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Modern ICT Management in Trondheim Municipality

Master's thesis in Informatics
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Abstract

To be able to effectively produce value, Information and Communications Technology (ICT) management is an important tool for public organisations. In this study we investigate the ICT procurement and management practices in the Norwegian public sector, using Trondheim municipality as a case study. An important focus in the study is the context of Trondheim municipality as a large Norwegian municipality, and how this context influences their ICT management.

Some of the key themes identified in the study include the values of data and system ownership to public organisations and a focus on innovation in the municipality. Some of the key challenges identified are challenges in cross-institutional cooperation and external institutional influence, as well as municipal duties of employees hindering productivity and contributing to delays.

Sammendrag

For å kunne effektivt produsere verdi er god forvaltning av Informasjons- og Kommunikasjonsteknologi (IKT) et viktig verktøy for den offentlige sektoren. I denne oppgaven utforsker vi anskaffelse og forvaltning av IKT prosedyrer i den Norske offentlige sektoren, ved å bruke Trondheim kommune som en casestudie. Et viktig fokus i oppgaven er konteksten av at Trondheim kommune er en stor kommune i Norge, og hvordan denne konteksten påvirker deres forvaltning av IKT systemer.

Noen av de viktige temaene som har blitt identifisert i oppgaven er verdien av eierskap av data og systemer for offentlig organisasjoner, og et fokus på innovasjon i kommunen. Noen av nøkkelutfordringene som ble identifisert er knyttet til samarbeid mellom offentlige etater og enheter, og innflytelse fra eksterne institusjoner, i tillegg til hvordan ansattes kommunale oppgaver kan redusere produktivitet og bidra til forsinkelser.

Preface

This thesis is a qualitative research project created at the Norwegian University of Science and Technology (NTNU) during the spring of 2023, in Trondheim, by Jonas Drageset Lindaas, as his master thesis in Informatics. Prior to the thesis itself a literature review on innovation and public procurement was performed during the autumn of 2022 as a preparatory project. The thesis and project were both supervised by Babak A. Farshchian at the Department of Computer Science at NTNU. The study was conducted in cooperation with Trondheim municipality.

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1 Introduction

In this chapter of the thesis we will introduce the topic of the thesis, our motivations for conducting this study, the research questions and goals of the thesis, and finally we'll conclude by outlining the structure of our report.

1.1 Motivation

The industry of software development is an important and ever-changing industry, recognised as one of the most important industries across the world (Xu and Brinkkemper 2007). It is a rapidly changing industry where new programming languages, tools, and procedures are developed and adopted rapidly, but despite the rapid innovations and importance of the industry, it is well documented that many software development projects fail in areas such as meeting deadlines, going over budgets, and failing to meet quality requirements (Marques et al. 2017). The development of Information and Communications Technology (ICT) systems, and especially so complex ICT systems can therefore be seen as both of significant importance and value, while also having the potential to be highly challenging.

Public procurement, which is a key pillar of public administration and economic policy, is also a significant component of modern economies, which in many highly-developed countries represents a large portion of both Gross Domestic Product (GDP) and governmental spending (Commission 2022, OECD 2022). As many governments have been spending significant resources creating on acquiring ICT services and products to serve the public interests, public procurement of ICT systems has become a significant segment of governmental spending on public procurement (Nyiri et al. 2023). The goals and outcomes of public procurement varies across governments, projects, and time, but in addition to efficient spending of funds, public procurement can also be used to improve or create public value for citizens (Bannister and Connolly 2014), or as a driver of innovation (Lember et al. 2014).

Despite the potential and importance of public procurement of ICT systems, a lack of empirical data on the topic of public procurement of ICT systems has been highlighted by the academic community (Moe 2014). The multi-faceted nature of the domain necessitates through research on the topic, as the creation of ICT systems, whether through procurement or through development, can be of significant challenge. In this thesis we would like to examine this topic further, while also focusing on the context of ICT procurement in large Norwegian municipalities.

1.2 Thesis Goal and Research Questions (RQs)

The main goal of the thesis is to contribute to the literature and to provide helpful insights on the topic of ICT procurement and management in the context of a large Norwegian municipality. Our focus in the thesis is thus to explore the relevant theoretical backgrounds relating to various related topics such as agility, both in the traditional software development perspective, but also from the perspectives of agile governance and agile transformation.

In addition to our theoretical focus we aim to connect this background to real cases and to examine the context that those cases exist within, and then to generate pratical insights that could be used to improve the practice of public procurement of ICT systems. By deeply exploring the context of the cases in the study we also hope to provide valuable insight on how the context of public procurement in Norwegian municipalities impact the ability to innovate and create public value.

In line with these goals we propose the following Research Questions (RQs) as the basis of our study to explore these topics: **Research Questions (RQs)**:

- **RQ 1:** What characterises the management of Information and Communications Technology (ICT) in modern public procurement in the Norwegian public sector?
  - **RQ 1.1:** What values, challenges, and strengths are present in these cases?
  - **RQ 1.2:** In which ways do the context of large municipalities in Norway impact these cases?
  - **RQ 1.3:** How is agility featured in these cases?

1.3 Case Study

To answer our research questions we have followed suggestions and methods from (Oates et al. 2022) and (Yin 2017). Our study is a case study of Trondheim municipality, where we have examined multiple recent projects involving public procurement and agility in the municipality. The type of our case study is exploratory, as there is not much literature on the specific topic we are interested in.

The study has been conducted in cooperation with Trondheim municipality. The case study is a multiple-case study as per (Yin 2017), which has examined 4 projects in the municipality. Qualitative interviews with subjects from the projects has been used as the primary source of data, and are supplemented by documents from the projects as well as an auxiliary interview. The details on the methodology is elaborated upon in the methods section.

The thesis builds upon a literature review conducted by the author on the topic of innovation and public procurement of ICT systems conducted the preceding semester, and has also gone through substantial changes in the focus of the study. Originally the main focus of the study was the role agility played in the cases, though throughout the study the focus was changed, as the data generated during the study were somewhat mismatched with the original RQs.

1.4   Contributions

This thesis provides some contributions to the fields of public procurement and information system, mainly by focusing on and exploring the domain of recent Information and Communications Technology (ICT) procurements in a large Norwegian municipality. We provide a comprehensive analysis of a set of cases in Trondheim municipality that feature agility, and explore the context of the municipality as a large Norwegian municipality to a great degree, looking at the values, strengths and challenges that emerge from our cases. Through examining a range of innovative public procurement cases the study aims to provide some specific insights into some of the complexities of procurement processes within the public sector.

Additionally, by contextualising our findings with relevant theories we hope to provide some practical insights which may be useful for overcoming the challenges encountered in the domain of ICT procurement. By focusing specifically on the context of large Norwegian municipalities and their context we aim to produce valuable and actionable insights. Lastly we hope that the findings reported in this thesis could be of use to other researchers, either as inspiration to explore related contexts, or as a set of empirical data that could be generalised to provide greater insights.

1.5   Structure

The thesis is divided into 6 chapters along with an appendix of various related documents. The overall structure of the thesis as well as the individual chapters were designed with inspiration from (Mathiassen 2017). In this first chapter we've introduced the thesis through the motivation, context and research questions. In chapter 2 we explore the relevant theoretical background through related literature that has guided the study. In chapter 3 we present the methods and processes used to gather and analyse the data in the study, as well as introducing and describing the context of the cases in our study. In chapter 4 we present the results of our study. In chapter 5 we discuss our findings, as well as reflecting on the limitations and potential for further work. The thesis itself is concluded in chapter 6, though an assortment of related documents is included in the appendix.

2 Background

In this chapter we will elaborate on some of the relevant theoretical background needed to contextualise and understand our thesis.

2.1 Digital Government

E-Government can be defined as the utilization and application of Information Technology (IT) and digital solutions in the functions of a government entity, aiming to enable and enhance the efficiency of delivering governmental services to a government's citizens and other constituents (Carter and Bélanger 2005). By utilising the rapidly evolving and improving field of Information and Communication Technologies (ICTs), e-Government can facilitate a closer and more interactive relationship between citizens and their governments, leading to a range of potential benefits and opportunities if utilised well (Nixon and Koutrakou 2007).

Through the adoption of ICTs, e-Government could enable governments to improve upon traditional bureaucratic structures and deliver services in a more agile and citizen-centric manner (Luna-Reyes et al. 2016). E-Government or digital government has been identified as a potential way to empower citizens by providing convenient access to information and services, allowing them to engage with the government and participate actively in decision-making processes, and to possibly remedy issues of citizen apathy and distrust of democracy (Tolbert and Mossberger 2006).

2.1.1 Defining Terms

Throughout this thesis we will use the terms "Digital government" and "E-Government" with somewhat different meaning and intention. How the terms are used and defined can vary in academic circumstances as well as in in practise, so for the sake of clarity we would like to briefly outline the definitions the thesis employs.

Firstly, when referring to e-Government we use the definition provided by the World Bank: "E-Government" refers to the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions." (Bank 2015).

When it comes to "Digital Government" we employ the short and more general definition: "Digital government, or the use of information technology (IT) applications in government . . ." as it is defined in (Luna-Reyes et al. 2016).

2.1.2 Public Value

"Public Value" is a term coined and used by Mark h. Moore to describe the "value", or benefit, that a public organisation or institution provides to a society through their activities, policies, and initiatives (Moore 1995). Several researchers argue that public value is a better way to measure the value or impact of a public organisation, and that public value transcends economic gains, encompassing political and social objectives such as improved efficiency in government, enhanced services to citizens, and social values like inclusivity, democracy, transparency, and participation (Twizeyimana and Andersson 2019). Additionally, several researchers highlight the usefulness of using public value as a measure of success or value in e-Government and digital government initiatives, and that you can view e-Government as a platform that has the potential to enhance governmental service delivery, engagement with the public, and the innovation capabilities of the public sector (Twizeyimana and Andersson 2019).

In this section we will discuss the potential and challenges of digital government as well as using public value to evaluate digital government.

