might lead to identifying unorthodox or obscure municipal challenges or smart solutions. As such, it is difficult to consider this case subject anything other than typical.

## 4.2  Research perspective
### Qualitative methodology
The case study is an inherently qualitative research approach. Yin (2011, p. 9) states: *"Qualitative research strives to collect, integrate, and present data from a variety of sources of evidence as part of any given study"*. Part of the reason for why we opted for a qualitative research design was the nature of our research topic. With sparse literature on small smart municipalities and a smart city concept still in maturation, collection non-numerical data in the small municipality is necessary for identifying *potential* interactions, contextual similarities, and appropriate subjects for future, qualitative research.

To achieve this in our embedded case study, we collected data by way of interview, with some ancillary information being drawn from relevant municipal websites. Qualitative

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research gives us more answers in depth on the topic we are researching. There are multiple benefits in using a qualitative approach: There are few limitations to your data collection, as you are not locked to certain segments of questions. In our case, the qualitative approach allows us to ask follow-up questions in interviews. This gave us more flexibility, which in turn gave us better insight into more stubborn or less obvious details. This provided the opportunity to gather information that we would perhaps not have been able to access using a quantitative design, as we were able to have detailed and organic interviews rather than fixed survey data.

### Exploratory research

The nature of our thesis subject matter lends itself to exploratory research. Jacobsen (2000, p. 73) states that *"Just as there are many different types of research problems, there are also many different types of design that suit those issues."* There are three main approaches to the case study; exploratory, descriptive and explanatory (Oates, 2006, p. 143). In our research design we have chosen to base our approach for the case evaluation of this study on the principles of exploratory research design. This approach can be used for a topic like ours where information on a topic is sparse and the investigation of a real-life instance is appropriate.

### Positivist or interpretive research?

The exploratory locus of this thesis lends itself to the interpretive perspective. As Oates (2006, p. 292) specifies: "*Interpretive studies… try to identify, explore, and explain how all the factors in a particular social setting are related and interdependent.*"

The assumption of the interpretivist is that the research subjects (and humans in general) have an incomplete and subjective understanding of the world around them, tinted by flawed perception and socially constructed artifacts. Yin states that "*The initial condition derives from the qualitative researcher's desire to capture the meaning of real-world events from the perspective of a study's participants.*" (Yin, 2011, p. 11).

In this sense, our study is very much interpretivist in nature. Our respondents as workers in the small municipal setting are products of their education, work experience, and views on how ICT should and can be used. They have differing views on what a smart city is or should be, and being humans, end up with different interpretations of the same events. Judging by how many definitions exists in the literature of what should be the same smart city concept, it is clear that researchers are no exception. While we cannot hope to prove causal links, but we can investigate these subjective understandings of the smart city and smartness in order to explore relationships between humans and IT and point out *potentially causal* relationships in our delineated case setting.

> "*Interpretive studies generally attempt to understand phenomena through the meanings that people assign to them and interpretive methods of research in IS are 'aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context'*"
> - Walsham (1993, pp. 4-5)

Stake (2005, p. 455), when explaining how knowledge transfer can occur for the case study, makes a point relevant to the interpretivist perspective:

> *"[Case researchers] will, like others, pass along to readers some of their personal meanings of events and relationships--and fail to pass along others. They know that the reader, too, will add and subtract, invent and shape--reconstructing the knowledge in ways that leave it...more likely to be personally useful."*

When dealing with a delineated, 'soft' system of people, technology, and their unknown mutual interactions, it seems inevitable that this phenomenon will occur to some extent, and that our best option beyond being rigorous in our method is to note that the reader beware.

However, this is not the end of the story. Our thesis is not dedicated to proving or disproving a hypothesis or conclusively identifying causal relationships. The case study is less suited for this purpose, and without a thorough analysis of quantitative data, we would not dare to make any such claims. Some authors seem to imply that the positivist perspective is tied to quantitative research, while the interpretivist perspective is tied to qualitative research. This is not the case (Oates, 2006, p. 287). Although the positivist perspective is appropriate for quantitative research, both perspectives can be appropriate for qualitative research. Yin (2011) and Paré (2004), frequently referenced in this chapter, have made significant efforts to elaborate on how case studies, and in particular how positivist case studies can be conducted.

The authors of this thesis have fundamental disagreements with the hard-line interpretivist perspective. For instance, it is said of interpretivism by Oates (2006, p. 292) that *"there is no single version of 'the truth', and that what we take to be 'real' or 'knowledge' is a construction of our minds".* Certainly, we acknowledge that the human understanding of reality can be flawed, but we share the positivist view that the world *does* exist independent of our flawed perspective, and that objective knowledge is attainable given sufficient rigour and replication, and an appropriate scope of research.

## 4.3  Data collection

**The interview as a method for collecting data**
When it comes to collecting data in a case study in qualitative research there are several ways by which this task can be approached. We have chosen to use interview as our source of getting information. As Mason (2002, p. 63) states, *"Interviews are one of the most commonly recognized forms of qualitative research method.".* Our source of evidence was to interview key personnel who were working on such initiatives in small municipalities. Our informant sampling strategy can thereby be described as purposeful (Paré, 2004).

There are both benefits and drawbacks to using interviews for data collection according to Paré (2004):

| Strengths | Weaknesses |
| --- | --- |
| Targeted - focuses directly on case study topic | Bias due to poorly constructed questions<br>Response bias<br>Inaccuracies due to poor recall |

| Insightful - provides perceived causal inferences | Reflexivity - interviewee gives what interviewer wants to hear |
|---|---|

the people we were interviewing could tell us more important information about smart-city initiatives in smaller municipalities, while we also could ask follow-up questions, to some of the answers we were getting from our respondents. We also did a literature study in advance on this topic in order for us to be able to gain more information and knowledge about the topic. This was also very helpful when we would create the interview guide.

### Informant sampling

As Paré (2004) states, there are several informant sampling strategies that can be employed for a case study. Our embedded research design makes the *Purposeful* strategy the most natural description for our approach, as we specifically selected for those ICT-employees, leadership figures, and smart city coordinators who were in the best position to substantively answer our questions:

> *Purposeful: Select information-rich cases strategically and purposefully; selected type and number of cases selected depends on study purpose and resources.* (Paré, 2004)

### Structuring the interview guide

There are different types of qualitative interviews, and we have in our research conducted semi-structured interviews, which is the most widely used interview form (Myers & Newman, 2007). In a semi-structured interview, you do have a set of questions, but the sequence you put them in is flexible. It allows you to ask follow-up questions, and there is room for flexibility to ask other types of questions as the interview starts to flow. Although the semi-structured interview allows for some flexibility, one should still follow a consistent structure. *"The qualitative interview should not be completely unstructured. As a rule, we should work out an interview guide."* (Jacobsen, 2000, p. 133).

Our interview guide was partitioned into four sections; Perception of smartness, challenges, smartness interventions, and benefits. These concepts are detailed in chapter 2.22.3. The first section on perception of smartness was an addition made to ensure that we were able gauge the respondent's awareness and understanding of the smart city concept, and to ensure that the interview would be conducted with a smart city frame of mind. This would help us stay on topic and avoid focusing on tangentially related IS or ICT subjects. The interview guide can be found as an attachment to this thesis.

### Arranging interviews

Qualitative interviews need planning in advance, because such interviews might be very long and complex. One needs to be able to ensure that the interview interaction generates data that is relevant, therefore preparation for such an interview would be essential. Mason (2002, p. 67) notes that *"The qualitative interviewer has to prepare themselves to be able to 'think on their feet' in the interview itself."* In our case, preparation meant doing some research on the candidate prior to the interview.

It is also important not to have an excess of interview objects on hand. According to Jacobsen (2000, p. 158) there should be a maximum limit on twenty respondents. This limit is due to the significant time and effort it takes to transcribe and analyse interviews.

Prior to contacting candidates, we researched their municipalities to get a general idea of the state of their ICT services and infrastructure, to make sure we did not ask redundant or inappropriate questions. We made sure to request contact with personnel who either we, or the candidate municipality considered best suited for answering questions related to the smartness and smart city concept.

We quickly learnt that the response rate over e-mail was limited. After having spent two weeks attempting to establish contact with respondents, we decided to change tactics and contact candidates by phone. After doing so, response rates improved drastically, and most interviews were arranged after a brief conversation.

### Conducting the interviews

Before the interviews commenced, we made sure to go through the following steps: We sent each interview object an e-mail with a document containing the information about the interview, the conduct of the interview and for what purpose it would be used. They would then read through this document, sign it and send it back to us as an agreement for the interview. We informed the respondent that the interview could be conducted in around 30 minutes. Most interviews stayed below the 30-minute mark, while some lasted longer. We informed the respondent that the interview would be recorded, and that all data would be anonymised.

The semi-structured nature of the interview proved useful for us, as the ability to ask follow-up questions allowed us to tap into data that otherwise would have been bypassed. This is especially the case when we came across initial answers that we considered to be highly relevant. In these cases, we would ask respondents to could provide more details, or spur their memories with examples of potential challenges, smartness interventions, and benefits.
Most of our interviews were done through video conference (skype) or phone. Ideally, we would have wanted to meet more respondents face-to-face, but this would have been highly impractical due to the distances between our selected municipalities, which are all located in different corners of the country. Only one interview was conducted in person; municipality M.

In our experience, the best and longest interviews were conducted either in person or by video conference. In one such instance, we were able to keep the conversation flowing after the interview had ended, and we acquired relevant information that we otherwise would not have been able to.

In all, 13 interviews were conducted between 08th February and 26th March 2018.

### Overview of municipalities and respondents

Below is a table of all of the municipalities that we interviewed, the size of the municipality, the role each interview object had in the municipality and also the duration of each interview.

| Municipality / Respondents | Population bracket | Date of interview | Approximate duration | Self-described role of interview object |
|---|---|---|---|---|
| Municipality A | 10,000-15,000 | 08.02.2018 | 35 minutes | Responsible Advisor to the Service Area |
| Municipality B | 1000-5000 | 19.02.2018 | 30 minutes | Responsible for planning and regulation work |
| Municipality C | 1000-5000 | 19.02.2018 | 40 minutes | Councillor in the municipality |
| Municipality D | 1000-5000 | 20.02.2018 | 30 minutes | Head of information department |
| Municipality E | 5000-10,000 | 21.02.2018 | 25 minutes | Information manager |
| Municipality F | Intermunicipal, all three brackets | 23.02.2018 | 25 minutes | Management, organisational development |
| Municipality G | 1000-5000 | 28.02.2018 | 20 minutes | Municipal Director |
| Municipality H | 5000-10,000 | 01.03.2018 | 30 minutes | Head of IT |
| Municipality I | 5000-10,000 | 07.03.2018 | 25 minutes | ICT responsible |
| Municipality J | 5000-10,000 | 08.03.2018 | 20 minutes | Head of IT |
| Municipality K | 1000-5000 | 12.03.2018 | 30 minutes | Mayor |
| Municipality L | 5000-10,000 | 13.03.2018 | 15 minutes | IT Manager |
| Municipality M<br><br>*Interview with three employees within the municipality.* | 10,000-15,000 | 26.03.2018 | 60 minutes | 1. Consultant at the helpdesk and working on digitisation<br>2. Manager of the helpdesk. Working with digitisation strategy and the archives<br>3. IT Manager. working with Digitization and operation, a jack-of-all-trades has several different tasks. |

*Table 10, overview of interviews conducted*

## Description of our respondents

When embarking on this study, we decided to anonymize respondents. The reason for this is twofold: Typical concerns of ethics and privacy apply, but we also suspected that allowing respondents to remain anonymous would make it easier to persuade them to participate. This suspicion was confirmed on several occasions. Informing the participants about the anonymity of the interview made candidates less apprehensive to accept. We consider it likely that the knowledge of this anonymity both relaxed respondents and encouraged them to answer more comprehensively.

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The name of the respondents and their respective municipalities will not be mentioned in this study, and details and characteristics that make it easy to identify a respondent are be censored.

In total, we conducted 13 interviews. 12 of these were with key personnel representing single municipalities, while one interview was with the director of an inter-municipal smart city collaboration. Total number of interview objects was 15, representing 19 different municipalities. *The list below is a more detailed description of the respondents in our study.*

**Respondent A – Municipality A**
Respondent A is advisor to the Service Area within the municipality. The respondent works on multiple projects along with being project champion for various smart city-projects within the municipality. The respondent also participates in planning future development in the municipality he is working for.

**Respondent B – Municipality B**
Respondent B has many different roles, like planning and regulating work in the municipality. This municipality is on the smaller end of our scale, which explains the multiple areas of responsibility for this respondent.

**Respondent C – Municipality C**
Respondent C is the councillor and chief administrative manager in the municipality. The respondent has primary responsibility for the municipal smart city initiative and has several years of leadership experience in different positions from the public sector.

**Respondent D – Municipality D**
Respondent D is the head of Information Department, where old service centres, receptions and ICT departments are being merged with the information department.

**Respondent E – Municipality E**
Respondent E is Information manager in the municipality. The respondent's main task it to help to develop new communication systems within the municipality as well as the users of those systems. She is the head of all digital communication within the municipality.

**Respondent F – Intermunicipal collaboration F**
Respondent F is responsible for the management and organizational development of an inter-municipal collaboration. The respondent has several years of experience from different organizations and also multiple years of experience within politics.

