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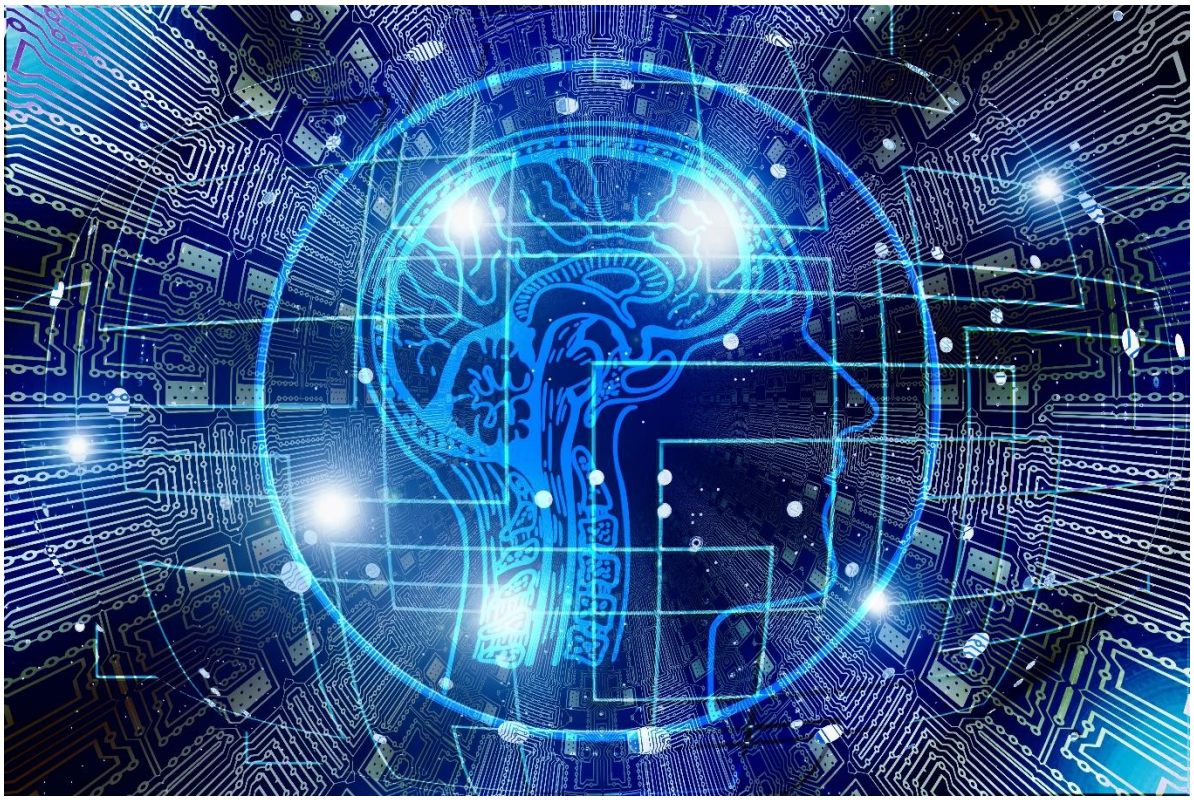

Demystifying Artificial Intelligence

Exploring how public sector organizations can approach Artificial Intelligence

Master's Thesis in the Master's Programme
International Project Management

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Sincerely,

Johan Lennartson

Chalmers University of Technology
Gothenburg, Sweden
January 17th, 2019

Glossary

English - Swedish

Home care - Hemtjänst

External monitoring - Omvärldsbevakning

Continuous management - Förvaltning

Big Data - Stor volym digital data (English: large volume of digital data)

Abbreviation - Meaning

AI - Artificial Intelligence

ML - Machine Learning

DL - Deep Learning

IoT - Internet of Things: digital devices capable of communicating with other devices through the internet

SKL – Sveriges Kommuner och Landsting: the members organizaiton for Sweden's municipalities and regions

Abstract

Artificial Intelligence has enjoyed a resurgence in recent years. After decades of lofty promises followed by an inability to realize them, the technology is now having a great and growing impact on our society. However, despite its apparent importance, only a fraction of Sweden's public entities have a structured approach to Artificial Intelligence. Previous research has not explored the intersection between Innovation Management and Artificial Intelligence. Therefore, this study attempts to help public organizations approach Artificial Intelligence strategically. To investigate the issue, interviews were conducted with ten individuals possessing strong insight into the subject. The empirical findings reveal several recurring factors impeding the strategic utilization of Artificial Intelligence in Sweden's public sector. These factors include an insufficient understanding of how Artificial Intelligence can be utilized, insufficient degree of overall digitalization, and a severe lack of guidelines regarding legal and ethical dilemmas, among others. The FINT-model is ultimately proposed as a suggestion for how public organizations should approach Artificial Intelligence. The model consists of four elements: Digital Foundation, Identification of Needs, Technology, and Innovation. Implementing the suggested model may enable public organizations to create a structured approach to Artificial Intelligence, leveraging the technology to fulfill the needs of their citizens.

Keywords: *FINT-model, Artificial Intelligence, Digitalization Strategy, Innovation Management, Leverage AI, Public Sector AI, Public Sector Digitalization*

Table of Contents

1 Introduction

This chapter will present the background, aim, scope, and outline of the report. In doing so, it will explain the purpose of the study and motivate its relevance.

1.1 Background

Artificial Intelligence, henceforth referred to as AI, has enjoyed a resurgence in recent years. After decades of unfulfilled promises, numerous practical applications of AI with great potential impact to our society are now taking form (Norvig & Russell, 2010). Two critical factors behind the resurgence are the increased availability of data and processing power (Vinnova, 2018). Autonomous driving, machine learning, and image processing are some of the AI-driven technologies on the verge of becoming prominent features in our professional and everyday lives (Cath et al., 2018). In some cases, such as our Facebook feeds, AI is already impacting billions of users, and we are just now starting to understand its implications (Bakshy et al., 2015). According to PwC (2018), AI's contribution to the global economy will be $15.7 trillion US by 2030, more than the combined economic output of China and India today.

The anticipated impact of AI is such that the White House, European Parliament, UK House of Commons, (Cath et al., 2018) and Chinese government (Church, 2018), all have issued reports regarding visions and preparations for the widespread use of the technology, addressing both opportunities and pitfalls. Similarly, the Swedish government published *Nationell inriktning för artificiell intelligens* (Näringsdepartementet, 2018), outlining the national goal regarding AI and key factors for reaching it.

The goal stated by the Swedish government in *Nationell inriktning för artificiell intelligens* is that Sweden is to be a global leader in realizing the potential of AI, with the aim of strengthening the country's competitiveness and welfare (Näringsdepartementet, 2018). The document also emphasizes that adopting AI applications in the public sector can prove critical in building sufficient capacity to overcome future societal challenges (Näringsdepartementet, 2018).

The public sector applications of AI are broad and growing around the world (Martinho-Truswell, 2018). In Sweden, AI projects being conducted on government, regional, and municipal levels (Vinnova, 2018). It is critical that both public and private sector organizations become test beds and perform pilot projects within AI, in order for Sweden to drive development of sustainable applications of the technology (Näringsdepartementet, 2018).

Despite its apparent importance, only a fraction of public entities have a strategic approach to AI (Vinnova, 2018). In addition, there is no national strategy in place to guide public or private organizations (Näringsdepartementet, 2018). Towards this background, there appears to be a need for increased understanding of how public organizations can approach AI strategically.

1.2 Aim

The aim of the study is to help public entities approach AI strategically, and by doing so accelerate the process of leveraging the technology. It will attempt to do so by answering the following questions:

1. How should public organizations detect potential AI applications and decide whether they should be implemented?
2. How can public organizations leverage AI within their operations?
3. What are the critical factors for successful implementation of technology-based projects in public organizations?
4. What ethical, regulatory, and security challenges does AI present for public organizations, and how can they be overcome?

1.3 Limitations

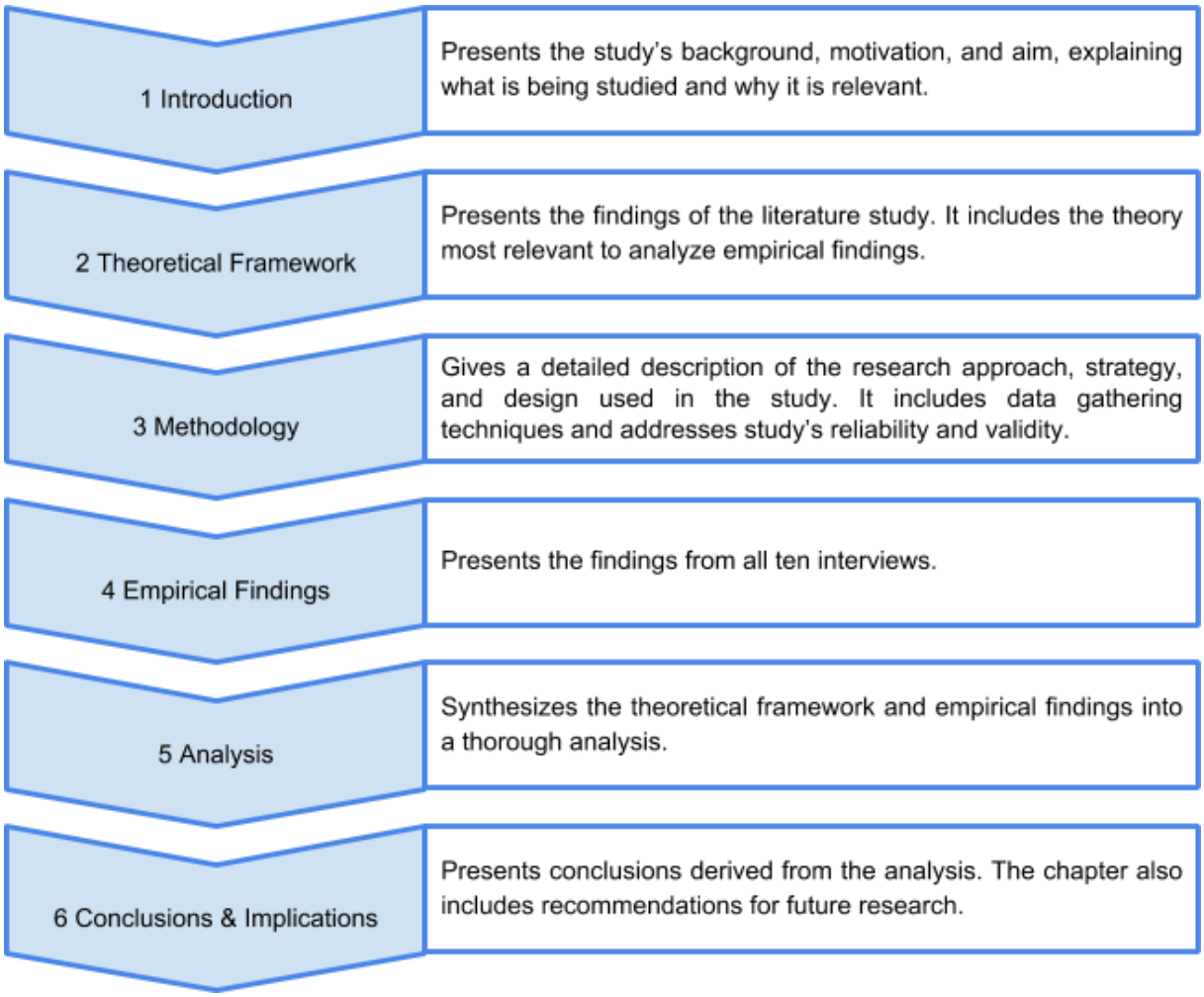
The study will largely ignore political factors. While most public entities are ultimately controlled by politicians, they are typically managed by non-political employees. Achieving operational excellence in terms of innovation management and leveraging AI is assumed to be a non-political issue. However, some political factors are brought up by interview subjects and will be discussed accordingly.

Most interview subjects are the only representative of their organization. This means that the collected data will reflect individual views to a larger degree than it would if deriving from multiple sources within the organizations. Similarly, most interview subjects work within IT or digitalization, which means that they may share some biases in their views, as they operate in similar environments within their respective organizations.

The sample of interview subjects has been geographically limited to Sweden. This is mainly due to convenience and accessibility as the project has limited resources. Staying within one country may also help gain a deeper understanding of Sweden’s specific context for AI, which in turn could foster a stronger understanding of empirical findings.

1.4 Report Outline

The report will be outlined according to the following structure:



2 Theoretical Framework

In this chapter, the findings of the literature study are presented. It includes the relevant theory regarding AI, innovation management, change management, and societal challenges related to the technology.

2.1 Definition of AI

There is no one single unambiguous definition of AI (Dobrev, 2004; Simmons & Chapell, 1988; Vinnova, 2018). Dobrev identifies Turing's definition of AI as the most widespread. It defines AI through a test, called Turing's Test. It states that if an object is placed behind a curtain and speaks to a person, and the person cannot tell whether the object behind the curtain is a person or not, the object is or has AI. A key factor in the test is the fact that the object is placed behind a curtain, ensuring that the test concerns the intellect of the object, rather than physical capabilities and attributes (Norvig & Russell, 2016). Including physical factors would require robotic features, which is a separate field, though the two occasionally overlap (Vinnova, 2018).

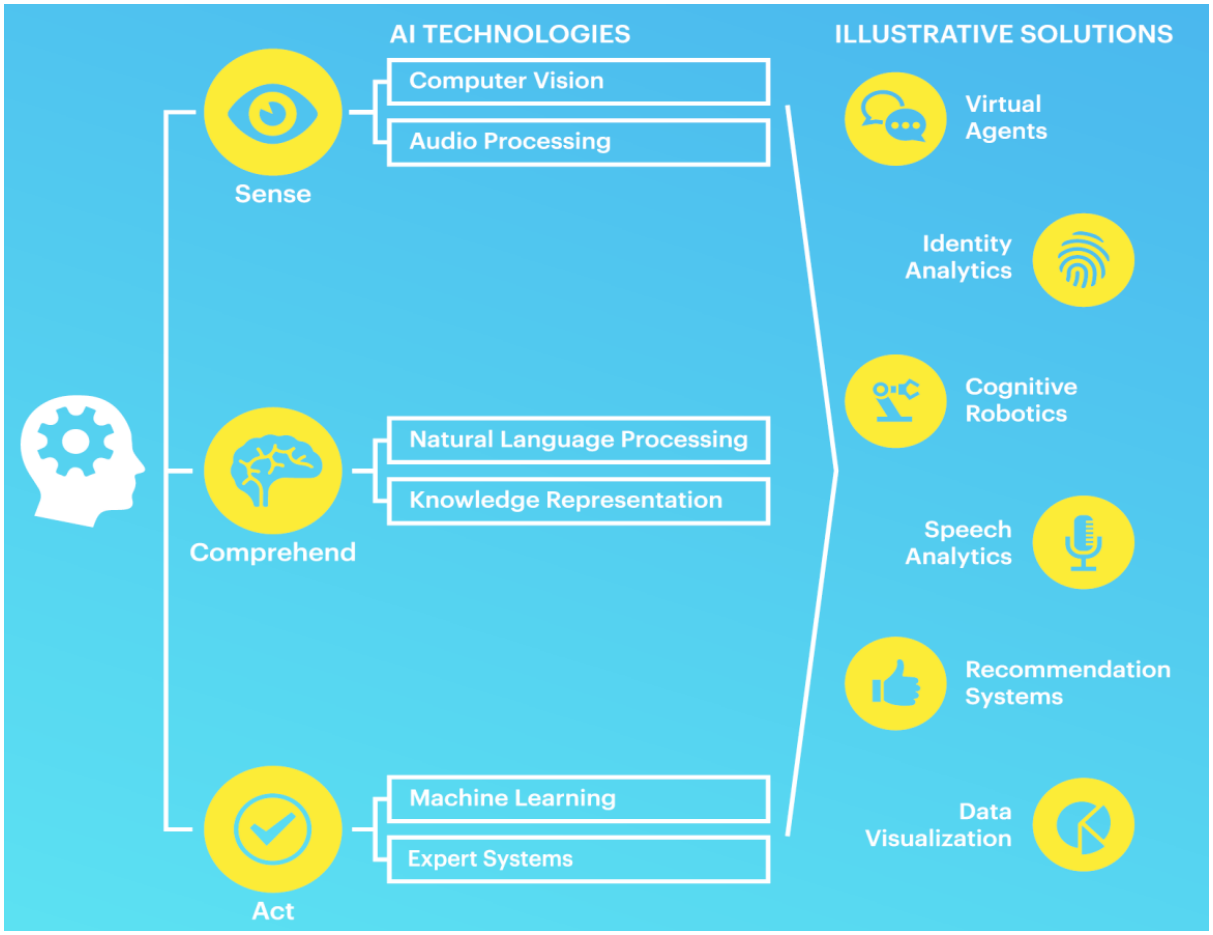
Dobrev (2004) also presents his own definition of AI. This definition states that AI is programs which are capable to perform at least as well as humans in an arbitrary environment.