2.1.3 The potential and challenges of Digital government and related literature

In their literature review of e-Government research, Yildiz discusses the limitations of research and literature regarding e-Government (Yildiz 2007). He discusses how ICTs have been identified in the literature as having significant potential to improve several key aspects of a government's services, such as improving inter-connectivity, the delivery of various services, the efficiency and effectiveness of the services provided by the government, interactivity between citizens and the government, decentralisation, transparency, and accountability (Yildiz 2007). However, despite this potential identified in the literature there were also significant limitations, concluding that the e-government literature suffers from definitional vagueness, insufficient consideration of the complex political and institutional environments surrounding e-government development, and a lack of process-oriented studies (Yildiz 2007).

In a paper focusing on the creation of Public Value, (Luna-Reyes et al. 2016) examines the potential of digital government in generating public value. The study concludes by emphasizes the importance of legal frameworks in shaping organizational practices, collaboration, and technology characteristics, thereby contributing to public value creation. Collaboration is identified as a key factor in value creation, and is argued to be of more importance than the characteristics of specific technologies, and the study highlights the need for improved collaboration models (Luna-Reyes et al. 2016). The authors also provide some practical guidance arguing that the internal processes, goals, and technology standards used in digital government projects has the potential to enhance the success of the projects and creation of value (Luna-Reyes et al. 2016). The study emphasises the importance of laws and regulations as aspects that can facilitate or hamper collaboration and technological development, and concludes that combining ICTs with collaboration can be an effective way of creating public value (Luna-Reyes et al. 2016).

In their review titled "The Public Value of E-Government", Twizeyimana and Andersson elaborate on the multi-dimensional aspect of public value in e-government implementations (Twizeyimana and Andersson 2019). The authors identify and categorise the public value of e-government into six dimensions that are part of three main dimensions: "Improved Public Services", "Improved Administration", and "Improved Social Value" (Twizeyimana and Andersson 2019). Within these overarching themes, they pinpoint six sometimes overlapping dimensions: "Improved Public Services", "Administrative Efficiency", "Open Government (OG)" Capabilities, "Ethical Behavior and Professionalism", "Improved Trust and Confidence in Government", and "Improved Social value and well-being" (Twizeyimana and Andersson 2019). The dimensions identified in the paper are visualised in figure 1. The article also highlights a general aim of governments to use ICTs to the relationship between the government and the citizens, which in turn can influence democratic processes and government structures (Twizeyimana and Andersson 2019). The authors conclude the review by advocating that "Public Value" should be gauged by the impact of e-Government on governmental actions, policies, and services for citizens (Twizeyimana and Andersson 2019).
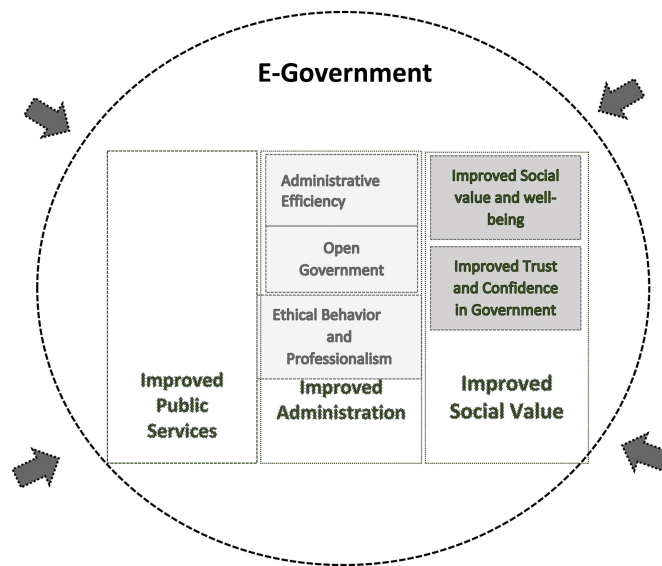
Figure 1: Fig 1 (taken from Twizeyimana and Andersson 2019): Generalization of the six dimensions of the public value of e-government into three main dimensions – a graphical representation..

3   Methods

In this chapter we will outline the data generation and data analysis stages of the study, delving into the methods and tools used throughout the process. The first section outlines the high-level context of the case as well as the processes that were performed to collect the data for the study. The second section describes the processes that were undertaken to process and analyse the data after it was generated. Lastly, the chapter is concluded by a more descriptive case description where we outline the context of the organisational units and cases featured in the thesis.

3.1   Data Generation

In this section we will outline the process that was employed during the data generation stage of the study, starting with a short introduction to Grounded Theory and the implactions of using Grounded Theory. In the second part we will outline the planning stage that was conducted prior to the start of the thesis, as well as the planned approach and expected outcomes. In the final part we will then briefly outline the execution of the data generation phase of the study as well as the complications that arose throughout it.

3.1.1   Grounded Theory

Throughout the study we have attempted to follow the basic principles of Grounded Theory. Grounded Theory, as proposed by (Glaser and Strauss 1967), is a qualitative research methodology with the goal of generating theories grounded in empirical data. In Grounded Theory an inductive approach is taken rather than a deductive approach. This approach focuses on systematically collecting and analysing data to develop substantive theories that are deeply rooted, or *grounded* in the field data (Glaser and Strauss 1967).

To start of the process the researchers identify a single participant or instance of data and then expand from there, slowly moving from unstructured data generation to more structured (Glaser and Strauss 1967). Rather than starting with predetermined theories or hypotheses, the researchers instead follow an iterative and continuous process of generating data, then analysing that data to identify key themes and theoretical concepts, until successive iterations does not yield any further changes to the theory that has been emerging and the data, at which point the research has reached *theoretical saturation* (Glaser and Strauss 1967). The theories that are derived from this process should ideally have practical relevance for the participants that are studied (Oates et al. 2022).

Although Grounded Theory offers valuable insights and can lead to robust theoretical frameworks, researchers may encounter some challenges when utilising this approach in their research. One of the main challenges is the intensive and time-consuming nature of repeated cycles of data generation and analysis. Grounded Theory requires researchers to engage in extensive fieldwork, conduct in-depth interviews, and immerse themselves in the data to identify patterns and concepts. This process demands considerable time, effort, and resources, which can pose practical constraints.

3.1.2 Planning

The main planning stage of the study started at the start of the Autumn 2022 semester, one semester before the study and thesis were formally started, and concluded around January of 2023 the following semester. The planning of the study was conducted in concert with a literature review on the topic of Innovation and Public Procurement of ICTs. The study itself as well as the bulk of the work on the thesis was conducted during the Spring 2023 semester.

The planning started with a conceptualisation stage that involved the author, the supervisor on the thesis, as well as a contact person from Trondheim municipality, to formalise a starting point and approach to the study. Throughout the semester the author continued working with the contact to select a set of cases to start the study with, and to ensure that the thesis could yield practical insights of relevance to the municipality. This was an iterative process, inspired by Grounded Theory, and towards the end of that semester a set of cases that fit with the goals of the study had been identified. Throughout the month of January of 2023 a process of unstructured and informal interviews with key stakeholders in the various cases that were identified in the preceding semester were conducted. The goal of these interviews was to further refine the approach and goals of the study, to identify key personnel to interview during the next set of interviews, as well as to get approval from the relevant stakeholders in each case. While the study was conducted on cases from Trondheim municipality, the municipality is quite large by Norwegian standards as the fourth largest city in Norway (defined as a "metropolitan area") (Norway 2022), and consists of many large and small organisational units, so receiving approval from stakeholders was an important prerequisite.

Throughout January and February the initial planning was concluded, after a total of six meetings with seven different stakeholders, resulting in a set of five initial cases for the next stage of the study. Originally the focus of the study was somewhat different, focusing more on agility, and the cases were selected based on this, though this focus later shifted. The plan was to conduct around eight to twelve semi-structured interviews, and to continue to use snowballing to identify further potential subjects to include in the study.

The main method used to generate data was interviews. The original intent was to interview 2 - 3 individuals from each case depending on availability and access. All of the interviews were intended to be performed in-person and individually. The participants were informed that the interviews would take about 60 to 90 minutes, including some time at the start and end of the interviews to sort out consent forms, basic information about the structures of the interviews, and to identify other individuals that might be of interest to interview through the practice of snowballing.

3.1.3   Execution

In the weeks following the conclusion of the planning stage a total of ten initial invites to interviews were sent out as part of "Wave 1", prioritising individuals that represented management in the cases. While examining agility was the initial focus of the study we wanted to focus on non-technical personnel to investigate their experiences of agility and how well agility was understood in the cases. From those ten invitation six responses were received, and of those one potential participant declined to participate. Of the five participants that accepted four of individuals represented four of the five cases that were originally planned to investigate. The participants in the study are displayed in table 1. In the table we included the format of the interview as well as the recording technology that was employed. Pseudonyms are used throughout the thesis.

Participants:

Participant	Format	Recording
Aksel	In-person meeting	Sound recording
Hanna	In-person meeting	Sound recording
Emilie	In-person meeting	Sound recording
Olav	In-person meeting	Sound recording
Ulrik	Digital meeting	Sound recording
Henrik	Digital meeting	Sound recording

Table 1: The participants, format, and recording method used in the interviews

As can be seen in table 1, the second interview involved two participants. This was originally not planned, as was mentioned in the planning section the intent of the study was to perform individual interviews, however, we decided to include both participate in the interview as the second participant was unable to schedule another interview. Additionally, the two last interviews had to be conducted digitally, in the first case because the participant fell ill and was unable to reschedule the interview, and in the second case because no convenient physical locale was available on the day of the interview. While the original intent was to perform physical interviews the format of the interviews were not considered to be of major importance, and in both of the digital meetings video conferencing tools were used. As noted in the recording tab all of the interviews were recorded using sound recording, including the digital interviews, were only audio was recorded for the sake of privacy.

Following the original plan, after the first set of interviews were concluded a second round of interviews was planned as part of "Wave 2", as we still wanted to collect more data and had identified more potential participants. Unfortunately these plans fell through when the author fell ill for a few weeks, which made it infeasible to conduct any more interviews as the end of the semester and thesis was approaching. This necessitated a change in approach, which shifted the focus during the data analysis stage.