**Respondent G – Municipality G**
Respondent G is municipal manager for economics, health, safety and executive duties, personnel, and technical services.

**Respondent H – Municipality H**
Respondent H is head of the municipal IT department, which is working on a smart city initiative. The respondent is one of the employees responsible for the smart city project within the municipality.

**Respondent I – Municipality I**

**Respondent I** is responsible for the ICT, and ICT related questions. The respondent is a coordinator within the municipality and is also responsible for the administrative work related to ICT.

**Respondent J – Municipality J**
Respondent J is the Head of IT within the municipality, and responsible for everything that has to do with IT and IT projects.

**Respondent K – Municipality K**
Respondent K is mayor of the municipality and is working on how the municipality will co-operate with other municipalise regarding smart initiatives. The municipality is in close dialogue with Microsoft and other stakeholders.

**Respondent L – Municipality L**
Respondent L is IT manager within the municipality and is responsible for the operation and maintenance of the municipality's data solutions. The respondent has a background in computer engineering and leadership.

**Respondents M (1,2,3) – Municipality M**
Respondents for this municipality are named respondent M1, M2, and M3. **Respondent M1** is responsible for multiple IT-related tasks within the municipality, from digitalisation to operations of IT systems as a jack of all trades. The respondent is used to different tasks due to his long experience in this position. **Respondent M2** is head of IT and is working with a digitalisation strategy. **Respondent M3** is working as a consultant and are also working with digitalisation, one of the main tasks for respondent **M3** is to look at what can be automatized within the municipality. All three of these respondents have at least 20 years of work experience within the municipality, which is unique for a smaller municipality.

## 4.4  Data analysis

For our data analysis, we decided to conduct a *thematic analysis*. One good reason for opting for a thematic analysis over other, more complex general analyses like grounded theory is its nature as a method of qualitative research that is applicable to many research designs – including the case study. A second reason is that it is also said to be less demanding of inexperienced researchers, e.g. the authors of this thesis.

> *"thematic analysis does not require the detailed theoretical and technological knowledge of other qualitative approaches, it offers a more accessible form of analysis, particularly for those early in their research career"*
>    -    Nowell et al (2017)

The third reason is the extent to which this method of analysis fits the subject matter. As we have mentioned, the smart city topic is complex and slippery. Researchers have made extensive attempts to define the concept and create conceptual smart city frameworks, as detailed in chapter 2. This conceptual work is heavily focused on encapsulating and delineating the multitude of facets and components of the smart city. As such, when we apply this already-work-in-progress concept to the related but potentially different context of the smart municipality, the task of identifying themes returns as a prudent course of action.

Jacobsen (2000, pp. 172-173) describes *three stages* of qualitative research, these three being *1. Describe, 2. Systematize and categorize,* and *3. Bind together.* Other authors have taken similar approaches specifically with regards to the case study. The steps we have taken in our analysis are similar and will be detailed below.

## Data coding

Described by Vaismoradi (2016) as the "initialization" phase. Stages include: Reading transcriptions and highlighting meaning units; Coding and looking for abstractions in participants' accounts; Writing reflective notes.

> *Coding allows the researcher to simplify and focus on specific characteristics of the data. Researchers will move from unstructured data to the development of ideas about what is going on in the data. During coding, researchers identify important sections of text and attach labels to index them as they relate to a theme or issue in the data.*
> - (Nowell, et al., 2017)

## Categorisation

When deciding how to group themes together, three components of categorization can be followed (Constas, 1992; Vaismoradi, et al., 2016). The parts of these components relevant to our analysis are:

Stage 1, Origination:

> *The researcher can refer to research or published works in the relevant area and derive categories from statements or conclusions found in the literature of other researchers who investigated a similar phenomenon;*

> *Using the investigator as a point of origination, categories are developed based on the personal interests, views, or intellectual constructions of the researcher;*

Stage 2, Verification, is in our case referential, rational, or empirical.

> *referential (utilizing existing research findings or theoretical arguments to justify categories)*

> *rational (relying on relies on logic and reasoning),*

> *empirical (relying on internal data and without reference to other studies to examine the coverage and distinctiveness reflected by categories)*

Stage 3, Nomination:

> *Category names can be derived from existing theories and body of literature; Labels can be derived from interpretative orientation.*

> *The labels may be identical to those used under the origination component;*

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### Content theme identification and grouping

After having transcribed each interview, we needed to systematize and categorize to get good overview over the results we have conducted, as we had very much text and it was a bit difficult to get an overview in over all of the interviews. Therefore, we needed to sit down evaluate, go through each interview and then pick out the most important findings, reduce information that was complex and pick out the most important findings from the complex information.

This was a challenging part as there was so much said during all of the interviews, it was difficult to point out what the most important findings are as we felt that everything was important. At the same time, it was also important to reduce the complexity of everything that was said. We managed to structure the findings based on our research questions and took the most important answers related to our research.

Of particular importance to us is the translation and transliteration of relevant statements. As our interviews were conducted and transcribed in Norwegian, it is highly important that we accurately convey the meaning of any given quote while simultaneously keeping the text as true to its original character as possible.

### Reviewing themes

This phase is named by Nowell et al (2017). Vaismoradi (2016) refers to this as part of the finalisation stage, while Jacobsen states that the third stage of the analysis, binding, is where one interprets the data (Jacobsen, 2000, p. 173). He continues: "*The third stage is dissolving the analysis and is focusing on different phenomena.*" (p. 193) This interpretation of data is primarily conducted in chapter 6, where we discuss municipal intervention themes in relation to the challenges they are intended to ameliorate, compare them with existing smart city literature, and finally discuss intended bottom-line benefits of smartness interventions and how these benefits are evaluated.

### Tools use for transcribing the interviews and analyzing the data.

Nvivo and Weft were used throughout the process to assist us with structuring and coding the data, as well as sourcing information from research articles. We used oTranscribe (2018) to transcribing the interviews. Using oTranscribe, we were able to listen to and transcribe interviews with greater ease, as it allowed us to pause, forward and rewind on command.

### Data analysis example

To make it clearer how we conducted our analysis, we will offer a brief explanation of each step taken, following an example theme to completion from unstructured data. These stages are also summarised in our research design in section 4.1. For more details on the results mentioned in this table, refer to chapter 5.2, Municipal challenge themes.

| Stage | Process | Example result |
|---|---|---|
| Data collection | Conduct interview | Recorded interview with respondent H. |
| Transcription/story extraction | Transcribe interview and mark salient quotes and points | Text interview with respondent H, highlighted relevant text areas. |
| Content theme identification/data coding | Comb data of all interviews and mark recurring or focal concepts and remarks in separate document | Respondent quote: *With regards to the environmental perspective, it's important that we don't want people unnecessarily driving cars.*<br>- Respondent H |
| Content theme grouping/categorisation | Establish a set of categories from existing literature and assign themes OR Group themes and label categories | The respondent quote concerns itself with challenge theme of *Environmental Sustainability and* is assigned to category *Environment.* |
| Discussion/reviewing themes | Discuss the consequences and interactions of themes, compare with appropriate smart city literature | Our quote: *"Among our respondents, there was a general agreement that attention should paid towards environmental sustainability…"* |

*Table 11, data analysis example*

## 4.5  Ensuring methodological rigour

**Reliability**

According to Jacobsen (2000, p. 19)*,* when collecting empirical data, it should be able to satisfy two demands. First, t*he empiricism has to be valid and relevant.* Second*, the empiricism has to be reliable and trustworthy.* As the interviews went on we tried to see if the answers we got from the different municipalities repeated themselves, and part of our analysis was to take note of repeating and similar answers across interviews, collect them as themes, and group them as categories; Jacobsen (2000, p. 20) states that "*When the same data is giving you the same results, we can tell that the data is reliable."*

Yin (2011) proposes to create a case study protocol to increase reliability. The protocol should include the following four components:

1. An overview of the case study project (objectives, issues, topics being investigated)
2. Field procedures (credentials and access to sites, sources of information)
3. Interview guides and/or survey instruments
4. A guide for case study report (outline, format for the narrative) Following these steps allowed us for a faithful replication of our study.

All four of these steps have been followed in our case study.

### Validity

When all interviews were conducted we had to ensure the validity of our answers. According to Jacobsen (2000, p. 206) one way to do so is to is by controlling our own conclusions against the conclusions of other researchers and literature.

In our case, this form of validation happened by comparing results with smart city literature in chapter 6. Furthermore, Paré (2004) also states that "*problems of construct validity can be addressed using multiple sources of information, because the multiple sources of evidence essentially provide multiple measures of the same phenomenon.*"

This is in essence part of our analysis. The themes in chapter 5 were identified and grouped according to, amongst others, how often they were repeated across 15 interviews.

### Transferability

Considering that this is a qualitative study, a high degree of transferability is not an expected result. Nowell et al say the following about transferability:

> "*Transferability refers to the generalizability of inquiry. In qualitative research, this concerns only to case-to-case transfer. The researcher cannot know the sites that may wish to transfer the findings; however, the researcher is responsible for providing thick descriptions, so that those who seek to transfer the findings to their own site can judge transferability*"
> - Nowell et al (2017)

The extent to which this study is transferable rests mostly with our unit of analysis, as detailed in section 4.1. However, Hodkinson & Hodkinson (2001) state that case study findings can be generalised in a sense that does not involve statistically significant large scale survey results, but rather in the sense that theory can be transposed beyond the original sites of study, findings can 'ring true' in other settings, and that case studies can provide *provisional* truths.

### Limitations of the embedded case study

Although we have already mentioned some limitations of our approach at this point, we can take the opportunity to summarise them.

The traditional case study usually takes the form of a depth analysis within an organisation or some other delineated phenomenon. In our case, we are sacrificing some depth for slightly more width. We conducted interviews with 15 respondents. 14 of them represented 12 municipalities while one respondent represented several municipalities within an inter-municipal collaboration. Jacobsen (2000, pp. 116-117) states that only interviewing a certain amount of people will inevitably restrict how representative the results are – which is to say, they will likely not be representative.

Furthermore, for our method of data collection, we might be prone to these weaknesses named by Paré (2004): Bias due to poorly constructed questions, response bias, inaccuracies due to poor recall, reflexivity - interviewee gives what interviewer wants to hear. These dangers are inherent to a study like ours. Of particular concern to us is the issues of reflexivity

and response bias. While the semi-structured nature of our interviews allowed us to probe for more detailed answers, we always kept in mind these pitfalls.

When the interviews were conducted, we mostly just acquired a single respondent's view at a time. This is partly ameliorated by the diversity of our respondents; while all of them were the person in the municipality most suited to talk about municipal smartness, their position internally varied from ICT director, to councillor, to mayor, and to smart city project champion.

Lastly, qualitative researchers have been criticised for not providing enough information on the inner workings of their data analysis (Oates, 2006, p. 267). Oates notes that *"often it is as if the conclusions appeared by magic."*. We hope to make this process more obvious by including an example, present in section 4.4, Data analysis example.

### Ethical concerns
Ordinary ethical responsibilities apply to the case study as it does with most other forms of study. Researchers should behave with integrity and professionalism, avoid intrusion and plagiarism, and behave ethically (Oates, 2006, p. 60). Furthermore, we should respect participants' expectations of anonymity and confidentiality, and acquire informed consent. We have ensured this by taking the steps mentioned in this section.

Respondents were made aware what the interview will be used for, what the main purpose of the interview is, and in what context the interview will be used. We also informed them that the interviews will be anonymised, and that they will be referred to as Respondents A through M, with the same applying to the municipality they represented. After being informed, respondents were given the option to withdraw from the interview, as per the advice of Davison et al (2001): *"They should certainly have the option at this stage of retrospectively withdrawing their consent to be involved, and so insisting that any data collected from or about them be deleted as well."*

Prior to conducting interviews, we made sure to send candidates information about the nature and purpose of our research, on how the interview would be conducted, and a form of consent to be signed by the candidate.

The decision to anonymise all respondents was made in advance for two reasons: Firstly, anonymising all respondents lets us avoid confusing the status of anonymity of different respondents. Secondly, we suspected that it might make candidates more agreeable – both in accepting interviews, and when disclosing information. As it turned out, a few respondents wished to remain anonymous, with some of them agreeing to participation after being informed about our policy.

# 5. Findings

In this chapter the most important results extracted from our data will be presented. Being part of the data analysis, this chapter corresponds to two stages of analysis; Categorisation, and Content theme identification and grouping. Details and a summary of these stages can be

found in chapter 4.4. The format used to identify and categorise themes are based on the same components used to construct the interview guide (chapter 2.7). To reiterate, the first component is the six smart city domains. These domains provide a literature background against which we can juxtapose the second component, which is the trio of challenges, smartness interventions, and benefits (chapter 2.3)

The scaffolding that these two components provide can then be shifted away from the *city*, and onto our research subject, the *small municipality*. The transposition of these challenges, interventions, and benefits within six smart city domains gives us a stable platform on which we can explore the smart city mindset in small municipalities. We will also reiterate the relevance this has to our research questions:

**RQ1: What challenges do small municipalities face that can be met by applying smart city thinking?**

**RQ2: What smart solutions can be implemented in small municipalities?**

**RQ3: Once implemented, how are such smart solutions evaluated?**

*Domain* is analogous to the *dimensions* of Monzon's (2015) model of city challenges - which is also the origin of *challenge*. This term helps us both formulate and answer **RQ1**. For **RQ2**, an inquiry has been made into which smartness interventions can be and are present in our selected municipalities. For **RQ3**, naming the various *benefits* of introducing smartness interventions into a small municipality allows us to either observe how knowledge of these benefits was acquired, or if not explicitly stated by respondents, infer it based on our own knowledge of information technology and information systems research.