Vinnova (2018) presents a third definition of AI, stating that it is the ability of a machine to mimic intelligent human behavior. The authors elaborate the definition by describing AI as the ability which enables machines to function in a meaningful way in relation to the specific tasks and situations it is designed to act within.

2.2 Classification of AI

Daugherty & Purdy (2016) divide today's AI technologies into three main categories based on their function: sense, comprehend, and act. Sense is the ability of an AI to analyze audio and video inputs. Practical applications include facial recognition. Comprehend is the ability of an AI to interpret and analyze gathered information. Language translation is an example of how it can be applied in practice. Act refers to the ability of taking actions, both digital and physical. Practical examples include assisted breaking within cars. A visual representation of Daugherty & Purdy's representation can be found in Figure 1, along with some examples of concrete applications.

Figure 1. Illustrates the main functions of AI and the underlying technology.



Source: Purdy, M. and Daugherty, P., Why Artificial Intelligence is the Future of Growth, Accenture, 2016, p.11.

Evans, Hu, Kuchembuck & Gervet (2017) divide AI applications into five system types: natural language processing, computer vision, pattern recognition, reasoning & optimization, and robotics. The system types largely correspond with the AI technologies identified and presented in Daugherty & Purdy's (2016) model. Evans, Hu, Kuchembuck & Gervet describes each of the categories as follows:

Natural Language Processing recognizes voice and text expressions.

Computer Vision identifies activities, scenes, and objects in visual inputs.

Pattern Recognition identifies recurring themes in large quantities of data.

Reasoning & Optimization enables complex inferences and efficient evaluation of options.

Robotics is the integration of cognitive technologies to perform physical processes

Another classification of AI aims to distinguish the applications' level of intelligence (Gurkaynak, Yilmaz & Haksever, 2016; Miailhe & Hodes, 2017; Evans, Hu, Kuchembuck & Gervet, 2017). The level of intelligence is determined by how well the applications perform in arbitrary environments. There is some discord regarding the distinction of each category (Miailhe & Hodes, 2017). Gurkaynak, Yilmaz & Haksever suggest three such categories, artificial narrow intelligence, artificial general intelligence, and artificial super intelligence, and describe each of the categories as follows:

Artificial Narrow Intelligence, also known as ANI, is designed to solve a specific task in a delimited environment. One example is IBM's Deep Blue, a chess computer that defeated then reigning world champion, Gary Kasparov. Beating the world champion was considered a great feat, but playing chess was the only thing Deep Blue could do.

ANIs are common in many parts of the world today, in the form of voice assistants such as Siri or Alexa, search engines, social networks, autopilots, traffic control software, and so on. The common denominator between these examples of narrow AI is that none of them can initiate processes outside of their predetermined scope of operation.

Having established the limitation of ANIs to processes within their predetermined scope, it should also be pointed out that they are becoming very skilled within these domains. Deep Blue is just one example of ANIs outperforming expert humans in their specific tasks.

Artificial General Intelligence, also known as AGI, represents human level of intelligence. This means that in order for a computer to show AGI, it must autonomously perform all intellectual tasks at least as well as a human.

The main challenge of achieving AGI is programming predetermined conditions capable of comprehending the inherent randomness of the real world. As an example, an AI could read a book much faster than a human being. If asked what happened on any given page, an AI could easily solve the task after reading the book once, while it would be virtually impossible for a human unless he or she studies the book over an extended period of time. However, if asked to casually review the book, a human could do it seemingly effortlessly, while the AI would most likely struggle a lot. Forming an opinion on whether the book was good or bad and avoiding 'spoilers', requires an intuition. Such intuition, or ability to handle randomness and understanding context, is what separates AGI from ANI.

Artificial Super Intelligence, also known as ASI, are computers that are significantly more intelligent than humans in every cognitive aspect, including soft skills such as creativity and sociability. ASI is the level of computer intelligence often depicted in popular culture as computers which decide to eradicate human kind in order to fulfil higher goals.

Some experts, such as Bostrom (2006), and Urban (2015), predict that AGIs will be able to quickly evolve itself into ASI through an exponential growth loop. The phenomenon is known as 'intelligence explosion' or 'singularity'.

Based on Moore's Law and his own theory on technological change, Law of Accelerating Returns (Kurzweil, 2001), Kurzweil predicts that singularity will be achieved around 2045 (Kurzweil, 2005). The emphasis of the theory is exponential advancement of technology, as in the case of Moore's Law (Kurzweil, 2014). Gurkaynak, Yilmaz & Haksever (2016) further note that humans intuitively gravitate towards linear perspectives on reality, meaning that many could find it difficult to understand the impact of exponential growth within AI.

2.3 Current Applications of AI

Lindsjö (2017), Vinnova (2018), and Evans, Hu, Kuchembuck & Gervet (2017) all agree that today's applications of AI are narrow and that they will most likely remain narrow in the coming decade. Because of the inherent limitations of narrow AI, the functionality of its applications will focus on complementing and enhancing humans, rather than replacing them (Vinnova, 2018). In doing so, the quality and efficiency of various tasks can be increased, enabling humans to work more creatively and less monotonously. In Figure 2, Evans, Hu, Kuchembuck & Gervet have illustrated the anticipated evolution of AI applications.

Figure 2. Illustrates the anticipated evolution of AI applications.

Rule-based RPA → Narrow AI → Broad "human-like" AI

Cognitive modes	Rule-based inference	Supervised learning	Unsupervised narrow learning	Unsupervised context-aware learning	Self-aware unsupervised learning
Natural language processing	• Spelling and grammar check	• Voice-to-text dictation	• Personal assistant apps with basic voice Q&A	• Real-time dialogue and translation	• Idiom, sarcasm, and nuance articulation
Computer vision	• Scanning typed characters in format forms	• Facial recognition • Scanning handwriting	• Complex classification (for example, video segment search)	• Vision systems in complex settings (for example, vehicles)	• Autonomous exploration agents
Pattern recognition	• Loans risk inference based on rules	• Fraud detection (based on known patterns)	• Product recommendation based on hidden customer preference	• Real-time clinical diagnosis • Anticipate cyberattacks	• Mimicking intuition and creative connecting of dots
Reasoning and optimization	• History-based predictive forecasting	• Forecasting using demand-sensing input with learned segmentation	• Identifying hidden biases from forecasting data and input	• Beating best-in-class human forecaster in specific domain	• Beat best-in-class human forecaster in several domains

Now–2025 | 2025 and beyond

Notes: RPA is robotic process automation. AI is artificial intelligence.
Sources: WEF expert panel interviews, press releases, company websites; A.T. Kearney analysis

Source: A.T. Kearney Analysts, Evans, H., Hu, M., Kuchembuck, R., Gervet, E., Will you embrace AI fast enough?, A.T. Kearney, 2017, p. 3.

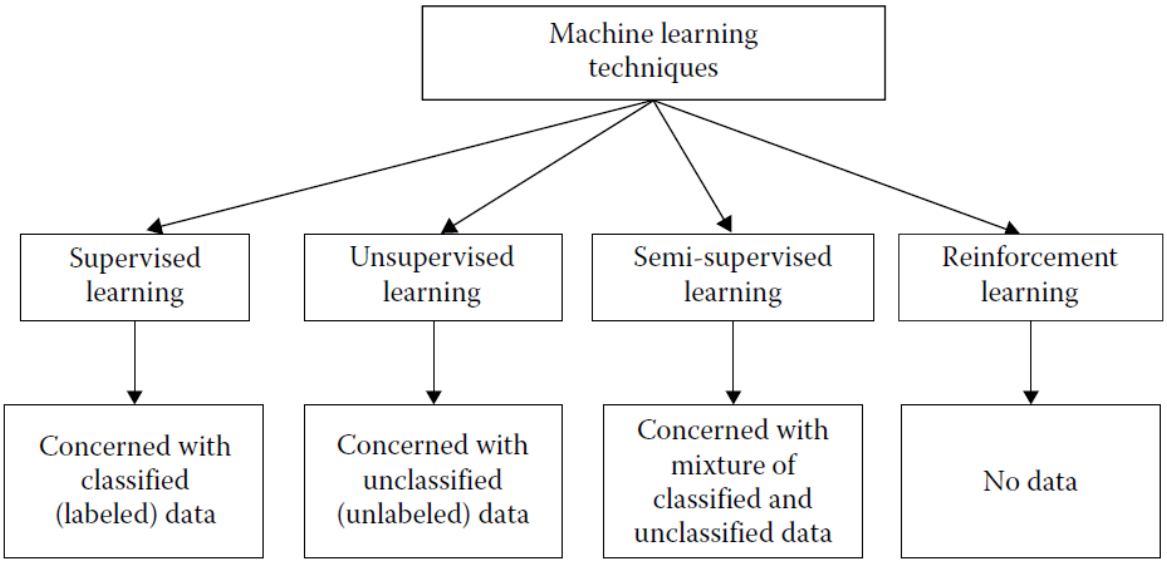
According to Evans, Hu, Kuchembuck & Gervet (2017) today's AI applications have progressed into the third stage of Figure 2, unsupervised narrow learning. Interactive voice assistants, complex video classification, and advanced forecasting are some examples of such applications.

2.3.1 Machine Learning

Mohammed, Khan, & Bashier (2017) describe Machine Learning, henceforth referred to as ML, as the intersection between computer science and statistics, enabling computers to program themselves. The goal is for the machine to create its own model that takes an input and produces the desired result. The construction and refinement of this model is what we refer to as 'learning', in the term ML.

There are four categories of learning techniques: supervised learning, unsupervised learning, semi-supervised learning, and reinforcement learning (Mohammed, Khan, & Bashier, 2017). The different techniques require different types of data. The different techniques and corresponding data types are illustrated in Figure 3.

Figure 3. Illustrates ML's four learning techniques and corresponding data types.



Source: Mohammed, M., Khan, M. B. and Bashier, E. B. M., Machine learning : algorithms and applications, Boca Raton, CRC Press, 2017, p. 7

Mohammed, Khan, & Bashier (2017) describes the four main techniques for ML as follows:

Supervised learning is a technique where a machine is fed with labelled training data. Labelled means that data has been classified either by a human or another computer. The goal is for the machine to develop a model that categorizes data using the same labels as the person or machine that labelled the training data. Once the model has been developed using training data, the model can be applied to analyze other data. Supervised learning can be used for two types of algorithms: regression & classification.

Unsupervised learning only concerns unlabeled data, meaning that no supervisor is needed to provide the machine with labelled training data in order for the model to be developed. The model aims to find hidden structures in the data through i.e. clustering. This technique is particularly useful when approaching *Big Data*.

Semi-supervised learning is a technique where both labelled and unlabeled data is used to develop a model. The reason for mixing labelled and unlabeled data is often the scarcity of labelled data, creating a need to expand the data set by adding unlabeled data, which is typically more easily available.

Reinforcement learning is a technique where the machine interacts with its environment, getting either rewarded or punished based on its actions. The action and corresponding reaction are memorized and analyzed before initiating the next action, as the machine attempts to maximize rewards.

2.3.2 Deep Learning & Neural Networks

Deep learning, henceforth referred to as DL, is a type of ML that leverages the power of neural networks to create powerful models which can tackle highly complex and demanding tasks (LeCun, Bengio & Hinton, 2015). Neural networks are a collection of processing units divided into layers. Each layer transforms the input and then passes the output on to the next level, which then replicates the process. In doing so, several processing units can work together in each layer and process many pieces of information simultaneously. This process is called parallel processing. The process is inspired by the neural network of the human brain, with the processing units mimicking synapses. Hence the name neural networks.

2.4 Potential & Limitations of AI

According to Desouza, K. C., Krishnamurthy, R., & Dawson, G. S. (2017), AI's capability of analyzing large amounts of data and drawing conclusions, is quickly making it an important tool for both public and private organizations. However, the authors also emphasize the importance of understanding the nature of AI, including its strengths and limitations, in order to utilize the technology efficiently.

Data availability is a fundamental requirement for developing effective AI software (Vinnova, 2018). As a result of increasing digitalization throughout society, the amount of available data has increased rapidly in recent years. However, the produced data is seldom standardized in such a way that it can be combined and analyzed with other data (Vinnova, 2018). As a result, big efforts must be made to standardize existing data and the creation of new data, in order to ensure its usability. Lindsjö (2017) believes that data will become the unique resource differentiating organizations, while the AI algorithms themselves will be easier to standardize and copy. In recent years, data lakes have become a popular approach for organizations to make data accessible (Llave, 2018).

(Data) Bias is a systematic distortion of a statistical result due to a factor not allowed for in its derivation (Oxford University Press, 2018). In plainer words: distorted results caused by unwanted factors. According to IBM (2018), more than 180 human biases have been defined, all of which affect our judgement. These biases can, consciously or unconsciously, affect both data and algorithms. As AI systems become more prevalent in society, the potential impact of bias grows. Vanian (2018) exemplifies the potential impact of biased data using AI in recruiting. If an AI software was trained to identify potential CEOs using historical data about previous CEOs, it may draw the conclusion that a suitable candidate must be a Caucasian male, as a vast majority of CEOs in western countries have been just that. Without exploring the factors behind Caucasian males dominating CEO positions, it becomes clear that AI is vulnerable to human bias if it is reflected in data.

The black box problem is a fundamental problem of AI systems in general and DL systems in particular. It refers to the lack of understanding regarding how these systems arrive at their conclusions (Lei, Chen & Zhao, 2018). The complexity of especially DL models can often make it very difficult, if not impossible, to explain the reasoning behind their conclusions.