Participant Roles:

Case	Participant	Role
Case 1	Aksel	Project Management
Case 2	Hanna	Case worker
Case 2	Emilie	Case worker
Case 3	Olav	Project Management
Case 4	Ulrik	Project Management

Table 2: The cases and related participants as well as their roles in the projects

An overview of the cases that were explored during this phase as well as the participants' roles in those cases is included in table 2. The participant "Henrik" is not included in this table, as that interview was not part of the primary study, but rather intended to provide context. "Henrik" is an individual in Trondheim municipality that works with the management of public procurement projects, and that interview focused on some of the more technical aspects of procurement, in the

sense of laws and regulation surrounding public procurement in Norway. As can be seen in the table most of the participants in the main study represented project management roles, with the exception of Case 2, which involved case workers. Details are included in the Case Description section of this chapter.

Interviews: The Interviews were planned and designed around recommendations from (Oates et al. 2022) and (Baškarada 2014). The interviews process consisted of three stages, which were adapted from the adapted model in (Baškarada 2014), which is itself adapted from (Kasunic 2010). The three stages of the interview process were "Orientation", "Information Gathering", and "Closing", which can be seen in 2, taken from (Baškarada 2014). Prior to the Orientation stage all of the participants were provided with a document describing the purpose, goal, and methods of the study along with the invitation to participate as per guidelines and regulations of Sikt, the Norwegian Agency for Shared Services in Education and Research (Sikt 2023).

Table 3: Interview Process, adapted from [25, p. 77]

Orientation	Introductions and exchange of contact details. Description of the study and the interview process. Clarification of any expectations regarding non-attribution, sharing of data, and any other issues.
Information Gathering	The interviewer uses a questionnaire to guide the interview and to record responses.
Closing	The interviewer reviews the key points, any issues, and/or action items, and confirms accuracy with the respondent. The interviewee is invited to provide feedback on the interview process. The interviewer thanks the interviewee and seeks permission for any future contact.

Figure 2: Table 3 (taken from (Ba˘skarada 2014): Interview Process, adapted from (Kasunic 2010)

For each interview a 90 minute long meeting was booked. Each of the meetings started with orientation, which consisted of introductions as well as a description of the topic and plan for the interviews. In addition to the information provided during this stage each participant also received a e-mail prior to the meeting about the topics of interest. Additionally, the privacy rights of the participants were explained, and consent forms were collected. During this stage no recordings or note-taking took place.

Then after orientation concluded the information gathering stage initiated, and recording of the interviews were started after the participants were informed. The interviews were semi-structured in nature, covering a range of different topics following a interview guide which was prepared beforehand, some of which are displayed in table 3 along with examples of the questions that were presented to the subjects.

Theme	Questions
Context	What role did you have in the project(s)? When did the project start (and end)?
Project Practice	Where "sprints" used in the project? What form did deliveries take?
Agility	How would you define "Agility"? Was Agility a part of the project(s)?
Suppliers	(How) did you cooperate with the supplier during the project? Where there any disagreements with the suppliers throughout the project?
Contracts / Legislation	(How) did laws and external expectations impact the project? Did any changes in regulation during the project impact the project?

Table 3: An overview of the general themes discussed in the interviews as well as some examples of questions that were prepared.

While the subjects included in the interview guide were all visited in all of the interviews not all of the topics were relevant in each of the cases, and some topics which were identified as unique or of particular interest to the stakeholders during the planning stage were included in addition to those from the interview guide. Additionally, the interview guide went through a revision after each interview, though only the first couple of revisions were major. Some notes from each of the interviews were generated in addition to the recordings of the interviews. Due to the variance in relevance when it comes to the topics the interviews varied significantly in duration, which is included in table 4 (the duration is determined by the recordings, and only covers the "information gathering" stage).

Interview	Length
Interview 1	87 minutes
Interview 2	47 minutes
Interview 3	58 minutes
Interview 4	65 minutes
Interview 5	29 minutes

Table 4: The length of the interviews (based on audio recordings)

Finally after giving the participants the chance to bring up any comments or topics as part of the interview the information gathering stage was concluded, and the recording stopped. This lead into the closing stage, where the participants were asked to recommend other potential participants for us to contact as well as discussing auxiliary documents on each of the cases. The documents gathered for this related to the projects, and were used only to describe the context of the cases and not as a unit of data for analysis. Lastly the participants were thanked for their participation and asked for any closing comments or remarks.

3.2 Data Analysis

In this section we will describe the processes used during the data analysis stage of the process. The first part describes the transcription as well as the reasoning for using the methods we employed. The second part covers the coding stage, and the final part covers the construction of the thematic network.

3.2.1 Transcription

The audio recordings obtained from each individual interview were transcribed by the author by using the intelligent verbatim approach.

Intelligent verbatim transcription, which is also known as clean or edited transcription, is a method that involves transcribing audio content while omitting filler words, false starts, and repeated words to maintain the clarity and readability of the transcribed text. The approach is intended to preserve the original intent and context of the speaker's message, but results in a clean, concise document that is easier for the researcher and readers to comprehend. It strikes a balance between verbatim transcription, which includes every utterance, and summarized transcription, which only highlights the key points.

This method was chosen to maintain the intent of the participants, but without adhering to it too closely, as the exact wording used did not matter. In our case, we decided to exclude non-essential elements, such as filler words like "uhm" or "ah". The interviewees' names and any identifying information were also systematically removed to ensure the process of anonymisation. False starts and repeated words were actually retained though, mainly to avoid potentially altering the context of the participants' statements, even if we deemed that to be unlikely, as the additional labour and effort this incurred was minimal.

For the transcription stage and the subsequent data analysis stage, we used NVivo, a popular software tool used in qualitative data analysis. Initial transcription was conducted directly within the NVivo software, and the software was again used later on during the coding stage. During the transcription process we maintained the original language of the interviews, Norwegian, which was the language used in all of the interviews.

3.2.2 Coding

After completing the transcription process, we moved on to the coding of the transcripts, which was performed across several stages. In the first stage we followed the recommendations from (Oates et al. 2022), separating the data units into three distinct categories: "Unrelated", "Contextual", and "Relevant". For the rest of the coding, the process followed recommendations from (Attride-Stirling 2001). In these stages, we adopted an inductive approach in combination with a specific focus on data relevant to our initial research questions.

In qualitative research, the inductive and deductive approaches are important tools during coding and in the creation of categories. An inductive approach is often used when new patterns, themes or categories need to be discovered from in the data (Oates et al. 2022). This approach involves creating categories and identifying patterns as they emerge during data analysis, allowing for insights that are firmly grounded in the data itself. Conversely, the deductive approach starts with a predefined set of categories or themes, typically drawn from theoretical frameworks, and applies them to the data. While this approach is more structured and allows for a systematic exploration of the data, it may potentially limit the discovery of unexpected patterns or themes (Oates et al. 2022).

After all of the relevant sections of the transcripts were broken down into codes the full transcripts were reviewed in context of the formed codes. During later stages of the coding the first two categories (Unrelated and Contextual) were reviewed, and units of data that in fact were relevant were then added to the related codes.

3.2.3 Thematic Network

In this section we will outline how we constructed the thematic network.

About Thematic Network Analysis

Thematic network analysis is a method used to organize and depict themes derived from qualitative data (Attride-Stirling 2001). The analysis involves extracting basic themes from the data, which are then grouped into organising themes that summarise more abstract principles. The highest level of themes is the global themes, which encapsulate the main metaphors in the entire text. Thematic networks are represented as web-like maps, illustrating the relationships between themes at different levels. The process involves moving from basic themes to organizing themes and finally to global themes. The networks provide a tool for interpretation, emphasizing interconnectivity and fluidity among themes (Attride-Stirling 2001).

The analysis process consists of three stages (Attride-Stirling 2001). In Stage A, called "Reduction or Breakdown of Text," the text is coded using a coding framework, dissected into text segments, and themes are identified and refined. Thematic networks are then constructed by arranging the themes, selecting basic themes, rearranging them into organizing themes, deducing global themes, and illustrating them as network diagrams. In Stage B, called "Exploration of Text," the thematic networks are described and explored, providing a deeper understanding of their content and connections. In Stage C, called "Integration of Exploration," patterns within the thematic networks are interpreted to derive meaningful insights (Attride-Stirling 2001)

Thematic Network Construction

After the development of a wide collection of codes, we moved on to the next phase: refining the codes into a thematic network. During this process, codes were clustered together, modified somewhat, or significantly redefined. After this stage we followed the recommendations of (Attride-Stirling 2001) to create a set of basic themes, the categories of codes formed the organisational themes, and the global theme was identified after grouping the categories of codes.

The thematic network is presented in chapter 4, results, though we would like to conclude this section by briefly outlining how the quotes that accompany the thematic network in the results were translated. To illustrate the various basic themes, we selected multiple quotes from the transcripts. The selected quotes were translated into English by the author to ensure a faithful representation of the participants' intentions. For purposes of transparency and rigour, we have provided the original Norwegian quotes alongside their English translations in the Appendix A.

3.3   Case Description

To conclude this chapter we will briefly discuss the projects and the context of each of the projects that are featured in the case study. Understanding the context of the projects in the study helps to contextualise the results. While our goal is to provide a thorough view of these projects we must balance that with the concern of maintaining confidentiality and privacy, and thus the projects are desribed in a general way.

All of the cases included in our study feature recent projects that are either ongoing at the time of writing or concluded within the last few years. The cases are not described in any specific order.

3.3.1   Case A

This case covers an ongoing project that involves the procurement of both ICT systems as well as physical devices. The project started out as a small pilot executed by one employee from Trondheim municipality as well as one external consultant, with an overall small budget (for a public procurement project). The pilot was intended as a proof-of-concept, and while it did encounter some challenges along the way the pilot was considered a success by the municipality, and the intent was to significantly scale the project.

Throughout the project the municipality was able to identify additional functionality that would provide significant value to the organisation as a whole, which further contributed to the project growing. The project encountered some organisational challenges involving politics, privacy, and needing to update internal guidelines, but were able to overcome these challenges without significant issue.