The simplest way to present our findings is to structure subchapters as a continuation of these components, with the addition of a section on perception of smartness, an addition made to ensure that we were able gauge the respondent's awareness and understanding of the smart city concept upon which this thesis is predicated. These four sections are:

| Chapter sections: | Purpose of section |
|---|---|
| Perception of smartness themes | Presentation of what municipalities understand to be "smart". |
| Municipal challenge themes | Presentation of municipal challenges – analogous to the six-dimensional city challenge model. |
| Smartness intervention themes | Presentation of interventions that municipalities have implemented or introduced |
| Benefit themes | Presentation of identified benefit themes |

*Table 12, overview of chapter 5*


## 5.1 Perception of smartness themes

The first theme group of this analysis draws from a question that is crucial to the premise of this thesis, namely the nature of the "smart" component of the smart city concept. In order to launch smart initiatives and orient the small municipality towards smart city thinking, one

needs to have an understanding of what such initiatives would entail. Respondents' perception of the smart city concept can be grouped in three overarching themes:

| Smartness category | Smartness themes |
|---|---|
| Municipal smartness | Applied ICT, services, governance considerations |

*Table 13, perception of smartness theme summary*

Most respondents expressed technology-centred notions of smartness that was founded in the deployment and application of various technologies, and several municipalities had made use of **applied ICT** in order to collect data for services and automation. This is in line with typical smart city thinking. Examples given include the deployment of detectors for smart bins, smart lighting, traffic, and water management, and trackers for snow ploughs.

> *"Our understanding of what it means to be smart is to think smart in in order to apply and use new technology, usually with the help of ICT."*
> - Respondent E

> *"First and foremost, thinking about providing good services to residents in a good, smart and efficient way, which also is going to be economical for us."*
> - Respondent G

> *"We have used GPS sensor in the slope machine, such as the typical ski slope, this allow us to keep up with it, when it has driven, and we can then see if the ski conditions are good."*
> - Respondent M3

In the second emergent theme many respondents stated that smart **services** constitute a key component in their view of a smart municipality. This is often enabled by the previously mentioned ICT. However, it is also a matter of improving efficiency, automating existing services, and providing new ones to hurry work processes along and making the user experience smoother.

> *"[Becoming smart] is about creating work processes that enables you to effectively utilise digital tools and automation, which in return allows you to consistently produce good services with minimal expenditure."*
> - Respondent J

Furthermore, we can observe the effects of having an overarching, national strategy for encouraging digitisation: most municipalities were preoccupied with digitisation as a method of reducing costs and improving services, only those who were aware and interested in smart city thinking made the connection between digitisation and the smart city.

> *"There are also requests from citizens of the municipality to have better digital services at their disposal. While these requests carry more clout in our view, pressure from the state is something we will have to handle regardless."*
> - Respondent J

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The notion of using smart city thinking to handle overarching tasks and **considerations of local governance** was shared by fewer respondents. This notion usually emerged among those municipalities who were already aware of the smart city concept and had a dedicated smart city initiative in place. Awareness of the concept was stated to be an important part of making a municipality smart.

> *"We have discussed this internally in the organisation. We do not intend do things differently, but rather become aware and conscious of our decisions."*
> - Respondent A

One notable finding that emerged was that although few municipalities have launched dedicated smart city initiatives, all municipalities employ some form of smart intervention in order to handle municipal challenges. Naturally, some municipalities have advanced further in this endeavour than others by investing in the smart city concept, or simply by virtue of being aware of it. The purpose of those smart city initiatives that we encountered appears to be centred around freeing up labour for more important tasks and becoming more efficient in their work.

Many of the municipalities still feel that the smart city term is new, and that they are still testing the waters with regards to becoming smarter. According to the literature there is no clear description of what a smart city is.

> *"I'm experiencing that smart municipality is still to some extent in an early stage. There is something new, things are being tested and there are many who use the term. I think that many people use smart city concepts to different degrees, without being aware of it."*
> - Respondent H

One respondent noted that as the technical threshold of becoming smarter lowers, it would be prudent to adopt a more human-centric approach to the smart city concept, with a focus on social innovation and entrepreneurship.

> *"Technology is just a small part of everything. They are starting to get a more social human approach to smart* [sic]. *It's just as much about social innovation, social entrepreneurship. It's a big change we're seeing now, municipalities have big budgets and we cannot handle everything. It must be socially beneficial, and I think more and more that smart industry is going to go in that direction."*
> - Respondent A

From our findings we see that the municipalities' understanding of smartness and being smart is for them to be able to provide different services, doing so efficiently, and being able to innovate. Some also find this term to be new and difficult to grasp.

> *"Innovation is about finding the things in your surroundings that can change people's behaviour and get them to do things a bit differently."*

- Respondent C

Respondents note that in order for them take the step into becoming smart, the infrastructure that allows them to do so needs to be in place first:

> *"My experience is that it is mainly larger cities that have gone that way, we wish to do the same. We wish to have a Platform for a smart city, and for us to be able to be a smart municipality, and that we build our services and infrastructure based on this."*
> - Respondent H.

## 5.2 Municipal challenge themes

When it came to the motivation or challenges given for becoming smarter, a few recurring themes emerged for most respondents. We have grouped these challenge themes in relation to our six-dimensional city challenge model in order to keep our findings analogous with the established smart city literature, and as mentioned in the start of this chapter. This is done in accordance with the category creation principles of Constas (1992), who states that *"Category names can be derived from existing theories and body of literature".* As such, the six city challenge dimensions serve the dual purpose of providing labels for our findings as challenge categories, shown below in Table 14, municipal challenge theme summary. Details on the original smart city challenge dimensions can be seen in chapter 2.2.

| Challenge categories | Summary of challenge themes |
| --- | --- |
| Environment | Climate change effects, environmental sustainability |
| Mobility | Geographical distance, geographical inaccessibility |
| Economy | Economic limitations, size of projects, cost effectiveness, infrastructure deficit, early adoption, sustainable local economies |
| Governance | Change and globalisation, time constraints, leadership commitment, corruption, diversity of municipal conditions |
| People | Lack of ICT competence, privacy concerns, citizen involvement, lack of innovation, low educational level |
| Living | Ageing population, service quality |

*Table 14, municipal challenge theme summary*

**"Environment" challenges**
Although environmental concerns were common among respondents, only some had viewed **environmental sustainability** from the smart city perspective.

> *"The sustainability that most people recognise is related to the environment. What we want to achieve is to govern in a sustainable manner... it's a very holistic approach to sustainability."*
> - Respondent A

> *With regards to the environmental perspective, it's important that we don't want people unnecessarily driving cars.*
> - Respondent E

One respondent named a specific environmental challenge. In this instance, **flooding caused by climate change** was reported to be a growing issue, and the respondent thought it prudent to 'think smart' in order to ameliorate it.

> *"We have had several floods in our area, so we have started to use drones… Due to climate changes we are forced to think in those directions."*
> - Respondent E

### "Mobility" challenges

For municipalities that are **remote and inaccessible** or have a low population density, transportation and mobility can be a source of consternation. One municipality had an unusual situation with regards to accessing the town:

> *There is only one route in and out [of the municipality]. You do not drive around, you do not drive through the municipality. This means that our electricity-charging strategy for electric cars is justified in that if can you reach us, you will be able to return home… it is important for us to have solutions that promote [mobility] otherwise it can present a challenge.*
> - Respondent C

> *Transportation and buses depart at different hours, and you need to travel by ferry to reach another municipality.*
> - Respondent B

This, combined with **geographical distances**, makes up two significant mobility challenges.

> *One of the municipalities in our inter-municipal cooperation is one of the largest in areal, so enabling smart technology we can save a lot instead of all the car trips that our employees would have to make.*
> - Respondent F

### "Economy" challenges

Some of the most significant challenges for our respondents were economic in nature. Nearly all municipalities faced **economic limitations** – a natural effect of having a low population and correspondingly limited budgets.

> *"We do not have the same economic backbone as the big municipalities"*

- Respondent I

*"One of the biggest challenge of introducing this* (Smart technology) *is economy."*
- Respondent C

*"...with the economy, you see that you are saving costs. You also spend less time and free up time for other things. But in the end, I would say it is the economical factor that weighs the heaviest. My understanding is that the motive is purely from an economic perspective. "*
- Respondent D

These limitations make it harder for municipalities to handle **large ICT projects** on their own. The smallest municipalities that we interviewed were at least partly dependent on cooperation with other municipalities for such projects. Furthermore, smart city initiatives in particular were considered to be high-cost endeavours, and some projects require great expertise. With a limited budget to work with, many respondents found it difficult at times to recruit skilled personnel to support such initiatives.

"*Our size affects what we would hope or wish to go through with. Our staff is small, and we lack resources. Right now, we do not possess financial means to adequately invest and implement projects."*
- Respondent J

*"It's clear that [municipality with low population] doesn't have the capacity to take significant steps. But in collaboration, we might be able to make something happen."*
- Respondent F

**Cost effectiveness** remains a challenge for several municipalities. Certain investments do not scale with population size, making them less suitable for smaller municipalities.

*"You have an option where you can use a robot or algorithms to process applications, the challenges are that a license on such an application cost a lot of money.  It is the same price weather you are a big municipality or a small municipality. In a large city like Oslo this robot could have been working 24/7 where it serves 500-600 thousand citizens. Compared that to our municipality with 4.500 citizens. Then you see that it has an impact on how big you are."*
- Respondent C

*"One has to be up to date and constantly on the last platform, it is demanding economically."*
- Respondent M3

Nearly all respondents stated that the size of the municipality mattered to some extent. As mentioned, many such projects are large, and are as such better suited for larger cities where the effect of such initiatives would be more significant.

**Economic sustainability** was a major concern for several municipalities. The concept of economic sustainability was usually defined as responsible and sober management of municipal finances.

> *"Sustainability in the sense that we're managing resources on the behalf of the public. We avoid spending money we don't have, and we prefer to manage it in a way that pays dividends."*
> - Respondent A

And in general, the interests of temporary residents are very much taken into consideration:

> *"We feel like we are able to reach the majority of people on our Facebook page, where we have [thousands] of followers. Far larger towns struggle to reach this level of popularity online, so you can tell that there is significantly more interest in small municipalities than larger ones."*
> - Respondent D, paraphrased.

> *"GPS and map services are crucial to cabin owners/renters, and hikers."*
> - Respondent G

A significant challenge named by respondents is the size and complexity of ICT projects. Many respondents consider many ICT projects to be excessively large for them to participate in. Another aspect can be that it also might be too expensive. Many of the municipalities receive offers to participate in projects that are related to smart city thinking.

> *"There is no lack of inquiries and requests, and our municipality, who is in front of how to implement smart in a municipality, we are receiving a lot of attention about this. However, what the challenge is for us is to find a sustainable economic model within this co-operation we are getting request for."*
> - Respondent A.

This indicates that there is no shortage of projects to join in on. However, there must be a clear benefit in participating in such initiatives, which is not always as easy to provide.

> *"If they cannot offer us a lot of beneficial elements in a collaborative project then we have to say no. One has to look at our finances in such cases; it is simply the hard reality."*
> - Respondent A

**Infrastructure deficit** was noted to be a recurring problem for many municipalities by one respondent:
> *The main challenge is solid infrastructure. By that I also mean software centrals that enable you to use the same data for multiple services.*
> - Respondent F

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In addition, the risk and cost associated with **early adoption** also appears to apply to the smart city concept:

> *"We were early with providing tablets to be used in a political setting, which is an investment we were ambitious with. We've been ahead of the curve in that sense."*

> *"At the same time, it would be quite expensive if every municipality came up with their own solutions. After all, we have the same bureaucracy in all 428 municipalities* [in Norway]*."*
> - Respondents M2, M3

### "Governance" challenges

Three respondents stated that some manner of external **change** pressured or inspired them to become smarter. Often, this change could be tied to **globalisation** and international trends, and the way to remedy an affliction or capitalise on an opportunity (depending on the perspective of the affected stakeholder) is often to find and apply innovative social or ICT solutions. Every respondent brought up digitalisation as part of their ICT program, and most municipalities were in part motivated to change by the national *digital agenda* (3.1):

> *"It's a request from citizens that we improve municipal services. I'd say citizen needs weigh heaviest, but it's clear that pressure from the state makes us address the topic* [digitalisation] *regardless."*
> - Respondent J

One respondent specifically remarked that globalisation is a main factor that influences and shapes their ICT policymaking and smart city concept.

> *"Smartness is about how we can adapt to... globalisation."*
> - Respondent C, paraphrased.