2.5 Digitalization and Industry 4.0

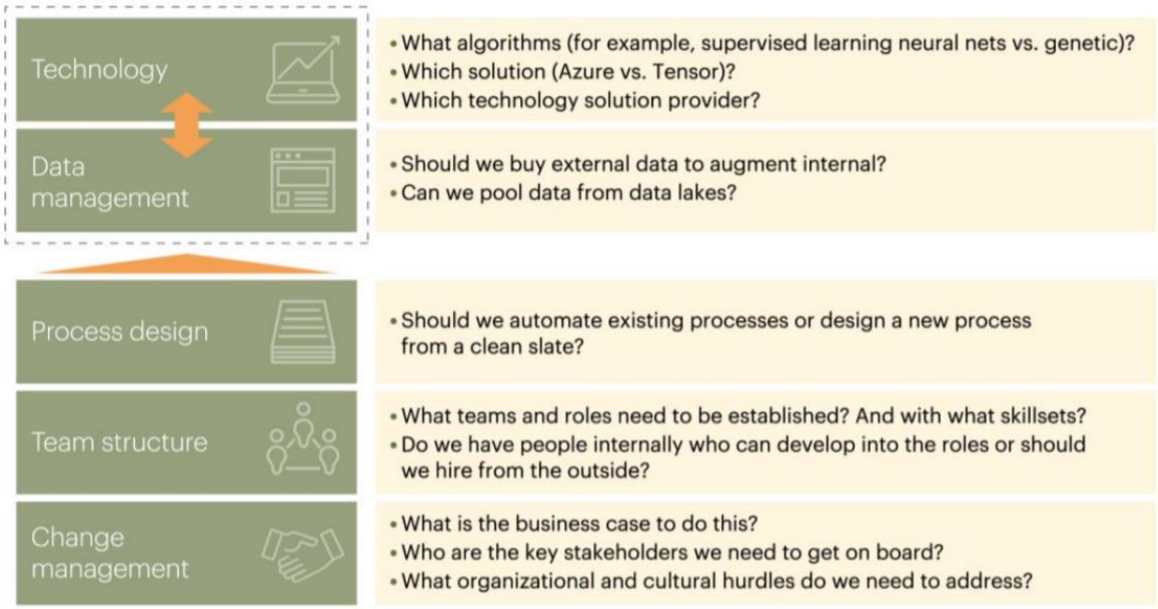
The fourth industrial paradigm, also known as Industry 4.0, largely refers to the integration between the physical and virtual space. This integration has been made possible by technologies such as AI and Internet of Things, henceforth referred to as IoT, in recent years (Xu, Xu & Li, 2017). Nanterme (2016) argues that digitalization presents the most significant threats and opportunities ever encountered in business, as it has enabled a unique pace and scale of disruption. He points to digital disruption as the main reason for over half of Fortune 500 companies, the largest companies in the United States by revenue, since 2000 having ceased operations by 2016. According to Nanterme, business leaders are intent on disrupting before being disrupted, embracing rapid experimentation to facilitate faster innovation. He concludes that success is no longer about changing strategies more often, but instead being able to execute multiple parallel strategies.

2.6 Innovation Management

According to Schreck et al. (2018), most organizations struggle to utilize the potential of AI. The authors argue that efforts must not be focused on the technology as a separate entity, but on redesigning processes to fully leverage the abilities of new technology. Similarly, Evans, Hu, Kuchembuck & Gervet (2017) argue that organizations must make fundamental changes to integrate AI holistically in both strategy and operations, in order to fully leverage its potential. Vinnova (2018) states that organizations must combine operation specific and AI related competence in order to successfully complete this transition. The authors emphasize that it is of great importance that such hybrid competencies are developed in order for organizations to leverage AI.

Evans, Hu, Kuchembuck & Gervet (2017) present a model illustrating what factors organizations should take into consideration when approaching AI. The model is presented in Figure 4.

Figure 4. Visualizes the interplay between factors critical to successfully leverage AI.



Source: A.T. Kearney Analysts, Evans, H., Hu, M., Kuchembuck, R., Gervet, E., Will you embrace AI fast enough?, A.T. Kearney, 2017, p.3

In Figure 4, Evans, Hu, Kuchembuck & Gervet (2017) describe how technology, data management, process design, team structure, and change management, all must be taken into account in order to successfully leverage AI. The model is also cited by Vinnova (2018) to exemplify the extent to which organizations must reevaluate their current operations. Evans, Hu, Kuchembuck & Gervet conclude that while smaller AI initiatives may generate valuable early insights, such measures are no substitute for a holistic approach.

According to Vinnova (2018), a characteristic of countries with successful AI development is national strategies and goals regarding AI. The authors emphasize that these countries do not just view AI as a trend within digitalization, but as a force which will impact national politics with respect to welfare, business, and employment. The Vinnova report also points out that Sweden lacks strategies for AI both on a national and regional level. Nor the national government or SKL, Sveriges Kommuner och Landsting, have such strategies (Vinnova, 2018). In a survey of public organizations in Sweden conducted by Vinnova, less than 5% of respondents claim to have a strategy or plan for efforts related to AI. Meanwhile, 10% claim to have initiated projects which to some degree includes AI. The majority of these efforts were described as early studies or pilot projects.

2.7 Change Management

The process of implementing change is a frequent (Fernandez & Rainey, 2006) and challenging (Isett et al., 2013) for public organizations. According to Voet, Kuipers & Groeneveld (2016), the implementation process itself affects how the initiative is received by employees and by extension how committed they become to the initiated change. The authors present two main types of change processes: planned and emergent.

Planned change processes are driven by management in a top-down manner, where the objective is formulated in advanced (Beer & Nohria, 2000). Top-down communication, design to inform and engage employees, is an important tool for management to create support for change initiatives (Russ, 2008).

Emergent change processes are bottom-up by nature and treat employees as active participants in change (Russ, 2008). While management will often initiate emergent change processes, they do not formulate specific objectives prior to involving employees (Voet, Kuipers & Groeneveld, 2016). Emergent processes utilize both communication and participation to build support within the organization (Rafferty & Restubog, 2010).

Apart from upper management, Voet, Kuipers & Groeneveld (2016) emphasize the importance of direct supervisors and their leadership in change processes. The authors define direct supervisors as an employee holding a formal managerial position at the first hierarchical level above other employees. According to Voet, Kuipers & Groeneveld, direct supervisors can foster commitment and openness toward innovative solutions, using appealing visions about the future of the organization.

2.8 Societal Challenges

While a significant increase of AI applications in both the private and public sector can improve welfare and drive economic growth, it also generates societal challenges which must be overcome to fully realize the potential benefits (Vinnova, 2018). In the context of public organizations, these challenges mainly concern transforming the workforce, regulation, ethics, and security. The Vinnova report deems the understanding of how increased AI utilization will affect society and risks can be mitigated to be very limited.

Workforce impact is expected to be significant as a result of increasing AI utilization (Vinnova, 2018). However, the net demand for human labor is not expected to be affected negatively by AI, it is rather the competencies required by employers that are anticipated to change. According to Schwab & Samans (2016), two out of three kids who start kindergarten in 2016 will work with jobs that do not yet exists. Van der Zande et al. (2018) raises the question whether traditional education and training systems can keep up with the rapid pace of change resulting from technical adoption, particularly at the lower end of the skill spectrum.

Security is another area which can be fundamentally transformed by AI (Vinnova, 2018). Conscious abuse of AI can affect the digital, physical, and political safety of both individuals, organizations, and communities. Brundage et al. (2018) identify three broad tendencies relating to security as a result of growing AI utilization: expansion of existing threats, introductions of new threats, and change to the typical character of threats. The expansion of existing threats is mainly attributed to the scalability of new AI systems which may allow an enhanced degree of automation in launching virtual attacks. The introduction of new threats will likely arise as AI will automate more functions, making a larger number of processes vulnerable to attacks. New types of threats are also likely to be developed, focused on exploiting weaknesses of AI systems. Brundage et al. also provide recommendations for how to policymakers should mitigate these threats. The authors argue that there should be close collaboration between policymakers and technical researches to mitigate, investigate, and prevent potential malicious uses of AI. Misuse-related considerations should influence research priorities and norms, and researches and engineers should reach out to relevant actors proactively when harmful applications are foreseeable. AI professionals should seek out and implement applicable methods for mitigating dual-use concerns from more mature fields. Policymakers should also work actively to expand the range of stakeholders and experts involved in addressing these issues.

Regulation & Ethics questions regarding data and data access will be vital in realizing the potential benefits of AI (Vinnova, 2018). The development of such regulation must balance the fundamental needs of integrity, ethical data utilization, and civil protection, towards data access needed to develop applications and realize the societal benefits made possible by AI. The rapid progression of AI technology makes the simultaneous development of a comprehensive regulatory framework very difficult (OECD, 2017). Some argue that regulation at this point in time would be premature, impeding technological development and thus potential benefits to society. Vinnova (2018) points to a need for governing and regulatory bodies to drastically increase their understanding of AI, data needs, and innovation processes, in order to facilitate the required regulatory changes. The authors also conclude that the interpretation and implementation of GDPR by different actors will be crucial for the development of AI. Nanterme (2016) emphasizes the importance of trust from consumers and citizens in organizations, in order to facilitate the sharing of data needed for realizing the potential of AI. A means of developing such trust is demanding high standards from organizations in terms of AI and data management.

3 Methodology

This chapter will explain the methods used to conduct the study and motivate why they were chosen. The chapter will also discuss the validity and reliability of the study.

3.1 Research Approach

Despite significant media and academic attention surrounding the technology itself, the connection between innovation management and AI is relatively unexplored. Therefore, this study intends to explore the intersection between two bodies of theory, innovation management and artificial intelligence. A descriptive approach is deemed appropriate for the study because there already exists some knowledge and explored patterns within the research area. This decision is in accordance with Bryman & Bell (2015), who argue that a descriptive approach allows the study to explore, explain, and add further information to the subject matter.

3.2 Research Strategy

Because of the complex phenomenon and patterns investigated in the study, a qualitative approach has been selected, in accordance with Eriksson & Wiedersheim-Paul (2008) and Bryman & Bell (2015). Choosing a qualitative rather than a quantitative strategy allows the study to focus on collecting people's views and perspectives, instead of measuring phenomenon (Bryman & Bell, 2015). Another key advantage of the qualitative strategy is that the acquired knowledge and data becomes strongly contextualized.

Combining a descriptive research approach with a qualitative research strategy allows new knowledge to emerge as the understanding of the studied phenomenon increases. Rather than resulting in strict classifications, the result becomes adjustable interpretations (Sandelowski, 2010).

3.3 Research Design

According to Yin (2013), case studies are suitable when research questions concern the how and why of contemporary phenomenon. Furthermore, Yin claims that multi-case studies, investigating multiple cases, are preferable when attempting to add new insights into existing theory. Therefore, a multi-case study design has been utilized, aimed at enabling generalizations for how public organizations should approach AI. The design enables the deep and thorough understanding of the organizations needed to make fruitful observations and inferences (Bryman & Bell, 2015). Previous studies of AI in Sweden's public sector have mainly had a macro perspective, basing its conclusions on shallow surveys and observations. By contrast, the in-depth nature of this study may contribute with new knowledge in the research area.

3.4 Literature Review

A literature review was performed in order to gain a deeper understanding of the subject matter and establish a theoretical framework. Other than identifying the current knowledge within the subject areas, the theoretical framework was utilized to analyze gathered data.

The literature was gathered from Chalmers University of Technology Online Library and Google Scholar. The research has been divided into two main topics: innovation management and artificial intelligence.

The following keywords were used compile an initial literature list: artificial intelligence + public sector, utilizing + artificial intelligence + public sector, innovation management + artificial intelligence + public sector, innovation management, innovation management + public sector. The initial list was then analyzed by reading the abstract of each publication to determine its relevance. A final list of literature was then created, containing the publications deemed interesting.

The theoretical framework was established based on the publications in the final list. The construction of the theoretical framework was an iterative process. In some cases, specific phenomenon mentioned in the literature were further researched through further keyword searches in the two databases. These searches mainly concerned terminology but also included a deeper understanding of technologies such as ML.

3.5 Interview Study

This study utilized semi-structured interviews to collect primary data. This means that a number of questions have been compiled into an interview guide, which has been used to steer the interviews, in accordance with Wilson (2014). Different interview guides have been used depending on the interviewee's profession, as their perspectives have been utilized for different purposes. Semi-structured interviews allow the interviewer to control the outcome while maintaining flexibility in the line of questioning (Lantz, 2013). The flexibility allows the interviewer to capture viewpoints that the interviewee was unaware of, but also allows the interviewee to contribute viewpoints outside of the interview guide (Lantz, 2013). The interview guides are attached in appendixes I and II.

When possible, the interviews have been conducted face-to-face. However, mainly due to geographical constraints, some interviews were conducted via Skype and telephone. Face-to-face interviews is the preferred interview method as it allows the interviewer to interpret body language and facial expressions, contributing to a more accurate analysis of the answers, and by extension a more comprehensive understanding of the collected data (Bryman & Bell, 2015). The locations of the face-to-face interviews have been at the workplace of the interviewees. Conducting the interviews at the interviewees' workplace may make them feel more comfortable, which in turn might lead to more valid and freely spoken answers (Lantz, 2013). When possible, the interviews were recorded.

3.5.1 Interview Subject Selection

The interview subjects were selected using a combination of snowball and appropriate methods, as defined by Denscombe (2018). The snowball selection method is based on referral, where one individual within the sample recommends other potential interview subjects who would be of interest for the study. This allows for fast expansion of the sample and increases the willingness to participate as among suggested interviewees as they have been recommended by an acquaintance (Denscombe, 2018). All interviewed employees at the Municipality of Umeå have been identified using the snowball method. Remaining interview subjects have been identified using appropriate method. This means that they have been specifically chosen based on their attributes. This method allows for handpicking what appears to be the most relevant interview subjects based on their knowledge and experience within the field (Denscombe, 2018). All interview subjects are presented in Table 1.

Table 1. Presents interview subjects of the study.

Name	Organization	Title	Interview Format	Recorded	Date of Interview
Tomas Forsberg	Municipality of Umeå	IT Manager	Face to Face	Yes	October 2nd 2018
Emil Forsberg	Municipality of Umeå	Development Leader	Face to Face	Yes	November 11th 2018
Katarina Sjöström	Municipality of Umeå	Organizational Developer	Face to Face	Yes	October 10th 2018
Leif Johansson	Social Insurance Agency	Senior Lead Architect	Phone	No	November 30th 2018
Michael Carlberg Lax	Municipality of Skellefteå	Chief Information Officer	Skype	Yes	October 26th 2018
Paul Davidsson	Municipality of Hörby	E-Strategist	Skype	Yes	October 24th 2018
Eleonore Schylter	Municipality of Trelleborg	Unit Manager	Skype	Yes	November 5th 2018
Henrik Suzuki	Swedish Public Employment Service	Lead Developer	Skype	No	November 13th 2018
Louise Callenberg	Municipality of Stockholm	Unit Manager	Phone	No	November 21st 2018
Virginia Dignum	University of Umeå	Professor	Email	Yes	November 26th 2018

3.5.2 Interview Data Treatment

When possible, interviews were recorded in order to ensure that the gathered data was available in an unaltered form for analysis. The recordings were used in combination with notes taken during the interviews to synthesize the empirical findings in writing. In order to validate the findings, interviewees were provided with the result of their interview and given an opportunity to correct any misinterpretations or misrepresentations, before approving them for publication. According to Bryman & Bell (2015), there is a tendency among interviewees not to reveal all available information when being recorded. This risk was mitigated by providing the interviewees with the option to decline being recorded, as well as the option to remain anonymous in the study. Furthermore, recording the interviews mitigated the risk of missing or misinterpreting what was being said in the interviews, which was deemed critical as the interviews were all conducted by a single interviewer. This means that without recordings, all collected data would be subject to the interpretation of a single person who was simultaneously asking, listening, and taking notes.

3.6 Data Analysis

The collected data was analyzed using an inductive approach, meaning that inferences and conclusions derived from analysis of observations after the collection of empirical data (Bryman & Bell, 2015). The process was iterative, meaning that the collection and analysis of data were performed concurrently (Bryman & Bell, 2015), which is beneficial according to Lantz (2013). By creating a summary of the findings and possible points of analysis after each interview, themes developed during the data collection process. The identification of these themes helped to identify topics of interest for the following interviews. The themes were further contextualized by comparison to the theoretical framework.

3.7 Validity & Reliability

Validity is the relation between what is supposed to be measured and what is actually being measured (Golafshani, 2003). This could be interpreted as deciding on a method to measure a phenomenon and then validating that the method is in fact measuring what it is supposed to measure. Achieving high validity is an inherent issue within qualitative studies (Bryman & Bell, 2015).