3.3.2   Case B

This case covers an ongoing project that involves the procurement of an ICT system to update and extend a legacy system. The project started out with a waterfall-style development plan, but transitioned to an agile workflow after some difficulties. The project has been significantly delayed, and has had some issues with intra-organisational cooperation, as the project originally started out as a collaborative project with another unit in the municipality.

In addition to changing the method of development towards agility the project also changed the reward-structure in the contract to encourage the supplier to create additional value outside of the specification through incentives. While there were significant challenges throughout the lifetime of project the state of the project as per the time of writing was identified as significantly improved by the municipality, despite the delays.

3.3.3   Case C

This case covers a project that involved the procurement of an ICT system to update a legacy system in the organisation. The project consists of several procurements of different, but related ICT systems. The first of these procurements were successful, and the intent was to use this ICT product in another system to be developing in another procurement. This second procurement ended up failing and being cancelled by the municipality after some significant challenges and issues between the municipality and the supplier relating to delays and disagreements about deliveries. Despite the failure of the second procurement the municipality was able to make use of the ICT product from the first procurement to realise their organisational goals with a different approach.

3.3.4   Case D

This case, similar to the other cases, involved the procurement of an ICT system to update a legacy system in the organisation. The project encountered some challenges throughout the development

of the system, as well as when transitioning from development to maintenance, but concluded successfully. Notably, the municipality has spent significant time and efforts after the conclusion of the procurement to not only maintain the system, but also to correct faults in the system. These challenges are resolved internally in the municipality rather than through the use of an external supplier.

3.3.5 Impacts of the Covid-19 Pandemic on the study

Before moving on to the results we would like to briefly mention how the Covid-19 pandemic influenced the study. One of the original topics of interest in the study was the nature of the collaboration between the employees in the municipality and the employees in the supplier organisations. Certain questions pertaining to nature of the collaboration, such as how many developers were working on-site as well as how much time was spent by the external developers on-site were asked, but the cases, who all spanned partially or fully through the Covid-19 pandemic, when working from home and digital presence and meetings became commonplace, were impacted to such a degree that this was a theme that we ended up shifting away from, as there was not any significant insights provided in the generated data.

4   Results

In this chapter we will introduce the results of our study through the use of a thematic network. The main section of this chapter covers the topic of our results, which is "ICT Management in Trondheim Municipality", which includes three categories which are explored in turn: "Values", "Strengths", and "Challenges".

4.1   ICT Management in Trondheim Municipality
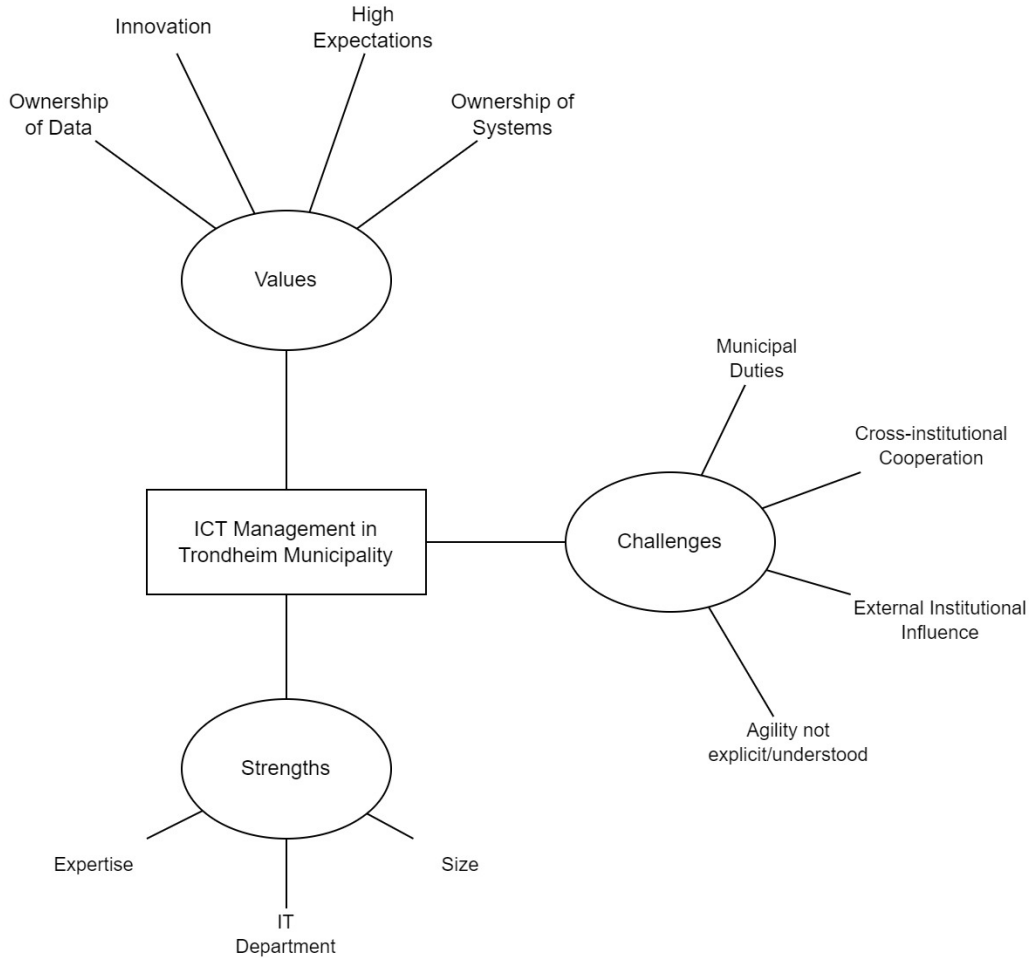
Figure 3: Thematic Network constructed based on recommendations from Attride-Stirling 2001

Throughout the process of conducting the interviews and later again during transcription and analysis, several recurring themes that to various extents were present throughout multiple or all of the 4 cases in our study were identified. These themes are presented in figure 3, which was constructed by following recommendations and the guidelines presented in (Attride-Stirling 2001) to merge several similar or related themes into basic themes, which are then grouped according to their organisational themes, which are all linked together into the global theme "ICT Management in Trondheim Municipality".

While all of the cases feature Public Procurement and our main focus is on analysing these cases in the context of public procurement, the thematic scope is wider, including processes performed in Trondheim municipality before and after public procurement as well. Additionally some of

the themes encountered throughout the study are relevant not only to public procurement, but also in the wider scope of ICT management, and thus the global theme is widened into "ICT management".

Throughout the rest of this section we will present the findings from our study following the organisational and basic themes presented in this figure. Some of the themes within or across organisational themes are considered related, such as "Ownership of Data" and "Ownership of Systems" being strongly related, and were identified as distinct themes when the context differed to a significant enough degree that splitting them up was warranted. Similarly, some basic themes across organisational themes are correlated, such as "High Expectations" and "Size".

As mentioned in the methods chapter, the appendix includes a table of all of the quotes as they are presented here, along with the original Norwegian quotes in the order of appearance.

4.1.1 Values

In the cases we studied we encountered several common values that were identified by the participants as important. The values of the organisation and the individuals it is comprised of impacts the procurement processes to a significant degree. In this section we will explore some of these values that were identified in our cases.

Innovation: In general all of the cases we studied involved some significant amount of innovation. As mentioned in the case description most (3 out of 4) of the cases involved replacing or updating a legacy system, but in each case the scope widened to be more than just a simple update. In one of these cases the participant remarked upon how the expansion of the scope happened:

"When [the system] failed we only expected that it would be an [update], only stable. So it was just that for our sake. So when a project group was put together and you could look a bit more at 'what can we do?' it was the IT department that was part of and saw that we could achieve [more functionality] into one and the same package. So it has become a lot better than we could have imagined." (Hanna)

In another of the cases more significant innovation, in that case through the use of new technology, was a significant goal:

"In the meanwhile we caught on to a solution related to machine learning. Then we started discussing, why not try out machine learning? . . . we looked at using the machine learning model in different scenarios, where we tested using machine learning to [process] everything." (Aksel)

Another participant highlighted and reflected on how their project was part of a larger effort to modernise the municipality:

". . . in a way it fits with the goals of Trondheim municipality, such as data-driven municipality, sustainability goals. In a way everything points towards this being something that should affect the entire municipality, so I have not had to fight hard to get [the project] bigger. It has in a way just been pulled upwards . . ." (Ulrik)

High expectations: While large projects and high expectations is certainly not always the norm it was identified throughout several of the cases that Trondheim municipality in several projects operates with higher expectations and demands, which can sometimes cause friction with suppliers. The difference in magnitude was brought up by one of the participants:

"What is certain, is that Trondheim municipality will not be working in the same way as in a smaller municipality, where you can click your way through 5 000 [cases] and [process] them in a year, that is not possible. We need to be able to see the large mass, we need to be able to [process] the large mass, and then we need to use our time on the things that do not fit with the large mass." (Aksel)

One point that was remarked upon by one of the participants is how the supplier market is not necessarily well-suited for large municipalities even if they spend more, and that the needs of large

municipalities differ from smaller ones:

"Then I think, as I've said earlier, [suppliers] have a lot of small municipality [clients]. A thing that they say are only a few clicks ends up being a lot more clicks for us. So we wanted to have as much automation as possible. Rather that the exceptions come out, so that 'you need to look at or process this' and the rest is fine." (Olav)

As a larger municipality Trondheim municipality has access to more resources and expertise, but this also means that they have higher expectations, and like we explored in the previous section, higher ambitions for innovation.