> *"Then you have digitalisation that is trend number two, all that can be digitized will be digital, and then we must adjust it as a municipality."*
> - Respondent C

Several respondents expressed that **time constraints** with regards to ICT projects and benefit realisation was a challenge:

> *"The temporal aspect is another* [challenge]. *Things take time* [sic]. *Thinking you can have something in place when you want it to be is a challenge."*
> - Respondent C

> *"Part of the challenge is that it can take some time before you see any benefit. You won't get it right away – you need patience. You won't see the full effect of such initiatives straight away."*
> - Respondent M3

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One respondent that had encountered **corruption** said the following:

> *"We had invested large amounts into storage capacity, and we didn't know how this* [lack of electronic storage capacity] *could happen. It turned out someone in our ICT leadership was corrupt."*
> - Respondent K, paraphrased.

While multiple respondents stated the importance of having municipal **leadership that is committed** to becoming smart:

> *"We've had a leadership with a councillor who works very closely* [with the smartness initiative]*, who understands the value of it, which is an enormously important basis."*
> - Respondent A

For some respondents, unique or specific conditions present areas of application for ICT solutions that might be unique or inapplicable for other municipalities. One important factor that influenced the way certain municipalities applied smart services was the local basis for labour and industry – something that varies from municipality to municipality. Results show that municipalities might have very different reasons to become smarter, and a challenge that comes with this is being aware of the **diversity of municipal conditions** and knowing what smartness interventions to apply in a given set of circumstances. As an example, the issue of flooding in *"Environment" challenges* depends on the geography and climate of the municipality. Other municipalities that were interviewed did not have problems with flooding, as such they were not in a position to use drones in the same manner. Keep in mind that in our selection, municipality E was unique, but it is highly likely that this challenge is present in other municipalities both within and outside of Norway.

### "People" challenges

Some municipalities participate in some form of smart city initiative and are working on becoming more efficient and improving the life quality of its citizens. One of the challenges that could occur was the difficulty of selling this idea to stakeholders, and concepts such as the smart city and digitalisation still might be unknown and fuzzy. As a consequence, making both employees and **citizens involved** and aware of this mindset and the benefits does not appear to be an easy task.

> *The smart concept has really been put under pressure here in the municipality. People are often alienated, and they feel that it is by no means smart. They often ask why things should be so "smart." We really have to work to popularize what we mean by this and we have by no means concluded the process. But we are well on our way to clarifying what it means to be a smart municipality.*
> - Respondent A

A **lack of ICT competence** to drive ICT investments and smart city initiatives is a recurring issue for most municipalities.

*Yes, there is a little lack of expertise in those areas where we could benefit most from. There is also talk of capacity to carry out projects on it.*
- Respondent J

*When we talk about competence it's a challenge with digitization, understanding the opportunities that the technology gives you. Interact with technology and turn that mindset. It is about organizational culture.*
- Respondent M1

To some respondents, recruiting skilled personnel to smaller municipalities can be a difficult task, and as is the case with holding onto them for a longer period of time. This can affect ICT projects, since many of them are long term. Recruiting and holding on to skilled personnel for such not something that is done overnight, as they take significant investment of time and expertise.

*"We are lacking competence in those areas where we could have a greater profit from. We are few persons; the lack of resources is making those things difficult for us"*
- Respondent G

*"I think skilled personnel and the need for skilled personnel is a factor that weighs heavily here in a small municipality as ours. You get more vulnerable in a small a small municipality when it comes to competence."*
- Respondent D

There are also some difficulties for smaller municipalities to cover broad spectre of services, as they often do not have sufficient manpower at hand.

*"If you look at ours IT department, we don't have sufficient competence our capacity to deliver what we should deliver. We are supposed to cover a broad spectre of services, where in our municipality you only have six people working on those services compared to a larger municipality who have 50 employees responsible for the same amount of services."*
- Respondent L

Similarly, a **low educational level** compared to larger towns and cities remains an issue for some municipalities.

*One of the challenges is precisely the competence of people in general. If you look at statistics from SSB* [central bureau of statistics]*, if you look at college education and vocational education. You have a larger proportion of the population who are college graduates in a city than you have in a rural municipality. I think that's the case, so I think expertise and the need for expertise is a factor that weighs heavier here in a road district area in a small municipality. You become more vulnerable in a small municipality in terms of competence.*
- Respondent D

Some municipalities noted that a **lack of innovation** was an issue that needed to be dealt with:

> *"We've seen that we couldn't keep doing what we've done before – we had to become more innovative"*
> - Respondent E

Finally, **privacy concerns** emerged as a theme with several respondents.

> *"[Open data] also poses some challenges in terms of ethics and privacy. We are working to obtain written consent from citizens."*
> - Respondent C

## "Living" challenges

One respondent remarks that the **ageing of the general population** is one of the five "megatrends" that informs their ICT policy and smart initiative. As a consequence, he notes:

> *I have to keep in mind that our municipality favoured as a place for older citizens to move. Rather than thinking about hiking paths, I have to think about pathways for walking aids.*
> - Respondent C, paraphrased.

The application of ICT and social innovation is stated to be important in handling the issue. A desire to make the municipality more attractive to younger and more demanding citizens has also influenced the introduction of smart services in some municipalities.

As the population ages, the need for healthcare professionals and services increase. The costs here are significant and growing, and each municipality has to approach the subject in unorthodox ways – usually, this means using healthcare technology to reduce costs and improve both efficiency and **service quality**.

Indeed, quality and efficiency improvement were main reasons for municipalities to adopt smart initiatives and become smarter. Efficiency and quality were often mentioned during interviews, where the main goal was to save time and costs. The money saved could then be used on other things, and the time saved could make them prioritize other tasks that they saw as being more important.

> *"As I have understood this is that the motive here is based on economy. We see that we can save a lot of money; we use less time and get time to do other thing. The economy weighs the heaviest here. It is about being more efficient and being more efficient has an impact on the economy."*
> - Respondent D

## Upsides of being a small municipality

Having a small population does not necessarily mean you will encounter challenges. There are also benefits to being a smaller municipality. New ideas and projects can be easier to

actualise, and the reduced size of the organisation can mean that the distance between decision and action becomes shorter in comparison to larger towns and cities.

> *"Yes, there are challenges, but we also have advantages. I like to think that when we decide to go for smart initiatives, we can also turn around quick. We also get things done faster when compared to a larger city that I will not mention, where they had to use several months to get a project started. It had to go through so many people before a decision was placed and confirmed."*
> - Respondent H.

Other respondents choose not to look at the negative side being a smaller municipality, instead focusing on some clear advantages compared to those larger municipalities. Decisions can more easily be made when the setting is smaller, and certain projects are reduced in size in proportion with the size of the municipality.

> *I will say that we actually have a benefit here in being smaller. We are seen as an attractive collaborator. Yes, larger municipalities have bigger economical muscles, but that doesn't necessary mean that they will do better when it comes to smart* [sic]. *They can be in a large degree too much project-oriented.*
> - Respondent A.

> *"But then I wish to see it from another perspective, in smaller municipalities you also have a much greater flexibility. It is easier to get things through in a smaller municipality. It's easier to try and fail. There are not so big consequences and there is less risk, and this is an advantage. Shorter way to regulations."*
> - Respondent M3

## 5.3 Smartness intervention themes

When organising the themes that emerged from inquiring about smartness interventions, we consulted the category creation principles of Constas (1992) once more. For the categories in this section, we followed a specific chain of subcomponents from the guide: "*Using the investigator as a point of origination, categories are developed based on the personal interests, views, or intellectual constructions of the researcher",* where we relied on internal data to examine the coverage and distinctiveness reflected by categories. This left us with 6 unique categories with their constituent themes, shown below in Table 15.

| Smartness intervention categories | Intervention themes |
|---|---|
| Digitalisation | Automation, digitalisation strategy, digitisation, digital education |
| Healthcare interventions | Welfare services, welfare technology |
| Environment interventions | Emergency management |
| Mobility interventions | Smart parking, charging stations, smart bus stop |
| Smartness-enabling technology | IoT, open data, big data, cloud computing, sensory devices, ICT infrastructure |

| Smartness interventions that can enable smart government | Leadership commitment, intermunicipal cooperation, project champion, stakeholder engagement, e-commerce |
| --- | --- |

*Table 15, smartness intervention themes summary*

## Digitalisation

It is difficult to refer to the smart city concept in Norway without mentioning digitalisation and the digital agenda (as mentioned in chapter 3). This national digitalisation plan involves that all municipalities in Norway should start moving towards **digitising** documents and the access to existing services. Unsurprisingly, all respondents brought up digitalisation, and several were interested in how digitising services and documents would help them become smarter. Some municipalities had come further than others in this process, but all of them were working on digitalisation within the municipality.

> *"But already in 2015-2016, this smart concept started to become fully accepted in Norway. Then people began to talk about smart communities and then talked about digitalisation and automation, data sharing, welfare technology… It is part of the digitization strategy."*
> - Respondent H

Furthermore, respondents are creating local **strategies for digitalisation**:

> *"We have had a digitization strategy since 2011, so it's quite long and we were out early. I would say we are no slouch. It is the digital agenda that is leading and that we are moving towards."*
> - Respondent M3

Digitalisation can contribute to enabling **automation**. One municipality improved work processes in a way which previously would not have been possible without a digitised format that allowed the alteration and of travel routes for caretakers and automatic update to electronic devices.

> *We also look at systems that deal with this automatic routing of home caretakers. If a caretaker is absent, we may automatically set up another route for another one and they will get that route on GPS. So, we try to get some smart solutions in those areas.*
> - Respondent I

> *"Yes, we have a lot of major projects in the field of digitization. It's about automating and making everyday life more efficient. It's about coordinating tasks putting it on automated processes that allow more time for our case managers to build up so that they can spend more time on more critical and qualitative things."*
> - Respondent A

But in terms of digitalisation it can be difficult for municipalities to always be doing thigs on their own. Like many of the efforts one is dependent that such innovative are also coming from the outside.

*"But the need for digitization out there where one has to produce services, I think it has to come from the outside, you cannot sit centrally at the town hall and evaluate it. You have to ask professionals and experts on this area. That is my view, and this is the direction I think one should go towards."*
- Respondent D

Multiple respondents noted that the use of **digital education** had become more prevalent in the educational system.

*"We also do quite a bit in schools. We're working on digital communication between parents and guardians, and the school."*
- Respondent J

### "Healthcare" interventions

The reason we have included healthcare interventions here is based on our findings; nearly all respondents gave a good account of their interest in healthcare and welfare technology, and each municipality emphasized this theme, where the primary concern is how to leverage **welfare technology** to improve and effectivise healthcare.

*...welfare technology and to enable security alarms, electronic systems for hospitals and doctors, so one can have those digital solutions at home, they can be notified digitally about taking pills or having night surveillance, GPS and many other things.*
- Respondent G

*We have a great commitment to welfare technology, where we established a response centre, and it's about... yes, a home can be equipped with a bunch of alarms - it can be security alarms or different measurements. All it needs is an infrastructure through the same portal.*
- Respondent F

*We have introduced digital surveillance, pill dispensers, e-locks, a lot of sensor technology, also called e-rooms. We are always focusing on development. What the challenge is to bring those who work with it, nurse, etc., to change the way to work, those things take time.*
- Respondent L

Of particular importance was the ability to provide **healthcare services** to an aging population, with the focus resting on improving conditions for the elderly to improve their ability to stay independent and self-reliant in their own homes.

*In terms of welfare technology, all municipalities in in our county are participating in a project to build welfare technology and digital healthcare services using technology.*
- Respondent H

This respondent illustrates how technology helps improve healthcare services:

*In practice, healthcare professionals can go to people who still live at home but who need medication and some such common things in the house. Health personnel bring a tablet that has a VPN line over 4G mobile network. Then they can log and inform about medication, write comments, while they are out at patients place and do their job. Before, they had to put this down on paper and write it down on the computer when they reached the office. It saves time for the one who performs the job, and it's a smart way to work."*
- Respondent D

## "Environment" interventions

From our findings the environment might play a significant role for adopting smart initiatives – however, this depends on the context and needs of the municipality. One municipality that have had many problems with floods, and deployed drones to help mitigate the problem:

*"We have had a lot of floods in our area, so we have started to use drones, and we have our own drone park. This helps us to map flood areas and help us to get a better overview. Due to climate changes we are forced to think in those directions"*
- Respondent E.

This is clearly context based, as the other municipalities that were interviewed did not have problems with flooding. It is a natural application of technology for municipality E to use smartness intervention that can aid in dealing with this issue.

*Respondent C* said for them it all started with a smart energy project within their municipality with corporation with academia, business and public sector where we made a test arena within our municipality the develop smart solutions within energy and water. Although this is not intended to counteract any specific challenge, it is nonetheless an intervention that impacts the environment.

## "Mobility" interventions

A few respondents were particularly interested in interventions that helped deal with mobility challenges. One respondent mentions an investment in a **smart bus stop**, possibly intended to attract would-be passengers:

*"...we can for example mention having a smart bus stop. It is going to be Norway's coolest bus stop. Heh heh."*
- Respondent A

Another respondent is more focused on dealing with issues of parking, and brings up the following point about investing in **charging stations** to improve electric car mobility and thereby incentivise drivers to make the trip to the municipality:

*Our electric charging-strategy for electric cars is based on the idea that if you can reach us, you should be able to return home. If you come out here in a car whose range isn't good enough, you won't be able to get back home.*
- Respondent C

The same respondent displayed an interest in **smart parking**:

> *"In terms of parking, it's like when you drive out, you could get a message how it's possible and how much pressure it's on parking. There are very good and inexpensive solutions available in that area, cameras that display locations and convert this into data to mention a few."*
> - Respondent C

## Smartness-enabling technologies

Nearly all municipalities were investing in some sort of technology that provided the groundwork to become smarter. Terms like **Cloud computing**, **IoT**, **Big data**, and **Open Data** were commonplace, and respondents mentioned how these technological concepts could be used as a means to becoming smarter.