Allowing the interviewees to review and correct the findings provides validation in terms of ensuring that the findings have been correctly interpreted. Meanwhile, recording the interviews mitigates the risk of important findings being missed and not taken into consideration in the study.

Translation is a risk factor in the study in terms of validity. The interviews are conducted in Swedish and then translated into English for the purpose of this report. Because translation is an interpretive process by nature, important meanings could get lost. Again, allowing the interviewees to review and approve the findings is a measure that mitigates the risk of losing or misrepresenting meaning in the translation.

Another issue with the study is that the interviewees are often put in a position where they speculate about future events, particularly in terms of how AI could be utilized and future organizational challenges. On the one hand, the interviewees can be viewed as relatively qualified to make such speculation because they have professional experience within the subject matter they provide data about. On the other hand, it is highly difficult to evaluate the accuracy of their speculation, as there is little frame of reference. One way in which the study mitigates this risk is interviewing multiple sources about the same subject, creating some frame of reference, albeit limited.

Reliability is the degree to which the study is repeatable (Golafshani, 2003). According to Golafshani, reliability is also an inherent issue within qualitative studies, because of the difficulty to replicate the settings in which they are performed.

The reliability of the literature review is considered relatively strong as it was performed in a fairly standardized matter. By providing the keywords and identifying the databases used to collect literature, replicating the initial list should be relatively easy. Discrepancies may however arise when analyzing abstracts in order to determine which publications are relevant. Some further discrepancies could arise when interpreting the publications which have included in the study. However, these are inherent risks in almost every literature study.

Publishing the interview guides along with the report increases the reliability of the study, as it facilitates recreation of the interviews. However, as some freedom is inherent within semi-structured interviews, the interview guide does not guarantee a representative replication. Furthermore, as follow-up questions are frequently thought up during the interview by the interviewer, the views of the interviewer affect what questions are being asked, and by extension what findings are made.

4. Empirical Findings

This chapter presents the findings of the data gathering process. Each interview is presented in five separate sections, corresponding with the research questions of this study. The interview with Virginia Dignum has its own structure, as a result of her expertise being limited to the social and ethical aspects of AI. The interviews are presented in no particular order.

4.1 Tomas Forsberg, IT Manager, Municipality of Umeå

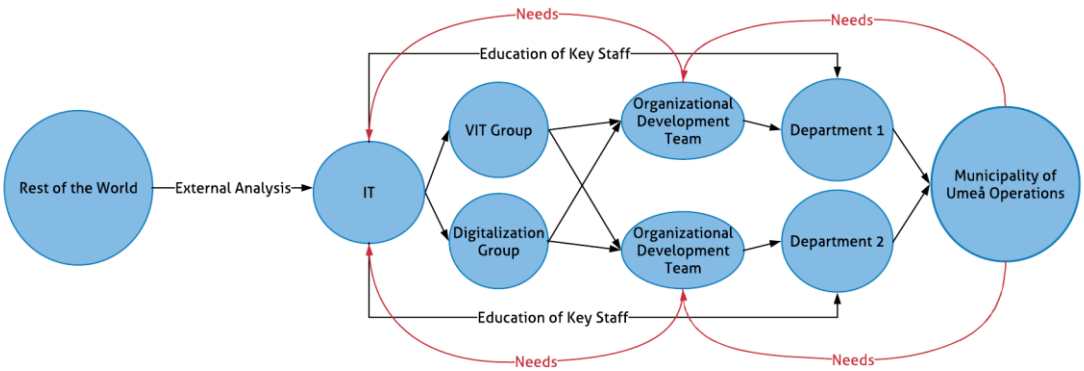
Tomas Forsberg, IT Manager at the Municipality of Umeå. As the municipality's IT Manager, Tomas has unique insight into the municipalities structure and strategy regarding technology.

4.1.1 Identifying New Technology & Applications

The Municipality of Umeå has no separate approach to AI, but rather treats it as an area within digitalization. In turn, digitalization is mainly approached through the general organizational development, which is carried out individually by each department. The organizational development has no uniform design throughout the municipal organization but is generally carried out by a number of employees within each function, aside of their regular duties. Tomas notes that the process may not just vary from department to department, but even from person to person within each organizational development team

When faced with the question, Tomas agreed that the IT knowledge of the staff within the organizational development teams could be a bottleneck in the identification of potential technology-related improvements. However, the municipality is already taking steps towards mitigating this risk. The first step is that the IT Department is tasked with external monitoring and informing the other functions within the municipality of findings that may be of interest. This information is then passed on to the rest of the organization through two groups: the VIT-group, Verksamhetsutveckling med Hjälp av IT, and the Digitalization Group. Both groups contain members from all departments and serve as channels where information about available technology is diffused. The second step is education of key employees from different departments, starting with the directors. The complete flow of information throughout the municipal organization is visualized in Figure 5.

Figure 5. Visualizes the flow of information throughout Umeå's municipal organization, as described by Tomas.



The municipality is also in the process of establishing a new unit, called the Catalyst Organization. It will be tasked with method support, change management and cross-functionality issues, among other things. Method support will help the individual organizational development teams establish how to best approach problems, and to some extent standardize their processes throughout the municipality. The cross-functionality issues arise from the fact that the municipality is organized in silos, or departments, each of which working autonomously to some extent. According to Tomas, much of the current inefficiencies within the municipality arises from a lack of cooperation and understanding between the silos. Recent organizational changes will make the departments even more autonomous, which in turn will most likely increase the disconnect, according to Tomas.

Tomas also identifies the silo structure and disconnect between units as a usability issue for the municipality's inhabitants. As an example, in order to construct a villa, the private citizen must be aware of the many different departments within the organization in order to obtain all of the necessary permits. Once the private citizen has identified each of the departments that must be involved, he or she must contact them separately and request the appropriate documentation. The entire process usually takes months and is very tedious for the citizen. Meanwhile, the process is rather straightforward for the municipality, as it is simply a case of comparing the application to existing regulation. As a contrast, Tomas mentions the Federal Tax Agency, Skatteverket, and its major overhaul focused towards becoming more user-friendly for citizens. In the past, declaring taxes has been very tedious. It has been up to the citizen to gather all the relevant information, calculate tax brackets and so on. Today, the tax agency gathers all this information itself and makes a preliminary tax calculation. All the private citizen has to do is log onto the agency's website, look through the preliminary calculation to ensure that there are no errors, and press submit. Tomas believes that a similar process should be able to exist for construction permits, where applying for a permit initiates a horizontal process, which automatically compares the application to the relevant regulation across all relevant departments and delivers a verdict. Tomas has a saying that processing a construction permit should not take more than 43 milliseconds.

Overall, Tomas also believes that there should be more cooperation between Sweden's public organizations. He notes that there are 290 municipalities in Sweden, all with the same mission, and questions how hard it should be for them to do the same things.

4.1.2 Decision Making Process

The final decision of whether or not to move forward with new projects is made by the departments which would be affected by the change. In technology projects, this will typically include the department wanting to implement the change and IT as they will need to help support and operate technical aspects.

4.1.3 Utilizing AI & Digitalization

The Municipality of Umeå has one project that involves AI, a new chatbot designed to answer queries by searching through large amounts of text. The bot was requested by three separate functions, so the IT Department is trying to develop a general bot that can be used by all three functions. A concept bot was created by an employee within the IT Department and was used as proof of concept before initiating the creation of the general bot. Tomas cities the relatively small amount of resources needed to develop the bot as a major factor behind the approval of the project.

Other than the aforementioned chatbot, the municipality does not have any AI-related projects in the pipeline. However, Tomas and the IT Department have identified some other applications of AI that he deems interesting:

- Monitoring bracelets that measure pulse, blood pressure and other vitals of patients could improve patient care by helping to detect issues earlier and reduce the time needed for caregivers to regularly perform such tests. Similar technology already exists within the fitness industry, but Tomas believes that big benefits could be reaped by applying it within home care.

- Tomas has witnessed what he deems to be successful tests of something he calls iPad robots. They are essentially a tablet placed on a mobile remote-controlled stand. The main benefit of these robots is to create a virtual presence of real people, such as doctors and caregivers, through video calls. Within home care, especially among elderly, getting digital face to face time appeared very popular. In combination with other smart solutions, such as video or bracelet monitoring, such digital presence has the potential to increase patient time and reduce travel time for employees within home care. He also sees potential in using such interactive robots to further create stimulation for home care patients, beyond answering direct questions and assisting healthcare processes.

- Dispensary robots, dispensing medicine to patients in certain doses at certain times. Not necessarily AI in itself but could open up for such applications.

- Personas developed through big data is a common tool within sales and marketing to predict behavior among customers. Tomas believes that the same principles should be applicable to urban development, predicting public service needs such as how many children in the area will require daycare, how many will require school in each grade, and so on.

- As previously mentioned, automated review of construction permit applications is another area Tomas believes has potential. Today's process can have a long handling time, but similarly to the social benefit applications, they are largely just a comparison between the applicant's construction plans and existing regulation. Creating a program that does much, if not all, of the work on many applications should be possible.
- Tomas also believes that AI could be utilized to support the budget process. Without being too specific he points out that it should be possible to create a program that helps optimize the budget based on available data and quantitative predictions.

4.1.4 Implementation Strategy

While Tomas sees potential in the utilization of AI, he is still a bit skeptical of current systems' efficiency. He brings up the financial support application program utilized in Trelleborg as an example. He believes that many have gotten the impression that it is a plug and play solution that anyone could just copy and implement within their own social welfare unit, just because it was largely successful in Trelleborg. Tomas knows of numerous examples where such attempts were made and failed, most famously the Municipality of Kungsbacka where most of the employees at the social welfare unit quit in protest to the system. Tomas pointed to the thorough organizational development work that laid the foundation for the AI implementation as a key part of making the Trelleborg project successful.

It is Tomas' impression that there is a general openness for change within the municipality. He believes that the willingness stems from a widespread understanding that the municipality's aging population will lead to increased demand for public services while simultaneously reducing the number of taxpayers per capita, demanding much greater efficiency. He believes that the openness has become especially apparent among the directors during their digitalization education sessions. However, Tomas also emphasizes that despite a sense of openness for change, there is also a lack of urgency. He attributes the paradox to the fact that many employees within the municipality are of an older generation, who are generally more anxious about losing and changing jobs. In short, Tomas believes that there is an openness towards new methods to meet the challenges facing the organization, but fear for too much change stemming from anxiety among some employees of losing their jobs. Tomas believes that this fear and the resulting reluctance toward change could be mitigated through better communication within the organization. He also believes that the willingness to change will increase as the future challenges related to the aging population will become more apparent.

4.1.5 Regulation, Ethics, and Security

Tomas mentions the lack of regulation connected to AI as an uncertainty that must be taken into account when considering such efforts. One example goes back to Trelleborg, where SKL stated that fully automated decision-making is prohibited according to municipal law. Tomas anticipates similar cases to arise in the future where the legal boundaries for what AI and other technologies can do within public sector entities will be defined.

Regarding integrity, Tomas mentions video monitoring within home care. A few years ago, video monitoring of home care patients was heavily rejected due to personal integrity issues. Many were of the opinion that nobody should be recorded in their own home just because they need care. However, following successful attempts in especially Västerås, it is Tomas impression that stances have shifted. While the personal integrity issues persist, there is a growing consensus that the benefits outweigh the risks. Other than the caregivers being able easily to monitor the patients, it also reduced anxiety among some patients. It also increases the quality of sleeping among some patients as some get woken up during nightly check-ins by caregivers. Patients also found comfort in the fact that it was their regular caregivers, who they already knew personally, that was monitoring them, rather than strangers. Today, the Municipality of Umeå is running a trail, installing a total of roughly 20 cameras in home care patients' homes. The patients were given the option to decide themselves whether they wanted to be part of the trail and have the cameras installed or not, which Tomas believes limits the sense of integrity infringement.

4.2 Katarina Sjöström, Development Leader at the Education Office, Municipality of Umeå

Katarina Sjöström is a Development Leader at the function Competence Centre for Digital Learning, which is part of the Development Department of the Education Office, within the Municipality of Umeå. The role of the Development Department is to act as a support and development resource, both towards the Education Office's leadership and the different operations within the scope of the Education Office, such as schools. The support entails managing central computer systems for the Education Office and its organizations, as well as development projects and competence development efforts of both staff and management.

Prior to the interview, Katarina was asked to estimate how many hours teachers employed by the municipality spend on grading tests and papers each year, and how much this time costs. According to Katarina's estimations, the Municipality of Umeå spends between 41.6 and 64.8 million Swedish Krona per year on grading. If this number is proportional to all of Sweden with regards to population, the national cost of grading is between 3.4 and 5.3 billion Swedish Krona per year. The calculations behind these numbers are presented in Appendix III.

4.2.1 Identifying New Technology & Applications

In identifying new technological applications and opportunities, The Competence Center for Digital Learning is responsible for external monitoring. Most monitoring is conducted via different networks, mainly social media channels and public entity networks. Katarina believes that the current external monitoring tools are sufficient to maintain an adequate understanding of available technologies and their potential applications to make other activities, such as conferences, redundant for her department.

There are also structures in place within the Education Office aimed at identifying needs from within its own operation units. The main tool is networking, where i.e. school principals and other staff within the operations can communicate and collaborate to identify needs. The municipality is developing the digital competencies of leaders within its organizations to help them better understand the capacity and possibilities of digitalization.

The identification process is mainly focused on plug-and-play solutions that can improve current processes, rather than fundamentally evaluating and rethinking processes based on available technology. Katarina agrees that the organization may get stuck in an operational perspective rather than a strategic approach. She likens the mentality to that of Maslow's Hierarchy of Needs theory. It categorizes human needs into sequential levels, where the needs of more basic levels must be met before a higher need can be fulfilled, i.e. one must have their physiological needs met before the need for safety can be fulfilled. In Katarina's technology version, it is hard for employees to envision large-scale change driven by technology if basic functions such as wi-fi and logins are malfunctioning. Katarina also believes that their focus on current processes and internal understanding of boundaries for what is possible with today's technology may keep the organization from understanding their needs on a deeper level and consequently creates an inability to convey these needs to potential suppliers.

According to Katarina, there is also a continuous dialog between the municipality and suppliers about possible improvements and available technology. However, she does not believe that the municipality has made their suppliers aware of the number of hours and amount of money spent on grading.

4.2.2 Decision Making Process

Once a new technology application has been identified and deemed interesting it is typically tested through a pilot project. The scope of the pilot can vary greatly depending on the nature of the application. A limiting factor of pilot testing is the fact that most testing must be carried out live in the organization, meaning that the potential benefits of developing processes must be weighed toward the municipality's responsibility to maintain sufficient quality of education throughout the test period.

If the test is deemed successful upon evaluation, the next step of the decision process is prioritizing it in budgeting. Each organization required to contribute in the implementation of the change must include and prioritize the effort in their budget. Depending on which organizations are affected by the change, the complexity of budget prioritization can vary greatly.

The next step is creating a specification for public procurement. Suppliers then provide bids based on the specification. In accepting one of these bids, the municipality makes the final decision of moving forward with the project.

According to Katarina, budget prioritizing is often the biggest obstacle in implementing changes. However, depending on the situation, willingness to change and other conditions within the affected operations can also become significant obstacles. While pilot testing is limited to some degree, it is Katarina's opinion that most tests are still able to be carried out, albeit limited in scope.

Katarina also emphasizes the difficulty of measuring the effect of changes within education, due to the large number of factors impacting performance. National organizations such as SKL and Skolverket, the National School Agency, provide some macro analysis of educational performance. Nationella proven, which are nationally standardized tests, also allow schools to benchmark the knowledge of their students nationally. These tools enable educational organizations to benchmark the quality of their educational services nationally to some degree. However, Katarina also points out that performing and correcting nationella proven demands a lot of resources. Furthermore, Katarina claims that numerous quality assessments point toward teachers as the key factor behind the quality of education.