Ownership of Data: Throughout several of the projects one important ideal that was present was the idea that Trondheim municipality should be the owner of the data from the projects, as mentioned by one of the participants:

"So we have shaken up the field . . . and in a way [we] wish for this to be the philosophy in the entirety of Trondheim municipality, so that regardless of what you're talking about, there should be free data-streams that we can use and manage as we wish. There is a problem here, in infrastructure in general as well there is the problem, that there are actors that are very large, who have systems that do not share data. Our dream, in a way, is to capture all of the data in [Trondheim municipality] and use it as we wish, and to have data-analysts that can analyse [data] in a smarter way than how we are currently doing now." (Ulrik)

In another case the participant discussed how suppliers can resist this and attempt to close their products throughout the development of the project:

"They [suppliers] try to close [the product], so that they can sell us additional services. How it ends up being in the end we'll have to see, . . . but the data itself will be stored in a database outside [of the supplier's product]. So that we can change [equipment], type[of equipment], technology to collect data, and all of that we can change, but we have the data, because analysing the data is what is of interest to us. We have been very conscious about that." (Olav)

Ownership of Systems: In addition to ownership of data several of the participants also stressed the importance of ownership of the systems created during the procurement process:

"Another thing, is that I think the way we have handled it in the [software system], where we have used assistance from consulting services to create an application or service, and then it is Trondheim municipality that owns the application and source code." (Aksel)

Another participant reflected on the state of the market and the risk of "lock-in":

"Yes, the market is settled. The actors have not been properly challenged, there's a lot of what you call lock-in, . . . where a [supplier] owns the entire value chain, from [equipment], to collection [of data], to database, to an analysis tool. That is the standard after all, and has been until now, and has been something all municipalities struggled with, managing to unlock their systems. That was something we wanted to challenge, and has challenged extremely hard I would say, and categorically denied all solutions that do not have an open philosophy for data sharing. And if you do not have an open philosophy for data sharing, if you demand extra to use [specific equipment], then we have said no, ... That has resulted in the supplier developing a model that is independent from their own system, and it has excluded suppliers that had a complete package [lock-in] before." (Ulrik)

Overall, whether it be through ownership of systems or data specifically there seems to be a clear trend towards the municipality avoiding lock-in of systems and recognising the importance of their data in these cases.

4.1.2 Strengths

Throughout the cases in this study we have identified several key points that pointed towards specific qualities that makes Trondheim municipality stand out from other municipalities. Some of these strengths can be argued to be the result or highly correlated with the sheer organisational

size of Trondheim municipality and would likely also apply to other large Norwegian municipalities, but this is not the case for all of the identified strengths. Notably the IT department was identified throughout the cases as an important factor in their projects.

Expertise: Trondheim municipality consists of several organisational units with a wide range of expertise across the organisation, and being able to tap into and rely on this internal expertise was highlighted by one of the participants as being highly beneficial:

"So now I have a lot more people around me that can help me out with [the project]. I have the data protection officer tightly involved, and the communication department to share information about [the project] . . .. For procurement I have a guy from IT that helps me a lot with the procurement of technical materials . . .. So having IT-resources with me has been very nice for me at least, now that we are going to scale the [ICT system] as much as we are doing now. Additionally there are a lot of others in the organisation that has been involved in short roles, such as advisors on specific topics." (Ulrik)

When it comes to expertise one point that was mentioned by one of the participants was that Trondheim municipality also relies on external expertise through the use of consultants to assist in their projects:

"We would have never managed to pull this off without using a ton of money [on consultants]. That has been very clear, we would not have stood a chance." (Olav)

Being able to rely on internal and external expertise was thus seen as an important driver of success in the projects.

Size: Highly related to the topic of expertise is the size of the municipality organisationally speaking:

"Yes, and it is nice to be a large municipality, in a way we have experts instead of having one person that knows everything. Now I have sort of become the person that knows a lot about [the domain], and that is mainly personal interest, but luckily I have experts that I can lean on in matters of privacy, IT, database structuring, and such things, and that is very good." (Ulrik)

We would also like to point to bring back the quote used previously in the section about High Expectations, as it is also a salient point on how the size of the municipality impacts their behaviour in the markets:

"What is certain, is that Trondheim municipality will not be working in the same way as in a smaller municipality, where you can click your way through 5 000 [cases] and [process] them in a year, that is not possible. We need to be able to see the large mass, we need to be able to [process] the large mass, and then we need to use our time on the things that do not fit with the large mass." (Aksel)

IT department: The IT-department of the municipality, which is responsible for maintaining the municipality's ICT systems as well as provide expertise was mentioned in all of the cases, and one of the participants remarked on an observed improvement in their capabilities compared to in the past:

"So we have shaken up the field . . . and in a way [we] wish for this to be the philosophy in the entirety of Trondheim municipality, so that regardless of what you're talking about, there should be free data-streams that we can use and manage as we wish. There is a problem here, in infrastructure in general as well there is the problem, that there are actors that are very large, who have systems that do not share data. Our dream, in a way, is to capture all of the data in [Trondheim municipality] and use it as we wish, and to have data-analysts that can analyse [data] in a smarter way than how we are currently doing now." (Henrik)

In one of the cases the participant highlighted how the municipality can use their internal IT resources in the IT department on smaller fixes and improvements to allow the municipality to be more self-served:

"And then we have seen that we want to be a little more self-served in specific things. That we

as a group, or that Trondheim municipality, can solve things on the lowest possible lever, or as close to the users as possible, unless it is very technical of course . . .. Now in a way it is [the IT department], the management contract is via [the IT department], so they are also involved in this. We have put in [employee] as the main resource, so she uses a lot of time coordinating things." (Emilie)

4.1.3 Challenges

As opposed to strengths, the challenges encountered in these cases are not all as universal, nor is this necessarily an exhaustive description of the challenges encountered in the cases, but rather a description of challenges that were mentioned or discovered across multiple cases.

Municipal Duties: In all of the cases one challenge that in various ways, such as causing delays, was identified by the participants, was the municipal duties of the employees involved in development and testing, as these are typically normal case workers who still have other duties that needs to be attended to.

One of the participants remarked that this fact made it more challenging to work in or with agile processes such as sprints:

"It is kind of like we can't just let go of everything, all of the case officers can't just let go of [all cases] for three weeks just to work with a sprint, that would, in a way, not work." (Emilie)

Another complicating matter that was mentioned were the various stringent deadlines some of the departments, like the ones working with calculating and collecting taxes have to work with:

"They had a deadline [in November] where they were going to deliver the finished system to us, and they said that they had delivered it, and we replied that we did not have enough time to perform acceptance testing, so we delay it [half a year], because now we need to write out [taxes] . . .. That is sort of part of the challenge when you are working with [taxes], that if you are going to implement [taxes] you have an absolute deadline, and that is the 1st of March. The year you are informing the citizen that [taxes] have been set, you have an absolute deadline, and that is the 1st of March, or you lose the grounds for income completely. That is the risk in all of this." (Aksel)

Using real users such as case workers for testing is important in terms of validating deliveries and quality, but this seems to be challenging for the municipality to achieve, as these employees are still expected to fulfil their normal municipal roles and duties on top of their work in the projects.

Cross-institutional Cooperation: In some of the cases cooperation across different public institutions were highlighted as challenges. One participant stressed how challenging it can be when the cost and benefits of conducting a project or mainting a system is spread across different public institutions:

"But the [national] government has to be willing to spend money on [ICT investments], and it is the municipalities that take out the efficiency gains. That is partially the challenge in public operations, that efficiency gains are achieved in other units and domains than where the service is invested in." (Aksel)

Later in the same interview the participant also mentioned the possibility of sharing their own ICT system with other municipalities, but noted again that resolving the cross-institutional cooperation barriers was challenging:

"[The software system] that we made, could in principle have been used in the entire country. There is no limits on using it. Who is going to take responsibility for running it, what is it going to cost to maintain it? Yes, we would have done that now, we have to do that now, but this could maybe have been a societal task for the Norwegian Tax Administration?" (Aksel)

External Institutional Influence: In two of the cases the influence of other public institutions were mentioned. In one of the cases the lack of national guidelines were a challenge that the municipality had to overcome during the project while not being able to wait for those guidelines

to be updated:

"But it requires a lot, just the clarification regarding privacy, because we do not have any regulations to rely on on the national level, so we have to interpret it ourselves, based on laws and regulations that we kind of have to find our selves. So we have worked very closely with the privacy specialist in Trondheim municipality, to know what we can do. This is personal sensitive data, it isn't the worst sort, but it is something that you in way, could create a pattern of behaviour on a actor or individual . . . so we have sensitive data, and thus have to handle it appropriately, and in [the field] it is a matter of judgement and the Norwegian Data Protection Authority is involved on a higher level, but they are sort of very far behind us, and we do not want to wait for them, so we have chosen a conservative interpretation and are proceeding. And there is nothing in the regulations that says that we cannot do it, and we are kind of certain that our interpretation is valid when we interpret [laws and regulations] in such as conservative way as we are doing. But they are time-consuming processes, also with the [regulations in the department] that we have had to change as well." (Ulrik)

In another interview, one of the participants reflected on how their work was influenced by municipal politics and local elections:

"What we work with is politically controlled, which follows the municipal election. So every four years there is a change of guidelines and frameworks that we work within, so things should sort of keep going through four years, then you might have to start over again, and then maybe you have a political correction or something or other that makes it so that you have to make a change, so we are maybe never going to be [completely done]." (Emilie)

For context, in Norway municipal elections are held every four years.

Agility not explicit / Understood: While the focus of our research shifted somewhat away from Agility it was still a topic of discussion during all of the interviews, and some of the participants mentioned that despite agility being a part of the project to some extent, this wasn't always fully understood or explicit. In one case it was remarked that while the leadership in the project had a goal of working in an Agile way, this may not have been practically achieved on the lower organisational levels:

"I think the idea of Agile development is very good, but both us and the supplier have struggled to make it work actually . . .. Internally in the steering group, they understood [agility], but there was something or other that disappeared along the way when we got down into the groups that [were developing], then it was kind of completely gone. Either it was poor internal communication on their side, or they had not actually understood what they were going to be part of, simply put." (Olav)

In one case the participants, who were case workers rather than leaders or management, did not have a formal understanding of the concept of Agility, though the software development of the project followed several agile practices such as sprints. When asked about what they thought "Agility" entailed, this was one of their responses:

"I do not think we ever used the word "Agility" . . .. I think I sort of unconsciously think that [Agility is] "this should make things better and thus more agile, for [the users], our controllers performing controls, and for us at the office. That all functions should run more "agile" for everyone, because you avoid [paperwork], you avoid a lot of those small detours and such things." (Emilie)

Proper understanding of agility in projects that follow or employ agile practices seems to be a challenge in the municipality.