The importance of big data in particular, and the ability to make use of big data was named by some respondents as being central to the smart city concept.

> *"This involves using big data and the data one has available to deliver better services. Use things across and do not ask for data we already have. Use technology to streamline and modernise our work processes."*
> - Respondent M1

> *Yes, if you think big, in urban development, it's about using big data.*
> - Respondent F

> *We are also working on using big data to chart things. We look at ways we can apply this and use it.*
> - Respondent E

These concepts are typically enabled by the use of sensors; for bins and lighting, for motion detection, traffic counting, water metrics, pill dispensers, recording plow truck GPS data and water metrics:

> *"We're looking at water metrics, reading that in a smart way… We're looking at sensors for street lights… and smart rubbish bins."*
> - Respondent A, paraphrased

> *"We have sensors on doors, 'fall' alarms, motion sensors, and so on."*
> - Respondent J

> "*We have GPS and sensors, 'fall' alarms, night cameras, surveillance, and so on…*
> *We have used a GPS sensor* [sic] *for the snow groomer* [note: for ski trails]"
> - Respondents M2, M3

It was also noted that the interaction between these technologies was crucial for realising benefits:

*"It's when you start to connect these things together, Internet of Things and Big Data. That's where we might see great benefit. That's how you start to measure and see what's the difference."*
- Respondent C

One of the respondents claimed that part of the reason they started to move towards smart thinking was due to IT security reasons. They have had a bad experience with an unfaithful employee which lead to corruption within the municipality. This lead to a major investment in **cloud computing** and services.

*"It was that we had huge expenses, we had a huge technological debt. We had major capacity problems and we had a major data security problem in* [redacted]*, which meant that all the systems in the municipalities in the ICT cooperation we had went in black for a few days… This lead us to invest in cloud-based solutions, to reduce operating costs and to improve security."*
- Respondent K, paraphrased

In order to being able to enable such technologies one needs to have the **ICT infrastructure** in place for doing so. Usually, this means improving fibre connectivity for citizens.

*"For us to be a smart city, we need to develop and have the infrastructure in place."*
- Respondent H

This municipality has an ongoing project to provide fibre access to all of its citizens with 100% guarantee by 2019/2020.

One respondent similarly notes that ICT infrastructure has been improved by using fibre connections to enable the access to water and waste metrics across the municipality – including for cabin sites. This is both costly and beneficial to the municipality due to its geographical size:

*"We have water and drainage to several cabin fields and population centres. We have reservoirs and pump stations. We're trying to connect all of these to a fibre network, with switches and controls so we don't have to drive out to these areas every time a pump fails… so I'm not just talking about water and drainage, but also fibre."*
- Respondent D

**Smartness interventions that can enable smart government**
Most municipalities stressed the importance of **collaborating with other municipalities**. Population size and a lack of resources is a recurring concern, and there is often a lack of skilled personnel. As a consequence, seeking out collaboration with like-minded municipalities can be a way to combine resources and take part in the smart city concept.

*"We are totally dependent on cooperation, and not to do things alone."*
- Respondent E

*"We cooperate with the other municipalities in an inter-municipal cooperation."*
- Respondent I

*"We're collaborating with other municipalities. We have five areas of cooperation where ICT operations is one of them. We have a common ICT platform and have run these ICT operations for over a decade."*
- Respondent K

In a similar vein, many of the municipalities remarked that launching smart city initiatives on their own was a difficult prospect, and often expressed the importance of cooperating with business, the local community and volunteer work, i.e. **engaging stakeholders**. This usually involves change management, cross-sectoral collaboration, or citizen involvement.

*"We participate in projects related to co-operation, volunteering how we can get things together. Business, community voluntary work. It is just as much about social innovation, social entrepreneurship, technology is just a small part of all this."*
- Respondent A

One municipality noted the potential of implementing an **e-commerce** system**.**

*"It's about making purchases through an e-commerce tool, which saves us maybe 20 per cent. Considering that we make procurements for 1,5 billion [Norwegian kroner] each year, there are saving to be made."*
- Respondent F

Some respondents stated that the desire to become smart was dependent on having a **committed leadership**:

*"We have a commitment; those of us who are out and meeting with the people, political heads, and business representatives, when they hear these messages it leaves a mark and that helps cement our municipality as a smart municipality."*
- Respondent A

One respondent noted the presence of a dedicated innovation department*:*

*"...we have our own department for innovation which is working with us in the municipality with regards to digitalisation solutions, which helps us enter into collaborations across municipalities."*
- Respondent E

Similarly, one respondent noted the importance of having a **project champion** when it came to implementing smartness interventions and becoming smarter:

*"You have to practice what you preach… I've decided that in order to change things as I'm doing, I have to be a good example. It's no use pretending like you're interested in something, you sort of have to stand for it."*

- Respondent C

*We also have a smart-city coordinator in the municipality who has been very positive and have had a "thumbs up" mentality to new things, and is very open about everything. He has put us on the map, and has opened very many doors for us."*
- Respondent A

## 5.4  Benefit themes

| Benefit categories | Benefit themes |
|---|---|
| Intended benefits | Reduced expenditure, service quality, increased effectiveness, stakeholder satisfaction |
| Measuring benefits | Survey, stakeholder consultation, financial oversight |

*Table 16, benefit theme summary*

### Intended benefits

As the final part of the questions sections the respondents were asked to say something about what benefits municipalities wanted to get out of current and future implemented smart interventions, and if there were any methods or tools to evaluate and measure the value of such smart initiatives and interventions.

For some of the municipalities we talked with, it can be difficult to see value of various interventions, as they often lack the right tools or resources to make evaluations.

*"For us it's hard to see the value. We know what we have, but it's more beneficial to merge with a larger municipality and get better systems on things. But as a small municipality we might end up losing our closeness to the inhabitants"*
- Respondent B

This municipality will be forced into merging with a bigger municipality and this could be one of the reasons why they don't measure the value of different initiatives as this will not be their task in the future, but the task of the municipality they are becoming a part of.
Other municipalities also expressed the difficulty in realising benefits on such projects, and they expressed that measuring benefits was something they were not good at, and that there is still room for improvement there.

*It's one of the things we might be the worst at, to get a profit from this. We are in the process of introducing methodology that Difi recommends for projects, it is a project guide and we will use it during the year here.*
- Respondent J

Using a project guide from Difi (Directory of Management And ICT, 2018) could be an alternative, as this might provide municipalities with more of an overview over projects they are participating in, so one could see the benefits of different projects. Another municipality also expressed some concerns with regards to benefits realisation:

> *"We are very bad at measuring the effect of such measures, that is something we think of all the time but at present we have no good method of doing so. The projects to date have been fragmented and department-based."*
> - Respondent E

Sometimes it is not always about the benefits realisation. Some municipalities have other views and perspectives, like Municipality A and C. Because such projects are, complex and it can be important to deliver good services, and the other stakeholders are succeeding with their initiatives.

> *"I would like to say that it does not matter if it's useful, it's about being able to survive and deliver as good or better services out there. So useful/benefit realization it's a nice word, but at last it's about to being able to deliver good services."*
> - Respondent C

When working with other stakeholders during such initiatives it is also important that the stakeholders are succeeding and are able to be sustainable. One cannot always measure the benefit, and sometimes the most viable course of action is trial and error.

> *"There must be room for trial and error. We depend others to succeed with their things; we cannot be the one who are always involved in things from scratch. It is important that others find their own sustainability, we have experienced that those we collaborated with have gone bankrupt, and they fail to stand on their own."*
> - Respondent A

Many of those things are efficient, but on the other hand implementing such things does have a cost. One of the respondent said that the money saved on pill dispensers is as much money it cots to get them.

> *"For example, what they save on the pill dispensers is as much as the dispensers cost they say. So, the question is, should you have warm hands that come up to the patient every day with medication, or you just have a cold box there that says now you need to take your medicine. There are many aspects to it, but at the same time this is also debatable in some cases, maybe it's okay to have someone on the door every single day. It gives you more freedom, you can go out and find other things instead of sitting at home and waiting for home help. Same with digital night surveillance, is it okay for people to wake you every night or it's better that they get into a camera. There are very many aspects of things and it depends on how things are viewed".*
> - Respondent M1

Again, this seems to be about people, and what one wish to measure as the respondent is saying that it can be difficult to measure such initiatives. It's the eye that sees.

However, most of the municipalities are talking about benefits realization, and being able to get benefits out of such initiatives, what most of them said that they could potentially see that they were able to save time and money by becoming smarter and adapting smart initiatives.

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*"We are mapping the profit, we are looking how to save money and get profit. Saved costs is saved money. We see the potential of things, especially for a small municipality. One just has to take it and can look where one can gain benefit. Especially in the healthcare, it is very important for us and gain benefit there."*
- *Respondent G*

Being able to save money and costs also seems to be a motivation, and many of the municipalities we interviewed expressed how they saw smart initiatives enabling them to save money, improve quality, and availability for its users.

*"We want to save money. Above all, we get good internal routines and to gain better quality and information flow internally, this is linked to information security. That we do not have to send patient records with internal mail but just post them on digital security archive. It provides better quality and increased safety.*

*Availability, increased availability. Something that comes from the digital agenda from Norway is that citizens must have a digital first choice to be able to solve their services digitally. We will be able to provide residents with automated services and processes to enable us to incorporate these services digitally and efficiently. It will provide better user experiences for the user. This will save the municipality administration costs."*
- Respondent H

This is one of the main motivation that often repeat itself, money, costs, quality availability and good services to the citizens of each municipality. The goal of smart initiatives does not always have be profit realization and about saving money. Sometimes is just as much about security and effectiveness.

*"The system here costs so it's not a purely economic gain, but we are going much on quality and safety, it is beneficial for security, you have more control now."*
- Respondent M3

Being able to be there for it citizens, and that there are automatized services is one of the biggest benefits realizations many of the municipalities have. Many of the respondents are expressing the desire for them that the citizens can use self-services and each person can in one way be their own "municipality". This can create effectiveness and make things go faster which is a great benefit.

*"One of the best services that we have that we are able to provide services 24/7, and we wish in the long term that more and more of our citizens are using those tools to be able to register their own cases. We can more efficiency in our operations, and we can provide our users with a higher level of service. That is our goal."*
- Respondent I

*ICT infrastructure investment can provide valuable returns for the same reason as why it tends to be costly; the monitoring and automation of waste and water leads to reduced time and resources spent driving to remote locations for manual maintenance and adjustments. Fibre connectivity for cabins also remains an important goal for the sake of cabin residents.*
- Respondent D

With regards to the benefits of healthcare, most municipalities talked about welfare technology. Using smart technology when it comes to health could makes things easier for employees working in the healthcare sector. This seem to be very relevant for elders who prefer to stay home rather than nursing homes, and this is where the use of smart technology could be of great benefit. But also, the usage of technology of healthcare professionals and how technology can help them in order for them to do their job.

*We have done things very well in the home service, so this has saved us a lot* [expenses].
- Respondent J.

### Measuring benefits

The municipalities find it often difficult to evaluate such efforts, as they often lack the tools, or they say it is hard to measure such initiatives.

*"It's hard to, tell too many of these projects have got a start-up where you do not know what the outcome will be. It is a little experimental, and we are not always good at detailing this here what is the desired outcome."*
- Respondent A

Some even gave a clear answer that they did not have any routines for measuring such efforts.

*"No, we measure, and we do a lot, but we do not have any fixed routines for how it is done. But perhaps one of the most important things is not the smart solution itself but will actually be use of Big data."*
- Respondent C

*"No, we don't. We don't have any tools or anything similar to measure such efforts."*
- Respondent D

However, many of the municipalities are working on trying to get some benefit realization out of such initiatives, and this is being measured by how the benefit realization is. Many of the projects in terms of smart initiatives are using Difis recommendations for following projects.

*"We are in the process of introducing methodology that Difi recommends for projects, it is a project guide and we will use it during the year here. It is a recommended process with some steps to get into digital projects. It is a five-phase project. Going*

*for profit realisation. It is to make sure that the projects we are working on are quality assured, we take out profits and know that we get some of what we are working on."*
- Respondent J

In addition to Difis recommendations for benefits realisation, there is also some use of Prince 2 methodology.

*"We are working on the project network. We have project wizards, we have a methodology based on Prince2 methodology and we use profit realisation. There you have specific tools, before winning, you measure things, you work in a project to track up winnings, and you evaluate and then this is the clue, how to ensure that winnings are actually picked up. We also have the idea that project managers get a responsibility to follow up this to follow the implementation. Profit realization is one of the most important tools we have for measuring and looking at the degree to which we achieve digitization. There is a project wizard through Difi."*
- Respondent H

*Many good initiatives cost money, it can be difficult to show in short time the benefits of such initiatives, and we have not been good in showing profit realization, which makes things a bit more difficult.*
- Respondent E.