4.2.3 Utilizing AI & Digitalization

Katarina cannot point to any clear cases where AI is utilized within the Education Office. However, she mentions several digital solutions where AI could possibly be incorporated in the future.

The municipality is testing several digital teaching aids which can adapt to its user. As an example, instead of just providing text in digital formats, new e-books can be played as an audiobook, adjust difficulty level of the text to suit the user, be convey information in several languages.

Some aids also come with prepackaged tests relating to specific parts of the material, such as themes or chapters. These tests are self-corrected and can provide both the teacher and student with some understanding of how well the student grasps the certain parts of the material, identifying what areas the student know well and which need further practice.

The aids that Katarina is familiar with are limited to binary questions such as true or false, multiple choice, and fill the gap. In creating the specification for such a system, the municipality added the possibility of detecting and allowing spelling errors, i.e. not deducting points for simply misspelling the correct answer, as a desirable function rather than required function. The reason for making this function desirable rather than required was an uncertainty among the municipality's staff whether it was feasible from a technological standpoint.

Katarina is also under an impression that both the public sector organizations and developers of teaching aids are now understanding the possibility of utilizing learning analytics. Meaning the potential benefits of gathering and analyzing data gathered from the students' learning process and using it to understand the development of both individual students and entire classes. Katarina believes that this process is already utilized to some degree concerning individual digital teaching aids, such as the abovementioned self-correcting tests, but that combining different data sources to create a broader understanding and context is not. Katarina also notes that the focus of learning analytics is pointed towards students and their development, rather than evaluating the teaching services provided by the municipalities.

The municipality has also acquired a digital school platform where teachers can create self-correcting tests, again limited to binary questions. Another feature of the system that addresses the process of grading enables sharing tests between teachers, allowing them to divide the grading process of a test by, i.e. question. Allowing the same teacher to correct the same question for larger groups of students reduces the variation in assessing the quality of the answer and decreases the time consumption of the correction process.

4.2.4 Implementation Strategy

Katarina mentions several success factors identified during previous implementations of technological solutions within the Education Office. The first one being that the change should be concerned with a clearly defined and well-known problem or need and well anchored within the management of the concerned units.

Another critical factor is creating sufficient competence and designating enough resources to manage the implementation. One concrete example is a network of nodes established within the affected organizations. A node is either an individual or a group of employees who receives extra training and access to the central organization and supplier. The nodes then manage much of the inquiries from colleagues, making the unit more self-sufficient in implementing the change.

Having a clearly defined organization for the continuous management of the implemented change is another key factor for success. Clearly defined responsibilities and resources ensure that projects are not abandoned once the implementation itself has been completed and that the full benefits can be achieved throughout the entire lifecycle of the project.

Lastly, Katarina believes that transparency and communication is another key in successful implementation. There should be no confusion regarding what need or problem is being solved, and what need or problem is not being solved, by the change. There should be no surprises for the involved parties.

4.2.5 Regulation, Ethics, and Security

Katarina feels that policy and regulation are clear about what the Education Office are allowed to do in their digitization efforts relating to data security and GDPR. While she acknowledges that these policies and regulations restrict creativity and curiosity within the organizational development, Katarina also believes that there is acceptance for the needs behind these restrictions.

4.3 Emil Forsberg, Organizational Developer at the Office for Social Services, Municipality of Umeå

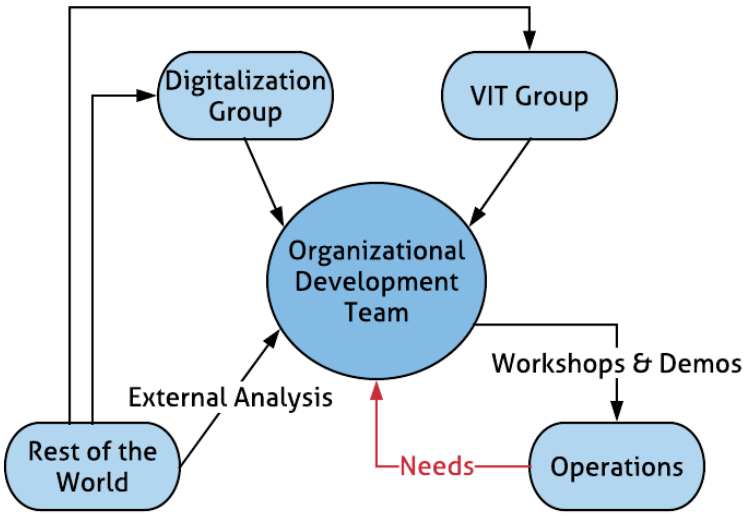
Emil Forsberg is an Organizational Developer at the Office for Social Services in the Municipality of Umeå. The office is tasked with social support, financial aid, and patient care within the municipal duty. Together with one other colleague, soon to be three, he focuses on digitalization of the Office for Social Services and its operations. Emil's role includes both system support and e-health.

4.3.1 Identifying New Technology & Applications

External monitoring in the form of conferences, newsletters, and input from other parts of the municipal organization, is the primary method for Emil's unit to identify new technology. The VIT-group and Digitalization Group are two examples of channels within the organization through which such information can be obtained and shared.

Innovation is also driven by needs within current operations. Activities such as workshops with operational staff, aimed at identifying and formulating needs, are conducted to enhance that drive. Workshops can include demos of new technology to help the operational staff understand what technology is available and how it can be utilized. There are also efforts being made to standardize the processes surrounding identification and formulation of operational needs, i.e. a template standardizing how needs should be conveyed. It is also the responsibility of operations to capture the needs of citizens. Ensuring that the needs of citizens are captured earlier is a point of emphasis. The innovation process is visualized in Figure 6.

Figure 6. Visualizes the innovation process at Umeå's Office for Social Services.



Efforts are also being made within the organization to share knowledge and increase understanding of technology and its potential. These efforts have increased significantly in recent years.

Pilot studies are sometimes conducted within the organization. However, Emil believes that such studies can be sensitive due to the neutrality requirements inherent to public organizations and their acquisitions.

The Office for Social Services has a goal to develop digitalization plans for each unit manager, i.e. the manager for elder care. These plans will supplement today's digitalization plans, which are aimed broadly at the organization, by being more specific to each unit.

Emil is under the impression that there is some difficulty in lifting the perspective of digitalization from current operation to strategy, questioning what things are done rather than how they can be done better. He believes that the organization will face large-scale changes in the near future, but that staff within their operations may not share his expectations regarding the extent and pace of these changes. He speculates that the discrepancy could be due to limitations in technical understanding and skepticism emanating from problems with seemingly less complex technological aids, questioning how more complex technical aids can be utilized successfully if less complex solutions have previously proved problematic. Emil likens the transformational challenge to that of large, well-established companies, where old investments often stand in the way of making new investments, as there is an unwillingness to make previous investments redundant.

Despite having one of the country's largest universities in the municipality, there is very little cooperation between the University of Umeå and the Municipality of Umeå in terms of digital innovation, to the best of Emil's knowledge. There is some cooperation taking place in very large projects where many of the region's major actors are involved. Emil attributes the lack of cooperation to resource limitations within the municipal organizations, leading to other initiatives taking precedence.

4.3.2 Decision Making Process

Once a need or interesting technology has been identified, a case study is initiated. The case study aims to establish benefits, risks, basic requirement specifications, and a basic understanding of acquisition options. A point of emphasis in recent years has been benefit realization and target group analysis. Staff from both management and operations have received training in how to identify benefits and ensure that they are realized.

If the proposed change involves acquisition and the case study is deemed successful, municipal acquisition officers are involved to manage the purchasing process in cooperation with the affected operations and the IT Department. The acquisition process is conducted according to a standardized model developed by the IT Department. The final purchasing decision is made during the acquisition process.

A challenge for today's acquisition process is the fact that many technical investments are related as the compatibility between systems and aids is of increasing importance. Until recent year, most technical acquisitions have involved distinctly separate systems.

4.3.3 Utilizing AI & Digitalization

The only project close to implementation involving AI is a chatbot. It is currently being tested and is planned to be implemented next year at the Reception Unit, which is the citizens' point of contact with the Office for Social Services. The aim is for the bot to automate some of the customer service functions within the Reception Unit.

Another current point of emphasis is health bracelets, enabling gathering of data regarding patient behavior and vitals. Behavior can include both instant information regarding sudden events such as falls, and long-term patterns. Monitoring vitals can enable medical supervision beyond physical behavior such as movement and other activities.

Language support has also become an area of interest for the Office for Social Services, mainly as a result of many employees not having Swedish as their native language. Via an e-health initiative from the governmental agency Socialstyrelsen, the Municipality of Umeå has secured funds to conduct some testing in the area.

Dictation of both speech and sign language is another possible application of AI identified by the municipality. Today, a small test concerning one employee is being conducted regarding this possibility. Overall, Emil believes that document management is an area in which the municipality has significant needs.

Technologies creating digital environments such as virtual and augmented reality are also under consideration for testing. Emil sees great potential for both caretakers and patients in using such technologies.

4.3.4 Implementation Strategy

In terms of implementation, Emil identifies communication as the key factor. He believes that involving all concerned stakeholders and creating a common understanding of what is to be done and why is of utmost importance for successful implementation.

Emil is under the impression that fear for change as a result of losing one's job is a thing of the past. There is a general understanding among most, if not all, staff that the municipality will need all its available resources moving forward, even though some may need to be utilized differently. The challenge is instead to change the organization to ensure that it is capable of managing future challenges. Emil likens the situation with large private organizations which often struggles to change with their surroundings.

Another key to successful implementation is, according to Emil, a well-established organization responsible for continuous management of the change. In technology related projects this process will typically include the IT Department and the departments affected by the project.

4.3.5 Regulation, Ethics, and Security

Emil views current regulation and its interpretations as one of the biggest obstacles in his work with digital development. While he believes that the regulation is not necessarily ambiguous, there are instances where other municipalities appear to violate regulations with no repercussion, reciting Trelleborgsmodellen and automated decisions as an example. Emil is also under the impression that government agencies provide very different levels of support in terms of digitalization and innovation, where some are focused on facilitating innovation while others have a more conservative approach. The inconsistency impedes innovation efforts to some degree.

In terms of security, Emil does not believe that digitalization or AI necessarily poses a much different challenge than traditional IT systems and technologies. These issues are typically managed in cooperation with the IT Department, and at the moment Emil does not see any reason for major changes in this process.

The ethical perspective poses a challenge in the Office for Social Services' digitization effort, namely when deciding what data should be collected. Emil acknowledges that there is a trade-off between gathering data to improve the quality and availability of services and infringement on its citizens' privacy. Emil believes that the acceptance for monitoring and data gathering has increased rapidly in recent years among the municipal managers as well as citizens and operational staff.

4.4 Leif Johansson, Senior Lead Architect, Social Insurance Agency

Leif Johansson is a Lead Senior Architect for Business Intelligence, Cognitive Data Analysis, and Big Data, at the Swedish Social Insurance Agency, Försäkringskassan. As such, he is responsible for applied IT architecture, organizational architecture, and the strategic development within these domains. AI is the primary focus within cognitive data analysis.

4.4.1 Identifying New Technology & Applications

The development of AI within the Social Insurance Agency is strongly driven by a group of three employees, including Leif. These three individuals found each other by chance among the agency's 12,000 employees and discovered a mutual interest for technology in general and AI in particular.

Management within the agency has agreed to create an innovation center, through which Leif and his team can experiment with AI and develop new capabilities. The innovation is mainly conducted by utilizing various open source tools, which according to Leif have virtually all the desired AI capabilities. In his view it, AI development is a question of learning how to utilize these open source tools. Because the development is conducted by a small team using open source tools, the agency's financial risk is largely limited to the hours spent on innovating by Leif and his team. Leif is also under the impression that management has accepted that some innovations projects will fail and not lead to organizational benefits. This understanding, combined with the limited financial risk, has enabled the Leif and his team to innovate without strong requirements for short-term gains and predefined goals. According to Leif, this degree of freedom has been vital to their innovation process, as true innovation is unpredictable by nature and some failure unavoidable.

The development strategy is to create separate abilities by utilizing AI, i.e. picture or text analysis, and then gathering these abilities in a framework. Different abilities within the framework can then be utilized in various combinations to create functions, which in turn can be implemented in the organization. This approach limits the scope of each project, avoiding large-scale endeavors, which typically require large resources.

In order to progress from technical ability to organizational function, Leif and his team utilize what he calls a socio-technical process. It entails showing operational staff AI abilities and then collaborating with them to identify possible applications and create proof of concepts. According to Leif, the key to this process is finding the right operational staff, who are willing to think innovatively. Leif also believes that it is critical to involve operational staff in an early phase, as they have the strongest operational understanding and are the ones who will ultimately have to train the AI. He is under the impression that most staff enjoy aiding the innovation efforts. The development of proof of concepts continues until the operational staff deems them good enough to sufficiently fill their function.

Overall, Leif believes that technology is relatively easy to develop, the key is understanding how it can be applied. He cites the Apollo project as an example: 50 years ago, humans were able to land on the moon and return back home safely using computers with the processing power of today's basic calculators, the key was applying technology in the right way. He is skeptical about the concept of recreating the human mind, capable of doing everything a human can do, using AI. Instead, he prefers to focus on developing specific abilities and finding ways to combine them to create value. It is also Leif's opinion that there are not enough data scientists in the Social Insurance Agency to truly leverage the potential of AI digitalization.

Leif emphasizes the strong contrast between their process and traditional digitization efforts. He describes how large teams handmade complex solutions which were acquired through a rigorous process of description, interpretation, and development of the system. By the time the system was completed, it was already outdated. Traditional systems are also structurally rigid, some code utilized today at the Social Insurance Agency dates back to the 60s and 70s. As a result, public organizations have become good at managing traditional systems, but due to the complexity it is still very costly. Instead, Leif emphasizes the importance of building flexible IT architectures, enabling the utilization of best of breed solutions. As an example, their initial DL applications were powered by an open source DL engine which is now becoming inferior to a competitor. This means that the IT architecture must be modular, making the underlying engines interchangeable, in order to avoid becoming locked into inferior systems.

The AI efforts have also revealed weaknesses in the general digitization efforts within the agency. In order for AI to be implemented the underlying digital structure must be at a certain level, generating and utilizing digital data in its processes. Leif is under the impression that the digitalization efforts at the Social Insurance Agency are lagging far behind the private sector, where he was previously active. The fundamental digital platform must be in place to properly utilize AI.

4.4.2 Decision Making Process

According to Leif, the decision-making process from proof of concept to full-scale implementation is very complex. The main principle is that the department which will ultimately use the innovation should also be the one to make the final decision and own the implementation.

4.4.3 Utilizing AI & Digitalization

The Social Insurance Agency has several applications of AI which have been successfully tested and in the process of being implemented in full-scale. However, as previously mentioned, this process is complex and none of the applications are in full use yet.

A cognitive search engine specialized in child and family regulation was the first AI driven application developed by Leif and his team. The engine responds to questions asked in spoken Swedish and answers by providing relevant regulation in written text. The answer is specified down to the most relevant paragraph among thousands of pages of regulation. As an example, the engine can be asked whether a grandparent is eligible for care of sick child compensation, commonly referred to as VAB in Sweden. The engine then realizes that the question regards a family member who is not the parent of the child and searches for relevant information. The engine also provides recommendations of potentially relevant information based on the inquiry, similar to the way in which Amazon recommends products based on customer behavior. The engine is the result of extensive socio-technical development, where two staff members of the customer support unit with extensive knowledge of child and family care issues trained the AI using reinforcement learning. The search engine has proved especially useful when training new staff in the customer support unit.