5 Discussion

In this chapter we will discuss the outcomes of our study, reflect around the limitations of the study, as well as suggestions for future work. The first section addresses the research questions, the second section discusses the limitations of our study, and the last section of this chapter suggests potential areas for future work to be done.

5.1 Addressing Research Questions

To begin this chapter we will discuss our results in the context of our research questions to try to answer these research questions. The first, and main research question in our study was "What characterises the management of Information and Communications Technology (ICT) in modern public procurement in the Norwegian public sector?", which is arguably a bit difficult to answer as a whole, so we will instead break it down and focus on the sub-research questions. Each of the three sub-research questions is elaborated upon in their own sections.

The first sub-research question was "What values, challenges, and strengths are present in these cases?", which is explored in section 5.1.1. The second sub-research question was "In which ways do the context of large municipalities in Norway impact these cases?", which is discussed in section 5.1.1 and 5.1.2. The last sub-research question was "How is agility featured in these cases?", which we will reflect around and discuss in section 5.1.2.

5.1.1 Values, Challenges, and Strengths

There were multiple important values, strengths, and challenges present throughout the projects we studied. The themes identified relating to values were "Ownership of Data", "Ownership of Systems", "High Expectations", and "Innovation". In the projects an important goal for the participants was that the municipality should own as much of the data and ICT systems produced in the projects as possible. There were multiple reasons for this, some practical such as avoiding lock-in or being able to be more flexible with their technologies and such, which relates heavily to the public value of "Administrative Efficiency" (Twizeyimana and Andersson 2019). The participants also expressed the intent to use the data produced by their systems and the systems themselves to provide value for other parts of the organisation or their citizens, leaning towards the dimension of public value that is "Open Government" (Twizeyimana and Andersson 2019). Contrary to how some literature portrays the public sector as being only focused on cost-efficiency all of the cases in our study featured heavy aspects of innovation and high expectations of the suppliers to produce value.

In terms of the challenges encountered in the projects included in the study, we found that the challenges varied more from project to project, though there were some recurring challenges. These recurring challenges that were identified are "Municipal Duties", "Cross-institutional Cooperation", "External Institutional Influence", and "Agility not Explicit / Understood". The last challenge will be discussed in more detail in the X section, since it is strongly related to the last sub-research question. The "Municipal Duties" challenge was the most recurring one, and was present through all of the cases. The employees in the municipality found it challenging to participate in ICT development while also attending to their main work in the municipality, and this challenge was identified to be a significant contributor to delays, though how these delays manifested varied more significantly from project to project based on the organisational context of the relevant unit in the municipality. Interaction with other units within the municipality or in external public organisations such as other municipalities or national institutions was another important challenge, which could hinder productivity and efficiency in the public sector.

The large municipality context

The final category of themes, Strengths also relates to both the first and second sub-research questions. The three main strengths identified in the study were "Size", "Expertise", and " (Mu-

nicipal) IT department". Overall all of the strengths are related in that they are influenced by the resources of the municipality. One notable result though is how Trondheim municipality is able to effectively wield their expertise and resources to overcome certain challenges. Going into the study, the authors expected legislation and regulation, such as the privacy regulation GDPR, to be more significant challenges in the projects, and while they were mentioned in some of the cases the participants noted that through the use of their internal experts on the related topics that the challenges were not significant in the projects, despite this being a challenge identified in the literature. Additionally, the IT department in the municipality was highlighted as very valuable in all of the cases in our study, and as mentioned in the results section, one of the participants remarked that the department had improved in the last few years, which indicates that Trondheim municipality has been able to effectively build up the resources and talent in the IT department.

5.1.2 Agility

As discussed previously, the importance of agility was originally more of a focus in the study, but due to the limitations of the data generated we do not think we can fully provide an in-depth answer to the related sub-research question. While all of the cases featured agility in some aspect, typically through agile practices such as sprints, there was not a lot of focus on this aspect of the projects from the participants, and this was only discussed extensively in about half of the interviews, which is why we chose to not focus on that aspect in our results. However, we did note that the challenge "Agility not Explicit / Understood" was present throughout most of the projects, even though as we mentioned all of the projects involved agility to some extent. The participants in our study were not developers, which likely influenced their understanding or lack of knowledge on the topic, but this may be a barrier to effectively utilising agility in public procurement projects.

5.2 Limitations

As outlined in the methods section, due to various complications, not all of the interviews were performed as planned. Originally, the intent was to perform all of the interviews individually and in-person, but due to a variety of complications several of the interviewees were not available for this. Thus, two of the interviews were performed digitally using Google Meet. One of the interviews also included two participants rather than one, due to scheduling constraints. Overall these complications did undoubtedly impact our research to some extent, but we believe this is a low threat to the validity of our research.

Another important threat to the validity of our research is the potential of bias in our research. We have attempted to avoid bias in our work throughout the processes, particularly during interviews, but throughout the process of conducting the research there have been multiple opportunities for bias to influence the study. Notably, while we followed procedures and guidelines to best try to avoid influencing interviewees during the interviews, some of the participants were in contact with the researchers prior to the interviews during the planning stages of the study. Throughout the planning stage of the research there was strong collaboration, which was necessary for the researchers to shape their approach and to get access to the various projects in the municipality, but this collaboration may have influenced the perceptions of the participants or interviewers throughout the process. This collaboration was present in two of the cases, Case A and Case B, the other two cases did not involve contact with the participants prior to the invitation to participate in the study.

5.2.1 Theoretical saturation

Arguably the biggest influence on the research was our inability to fully saturate the topics of the research as originally planned. As mentioned in the methods chapter the original intent was to perform several more interviews, and unfortunately despite the interviews we were able to perform yielding valuable insights we still believe further data collection could have yieleded additional insights or strengthened our results. Several key individuals from the cases covered in the study as

well as other cases that were not included in the study were identified, that we belive could have improved the study, but that we were unable to pursue either due to not receiving responses or due to the author falling ill.

Several of the invited individuals either declined or did not respond to our invitations. In total we invited 13 individuals to participate in the project, which would have spanned five projects in the municipality and other supporting parts of the organisation, but we ended up with 4 projects, and only 5 interviews. This represents a non-insignifciant threat to the validity of our research, as it is not unlikely that we were unable to gather enough data to accurately represent the domain's richness.

Additionally, while we would have liked to interview more participants from each case to hopefully gather a more complete set of experiences, we were only able to interview one or two indivduals from each case. As outlined in table X from the methods section, most of the interviewees had similar positions and responsibilities in the projects, and none had a background in software development, though this allowed us to bring the focus of the research away from agility in the context of software development. Gaining more perspectives from each case through including more participants could have reduced the chance of the biases of the participants influencing the study.

In hindsight we believe that the initial plans and scope of the project were too ambitious for a single author to pursue. Reducing the amount of cases from the originally planned five cases down to two or three and focusing on covering more perspectives from each case could have potentially yielded deeper insights. Additionally, the author could have started inviting more participants earlier on in the project, rather than waiting for all of the planned interviews from "wave 1" of the participants to conclude. The scheduling constraints of some of the participants spread out the interviews across two months, so it would have been prudent to iterate faster.

5.2.2 Challenges of Grounded Theory

Grounded theory, although widely recognized for its usefulness in generating theory from empirical data, is not without its challenges. One significant issue pertains to the sheer volume of data it requires, which can be daunting and time-consuming to handle. Furthermore, as it relies on constant comparison across different data sources, it requires researchers to be thoroughly engaged in the data collection and analysis process. This meticulous attention to detail, combined with the need for saturation—a point where no new or relevant information emerges—means that the method is not well-suited for research with constraints on time or resources (Oates et al. 2022).

As was discussed briefly in the methods chapter there are some challenges related to conducting studies according to the grounded theory method. In line with the reflections from the previous section we believe these challenges did have an impact on our study. The author was not experienced with using the method, and in hindsight the rigour employed throughout the study was possibly not as high as a grounded theory approach necessitates. Additionally, as we were unable to fully conclude the data collection stage of our study this has had an impact on the focus and outcome of the study.

5.3 Future Work

In this study we have explored the topics of modern ICT management in Trondheim municipality through the context of public procurement projects. The context of Trondheim municipality has become an important aspect of our study, and we believe that further work relating to this context could be valuable.

This study was primarily focused on examining procurement projects from the municipal perspective. All of the participants in the study were employees from Trondheim municipality, and we believe that examining other perspectives could be valuable. Future work could provide a more comprehensive and holistic view of the procurement process and ICT management by examining the interactions from both supplier and municipal perspectives. This kind of approach could allow

deeper insights into the challenges and opportunities related to public procurement, and could possibly lead to the development of more effective procurement strategies. One related theme that was not explored in our study, but which came up was the importance of collaboration and communication with the supplier, and we think investigating this in the context of agile procurement projects could be interesting. Alternatively, a specific exploration of the supplier's perspective could be similarly beneficial. A deeper understanding of supplier motivations, challenges, and strategies to win procurement contracts could yield valuable insights and contribute significantly to the body of knowledge surrounding procurement processes. The need for more longitudinal studies to be conducted was something that has also been brought up in other literature (Moe 2014).

In our study we have focused exclusively on Trondheim municipality, which represents one of the largest municipalities in Norway, and which has access to different resources and could encounter different challenges compared to other Norwegian municipalities, particularly medium- or small-sized municipalities. Thus, an interesting avenue for future research could be to explore procurement processes and ICT management in smaller municipalities, contrasting them with the results from larger municipalities. Such a comparative study could highlight how size and resource availability affect procurement practices, inform whether strategies from larger municipalities can be effectively scaled down, or whether smaller municipalities require different approaches.