Other challenges could be that one might not yet see the full effect of such initiatives and that it takes time to see such an effect. One needs to have patience with such projects.

*I think of the challenge is that it may take a long time before you see the benefits. You might not get benefit realization right away, you need some patience.*
- Respondent M3

# 6. Discussion

This chapter is structured after our smartness intervention theme categories. This provides a format that is consistent our findings and allows us to discuss their relationship with various challenges and benefits. In this chapter we will discuss the most important findings from those four theme groups, we will discuss how our findings relate to existing smart city literature, and how they can be relevant for small municipalities.

| Chapter sections: | Purpose of sections |
|---|---|
| Digitalisation | Discuss municipal intervention themes in relation to the challenges they are intended to ameliorate. Compare with existing smart city literature. |
| Healthcare | |
| Environment | |
| Mobility | |
| Smartness-enabling technology | |
| Smart governance-enabling interventions | |
| Evaluating benefits | Discuss intended bottom-line benefits of smartness interventions, and how these benefits are evaluated. |

| Theme interrelation matrix | Illustrate how challenge, smartness intervention, and benefits themes interrelate as discussed in preceding sections. |

*Table 17, overview of chapter 6*

## 6.1 Digitalisation

According to the digital agenda plan for Norwegian municipalities there is a connection between digitalisation and the smart city term. Digitalisation plays a central role in making cities more sustainable and attractive to live in. Using digitalisation means that one must use ICT, and the term smart cities have been rooted as a term for ICT-based ways to organise the life in cities. Although smart city literature does not explicitly address digitalisation to a significant degree, there are several definitions and phrases used to describe types of smart cities that involve digitalisation. One of them is the *Digital City*. The digital city refers to *"a connected community that combines broadband communications infrastructure; a flexible, service-oriented computing infrastructure based on open industry standards; and, innovative services to meet the needs of governments and their employees, citizens and businesses"* (Nam & Pardo, 2011). Yovanov & Hazapis (2009) states that the goal of the digital city is *"...to create an environment for information sharing, collaboration, interoperability and seamless experiences for all inhabitants anywhere in the city".* We can observe from the literature that digitalisation plays an important role for smart cities and represents one approach for cities to become smarter. Nam & Pardo (2011) states that *"every digital city is not necessarily intelligent, but every intelligent city has digital components."*

In spite of not being entirely aware of, or invested in the smart city concept, digitalisation nonetheless appears as a topic of significant interest or investment in every municipality. All municipalities interviewed provided some sort of automated service to their citizens. This automation for public services helps free up resources and labour within the municipality where citizens can now use services for tasks that previously were tedious, time-consuming, or demanding to perform manually.

Examples of digitalised services include an automated service for applying for enrolment in a public kindergarten, digitalised building permit forms, amongst others. Forms and applications that previously needed to be filled out manually and handed in are now streamlined electronically. This is referred by to respondents as *"improving the flow of documents"*.

By doing so, municipalities have established a better process for collecting and distributing forms that satisfies the interests of citizens. The term used here is to have an electronical paper flow. Naturally, this is said to reduce costs, as approval or disapproval of forms is not hamstrung by having to push paper up and down the service chain. Some expressed that it didn't matter how such digitalisation was done, as long as one would be able to deliver services in a manner that is both efficient and effective.

> *"It's about being smart in the way you get their data out. Competence cooperation is important, that's what it's all about. Sharing expertise. The technologist is there, but it's only if you want it in your own place or in the cloud. It's not so terribly important.*

> *It's important being able to deliver, how to get it done does not matter very much, as long as one can provide services."*
> - Respondent M1

Dividends in the form of both cost reduction and service quality appears to be a primary motive for digitalisation. This overarching focus on digitalisation is not entirely surprising, and is likely a result of the national *digital agenda* (chapter 3.1) which heavily encourages Norwegian municipalities to digitalise services.

Digitalisation is also utilised in education, where digital tools are used to promote learning. Multiple respondents noted that the use of digital education had become more prevalent in the educational system, and that the use of digital tools in the education system could be used to improve human capital. This is confirmed by Neirotti et al (2014), who states that "*Extensive Use of modern ICT tools (e.g. interactive whiteboards, e-learning systems) in public schools Policies to improve human capital investments and attract and retain new talent"*. Respondents noted the importance of not just hoisting consumer electronics into the classroom, but rather incorporating e.g. web applications and tablet use into a holistic pedagogic plan.

## 6.2  Healthcare

We could observe that Norwegian municipalities had a significant focus on healthcare services, and respondents were eager to use ICT and as a way to provide and improve healthcare services. As a result, all municipalities had made investments and progress in providing smart healthcare services. The benefits of using ICT and the smart city concept to improve healthcare is recorded in the literature (Batty, et al., 2012). Hashem (2016) says the following about smart healthcare: "*Healthcare can be enhanced by improving preventive care services, diagnosis and treatment tools, healthcare records management, and patient care"*. On the same subject, Neirotti et al is more detailed, and focuses on leveraging ICT:

> *SC interventions in these [healthcare and public safety] settings can be characterised by the deployment of sensors and wireless technologies (e.g. the use of such technologies to automate the remote assistance of patients outside hospitals) or by the deployment of practices and domain that have been covered by initiatives launched by municipalities.*
> - Neirotti et al (2014)

Within healthcare, the main concern of our respondents was the use of smart technology to benefit older citizens. This investment is justified by the need to take care of a population that is steadily ageing, and whose life expectancy is still on the rise (SSB, 2018).

In addition to enabling digitalisation and automation, IoT also enables healthcare services and technology through the deployment of sensors for movement surveillance of patients. This is an example of utilising sensor data for healthcare (Perera, et al., 2014). Due to the often-vital importance of certain health services, it should be noted that the reliability of the underlying ICT is of paramount importance – as is usually the case with medical technology (Raheja, 2008; Borgia, 2014). Borgia notes that "*Healthcare applications are, on the other hand,*

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*characterized by massive device transmissions that have to be highly reliable and have to respect extremely stringent delays when delivering medical data".*

Since it is likely that healthcare costs will rise proportionally with the ageing population, we suspect that investments in smart healthcare will be a topic of interest for both state and municipal government in the future. As this challenge grows, so does the need to increase the efficiency and quality of services, to lower their cost, and to potentially come up with new concepts for the purpose. We suspect that this will require a high degree of ICT competence.

All municipalities interviewed are focusing on this area, as they see great potential in the smartness of healthcare services. It can help them reduce costs and enable the improvement of healthcare, as they can find it difficult to cover for all potential patients. The need for thinking smart within healthcare are only increasing, and this seems to be an area that municipalities wish to emphasise both now and in the future.

## 6.3  Environment

Among our respondents, there was a general agreement that attention should paid towards environmental sustainability. However, it did not appear to be a pressing concern in and of itself. For one respondent, emphasis was rather placed on managing the potential consequences of climate change. This particular instance of crisis management came in the form of deploying drones for mapping flooded areas, which constitutes an application of IoT (Borgia, 2014). Contrast this with the literature, where a much larger range of environmental challenges are named (Kitchin, 2014; Mathiesen, et al., 2015).

The absence of "typical" environmental challenges might have two explanations. Firstly, 98% of Norwegian electricity production is derived from renewable energy, with 95 of those percentage points originating from hydroelectricity (International Energy Agency, 2017). Despite being an oil-producing nation, the consumption of fossil fuel might not currently impact small Norwegian municipalities apart from general climate change effects, such as flooding. For some respondents however, it might be an indication that environmental sustainability is internalised, and that the attention given to the issue by municipalities is appropriate given their size and capacity to affect the climate positively. On the other hand, the absence of environmental challenges might be a consequence of the municipality's size and a perception that the ability for small municipalities to affect the climate is negligible when compared to large cities, Stockholm being an example (European Commission, 2010).

Regardless, smartness interventions are being implemented that aid the cause of greenhouse gas reduction - even if that is not the primary objective. Examples include charging stations that encourage long-range travel by electric cars, welfare technology that allows for a reduction in car travel, or a smart bus stop that encourages the use of public transit.

## 6.4  Mobility

Mobility challenges for small municipalities appear difficult to handle through orthodox and costly means of infrastructure investment and public transportation, and typical smart city mobility issues such as traffic congestion might not apply. The geography of these

municipalities often serves as a significant barrier – sometimes literally - due either to the remoteness of the municipality (often an issue for island municipalities), or due to a combination of size, low population density, and difficult terrain. However, many smartness interventions can contribute either directly or indirectly to ameliorating these challenges by making travel either easier, faster, more convenient, or less expensive for certain stakeholders.

Of the municipalities that we consulted, three significant interventions came up that directly affected mobility. These were charging stations, a smart bus stop, and smart parking. Of the three, charging stations and the smart bus stop – these interventions are respectively intended to encourage travel to and from a remote area by car, and to encourage the use of public transit.

One municipality stated a great interest in concepts related to smart mobility, such as smart parking, bicycle parking, self-driving buses, smart bus stop, and carpooling. However, these concepts were still on the drawing board, and the specifics of implementing them were yet to be decided. Indeed, many interventions may not be appropriate for a municipality - implementation can be dependent on any number of variables like the aforementioned geographical challenges, municipal finances, the availability of ICT competence, or leadership initiative.

Indirectly, other interventions can be included to affect municipal mobility. The use of IoT to enable automated water management, welfare services, and surveillance is relevant for municipalities with small populations and large distances, since potential benefits increase as travel time is reduced. In practice, it means e.g. that routine check-up and maintenance by workers becomes less necessary. Caretaker visits can be made less frequently, on-demand, or in the case of emergency, while machinery can be monitored remotely rather than being patrolled. Some interventions may not directly solve the challenges of a smart city dimension, but some are interesting because they mitigate challenges in ways that might not be obvious. Due to this, it is probably unsurprising that many mobility interventions could also be categorised as environmental interventions – at least if their primary goal was to affect the environment.

## 6.5 Smartness-enabling technology

**What constitutes 'smartness-enabling'?**

The Norwegian municipalities were mentioning at the usage of different technologies when it comes to the step to become smarter and enabling smart technology. Terms such as cloud computing, IoT, Big data, and Open Data were often mentioned. Using these concepts seemed to be central for their future development. Several municipalities mentioned how the use of such technologies could help them in the process of becoming smarter, and pointed out how the use of such technology could open many opportunities for them. Although not all of the municipality were using such technology, but they saw the importance of it and something that was going to be the next step in the process of enabling smart technology.

This was mostly centred around a few IS and IT phenomena, Open Data, Internet of Things, which helps enable Big Data analysis and Digitalisation. Amongst our respondents, we could observe that the status of these phenomena within the municipalities varied greatly. It appears

that for our respondent municipalities, a progress hierarchy is naturally established where digitalisation and open data is the first in line for municipalities as a natural consequence of state incentivisation and mandate, but also a general awareness of the utility and value of going through with such efforts. Secondarily or in parallel with digitalisation, an increased interest in IoT appears to come into play for municipalities. This enables real-time monitoring, data collection, and automation of services that would otherwise be done manually. Last comes big data analysis. Few of our municipalities had entertained going down this route, and these respondents only had an ambition of eventually making use of big data in some capacity that is currently unknown to them. This potential hierarchy is illustrated below in Table 18, prioritised ICT phenomena.

| Phenomenon | Digitisation | Open data | IoT | Big Data |
|---|---|---|---|---|
| Priority | High | High, medium | Medium, low | Medium, low |
| Typical motivation | State incentive: Cost effectiveness, service quality | State incentive: Cost effectiveness, service quality | Becoming smart: Cost effectiveness, innovation | Becoming smart: Cost effectiveness, innovation |
| Typical smart city awareness or interest | Low, partial | Low, partial | Low, partial, high | Partial, high |

*Table 18, prioritised ICT phenomena*

Although few municipalities had a clear vision of adopting the smart city label or promoting themselves as a smart municipality, everyone had implemented or launched one or more interventions that de facto could be deemed a "smart" use of technology. In practice, digitalisation at the behest of the national government forms a significant basis for this smartness. However, several municipalities were explicitly interested in leveraging ICT in clever and unorthodox ways, or in expanding communications infrastructure for this purpose. Indeed, ICT and "smart computing" enables smart cities, undergirds smart city initiatives, and allows large cities and small towns alike to address a myriad of challenges (Chourabi, et al., 2012; Perera, et al., 2014). As Chourabi et al states:

> *"Technology may be considered as a meta-factor in smart city initiatives, since it could heavily influence each of the other seven factors. Due to the fact that many smart city initiatives are intensively using technology, it could be seen as a factor that in some way influences all other success factors in this framework."*

All of this supports the primacy of ICT when it comes to enabling the smart municipality. As Batty et al (2012) notes: *"Intelligent cities, virtual cities, digital cities, information cities are all perspectives on the idea that ICT is central to the operation of the future city."*, while Hollands (2008) notes that *"It is ICTs in particular that undergird all of these networks and which lie at the core of the smart city idea"*. Despite this, all respondents were able to recognise that ICT is 'just' an enabler for developing municipalities and society as a whole -- i.e. a means to an end, and not goal in and of itself. Similarly, IS scholars often argue that smartness is not simply achieved through technology investment and adoption, but that the

matter is ideally a holistic vision of how technology and stakeholders can interact in complex ways to actualise a potential for optimisation and improvement that was previously beyond our reach. It seems clear that the distance between these two views is significant, which gives would-be smart cities (and small municipalities) a decent amount of wiggle space to decide how and to what extent they want to be smart.