Another AI-powered application under development at the Social Insurance Agency is what Leif calls the digital co-worker. The digital co-worker is a program which will interpret the text of healthcare related cases to make recommendations and categorizations based on relevant regulation, i.e. determining what type injury a person has sustained and recommending how the Social Insurance Agency should handle sick leave compensation. Because these cases can often require human intuition, i.e. a terminally ill person with only weeks to live can be required by law to still apply for jobs in order to qualify for financial support, the digital co-worker is limited to recommendations rather than final decisions. The sensitive nature of healthcare issues has also influenced the development of the application. Leif is under the impression that the five doctors who helped train the applications realized that their judgement could ultimately affect millions of patients and that this insight was a burden to some of them. The AI's learning process has also been highly supervised, and quality of output tested by external doctors.

A third application of AI combines picture and text analysis to detect fraud in dental compensation applications. When seeking compensation for dental procedures, the applicant must provide information about the procedure, which typically includes x-ray results and a text document describing the procedure. The AI first compares the image with other x-rays which have been sent to the agency in previous claims and images on the internet, determining whether the image appears to be an original or not. The program can detect duplicates even if the image has been altered to some degree. If the image has appeared before, the AI flags for the case as potential fraud. If not, the AI proceeds to compare the x-ray with the text description of the procedure, searching for discrepancies. I.e. if the text describes that there has been a filling done on Molar 37, the program analyzes the x-ray to investigate whether there in fact appears to be a filling in Molar 37. If the x-ray images appear to be originals and match the described procedure, the application passes the screening.

Leif is also in the process of creating a data lake, gathering all the data collected by the agency. While the data lake itself does not require AI, making all data available in compatible formats will enable AI driven applications to utilize the data for different purposes.

Leif sees potential in moving the operation of their AI capabilities to a government cloud, servicing all public organizations in Sweden with their framework of AI abilities. According to Leif, there are roughly 400 government agencies in Sweden and around 260 IT operation centers servicing those agencies. He believes that there should only be one, pointing to Norway as an example where there is only one central IT operation center servicing all government agencies. In moving all public IT operations to one centralized unit, the AI framework and its capabilities would be made available to all public organization. This would enable smaller public organizations, lacking resources to develop their AI capabilities, to access the framework, while also avoiding duplicate efforts as multiple agencies separately develop the same abilities.

4.4.4 Implementation Strategy

Similar to the decision-making process, the principle for implementation is that the operational departments themselves must own the implementation process. This process is complex and often requires large resources. Leif sees it as a big challenge today.

Beyond the initial implementation process, Leif also emphasizes that the operational departments must understand that they own the quality of the AI applications and are responsible for ensuring that they keep up with their changing environment, i.e. regulatory changes which the AI must be taught. This training process must be ongoing throughout the lifetime of an AI application to ensure that it is up to date.

4.4.5 Ethics, Security & Regulation

In terms of regulatory constraints, Leif believes that there is a big difference depending on what type process the AI application is involved in. The search engine specializing in family and child care issues only searches through public regulations and presents relevant parts of the text, making regulatory constraints a non-issue. The digital co-worker on the other hand, which analyzes sensitive information and makes recommendations regarding issues which can have a significant impact on citizens, represents a big regulatory challenge. In order to face this challenge, Leif and his team develop the AI abilities using open data, which is already in the public domain. Because the data is already available to the public, there are no legal obstacles with regards to GDPR or other laws pertaining to sensitive information. This allows Leif and his team to build a solid understanding of the applications without facing legal issues. Once the team feels confident about the application and their understanding of it, they involve legal professionals to discuss the legal aspects of making it fully operational. Leif believes that it is critical for him and his team to build a strong understanding of applications before facing the legal issues in order for them to overcome these challenges. Overall, Leif is under the impression that there is a taboo in public organizations regarding the use of real data when developing new aids and that many support the use of mock data, i.e. creating fictive patient cases which are used to train the algorithms. Leif is a strong opponent to mock data, as he believes that real data is important both to make the algorithms accurate and create more commitment from operational staff, as they can more easily relate to the development process when using real data. He also believes that today’s regulations generally inhibit the use of real data.

Procurement laws for public organizations also constitute a challenge for Leif and his team's innovative process. These laws are created in accordance with traditional projects, such as traditional digitization efforts described by Leif in section 4.2.1.1, requiring clear goals and predefined requirements before acquiring technology. The rigid nature of these laws stands in stark contrast to the unpredictable nature of innovation. Open source tools have allowed Leif and his team to circumvent these laws as they are free to use, meaning that no acquisition process is required in order to experiment with them.

Regarding ethically and morally challenging processes, as in the case of the digital co-worker, Leif believes that humans must make the final decisions in order to ensure both the quality and accountability of the decision. However, AI can still support the process by automating administrative tasks such as categorizing incoming cases and even make recommendations regarding the correct course of action.

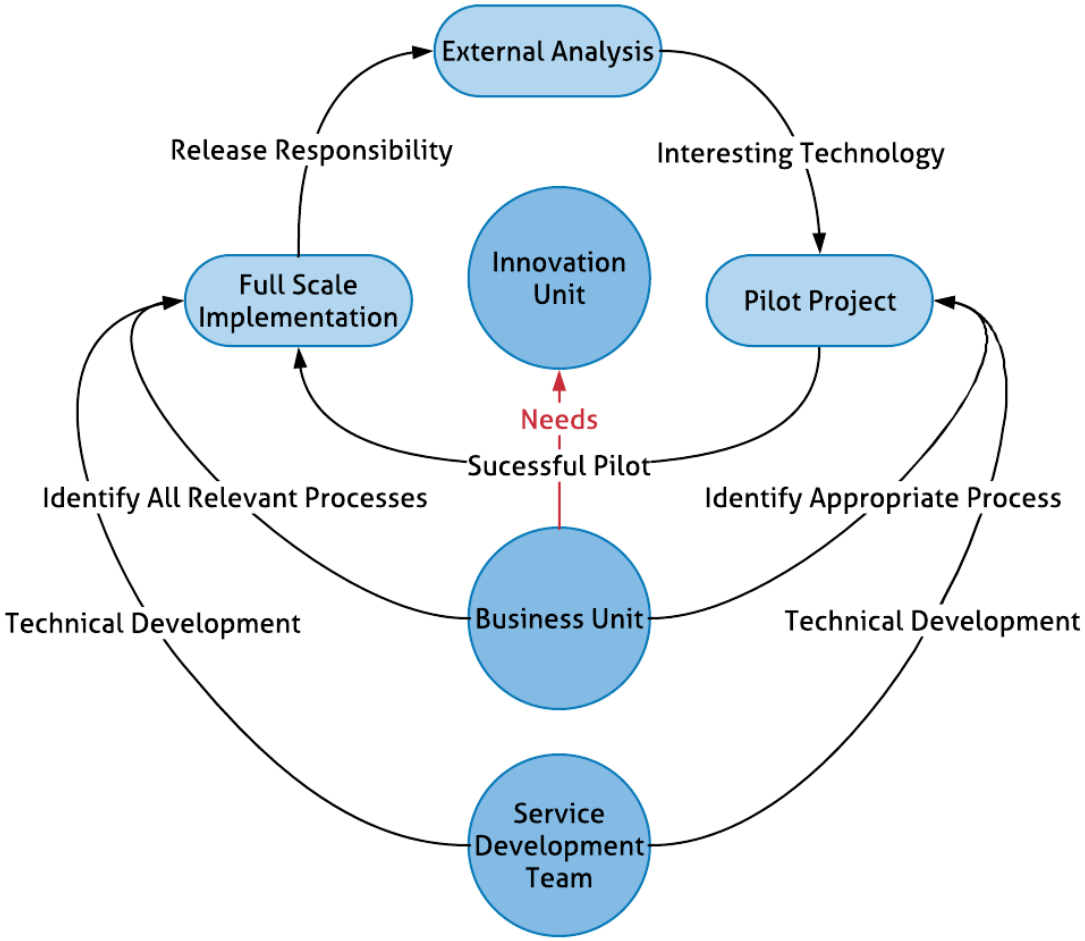
4.5 Michael Carlberg Lax, Chief Information Officer, Municipality of Skellefteå

Michael Carlberg Lax is the Chief Information Officer in the Municipality of Skellefteå. The position was created in 2012 as a result of upper management realizing that digitalization and innovation is an issue for upper management, not the IT Department. The creation of the role was connected to a major overhaul of the municipality's organization where many external competencies were acquired. The role is strategic rather than operational and focuses on innovation. Michael describes it as a bridge between technology and operations. Unlike most public sector employees, Michael does not have any responsibility for the continuous management of any operations or systems. Before being hired for this role, Michael worked with research and development within internet of things, IoT, for Ericsson.

4.5.1 Identifying New Technology & Applications

Michael and his innovation unit perform external analysis to identify possible technical applications and aids which could be beneficial for the municipality's organization. Once an application has been identified it is tested in a process where the application is expected to have a strong impact. The test is conducted in collaboration between Michael's unit, the service development team and affected business unit. If the test is successful, additional processes are identified where the technology could be effective. The technology is then implemented on a wider scale, with the support of the IT and development organizations. Once the implementations have been completed successfully, Michael's team releases responsibility of the process. The responsibility is instead assumed by the organization which will be responsible for the continuous management of the new process and its components. Michael and his team then move on to identify new applications or aids and repeats the cycle. The process can be described as an innovation cycle, as visualized in Figure 7.

Figure 7. Visualizes the Municipality of Skellefteå's change process, as described by Michael.



A point of emphasis for Michael is systemizing the identification phase of the innovation cycle. The goal of systematizing the phase is to reduce the level of randomness in whether or not available technologies and applications are identified.

The operations within the municipal organization can also drive innovation by expressing their needs. However, Michael believes that there is currently discord in this process, as the operations typically request specific technical solutions, often whole systems, to fulfill their needs. As a result, the requested solutions become limited by the understanding of technology and innovation among the staff within the operation at hand. Instead, Michael believes that the business units should focus on their needs, and then collaborate with the Innovation Unit to find the best solution together, allowing Michael and his team to utilize their technical expertise. Michael also emphasizes the importance of appreciating the fact that staff within business units are those who understand their organization best and that they are getting better at articulating their needs. Furthermore, the business units are asking for help to understand the possibilities of new technologies.

Overall, Michael believes that the focus of innovation and digitalization efforts must be shifted from systems to needs, especially the needs of citizens. The Municipality of Skellefteå has utilized the concept service design for some time, asking citizens what they need, rather than guessing what citizens want based on their own organizational needs. This has sometimes led to projects change nature completely, as asking citizens has revealed that their needs are different from those expected by the municipality at the beginning of the project. Michael believes that public organizations overall must learn to operate more agile, accepting that not all relevant information will be available at the start of projects and that some initial information may be wrong. By focusing on the needs of citizens and working more agile, Michael believes municipalities can make citizens co-creators in driving innovation, rather than just end users.

Thanks to the absence of competition, public organizations are in a great position to collaborate. However, Michael believes that there are big improvements to be made in the collaborative efforts. He describes the situation as 290 municipalities doing the same thing in as many ways, and that the situation can often be the same within the municipal organizations. In broad terms, Michael believes that placing sensors to gather data is one of the few things municipalities must do individually to leverage AI, other critical factors such as digital infrastructure, information standards, information flows and digital services, should be approached collaboratively in order to promote standardization and cooperation. Michael emphasizes that there is great need for more collaboration to take place. He mentions the region Västerbotten, which both Umeå and Skellefteå are part of, as an example where the municipalities collaborate to a relatively high degree on the development of digital services. Collaboration and cooperation will be key for enabling smaller municipalities to transform to a digital enterprise as their budget limitations may not allow room for sufficient individual development efforts.

Michael believes that the digital transformation is as fundamental revolution on the same level as electricity and the steam engine, that can increase efficiency many times over if done correctly. After reading Vinnova (2018) he believes that AI might provide the 5th industrial revolution, showing both great potential and that the time between revolutions is shortening. He believes that the municipalities' mission must be profoundly reevaluated from the perspective of how they can provide good service for its citizens. In a narrower perspective, Michael has seen reports indicating that Sweden's public sector must become 20% more effective by the year 2035 to maintain the same standard of service, which underlines the need for change.

On a strategic level, Michael emphasizes that public organizations should not focus their efforts on developing technical AI capabilities themselves, but rather on developing high-quality data. By gathering data and using their unique operational understanding to classify the data, municipalities can develop high quality categorized data which in turn can be utilized for supervised learning of ML applications. This approach allows municipalities to utilize their strength, which is understanding of their own operations, and private sector suppliers to utilize their strength, which is providing the actual AI applications. A key part of enabling such cooperation is ensuring that data is available, accurate, and standardized. This is important not just within individual municipalities, but between municipalities as well. Ensuring data standardization between municipalities enables the possibility of cooperation in training AI applications using larger datasets, which in turns improves the quality of the AI's output, while also reducing the effort required by each individual municipality. Michael believes that the availability of high-quality data can elevate the possibilities of digitalization and increase co-creation with citizens.

Making data available also imposes new requirements on traditional systems often utilized by municipalities. Today, much of the information generated within the municipal organization becomes locked into old systems owned by their suppliers, inhibiting the possibilities to utilize the data efficiently for new purposes.

According to Michael, there are varying understandings of what digitalization really is. To many, it seems to be similar to traditional organizational development where technical aids are utilized to incrementally improve current processes. Instead, Michael believes that public organizations must question the very foundation of what they do, which he acknowledges is a very difficult process. Most managers barely have development as part of their job description, only operational responsibilities. Michael believes that the municipality's General Director understands the power and importance of digitalization and that this is a key requirement for a successful transformation.

4.5.2 Decision Making Process

The decision-making process takes place between phase two and three of the Skellefteå's innovation cycle, as described in Figure 7. After identifying all processes relevant to the new application, the affected departments of the organization are involved to decide whether or not to move forward and implement the change.

4.5.3 Utilizing AI & Digitalization

Michael identifies two projects within the municipality as most interesting in terms of AI. The first of which is related to IoT, where Skellefteå acts as an IoT hub as part of the initiative IoT Sverige. The initiative aims to make Sweden a world leader in IoT. The Municipality of Skellefteå's efforts are directed toward healthcare, where they have installed several sensors in the apartments of home care patients in order to gather data. The data is then analyzed to identify patterns in the behavior of the patient. If the patients stay within their regular patterns, the caregivers can assume that they are probably doing okay. However, if a patient diverges from his or her regular pattern, it may indicate that something has happened. Abrupt changes in the daily routine may indicate that the patient is in need of urgent assistance, i.e. if the patient has been in the shower much longer than usual it may indicate that he or she has fallen and is in need of immediate attention. Long-term changes may indicate a change in physical or mental status, i.e. if the patient usually reads the newspaper on a daily basis but stops doing so for an extended period of time, it may indicate deteriorating eyesight or cognitive abilities, which in turn could mean that a doctor should examine the patient.

Another project is taking place through Föreningen Sambruk, where several municipalities cooperate in performing different projects. The project at hand aims to identify personal information in unstructured documents in order to ensure compliance with GDPR. Most, if not all, municipalities have large quantities of documents which may or may not contain personal information. This information is often unstructured, meaning that the information can be presented in different places and ways which are too random for traditional computer applications to detect. Going through all these documents manually and identifying which contain personal information would require tremendous resources. Instead, municipalities in Föreningen Sambruk have cooperated in training IBM's Watson, an AI computer, to identify personal information in these documents using ML. The project has resulted in a commercial application and an independent company providing this service, which is being utilized by multiple municipalities to ensure GDPR compliance.

4.5.4 Implementation Strategy

Michael believes that a successful strategy in Skellefteå's implementation efforts has been allowing the business units to be at the center of attention. Allowing the operations, rather than upper management, to gain attention for positive results and innovation has encouraged them to own and drive the implementation processes.