In the period during and following the Covid-19 pandemic there has been a rise in projects that feature cross-institutional cooperation, with increased collaboration between large municipalities or between municipalities and national governmental institutions. One such is DigiBarnevern, a collaboration between several national institutions and municipalities in Norway (Bufdir 2023). Future work could explore this emerging trend in more depth, examining the reasons behind these partnerships, the challenges they face, the benefits they offer, and their impact on procurement and ICT management processes.

6   Conclusion

In this thesis we have investigated the modern practices of ICT management in Trondheim municipality, through looking at recent projects featuring public procurement of ICT systems, and involving agility, in the municipality. The research was mainly focused on the overarching question, "What characterises the management of Information and Communications Technology (ICT) in modern public procurement in the Norwegian public sector?" which was broken down into three sub-questions for a more in-depth analysis.

We identified a set of values, challenges, and strengths present related to the ICT management in Trondheim municipality, with values focusing on data and system ownership, high expectations, and innovation, which relate strongly to some dimensions of public value such as Administrative Efficiency and Open Government. The challenges that were identified in the cases varied from project to project, but we found that the municipal duties of the employees involved in the development of the ICT systems was consistent across the projects, and that cross-institutional cooperation was also a somewhat consistent challenge, both of which contributed to delays and reduced productivity.

We found that the context of Trondheim municipality as a large municipality offered it several advantages in the projects such as size, and expertise, which the municipality has been able to utilise to effectively address various challenges such as legislation and privacy concerns. In addition to the value of the resources that are associated with larger institutions, the municipality has also managed to develop a valuable IT department that was identified as a strength in our study.

However, the aspect of agility, while present in all projects, was found to be less explicitly understood or focused upon in several of the projects. This ambiguity could potentially inhibit the effective utilisation of agility in public procurement projects, which merits further investigation. In conclusion we believe that further studies exploring the municipal context and role of agility in public procurement would be valuable.

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Appendix

A Quotes

The following table contains a list of all of the quotes used in the paper, both in English and in Norwegian, as well as the person who said the quote.

Person	Norwegian Quote	English Quote
Emilie	"Når [systemet] sviktet så hadde vi egentlig bare en forventing om at det skulle bli en [oppdatering], bare stabil. Så det var egentlig ikke så mye mer enn det for vår del. Så når det ble satt ned prosjektgruppe og man kunne se litt mer på "hva kan vi gjøre?" så er det IT avdelinga som har vært med på å se at vi kan få [mer funksjonalitet] inn i en og samme pakke. Så det har jo blitt mye mye bedre enn det vi kunne forestille oss."	"When [the system] failed we only expected that it would be an [update], only stable. So it was just that for our sake. So when a project group was put together and you could look a bit more at 'what can we do?' it was the IT department that was part of and saw that we could achieve [more functionality] into one and the same package. So it has become a lot better than we could have imagined."
Aksel	"I mellomtiden her så fanget vi opp en løsning i forhold til dette her med maskinlæring. Da begynte vi å diskutere, hvorfor ikke satse på maskinlæring? . . . vi så på bruk av maskinlæringsmodellen på ulike scenarioer, der vi testet å bruke maskinlæring til å taksere absolutt alt . . . ."	"In the meanwhile we caught on to a solution related to machine learning. Then we started discussing, why not try out machine learning? . . . we looked at using the machine learning model in different scenarios, where we tested using machine learning to [process] everything. . .."
Ulrik	". . . det passer på en måte i målsettingen til Trondheim kommune, dette med datadrevet kommune, bærekrafts mål. Alt på en måte peker på at dette er noe som bør angå hele kommunen, så jeg har ikke måtte kjempehardt for å få [prosjektet] større. Det har på en måte bare blitt trukket opp . . ."	". . . in a way it fits with the goals of Trondheim municipality, such as data-driven municipality, sustainability goals. In a way everything points towards this being something that should affect the entire municipality, so I have not had to fight hard to get [the project] bigger. It has in a way just been pulled upwards . . ."
Aksel	"Det som er sikkert, er at Trondheim kommune kommer ikke til å jobbe på samme måte som i en mindre kommune, hvor du kan klikke deg gjennom 5 000 [saker] og [behandle] de på et år, det går ikke an. Vi må kunne se den store massen, vi må kunne [behandle] den store massen effektivt, og så må vi bruke tiden vår til på de tingene som ikke passer med den store massen."	"What is certain, is that Trondheim municipality will not be working in the same way as in a smaller municipality, where you can click your way through 5 000 [cases] and [process] them in a year, that is not possible. We need to be able to see the large mass, we need to be able to [process] the large mass, and then we need to use our time on the things that do not fit with the large mass."
Olav	"Så tror jeg, som jeg har sagt tidligere, [leverandører] har mange små kommuner. En ting som de mener bare er noen få klikk det blir himla mye mer klikk til oss. Så vi ønsket egentlig å ha mest mulig automatikk. Heller at avvikene kommer ut, sånn at 'der her må du se på eller behandle' og resten er greit."	"Then I think, as I've said earlier, [suppliers] have a lot of small municipality [clients]. A thing that they say are only a few clicks ends up being a lot more clicks for us. So we wanted to have as much automation as possible. Rather that the exceptions come out, so that 'you need to look at or process this' and the rest is fine."

Ulrik	”Så vi har røsket litt opp i bransjen da . . . og på en måte ønsker [vi] at dette skal være filosofien i hele Trondheim kommune, at samme hva du snakker om, så skal det være frie data-strømmer som vi kan bruke og forvalte som vi ønsker. Det er et problem her, på infrastruktur generelt og er det et problem, det at det er aktører som er veldig store, som har systemer som ikke deler data. Drømmen vår er på en måte å fange all data i [Trondheim kommune] og bruke det sånn som vi vil, og ha data-analytikere som kan analysere [data] på en smartere måte enn det vi gjør nå.”	”So we have shaken up the field . . . and in a way [we] wish for this to be the philosophy in the entirety of Trondheim municipality, so that regardless of what you're talking about, there should be free data-streams that we can use and manage as we wish. There is a problem here, in infrastructure in general as well there is the problem, that there are actors that are very large, who have systems that do not share data. Our dream, in a way, is to capture all of the data in [Trondheim municipality] and use it as we wish, and to have data-analysts that can analyse [data] in a smarter way than how we are currently doing now.”
Olav	”De [leverandører] prøver jo å lukke [produktet], slik at de kan selge oss tilleggstjenester. Hvordan det blir helt i det får vi se, . . . men selve dataen vil vi legge i en database utenom [leverandørens produkt]. Sånn at vi kan både skifte [utstyr], type [utstyr], teknologi for å samle inn data, og alt det kan vi skifte, men dataen har vi, for det er å analysere dataen som er av interesse for oss. Der har vi vært veldig bevist.”	”They [suppliers] try to close [the product], so that they can sell us additional services. How it ends up being in the end we'll have to see, . . . but the data itself will be stored in a database outside [of the supplier's product]. So that we can change [equipment], type [of equipment], technology to collect data, and all of that we can change, but we have the data, because analysing the data is what is of interest to us. We have been very conscious about that.”
Aksel	”En annen ting, så tror jeg at sånn vi har gjort det på [programvaresystemet], så har vi gått ut med bistand fra konsulent-tjenester for å lage applikasjon eller tjeneste, og da er det Trondheim kommune som eier applikasjonen og kildekoden selv.”	”Another thing, is that I think the way we have handled it in the [software system], where we have used assistance from consulting services to create an application or service, and then it is Trondheim municipality that owns the application and source code.”

Ulrik	"Ja, markedet er jo satt. Aktører har ikke blitt utfordret skikkelig, det er mye preg av det du kaller Lock-in, . . . det at en [leverandør] har hele verdikjeden, fra [utstyr] til innsamling [av data], til database, til et analyse-verktøy. Det er jo standarden, og har vært det til nå, og har vært noe alle kommuner sliter med, å få låst opp systemene sine. Det ville vi utfordre, og har utfordret knallhardt ville jeg si, og sagt kategorisk nei til alle løsninger som ikke har en åpen filosofi for data-deling. Og hvis du ikke har en åpen filosofi for data-deling, om du krever noen sånn ekstra for å bruke [spesifikt utstyr], så har vi sagt nei, ... Det har resultert i at den aktøren har utviklet en modell som er fri for sitt egent system, og det har og utelukket leverandører som på en måte hadde en sånn ferdig pakke [lock-in] fra før."	"Yes, the market is settled. The actors have not been properly challenged, there's a lot of what you call lock-in, . . . where a [supplier] owns the entire value chain, from [equipment], to collection [of data], to database, to an analysis tool. That is the standard after all, and has been until now, and has been something all municipalities struggled with, managing to unlock their systems. That was something we wanted to challenge, and has challenged extremely hard I would say, and categorically denied all solutions that do not have an open philosophy for data sharing. And if you do not have an open philosophy for data sharing, if you demand extra to use [specific equipment], then we have said no, ... That has resulted in the supplier developing a model that is independent from their own system, and it has excluded suppliers that had a complete package [lock-in] before."
Ulrik	"Så nå har jeg mye mer folk rundt meg som kan hjelpe meg med [prosjektet]. Jeg har personvernombudet tett knyttet opp, og kommunikasjonsavdelingen for å dele informasjon om [prosjektet]. . .. For innkjøp har jeg en fyr fra IT som hjelper meg veldig med det innkjøpstekniske, og jeg har IT-ressurser . . .. Så det å ha med seg IT-ressurser har vært veldig fint for min del i hvert fall, når vi skal begynne å skalere det [IKT systemet] så veldig mye som vi gjør nå. I tillegg så er det veldig mange andre i organisasjonen som har vært innom i korte roller, som rådgivere på et og et tema."	"So now I have a lot more people around me that can help me out with [the project]. I have the data protection officer tightly involved, and the communication department to share information about [the project] . . .. For procurement I have a guy from IT that helps me a lot with the procurement of technical materials . . .. So having IT-resources with me has been very nice for me at least, now that we are going to scale the [ICT system] as much as we are doing now. Additionally there are a lot of others in the organisation that has been involved in short rolls, such as advisors on specific topics."
Olav	"Vi hadde aldri klart å få dette her til uten å bruke en haug med penger [på konsulenter]. Det har vært helt klart, vi hadde ikke hatt sjans."	"We would have never managed to pull this off without using a ton of money [on consultants]. That has been very clear, we would not have stood a chance."
Ulrik	"Ja, og det er fint å være en stor kommune, vi har på en måte nisje-folk istedenfor å ha en mann som kan alt. Nå har jeg på en måte blitt den fyren som kan mye om [domenet], og det er jo egentlig bare egeninteresse, men jeg har heldigvis nisje-folk til å lene meg på i personvern, IT, database-strukturering, og litt sånt, så det er kjempegreit."	"Yes, and it is nice to be a large municipality, in a way we have experts instead of having one person that knows everything. Now I have sort of become the person that knows a lot about [the domain], and that is mainly personal interest, but luckily I have experts that I can lean on in matters of privacy, IT, database structuring, and such things, and that is very good."