For many of our participants, the infrastructural groundwork is only partly able to support typical smart city interventions. On a mature ICT infrastructure basis, software can be developed, sensors deployed, and data collected, analysed, and made public. These ICT solutions come at a cost, and an investment might not be appropriate or realistic given the budget or professional capacity of a given municipality, or the meagre effect afforded by a small population when compared to large cities.

### IoT And Big data

The use of IoT and Big data was often mentioned. Respondents said they saw this technology as important, although some were just at the beginning phase of introducing them. As we mentioned earlier all of the municipalities have adopted some manner of smart intervention, but this varies from municipality to municipality.

Among those who had made use or were planning to make use of IoT and big data, it was often mentioned that in order to 'properly' make the municipality smarter, they would need to focus on these interventions. From the literature the usage of IoT and in the smart city is highly relevant. Perera et al (2014) states that "*The Internet of Things (IoT) and Smart Cities (SC) are recent phenomena that have attracted the attention from both academia and industry.*" The use of IoT seems to be very central for smart cities, and both the industry and academia have drawn attention towards it, hence why this was often mentioned by the interview objects when asked about smart city initiatives and how their municipality were adapting such initiatives. The use of IoT can help for a wide variety of devices and services.

> *"By enabling easy access and interaction with a wide variety of devices such as, for instance, home appliances, surveillance cameras, monitoring sensors, actuators, displays, vehicles, and so on, the IoT will foster the development of a number of applications that make use of the potentially enormous amount and variety of data generated by such objects to provide new services to citizens, companies, and public administrations."*
> -    Zanella et al (2014).

There is no doubt that the use of IoT plays an important role of creating the future smart city and the use of such technology will help to provide services to citizens, industry and public administration. IoT and big data are often linked together and offers a unique way to gather a large amount of data from many sources (Hashem, et al., 2016). IoT allows the integration of sensors, Bluetooth and network services, and the usage of such technologies can potentially produce significant benefits for the future development of small municipalities.

As such, it is understandable that some municipalities consider making use of big data and IoT in the future. The next step is to implement such technology – a prospect that is once more complicated by limitations of budget and ICT competence.

## Open Data

Open data is a term that is often used when smart cities are mentioned, the purpose of the open data is that data should be open and shared with everyone, so all can access data and information. "*Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.*" (Auer, et al., 2007)  There is no doubt that open data can give many opportunities, and according to Janssen et al (2012), "*there are both political, social, economic, operational and technical use when it comes to Open Data*". From the municipalities viewpoint they saw this as something of benefit and how the use of open data was exciting as it opened opportunities they didn't have before. However, privacy concerns would have to be dealt with. New EU privacy laws (European Commission, 2018) are in effect from May 1st, which was an important factor to take to consideration. Many citizens sometimes felt that they were being watched and were uncomfortable about the notion of having data on them stored and potentially made open. This was especially a concern regarding surveillance and that the public suddenly have access to a lot of information both through big data but also open data.

## Cloud computing

One important intervention that was rarely emphasised by respondents was the adoption of cloud services. In the main example recorded in our data collection, this carried with it benefits that were crucial to the municipality: Increased security, improved service quality, and reduced costs. We also had the impression that switching from home-operated services to cloud services brought with it a sense of relief; that the burden of being responsible for one's own ICT systems had been lifted.

The benefits of cloud computing are also described in the literature, "*Further, cloud computing service models provide many other benefits such as business agility, scalability and elasticity, reliability, green initiatives, less maintenance work including backup and disaster recovery.*" (Perera, et al., 2014) This also confirms our findings for why there was an interest in adopting cloud services.

This is not to say that the decision was without issues: A downside of the cloud-based approach is the implication it has for ventures – both private and municipal - that provide mass data storage within national borders. As foreign actors – in this case, Microsoft - become compliant with national requirements on privacy and data security, local data storage companies might find themselves becoming uncompetitive and geared towards non-cloud ICT solutions that are considered obsolete or inferior.

Albino et al (2015) also states that "*...the potential of integrating cloud and sensors in smart cities and present a new architecture that provides the capability of obtaining any type of data acquired from different sensing infrastructures. In some cases, these technologies subvert the top-down, corporate vision some offer as a smart city.*"

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Overall, however, it seems that small municipalities might be undervaluing the potential that cloud services might have to improve their situation and become smarter. This is a potential topic for further research.

### ICT infrastructure

When discussing ICT infrastructure in the context of the small municipality, it is difficult to avoid talking about the lack of it as a barrier for further development. It has been difficult to justify investing ICT infrastructure in rural areas, as the low population density makes investments less profitable (European Commission, 2016). This confounds the EU's goal of attaining universal 30 Mbps coverage by 2020. In the case of Norway, rural internet coverage is the second-worst out of 28 European countries surveyed (European Commission, 2016). This is reflected in our findings, where several respondents note difficulties of having underdeveloped internet connectivity. Unfortunately, the authors of this article cannot present any silver bullet to deal with this challenge. However, viable cost-effective investment alternatives to improve ICT infrastructure in rural areas are FTTN (fibre to the node) and mobile broadband (4G). FTTN allows for home connections to be established with fibre nodes over long distances using existing copper infrastructure, while mobile broadband will be able achieve great consumer coverage and bypass many expenses entirely by virtue of being wireless.

It is worth noting that infrastructure and technology can be considered to be two separate entities within the smart city concept (Chourabi, et al., 2012). For our purposes, we have included it in the smartness-enabling technologies section as we consider the operating word here to be *enabling*. Like other ICT investments, ICT infrastructure has no inherent value apart from what it allows stakeholders to do that they find valuable. Of course, in most cases, we consider it likely that stakeholders would appreciate improved internet speeds precisely because it allows them to do things they were previously unable to. As Chourabi et al (2012) state: *"A smart city relies, among others, on a collection of smart computing technologies applied to critical infrastructure components and services."*

## 6.6 Interventions that enable smart governance

Many IS scholar stress the importance of acknowledging that the smart city is more than just applied ICT:

> *"The point of departure is the definition which states that a city may be called 'smart' "when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory government"*
> - *Schaffers et al* (2011)

There is also a need for people with skills and knowledge who can help facilitating smart initiatives. This can be a challenge for smaller municipalities; many respondents experienced difficulties recruiting skilled personnel, and that they often felt understaffed for the task of launching a smart city initiative. But making a smart city, one cannot get away with not

talking about ICT and the importance of ICT for making a city smart. *"In cities, ICT is likely to contribute substantially to solve the emerging problems of urban living."* (Neirotti, et al., 2014)

Most respondents shared the notion that being smart in a city context involves the utilisation of technology for the sake of achieving some higher goal. This also reflected in the literature, *"The Natural Resources Defense Council defines smarter in the urban context as more efficient, sustainable, equitable, and livable."* (Chourabi, et al., 2012) While Nam & Pardo (2011) says that *"A smart city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively"*

However, we could observe that not all municipalities were concerned with the smart city concept, and this ties in with the recurring IS axiom of technology being a facilitator or enabler for nontechnological activities and goals (Janson & Wrycza, 1996; Savino, 2009); the opinion that technology is a means to an end rather than a goal in and of itself was shared amongst nearly all respondents.

Throughout the interviews in this study, it shows that most of the municipalities are positive in terms of implementing smart initiatives within their municipality and that they wish to work with efforts becoming smarter. There was a clear expression that in order to become smarter they saw the use of ICT as a facilitator in order for them to become smarter and launch smart initiatives.

But it's not just to start and implement smart initiatives, there also were an expression that things need to be planned and there also has to be some strategic direction in order to become smarter. From the literature we see that such initiatives require strategic directions, in order to succeed with such initiatives and in the long term this can give benefits.

> *"Being smarter entails strategic directions. Governments and public agencies at all levels are embracing the notion of smartness to distinguish their new policies, strategies, and programs for targeting sustainable development, sound economic growth, and better quality of life for their citizens."*
> - Nam & Pardo (2011)

This idea of smart cities is emerging in a wide range of infrastructure intervention uch as transport, business, and services both public and private. Respondents who were aware of the smart city concept also noted that in order for them to become smarter, they would have to involve all aspects of human life within the municipality.

Those municipalities who had entertained the idea of engaging with the smart city concept had slightly more advanced goals than the digitisation of services. For these municipalities the challenges remained similar, but dedicated efforts were made to become smarter as a way to counteract them. In several instances, challenges had been overcome by combining resources with other municipalities. By joining some form of intermunicipal collaboration, smaller

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municipalities were able to counteract the challenges of having limited finances and a lack of ICT competence.

This will able to add a foundation for the municipality and also decide what direction the municipality will be going towards when making such initiatives. There is a lot of untapped potential, and still much more to work on for each municipality. Proclaiming a municipality to be a "smart municipality" appears not to be of significant consequence. Rather, interests lie with simply continuing the ongoing process of making the municipality smarter.

The size of a municipality can influence the threshold of launching a smart city initiative or introducing smartness interventions. It appears that for certain interventions, as a population decreases, so too does the complexity of introducing them go down along with the ease with which local government can approve and initiate the intervention.

The state or presence of smart city initiatives varies from municipality to municipality. As mentioned, all municipalities had a focus on healthcare services. There was also a focus on services between the public and the citizens that each municipality were working on and made efforts to facilitate such initiatives.

Apart from this, what we found that the nature of introducing smart city initiatives for smaller Norwegian municipalities depends on the context and conditions of the municipality. The municipalities would often express that they introduce smartness interventions based on different criteria. Factors such as geography, size, climate and population played an important role when implementing such initiatives. For example, a municipality that had issues with flooding in their area had focused on the deployment of drones to mitigate the issue. In this instance, drones could help them to create an overview over the flooded area, which in turn let them assess the damage and how much help that was needed. Another municipality with significant tourist activity would naturally set the resources on map services and other services to facilitate for tourists.

The nature of the smartness intervention introduced can vary dependent on size, population, demography, and other municipal conditions. Chourabi et al (2012) mention eight critical factors of smart city initiatives, and amongst those eight is also context. This is also confirmed by Neirotti et al (2014): *"results reveal that the evolution patterns of a SC highly depend on its local context factors."*

From the interviews one could clearly see that the personnel who were the most positive to such initiatives were those who worked on creating an awareness in the municipality and actively worked on the smart-city idea. They had a clear intention to 'spread the message' and wanted to go towards this direction of having the label "smart" applied to their municipality. Having a project champion and a dedicated leadership appears to be of significant importance for driving a smart city initiative forward.

Monzon (2015) summarises the issue of varying conditions succinctly: *"A Smart City project should not follow the same strategies in one or another urban area because the challenges,*

*starting conditions, available resources and citizens' willingness can be completely different."*

## 6.7 Evaluating benefits

The concluding questions asked in each interview were inquiries into the ability with which the benefits of various smartness interventions are realised. The answers varied significantly, although most municipalities had some difficulty in evaluating and measuring benefits. Intuitively, it would be safe to assume that most projects had some tangible benefit. The awareness of this was present with respondents. Some municipalities said that they used some form of tool or methodology to identify the specific value of different interventions, but they were in a minority. Most municipalities acknowledged this shortcoming, and noted that this was an area in which they intended to improve. Similarly, it is noted in smart city literature that measurement of such initiatives can be difficult: *"Results show how complicated the measurement of a smart city is."* (Albino, et al., 2015).

Multiple respondents noted that the main motivation for implementing such initiatives was due to economic reasons. One of the primary reasons given by respondents for the absence of a benefits analysis was the limitations of their finances and lack of skilled personnel. This combination could mean that municipalities do not have the human or financial resources to evaluate interventions. However, it also appeared that some respondents took for granted that introducing certain interventions would have some benefit in the form of effectiveness or cost saving.

All municipalities interviewed provided some digitised service to its citizens. By doing so, the processes surrounding the needs of citizens are improved. This reduces time spent and expenses, with documents changing hands less frequently. In other words, the benefits of introducing certain smartness interventions – digitisation in particular - becomes apparent with service quality and time and costs saved in processing documents. As Chourabi et al (2012) states: *"Economy is the major driver of smart city initiatives, and a city with a high degree of economic competitiveness is thought to have one of properties of a smart city."*

## 6.8 Theme interrelation

When reviewing and discussing the themes that emerged from the analysis, we sometimes found it difficult to delineate the boundaries between them. As pointed out multiple times in the discussion, certain intervention themes had an impact beyond their intended or primary goals, and certain challenge themes ended up being higher-level abstractions of other themes. For example, healthcare services are often enabled by healthcare technology, which in turn can be said to be both enabled by IoT and digitalisation. In our case it is a theme of its own due to its specialised purpose – you are unlikely to e.g. find pill dispensers outside of the realm of healthcare technology and services.

Most of these relationships are beneficial. However, some interventions bring with them both benefits and drawbacks for certain challenges, while others can be beneficial for its solving its intended challenge, but detrimental to another challenge. This is usually related to privacy

concerns, where the use of sensors and metrics can lead to a level of surveillance that some citizens might find unacceptable.