According to Michael, the receptibility of low-level managers, those managing employees at the 'frontline' of the operations, can be a challenge. Most often it is not a problem, but sometimes they are too stressed to embrace change. Pushing changes in stressed groups can cause social tension and make the implementation very difficult. In these situations, Michael believes that it is better to take a step back and perhaps try the implementation in another part of the organization, timing is important.

Another lesson Michael has learned is that just because something is established within the upper management of an organization, it does not necessarily mean that the rest of the organization is onboard. In these situations, Michael believes that the best solution is going back to upper management and let them attempt to approach the rest of the organization. Projects involving the entire municipal organization can become very complex and include thousands of stakeholders who all must buy into the implementation effort.

Overall, the affected organization must have time, engagement, and resources to successfully perform implementations. Michael believes that the availability of these three elements is a bottleneck in the implementation process.

4.5.5 Ethics, Security & Regulation

Michael believes that AI raises many questions for municipalities when considering ethical, security, and regulatory perspectives. While Swedish law today prohibits municipalities from fully automated decision-making, Michael believes that this will soon. Given this anticipated change, municipalities must increase their understanding of AI in order to understand their decision-making. Michael believes that managers will still be accountable for decisions made in their operations, regardless of whether they are made by AIs or employees, thus they must understand AI well enough to understand the reasoning behind decision. Understanding how limitations in the training data impacts decision-making and how to achieve sufficient transparency in complex DL models so that the reasoning behind the decision can be explained, are some examples of obstacles that municipalities will face.

Security is another area that will be tested to new extents as a result of IoT and AI, according to Michael. He cites an example, where thieves managed to rob a casino by hacking a sensor in an aquarium, to exemplify these new vulnerabilities. Again, Skellefteå collaborates with other municipalities in a group where each member contributes with its unique perspective and ideas regarding security. Michael believes that cooperation is very positive in this area.

In terms of integrity, almost all response from patients who have had sensors installed in their homes has been positive because it increases their independence. While the data-collection and supervision pose some infringement on personal integrity, the benefit of increased interdependence appears far more important to patients.

Overall, Michael believes that there is much uncertainty in public organizations surrounding these questions and that this in turn inhibits progression. Especially at the municipal level, where so many organizations are working independently towards the same goal, Michael believes that it would be beneficial to approach these problems together. Creating broadly established interpretations of the law and achieving consensus around ethical dilemmas would reduce the risk of being singled out when pushing the boundaries, helping more municipalities to dare take on these challenges.

4.6 Paul Davidsson, E-Strategist, Municipality of Hörby

Paul Davidsson is an E-Strategist at the Municipality of Hörby's Social Services Department, meaning that he focuses on digitalization and technology for increased welfare. The Municipality of Hörby only has roughly 15 000 inhabitants, making it the smallest municipality in the study.

4.6.1 Identifying New Technology & Applications

External monitoring is the main method of identifying new technologies and applications for the Municipality of Hörby's Social Services Department. This process is largely carried out by Paul himself. Social media such as Facebook and LinkedIn are used in combination with conferences, exhibitions, and personal networks as his main channels for input.

Some input for potential improvement also comes from other staff within the organization. There is a project currently being conducted within the municipality which aims to build the digital competence of healthcare staff in order to promote innovation and increase the ability to adopt technical solutions. Paul hopes that it will make digitalization a natural part of the entire organization, not just the IT Department. Starting next year, there will also be a digitalization council, containing representatives from all of the Social Services Department's operations. Paul also believes that he has decent a understanding of the social services operations, having worked within them for nine years.

The benefits of new technologies are mainly measured from the perspective of citizens, rather than efficiency for the municipality's organization. Paul concisely describes the motto of the Social Service Department as 'increased support for an independent life'. Because the patients utilizing Hörby's social services are between 65 and 105 years old, Paul argues that they must be approached in different ways. In order to provide a variety of services, the municipality needs a palette of different technologies. He also emphasizes that the municipality cannot expect to have complete information about new technological applications before testing them, as that would impede innovation to a halt. Instead, knowledge will often need to be obtained by testing.

Paul estimates that only about 30% of the change needed to obtain the benefits of digitalization is the technology itself, the rest comes from changing methods, organizations, and leadership. The digital transformation is about having the courage to change enough to fully utilize the available technology. Paul mentions the Swedish government's digitalization commission, which delivered its final conclusions in 2016. The result was four success factors for digital transformation: having a strategy for digitalization, competence for digitalization, leadership for digitalization, and organization for digitalization. Without either of these four factors, the commission concluded that it would be difficult to succeed with the digital transformation. While Paul believes that most public organizations today have a strategy for digitalization, he also believes that most fail on all the other factors. Paul draws a parallel to when the municipalities were given healthcare responsibilities for the first time. Many healthcare professionals were hired quickly to ensure that there was enough healthcare competence within the organization. The same is not happening today with digitalization, instead many municipalities are hoping that their current competencies will suffice.

4.6.2 Decision Making Process

Once Paul has identified a tool of interest, he presents it to the Quality Council, which consists of managers from different departments within the municipality. If the council approves of the idea, Paul contacts the supplier to initiate a test. Depending on the success of the test, the municipality then decides whether to invest further in the application.

While Paul and the Municipality of Hörby mainly measure the benefits of digitalization through the perspective of the care recipients, he acknowledges that this measurement must be expanded to include economic and patient safety perspectives, among others. The tools used today are inadequate and inefficient long-term.

4.6.3 Utilizing AI & Digitalization

The Municipality of Hörby's technology palette includes several unorthodox digital aids. Paul describes several of these in depth.

The first aid mentioned by Paul is a digital sensor which is placed in the incontinence guard of a patient. The sensor detects when the guard needs changing and is also linked to an underlying program which maps out the biorhythm of the patient. This means that the program learns to predict when the patient will need to use the bathroom. In doing so, the sensor removes the need for caregivers to manually check the patients. In order to manually check the guard, caregivers typically place their hand inside the guard, a process which can be experienced as invasive and integrity infringing for both caregivers and care recipients.

Another technical aid is what Paul calls The Giraffe, a social robot. It is essentially a tablet placed on a remote-controlled set of wheels, through which family, friends, doctors, and caregivers can communicate with the care recipient. While many view it as a tool for nightly check-ins, Paul disagrees with that notion due to the amount of noise that is created when the robot is operated. However, he does believe that it could be a great tool for social stimulation.

The municipality also utilizes medicine dispensary robots, which dispenses pills according to a schedule and uses sound to alert the care recipient that medicine has been dispensed. The main benefit is that care recipients can become more independent by managing their own medication intake, with support from the robot. Paul notes that the robots are not suitable for all care recipients, but those with relatively strong cognitive ability and limited memory. The limited suitability, combined with a demanding size of the robot and an unwillingness on behalf of care recipients to reduce the number of visits, has limited the number of dispensary robots being utilized. Paul estimates that the robots have an insignificant impact of organizational efficiency in terms of reduced workload on caregivers, as most medicine deliveries are done in conjunction with other tasks. Paul and the supplier are working on connecting the robots to the municipality's safety central so that caregivers get alerted immediately if recipients have failed to take vital medicine. It may also enable the municipality to detect changes in cognitive and physical status via data analysis.

The municipality also utilizes Tovertafel tables, an interactive game table designed for people with dementia. According to Paul, it has been very successful, giving physical, mental, and social stimulation, while also creating a purpose for the day. Caregivers can also be alerted to declining conditions by observing changes in care recipients' interactions with the table.

Paul and the municipality are also working towards creating a centralized alarm central. As the number of digital aids increase the points of interaction increase as well. This makes the devices less user-friendly for caregivers and makes the generated data more difficult to gather and analyze. The goal of creating a centralized alarm system is to gather all the incoming alerts into one point of entry. In conjunction with these efforts, Paul and the municipality are working on enhancing the capability of monitoring and analyzing the generated data, thus increasing the quality of services. As part of the system integration, the municipality is also in the process of acquiring a new safety alarm system which will interact with the continence guard, a web camera, and digitals door locks. The system will be tested in three different care recipient facilities.

Digital signatures for medicine administration are also under implementation in the municipality. By making the process digital, medicine administration can be monitored in real-time, ensuring faster detection of mistakes and, according to the supplier, 80% decrease in medicine administration errors.

In collaboration with Lund's University of Technology, the municipality is also part of an EU funded research project which will place care recipients in environments close to water using virtual reality. The goal of the project is to study waters calming effect on people.

In collaboration with the Royal Institute of Technology's Users Association, the municipality is also looking into the possibility of utilizing drones for food transports. The purpose of the project is to test whether drones will contribute to more efficient transport and also to identify other potential applications.

Another technology, which is currently being tested in the home of a citizen without special needs, is Larmcentral 2.0. The system is built upon a number of sensors which are placed in the user's home. These sensors gather data and store it for fourteen days. A program analyses the data, identifies patterns, and signals if anomalies occur. By combining this system with cameras or a giraffe robot, caregivers can check on the care recipient with minimal intrusion when anomalies occur. Paul believes that these types of systems combined with monitoring aids will be a reality in the near future.

The municipality is also testing a wearable aid which measures how much the user moves around, exercised his or her legs, and his or her walking symmetry. Using data from the previous fourteen days, a program calculates the user's risk of falling, and signals if the user does in fact fall. The user can also signal manually if he or she feels uncomfortable for some reason. Furthermore, the aid also has a geographical location component which allows the municipality to create a jail fence, an area where the user can move freely, but alerts if the user leaves the designated area. If the user leaves the designated area, a warning is sent via cellphone and offers directions back using only a single arrow, making it easy to understand. Other than added safety and monitoring of movement capabilities, the aid also reduces locked in effects via its jail fence. If all safety aids are limited to their homes, care recipients may become reluctant to leave them. By having aids that follow the care recipient outside the home, it encourages physical, mental, and social activation.

The last tool mentioned by Paul is a portable EKG device, which is user-friendly and produces an EKG in only two minutes. By using it continuously, irregularities can be detected earlier, and appropriate measures be taken faster.

4.6.4 Implementation Strategy

Paul views implementation as a process where there must be an understanding of where the change fits into the current organization, who it will affect, and how it will affect those people. This means mapping out the affected processes and making the necessary changes to facilitate the change.

In a municipality where Paul previously worked, there was a virtual organization called process team which mapped out every process within the municipality’s organization. These process maps contained participants, routines, and risks of every process. Using these maps were a very helpful tool for Paul when he analyzed the impact of implementing new technological tools. Workshops would be held based on the information from the process maps, in which it was determined who, what, how, for whom, and the desired result, for each part of the process. The thorough process map made it easy to identify problems and opportunities but require much time and resources to create.

According to Paul, the most sensitive part of ensuring that the benefits of a change are being captured is the transition between implementation and regular operation. He believes that involving the organization responsible for continuous management as early as possible is essential for successful implementation, as it reduces resistance. Success in the development and implementation phase is irrelevant if the change is not managed properly once implemented. Paul brings up the medicine dispensary robot as an example. Upon acquisition, it had not been made clear who would be responsible for managing the robots. As nobody wanted to take that responsibility, the robots were simply standing unused costing money. Once it was clarified who was responsible for the robots, the situation quickly changed, and today all but one is utilized.

Paul also believes that there is an understanding among ‘frontline’ employees, politicians, and upper management that technical aids can help improve the quality and efficiency of their operations. Instead, Paul views the low-level managers within the organizations, those managing the ‘frontline’ employees, as the main source of resistance and key to successful implementation. Paul believes that the resistance is a result of the high workload required to manage the operational process, leaving little time and energy for strategic processes such as innovation. Paul draws a parallel to his time in the military. Despite having state of the art technological aids at their fingertips, they would revert to paper maps and other analog equipment when put under pressure. In a similar way, Paul believes that the managers within healthcare are under such pressure to meet their operational requirements that they are afraid of disrupting their methodology with innovation.

A clear example of this phenomenon, according to Paul, was when the department manager of social services decided that all operational managers were to attend a technology conference regarding welfare technology and e-health, despite strong resistance from many of the operational managers. Paul got the impression that the managers were inspired by the conference and became motivated to pursue digitalization and its benefits. However, when the managers went back to their operational duties this enthusiasm quickly disappeared. Paul believes that it his part of his responsibility to push and encourage the managers into taking on the innovative processes as well.

The continence guard sensor is a great case study for failed and corrected implementation, according to Paul. When first introduced to a facility, there was an insufficient technical infrastructure in place to properly utilize the sensors. The sensor required an internet connection to communicate with the iPads used by caregivers to monitor their output. However, the facility did not have Wi-Fi. In an attempt to solve the problem, the iPads were equipped with portable internet solutions via the mobile network. This was also unsuccessful as the facility had limited network coverage. Today the facility has Wi-Fi, allowing the sensors to communicate properly.

Despite having provided proper infrastructure, the sensors are still not being utilized as intended. Instead of utilizing the sensors to determine the biorhythm of care recipients and then relying on prediction to indicate when an event is about to occur, the caregivers use the sensors as alarm systems for when an event already has occurred. As a result, fewer patients are able to benefit from the sensors.

Paul feels that there is still some resistance among staff towards the sensors because of the earlier failure. There are current efforts being made to promote proper use of the sensors. In every staff meeting, the biorhythm of patients is being determined. The aim of this activity is to increase understanding and participation of technology, as well as spreading knowledge from management to the rest of the staff.

4.6.5 Ethics, Security & Regulation

Due to time restrictions, specific questions regarding ethics, security, and regulations were unable to be asked.

4.7 Eleonore Schylter, Unit Manager Financial Support, Municipality of Trelleborg

As the Unit Manager for Financial Support, Eleonore is responsible for the processes related to financial support and the care of unaccompanied immigrant minors residing in the municipality. Her responsibilities include both general management and development of these processes.

4.7.1 Identifying New Technology & Applications

The Municipality of Trelleborg approaches the identification of new technological applications and aids as part of their general organizational development. The foundation of this process is the needs of their citizens. Based on the identified needs of their citizens, the municipality sets organizational effect goals aimed to fulfill those need, aiming to improve the quality and availability of their services from the perspective of their citizens.

Once the effect goals have been set, employees at the affected departments analyses needs within the organizations which must be addressed in order to meet the effect goals. Based on those organizational needs, a project team is assembled which searches for a solution that can fulfill the organizational needs, and by extension the needs of citizens. The project team typically includes all departments affected by the identified solution, i.e. for technical solutions the IT Department will most likely be involved, regardless of where in the organization the solution is needed. The entire innovation process is described in Figure 8.

Figure 8. Visualizes the Municipality of Trelleborg's innovation process, as described by Eleonore.

According to Eleonore, a key factor in Trelleborg's organizational development is a strong culture and model within the organization of daring to challenge current processes, willingness to change, and result orientation. As a result, much of the development process is driven from within the operations and its employees.

One example of identifying citizen needs is the analysis behind the municipality's way of processing financial aid applications, known as Trelleborgsmodellen. The municipality drew two main conclusions when analyzing the citizen's needs when applying for financial aid:

- The citizen is likely to be in some degree of financial hardship, which indicates a need to quickly gain clarity regarding his or her economic situation.
- The citizen is likely lacking income to some degree, which indicates a need for securing employment.

In 2013, the processing of financial aid applications was complex. The lead time was up to eight days for continuous applications and three weeks for first-time applications. Eleonore describes it as a process designed for the employees rather than the citizens of the municipality. Based on the need for quick financial clarity identified among their citizens, the municipality set a goal in 2014 that processing financial aid applications should not take more than 24 hours.

The municipality thought that a digital application service would be needed to reach the goal of processing every application within 24 hours. However, the goal was achieved within six months using other tools. Despite having already met the 24-hour goal, the municipality decided to move forward with creating the digital application service more, making it more accessible for citizens. The digital application process was taken into use in 2015 and within six months 75% of all financial aid applications were submitted digitally.