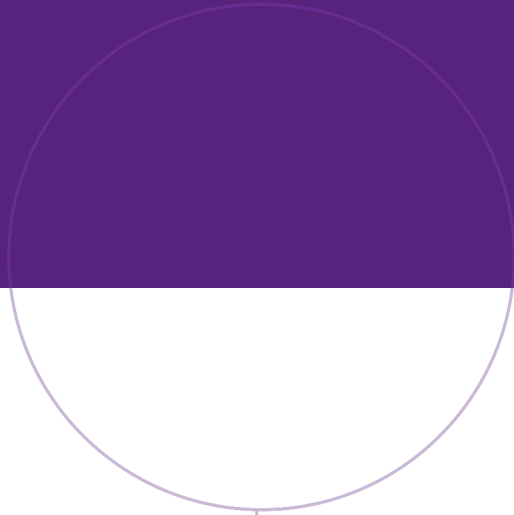|		
Olav	"Det er veldig flinke folk på IT tjenesten, og [leder i IT-tjenesten] har vært flink til å bygge opp kompetanse, så jeg føler kanskje de er bedre staffet med folk nå en de har vært noensinne . . .. Det her med IT sikkerhet er jo hot så det holder."	"There are very skilled people in the IT service and [IT service leader] has been very good at building up competency, so I feel that perhaps they are better staffed with people now than they have ever been. . .. This thing with IT-security is very [important]."
Emilie	"Og så har vi lyst til å være litt mer selvgående på enkelte ting ser vi da. At vi som gruppe, eller at Trondheim kommune, kan løse ting på lavest mulig nivå, eller tettest mulig på brukere, med mindre det er veldig teknisk selvfølgelig. . .. Nå er det jo IT som på en måte, forvaltning avtalen er via IT, så de er jo og inne i bildet. Vi har satt inn [ansatt] som hovedressursen, så hun bruker mye tid på å koordinere."	"And then we have seen that we want to be a little more self-served in specific things. That we as a group, or that Trondheim municipality, can solve things on the lowest possible lever, or as close to the users as possible, unless it is very technical of course . . .. Now in a way it is [the IT department], the management contract is via [the IT department], so they are also involved in this. We have put in [employee] as the main resource, so she uses a lot of time coordinating things."
Emilie	"Det er litt sånn at alle kan ikke bare slippe alt, alle saksbehandlerne kan ikke bare slippe [all saksbehandling] i tre uker for å bare jobbe med en sprint liksom, det ville på en måte ikke gått."	"It is kind of like we can't just let go of everything, all of the case officers can't just let go of [all cases] for three weeks just to work with a sprint, that would, in a way, not work."
Aksel	"De kom med en frist [i november] der de skulle levere ferdig systemet til oss, de sa at de hadde levert, og vi sa at vi hadde ikke nok tid til å kjøre akseptansetest, så vi utsetter det [et halvt år], for nå må vi bruke tiden til å skrive ut [skatt]. . .. Det er på en måte litt av utfordringen når du jobber med [skatt], det at skal du innføre [skatt] har du en absoluttfirst, og det er 1. mars. Det året du innfører skriver du ut til innbyggeren på at [skatt] er satt og det, innen 1. mars, eller så mister du inntekstgrunnlaget fullstendig. Det er risikoen oppe i det her."	"They had a deadline [in November] where they were going to deliver the finished system to us, and they said that they had delivered it, and we replied that we did not have enough time to perform acceptance testing, so we delay it [half a year], because now we need to write out [taxes] . . .. That is sort of part of the challenge when you are working with [taxes], that if you are going to implement [taxes] you have an absolute deadline, and that is the 1st of March. The year you are informing the citizen that [taxes] have been set, you have an absolute deadline, and that is the 1st of March, or you lose the grounds for income completely. That is the risk in all of this."
Aksel	"Men staten må være villig til å bruke penger på [IKT investeringer], og det er kommunene som tar ut effektivitetsgevinsten. Det er litt utfordringen i offentlig virksomhet, det at effektiviseringsgevinsten tas ut på andre enheter og virksomhetsområder enn der det investeres i tjenesten."	"But the [national] government has to be willing to spend money on [ICT investments], and it is the municipalities that take out the efficiency gains. That is partially the challenge in public operations, that efficiency gains are achieved in other units and domains than where the service is invested in."

Aksel	"[Programvaresystemet] vi har laget, den kunne vi i prinsippet ha brukt i hele landet. Det er ikke noen begrensinger på å bruke den. Hvem tar ansvaret for å drifte den, hva koster det å vedlikeholde den? Ja, vi ville ha gjort det nå, vi må gjøre det nå, men det her kunne jo kanskje ha vært en samfunnsoppgave for skatte-etaten?"	"[The software system] that we made, could in principle have been used in the entire country. There is no limits on using it. Who is going to take responsibility for running it, what is it going to cost to maintain it? Yes, we would have done that now, we have to do that now, but this could maybe have been a societal task for the Norwegian Tax Administration?"
Ulrik	"Men det tar jo veldig mye, bare avklaring av personvern, i og med at vi ikke har noe regelverk å støtte oss på nasjonalt så må vi tolke det selv, basert på lover og forskrifter som vi på en måte må finne frem til selv. Så vi har vært veldig tett med personvernombudet i Trondheim kommune, for å vite hvor vi kan legge lista. Dette er jo personsensitive data, det er ikke den verste sorten, men det er ting du på en måte, du kan danne deg et forbruksmønster på en aktør eller på en person . . . så vi sitter på sensitive data og må behandle det deretter, og i [bransjen] så er det en vurderingssak og datatilsynet er involvert på et større nivå, men de ligger på en måte langt bak oss, og vi vil ikke vente på de, så vi har valgt en konservativ tolkning og kjører på. Og det er ingenting i regelverket som sier at vi ikke kan gjøre det, og vi er på en måte sikre på at vi er innenfor når vi tolker [lover og forskrifter] så konservativt som vi gjør da. Men det er tidkrevende prosesser, og med det [reglementet i etaten] som vi har måtte gjøre om da."	"But it requires a lot, just the clarification regarding privacy, because we do not have any regulations to rely on on the national level, so we have to interpret it ourselves, based on laws and regulations that we kind of have to find our selves. So we have worked very closely with the privacy specialist in Trondheim municipality, to know what we can do. This is personal sensitive data, it isn't the worst sort, but it is something that you in way, could create a pattern of behaviour on a actor or individual . . . so we have sensitive data, and thus have to handle it appropriately, and in [the field] it is a matter of judgement and the Norwegian Data Protection Authority is involved on a higher level, but they are sort of very far behind us, and we do not want to wait for them, so we have chosen a conservative interpretation and are proceeding. And there is nothing in the regulations that says that we cannot do it, and we are kind of certain that our interpretation is valid when we interpret [laws and regulations] in such as conservative way as we are doing. But they are time-consuming processes, also with the [regulations in the department] that we have had to change as well."
Emilie	"Det vi jobber med er politisk styrt, som går etter kommunevalget. Så vært fjerde år så er det en rullering av retningslinjer og rammeverk som vi jobber innenfor da, så ting skal liksom rulle og gå igjennom fire år, så skal du kanskje starte igjen, også har du kanskje en politisk korrigering eller et eller annet som gjør at du må gjøre en endring, så vi blir kanskje aldri helt "ferdig ferdig". "	"What we work with is politically controlled, which follows the municipal election. So every four years there is a change of guidelines and frameworks that we work within, so things should sort of keep going through four years, then you might have to start over again, and then maybe you have a political correction or something or other that makes it so that you have to make a change, so we are maybe never going to be [completely done]."

Olav	"Jeg tror ideen med Smidig utvikling er kjempegod, men både vi og leverandøren har jo slitt med å få det til faktisk. . .. Internt i styringsgruppa, de skjønte [smidighet], men det var et eller annet borte på veien når vi kom ned i gruppene som [utviklet], da var det liksom borte vekk. Enten var det dårlig intern-kommunikasjon hos dem, eller så hadde de ikke skjønt hva de faktisk skulle være med på, rett og slett"	"I think the idea of Agile development is very good, but both us and the supplier have struggled to make it work actually . . .. Internally in the steering group, they understood [agility], but there was something or other that disappeared along the way when we got down into the groups that [were developing], then it was kind of completely gone. Either it was poor internal communication on their side, or they had not actually understood what they were going to be part of, simply put."
Emilie	"Jeg tror aldri vi har brukt det ordet, "Smidighet". . .. Jeg tror litt sånn ubevist jeg tenker at [Smidighet er] "dette skal gjøre det bedre og da mer smidig, for [brukere], kontrollørene våre som går og kontrollerer, og oss på kontoret. At alle funksjoner skal gå mer "smidig" for alle, for at du slipper [papirarbeid], du slipper mange sånne små omveier og sånne ting."	"I do not think we ever used the word "Agility" . . .. I think I sort of unconsciously think that [Agility is] "this should make things better and thus more agile, for [the users], our controllers performing controls, and for us at the office. That all functions should run more "agile" for everyone, because you avoid [paperwork], you avoid a lot of those small detours and such things."