In total, we identified 22 challenge themes and 22 smartness intervention themes. To illustrate the various junctions at which these themes affect one another, we have created an overview in figureFigure 6, overview of theme interrelation. The construction of this matrix was done by reviewing sections 6.1 – 6.6 in this chapter, and the points of intersection are based on indirect or direct relationships that have been previously discussed. Note that the purpose of this matrix is not to display how these themes relate, as this has been done in preceding sections. Rather, it meant to provide a concise overview that lets the reader know that smartness interventions do have effects beyond the challenge they are meant to deal with.

Figure 6, overview of theme interrelation

Legend:

✓ Beneficial effect - Directly or indirectly alleviates, mitigates or solves challenges

⊕ Potentially beneficial and detrimental effect

✗ Detrimental effect on a challenge

Blank: No significant effect reported by respondents

# 7. Conclusion

The premise of this thesis is that cities and small municipalities are two closely related but different types of entities. With regards to making settlements smarter however, the smart city has received ample attention, while the small smart municipality has been neglected enough that an investigation into the trials and potential triumphs of the smart municipality is warranted.

In this chapter we will present our most important findings, and how they contribute to answering our research questions. We will detail some of the limitations of this study, present recommendations for small municipalities, and recommend options for further research on the topic of the small smart city.

## 7.1 Answering research questions

**RQ1: What challenges do small municipalities face that can be met by applying smart city thinking?**

In total, we identified 22 small municipal challenges that could be met by applying the smart city mindset. We have categorised them according to a six-dimensional city challenge model in order to keep our findings congruent with existing smart city research. The small municipal challenges (detailed in chapter 5.2) that emerged from our findings were:

| |
|---|
| Climate change effects, environmental sustainability |
| Geographical distance, geographical inaccessibility |
| Economic limitations, size of projects, cost effectiveness, infrastructure deficit, early adoption, sustainable local economies |
| Change and globalisation, time constraints, leadership commitment, corruption, diversity of municipal conditions |
| Lack of ICT competence, privacy concerns, citizen involvement, lack of innovation, low educational level |
| Ageing population, service quality |

Of these challenges, a few appeared to be more pressing or detrimental than others for launching smart city initiatives or implementing smartness interventions.

The shortage of ICT competence was a source of consternation for many small municipalities. The size and remoteness of smaller and more rural municipalities meant that these places often end up being less attractive for ICT professionals. Without the finances and attributes to attract the skills necessary for a dedicated smart city initiative, municipalities often found themselves having to seek out alternate approaches. This can in turn lead to other challenges like a lack of innovation, or a lack of leadership commitment.

Economic limitations were a second challenge of small municipalities. Predictably, most municipalities didn't have the same financial clout as larger towns and cities. These limitations expressed themselves in a variety of ways; Some projects – both ICT and non-ICT - become prohibitively costly to initiate due to their complexity and the time it takes to finalise them.

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### RQ2: What smart interventions can be implemented in small municipalities?

In total, we identified 22 small municipal smartness interventions that can be used to handle small municipal challenges. These smartness interventions (detailed in chapter 5.3) were:

| |
|---|
| Automation, digitalisation strategy, digitisation, digital education |
| Welfare services, welfare technology |
| Emergency management |
| Smart parking, charging stations, smart bus stop |
| IoT, open data, big data, cloud computing, sensory devices, ICT infrastructure |
| Leadership commitment, intermunicipal cooperation, project champion, stakeholder engagement, e-commerce |

Some smartness interventions were nearly universally present for selection of municipalities. The ones that appeared to be most important from a non-smart city perspective were automation, digitisation, and welfare services. These interventions were mostly viewed as a means to a clearly beneficial end; saving costs, increasing efficiency, and improving service quality. In most instances, the smart city mindset was either peripheral or non-existent. However, insofar that these interventions are smart, they can also be said to contribute to making the municipality smarter.

Those municipalities who had entertained the idea of engaging with the smart city concept had slightly more advanced goals. For these municipalities the challenges remained similar, but dedicated efforts were made to become smarter as a way to counteract them. One of the most important interventions for becoming smarter in these instances was joining an intermunicipal collaboration. By combining their resources, smaller municipalities were able to counteract the challenges of having limited finances and a lack of ICT competence. Furthermore, having a project champion and a dedicated leadership appears to be of significant importance for driving a smart city initiative forward. By combining these two governance interventions with a foundation of ICT infrastructure, the path towards becoming a smart municipality can be cleared.

### RQ3: Once set in motion, how are the benefits of such smart interventions evaluated?

We would ask at the end of each interview how the benefits of different smartness interventions were evaluated. Most municipalities answered that this was an area in which they were underperforming, and measuring such interventions was often not prioritised. Based on our findings, it appears that municipalities often do not measure benefits. Reasons for this could be that municipalities might not have the capacity or means to go through with benefit analyses. This issue is compounded by their size. Sometimes it is the case that the benefits of certain interventions are too intangible to identify as a data point for evaluation, or that measuring them simply proves to be difficult, time-consuming, or based on significantly delayed gratification. On occasion, the benefit analysis is not prioritised because the implemented smartness intervention is obviously better. While we agree that this sometimes appears to be the case – depending on the intervention - the downside of this attitude is that the municipality remains unaware of *how* much better the improvement is. One option is that a municipality can rely on the benefits stated by another municipality that did measure

benefits – however, this assumes that the intervention is implemented correctly or has the same impact in a different context.

However, when benefits *are* evaluated, it usually takes the shape of a benefits realisation plan designed according to the guidelines by Difi (Directory of Management And ICT, 2018) or as part of Prince2 project management methodology, where customer satisfaction can be confirmed and follow-up actions recommended (Prince2, 2018). Finally, readily observable metrics produced by newly implemented digital services such as e-commerce tools or digitised document management. In such cases, smartness interventions measure themselves by recording money or time spent, whereupon comparisons can be made to pre-digitised expenses.

## 7.2 Weaknesses of this study

Aside from the usual limitations of a case study, there are some limitations and weaknesses to this thesis. Firstly, having an embedded unit of analysis with (mostly) one respondent per municipality does not provide the depth insight into an organisation that one might associate with a case study, nor does it provide the quantity of data required to make a more advanced analysis.

Our study ends up somewhere in between (but closer to the qualitative end of the spectrum), and thus does not fulfil either niches. As a consequence of our selection and unit of analysis, the collection of challenges, interventions, and benefits that we identified might not be comprehensive as it could have been with more respondents, and it might not be as detailed as it could have been with fewer respondents. In particular, the benefits revealed by respondents and the details of benefits realisation of smartness interventions could have been inspected in greater detail when conducting interviews – however, this could also have extended the scope of the study beyond its intention.

Finally, a potential weakness is the delineation between the themes that we identified. This delineation proved challenging, as themes were frequently melded together across domains. This strikes us mainly as being a fundamental issue of trying to model a complex reality, but it can also be seen as a consequence of the fuzzy nature of the smart city concept itself.

## 7.3 Implications for Norwegian municipalities

Although the participant municipalities of this study are already occupied with digitisation and automation, introducing smartness interventions and launching smart city initiatives can provide small municipalities with other opportunities for improvement.

The greatest challenges in this regard is a consistent dearth of ICT professionals (or otherwise qualified personnel) who can drive such initiatives, along with the costs associated with going through with major ICT projects. The major steps a municipality can take to ameliorate these challenges are to combine their efforts with neighbouring or like-minded municipalities. By doing so, small municipalities can attain the financial clout to attract expertise, which in turn can lead to smart city-related development that were previously out of reach. A project champion appears to be particularly beneficial for this purpose – employing someone who is

aware of the smart city concept and what opportunities it can provide for a smaller municipality can present a driving force for positive change that was previously not apparent.

## 7.4 Recommendations for future research

Due to the size and complexity of the smart city concept, there are likely myriads of potential inquiries that can be made into the topic. In this section, we will suggest a few of them.

Authors and researchers often note that the attitude towards the smart city concept is overly positive (Hollands, 2008) – being an extension of the smart city, this naturally applies to the *small smart municipality*. Our thesis is heavily focused on the benefits of introducing smartness interventions into this setting. As such, researchers could take the opportunity to focus on uncovering the potentially negative aspects of smart city initiatives.

Many municipalities struggled to measure the benefits of introducing smart interventions. An option for future research is to delve into benefits realisation from a smart city perspective and find out why this might be the case. Another option for this purpose is to focus on defining key performance indicators and identifying critical success factors.

Another angle of attack for the small smart municipality is the project management perspective. By following a single smart city-related project in a small municipality from initiation to closure, one can better understand the inner workings of implementing specific smartness interventions.

Overall, it appears that small municipalities might be underestimating or might not be aware of the potential that cloud services can have to improve their situation and become smarter. This is a potential topic for further research.

By repeating this study – or one similar to it - in another national setting with different conditions (detailed in chapter 3.), one can better control for these conditions and establish a more comprehensive view on the topic of small smart municipalities. Finally, another option is to reduce the scope of the study and make the selection quantitative. By collecting large-N data for a quantitative analysis, a more complete view of effects and benefits of smart city thinking in small and rural settings can be illuminated.

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# Attachments

| # | Researchers | Name of study | Focus of study |
|---|---|---|---|
| 1 | ASCIMER Monzon | Smart Cities Concept and Challenges: Bases for the Assessment of Smart City Projects | Smart Cities Concept and Challenges |
| 2 | Zanella et al | internet of things for smart cities | IoT in smart cities |
| 3 | R_Kitchin | The real-time city? Big data and smart urbanism | Big data and smart urbanism |
| 4 | Chourabi et al | Understanding smart cities: An integrative framework | An integrative framework |
| 5 | Neirotti et al | Current trends in Smart City initiatives: Some stylised facts | Facts about trends in SC |
| 6 | Yan et al | A survey on smart grid communication infrastructures: Motivations, requirements and challenge | Survey on smart grids, communication infrastructure |
| 7 | Ganti et al | Mobile Crowdsensing: Current State and Future Challenges | Computing devices, IoT, sensor technology etc. |
| 8 | Ablino et al | Smart cities: Definitions, dimensions, performance, and initiatives | What constitutes a smart city, how it is compared to traditional cities. |
| 9 | Nam & Padro | Conceptualizing smart city with dimensions of technology, people, and institutions | How do we consider cities as smart? Factors for successful SC. |
| 10 | M Batty | Smart cities of the future | How do we define a SC where ICT is emerged, using new technology? |
| 11 | Perera et al | Sensing as a service model for smart cities supported by internet of things | How the use of IoT can help SC in the future, with sensors etc. |
| 12 | Hollands et al | Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? | What is a smart city, and the ideology behind it? |
| 13 | Borgia | The Internet of Things vision: Key features, applications and open issues | Usage of IoT in cities, and challenges. |
| 14 | Wang | Cyber security in the Smart Grid: Survey and challenges | Cyber security issues for the smart grid. |
| 15 | H Sundmaeker, P Guillemin | Vision and challenges for realising the Internet of Things | How to realise IoT, and visions of IoT in the SC. |
| 16 | Mc_Daniel & McLaughlin | Security and privacy challenges in the smart grid | What the security and privacy challenges are in the smart grid. |
| 17 | Mathiesen et al | Smart Energy Systems for coherent 100% renewable energy and transport solutions | Usage of smart energy systems. |
| 18 | Schaffers | Smart cities and the future internet: Towards cooperation frameworks for open innovation | Future internet and technology in the SC. |
| 19 | Khorov et al | A survey on IEEE 802.11 ah: An enabling networking technology for smart cities | Smart technology for sustainable growth. |
| 20 | Hashem et al | The role of big data in smart city | IoT and big data in SC. |
| 21 | Harrison et al | Foundations for smarter cities | The foundations needed to make a SC |

*Table 19, overview of articles used for literature review*

# Interview Guide

Name
Position
Years in the position
Expertise – Main area
Information about the municipality
Size of municipality

Date – Time – Type of interview – Duration

# Questions

**Smartness**

1. Hva er deres forståelse av å være en smart-kommune? (Hva vil det si å være en smart kommune?)

**Challenges**

2. Hva motiverte dere til å bli en smartere kommune? (Problemer? Ønsker? Statlig vedtak?)

3. Hvilke utfordringer møter dere på for å kunne bli en smartere kommune? (vanskelig å innføre tjenester, dyrt, mangel på kompetanse, vanskelig å få i gang samarbeid mellom aktører)

4. Hvilke utfordringer ser dere for dere at dere har sammenlignet med større byer?

**Smartness interventions**

5. Hva slags smarte tiltak har dere i deres kommune og hva inngår i disse? (Digitalisering? Samarbeid på tvers av sektorer? Sensorer? Tjenester?)

6. Hvor viktig er det for dere å eventuelt involvere borgere ved slike tiltak? (Hvordan tar dere hensyn til borgernes interesser?)

7. Har dere noe spesielt tiltak for å involvere alle borgere, da særlig med tanke på eldre mennesker og mennesker med nedsatt funksjonsevne?

8. Samarbeider dere med andre byer om slike tiltak?

**Benefits realisation**

9. Hvilken nytteverdi ser dere for dere at dere får ut av nåværende eller fremtidige smarte tiltak?

10. Om noen, hvilke metoder eller verktøy har dere for å måle eller vurdere nytteverdien av smarte tiltak?