Despite their success, the municipality continued to ask itself how the process could be improved further. Via another department within the municipality, employees involved in the financial aid processing development came in contact with a supplier of robotic process automation, also known as RPA, solutions. Realizing that financial aid application processing is largely rule-based, making it suitable for RPA, the municipality decided to pursue automating it. In 2016, a value chain analysis was made along with a complete mapping of the application processing process. From this analysis, rules were formed to enable programming of the automation algorithm. The algorithm is now in use and has been making application denial decisions since 2017. Approximately 75% of all applications are processed by the algorithm and it makes a final verdict on 36% of all applications.

Making the application processing process more efficient has also allowed the department to move more resources from application processing toward helping recipients of financial aid to obtain employment, thus fulfilling the need of securing income. As a result of these efforts, the total amount of financial aid paid by the municipality has decreased by 15%, which indicates that more citizens have obtained employment and are now financially independent. Meanwhile, the application processing process requires fewer resources and has become more easily available to citizens.

4.7.2 Decision Making Process

Final decisions are typically made in conjunction with the process of detecting solutions for the organizational needs. The process typically involves every function which is affected by the proposed solution, which can include several departments and upper management. While Eleonore has executive powers in matters concerning her unit, she places a strong emphasis on ensuring support from her coworkers.

Efforts are also made to include the citizens' perspective into the decision-making process. However, these efforts are limited to ensuring sufficient degree of practicality within the solution. One example is the development of the digital application service, where citizens were invited to test the service and give feedback to the development team.

4.7.3 Utilizing AI & Digitalization

Today, the digitization efforts of the Financial Support Unit are mainly focused on creating digital application and document handling processes, such as the ability to submit appeals and estate applications online. There are currently no plans to utilize algorithms to aid processing these submissions. However, the unit will consider additional applications once the above-mentioned services have been developed.

There are also plans to develop a cell phone application which gathers labor market planning and financial aid decisions in one easily accessible place for citizens. Eleonore also emphasizes that all administrative processes can be automated using RPA, provided that they are rule-based.

Eleonore also mentions the possibility of utilizing ML to match vacancies with unemployed citizens. However, this application is not being pursued development at the moment.

4.7.4 Implementation Strategy

Eleonore identifies employee engagement as the key to successful implementation. This is achieved by making the employees engage with goals, continuous monitoring, and feedback, as well as ensuring transparency and participation.

The culture within the municipality's organization also fosters self-awareness and role understanding. This means that employees have a strong understanding of why their work is important, for whom it is important, and that there is a will to participate in the organization and its culture. The cultural willingness to change and drive to improve ensures that inefficiencies are quickly identified and corrected.

Another success factor in the municipality's change management is that every manager owns his or her own processes. This fosters a close leadership with efficient decision-making processes and encourages employee participation in organizational development.

4.7.5 Ethics, Security & Regulation

Eleonore cannot recall any issues in their digitization efforts relating to ethics or security. However, the automation of decision-making has become subject of some controversy and discussion. Lawyers of SKL released a statement in 2018 in which they concluded that fully automated decision-making was not consistent with the Municipal Law, which all municipalities of Sweden must abide. The Municipality of Trelleborg has launched an investigation to analyze the law from a different perspective. In light of the situation, Eleonore believes that there are ambiguities in current laws, which have derived from an inability to keep up with digital progression. As a result, Eleonore believes that the law can be viewed as a bottleneck for progression to some degree and that clarification regarding fully automated decision-making would be beneficial.

4.8 Henrik Suzuki, Lead Developer at Matching Unit, Swedish Public Employment Service

Henrik Suzuki is a Lead Developer at the Matching Unit of the Swedish Public Employment Service, Arbetsförmedligen. His role focuses on taxonomy utilized to match job applicants with vacancies. Prior to this role, Henrik worked as a developer at the Swedish Public Employment Service's IT Department.

4.8.1 Identifying New Technology & Applications

As a developer, Henrik has somewhat limited insight into processes designed to detect new technologies. However, his impression is that most of the innovation relating to AI is driven by developers such as himself. Typically, developers will create a proof of concept on a smaller scale and then present it to relevant managers in order to secure funding for developing the concept further.

According to Henrik, the amount of work required by developers to gain support for new ideas varies between departments and managers within the organization. He believes that the differing receptibility is mainly due to two factors: organizational structure and technical understanding of managers. Some departments are more hierarchical than others, requiring new ideas to be supported by managers on many levels before it can be tested, while other departments are more decentralized and only require the support of developer's own supervisor. Henrik is also under the impression that managers with strong technical understanding are more prone to support new technical applications than managers with less technical understanding. Overall, Henrik feels that gaining support for new ideas can be demanding, especially ideas with a wide scope as they require many managers to be convinced. Henrik likens the process to lobbying. He believes that the process is relatively easy within his current unit, as his current manager has strong technical understanding and mandate to allow further development of new ideas.

In May 2018, the Swedish Public Employment Service restructured its organization to bring all employees involved in the matching process closer. As a result, developers such as Henrik have come closer to operational staff, which has increased his understanding of needs within the organization and by extension led to him provide better solutions. A concrete example of such benefits is that he is now able to validate new ideas faster with the help of coworkers with operational expertise.

4.8.2 Decision Making Process

Similar to the identification of new technologies, Henrik's role as a developer offers limited insight into the decision-making process. Beyond the previously mentioned factors, organizational structure and technical understanding of managers, Henrik believes that the potential impact of proposed changes should be a key factor in managers' proneness to accept proposals. New ways of adding words to the matching engine is an example of a relatively low-risk application with limited implications in case of malfunction. In contrast, new methods designed to impact whether or not unemployed citizens qualify for financial support can have significant implications and thus poses high-risk.

4.8.3 Utilizing AI & Digitalization

The Matching Unit is developing an engine which utilizes natural language processing to extract key information from the text of vacancy announcements, mainly which competencies are required to fill the vacancy. By performing a similar analysis on resumes, extracting the key competencies of job seekers, the engine can match vacancies with suitable candidates.

Aside from the ability to match vacancies and candidates, Henrik believes that the data produced by the engine can be utilized to create new insights regarding Sweden's labor market. Such insights could include aggregated demand for competencies, shortage of competencies, and affluence of competencies.

Beyond developing software, utilizing the matching engine requires changes to the IT infrastructure of the entire organization. At the moment, the main infrastructure challenge relates to standardizing data formats.

4.8.4 Implementation Strategy

Because Henrik is working on a project still under development, he is not in a position to provide meaningful insights into the implementation processes of the Swedish Public Employment Service.

4.8.5 Ethics, Security & Regulation

With regards to the matching engine, Henrik and his coworkers have encountered legal uncertainties, such as what data is permitted to extract from resumes in order to train the AI, as resumes contain personal information by nature. When faced with legal issues, developers typically back away from the idea altogether, rather than taking on the issue. Henrik believes that cooperating with legal professionals to establish what is permitted according to the law would be a much more beneficial approach, enabling law-abiding problem solving and innovation. A concrete example is developing what Henrik refers to as a 'white-list', establishing what terms algorithms can search for in resumes and which must be excluded. Such a list would enable developers to program an AI to analyze resumes and cover letters without uncertainties regarding legality.

Another issue facing the Swedish Public Employment Service is the risk of biased training data affecting the matching engines' output. Henrik is very clear about the team being well aware of the risk. Other than to the best of their abilities ensuring that the training data is unbiased, the Swedish Public Employment Service also presents their code open source, meaning that anyone can test their software using his or her own data and look for bias in the results.

4.9 Louise Callenberg, Unit Manager for Digital Organizational Development & Management, Municipality of Stockholm

Louise Callenberg is the Unit Manager for Digital Organizational Development and Management at the Municipality of Stockholm. Her unit is responsible for helping the municipal organization leverage the potential of digitalization and continuous management of some IT systems.

4.9.1 Identifying New Technology & Applications

External monitoring in the form of conferences, meetups, supplier dialogs, magazines, digital media, and exchanges of ideas both within and beyond the organizational borders, is a means of identifying new technology. There are several channels through which Louise's unit can promote dialogue and innovation among a multitude of stakeholders. One example is Digital Demo Stockholm, DDS for short, where academia, private sector, and public sector, representatives gather to test new ideas and promote cooperation. The municipality also has a partnership with SKL which focuses on IT architecture, aimed at modernizing the underlying IT infrastructure to ensure that it can facilitate innovation. There are also efforts being made to establish an AI Day, promoting interaction between the municipality's operational employees working closest to the citizens and technology suppliers, aiming to increase understanding of technology and its potential in operational parts of the municipal organization. Overall, Louise believes that the information gathering process could be more clearly structured.

The municipality also has an initiative called Inspirationsprojekt, in which municipal and private sector employees collaborate on a project for three months to test a new concept, idea, or product. Some successful inspiration projects have resulted in full-scale acquisitions.

Smart Stad is another initiative, where the Municipality of Stockholm aims to be one of the world's smartest cities. One facet of the initiative is that different parts of the municipal organization can request funding outside their regular budget to test new ideas. The funds come from a pool set aside by the municipality to facilitate innovation by reducing the financial constraints on innovation within the organization. If needed, Louise and her unit can support the project execution and follow-up.

Louise believes that further support is needed to help operations within the municipality understand their needs. One example of such efforts is a tool designed to evaluate the potential benefit of automating processes, which is currently being developed. There are also efforts being made within the municipality to promote that the needs of citizens are placed at the center of innovation. According to Louise, the operations are often better at finding solutions which facilitate their own work, which typically has limited impact on citizens, then they are at creating value for citizens. Instead, the municipality challenges its operations by requiring new proposals to specifically include the potential benefit of citizens.

4.9.2 Decision Making Process

Louise typically tries to keep herself and her unit out of the decision-making process for full-scale implementations, limiting her involvement to providing proposals and information. Instead, proposals must be accepted by managers of the departments which will be affected by the proposed change and tasked with implementing it.

4.9.3 Utilizing AI & Digitalization

The Municipality of Stockholm currently has a few projects which include the utilization of AI. None of the projects have been implemented in full-scale throughout the organization.

In one project, ML is utilized to support the maintenance of the sewage and water system. A student at the Royal Institute of Technology approached the municipality with an idea for his thesis. With the support of the municipal organization, the student developed an algorithm which identifies pipes with a high risk of leakage by analyzing data relating to soil properties, pipe properties, and flow of water and waste. The risk analysis can improve decision-making regarding maintenance of the sewage and water system. Following the proof of concept developed by the student during his thesis, a six-month pilot project has been performed and deemed successful. The scale of testing is now set to increase. According to Louise, the main challenge in developing the algorithm was gaining access to, and standardizing, the data needed to train it. She also identifies the support of upper management within the affected unit as a key factor behind the success.

In another project, ML is used to analyze eye movement and identify potential cases of reading and writing difficulties, such as dyslexia. The technology and method were readily available from a Swedish supplier and reduced the investigation time from four hours to two minutes. An employee within the municipality came in contact with the technology as part of the Inspirationsprojekt initiative and presented the opportunity to a superior, Adelinde Schmidhuber. However, the Adelinde was not convinced and dismissed the idea. A few weeks after dismissing the idea, Adelinde was travelling in a rental car with her husband when the car suddenly alerted the couple that the driver was tired and should rest. After learning that the car identified tiredness by analyzing the driver's eye movement and recognizing the similarity to the reading and writing analysis, Adelinde changed her opinion regarding the application and approached her superior with the idea. However, due to a strained relationship between Adelinde and her superior, the project was halted again, this time by Adelinde's superior. It would take another six months, until Adelinde's superior left her position, before management decided to test the aid. After a successful pilot, the aid is now available for all schools in the Stockholm region. Louise believes that the case provides numerous lessons, the first being the importance of managers understanding technology they have no previous experience with. The second lesson being that the support of management is vital for innovation projects to succeed. In contrast to the sewage and water algorithm, this project almost died twice due to lacking support. The third lesson, which is partly connected to the support of management, is the importance of having a culture fostering innovation, encouraging experimentation with new technology and methods. Having learnt from these lessons, Louise believes that if the employee would have approached her superior with the same proposal today rather than a couple of years ago, the progress would be both faster and easier.

A decision support system utilizing ML is also in an early stage of development. By gathering as much data as possible, such as demography statistics and financial data from municipal operations, ML algorithms will be able to perform advanced analytics to provide new insights. The current focus of the project is to improve the quality of produced data to enable future AI applications.

There are also early stage projects relating to decision-making support tools in financial aid. One example comes from the Culture Department, which is looking into the possibility of automation in parts of the application processing process.

Aside from the technical projects, there are also several organizational projects being performed in the municipality's digitalization efforts. The aim of these projects is to support the organization and prepare it for future AI endeavors.

4.9.4 Implementation Strategy

Just as the decision-making process, Louise and her unit try to stay out of implementation efforts. However, she has identified some key factors which affect the outcome of implementation efforts.

The affected organizations must be involved from the beginning of the project in order to promote inclusion and a sense of ownership, as well as ensuring a positive attitude toward the change. Furthermore, it is vital that a clear organization responsible for the continuous management of the implemented change has been established.

4.9.5 Ethics, Security & Regulation

When discussing challenges related to regulation and ethics, Louise focuses on the interdependence between the two, meaning that one cannot be overcome without the other. She believes that we must have a broad ethical discussion to clearly establish what we want our society to become with respect to these issues, and in parallel establish regulation which steers our technical development and utilization towards that goal. Questions such as; which needs should be prioritized above others? whose needs should be prioritized? what data should be gathered? to what extent should individuals be able to control the collection of data regarding their behavior? where does the human liability end and where does the digital liability begin with respect to digital automation? must all be answered collectively and lay as a foundation for regulation to reflect our common answers. Louise calls for frameworks and structure, towards which discussions about these issues can move forward, from ethical dilemmas to practical solutions. In short, she believes that we must have an ethical discussion about what society we want with respect to these issues and create clear regulations which facilitate development towards that society. In doing so, we can consciously create the society we want, starting now.

Louise also lifts the issue of digital alienation. As welfare services become increasingly digitized, public sector organizations must ensure that all citizens are still able to utilize them, regardless of technological proficiency and economic status. Furthermore, digitalization across both the private and public sector is transforming the labor market, leaving many people ill-equipped to contribute in modern organizations requiring new competencies. Ensuring that these people stay part of our society despite the digital transformation will be a challenge for public sector organizations, especially in coming decades while the transformation is still taking place.

In terms of security, Louise is under the impression that digitalization entails new challenges. She believes that there is a lot of discussion about these new challenges, but not enough action to overcome them. Some mistakes relating to information classification are already being made by the municipality as a result of not keeping up with changes and lacking resources. Louise also emphasizes that security is an area where it is far better to do too much than too little, as the potential impact of insecure systems can be severe.

4.10 Virginia Dignum, Professor of Social and Ethical AI, University of Umeå

As a member of the European Commission High Level Expert Group on Artificial Intelligence and professor, along with several other engagements within the field, Virginia is an expert on the social and ethical aspects of AI. As her expertise lies outside of the organizational aspects of public entities, her interview questions are different from previous interviews in the study.

4.10.1 Potential of AI in the Public Sector

According to Virginia, the main potential of AI in the public sector is improving decision-support systems. Complex decisions requiring analysis of large quantities of issues can often be benefitted by AI. She also emphasizes that a condition for this to be true is that enough data of sufficient quality, i.e. unbiased and representative of the population as a whole, is available.

4.10.2 Ethical Challenges of Utilizing AI in the Public Sector

Virginia raises three main issues when considering ethical implications of AI in the public sector: quality of data used by the AI system, power of explanation and reporting to stakeholders affected by the AI's decisions, and proper chain of responsibility.

The quality of data is important to ensure that decisions made by an AI are not affected by factors such as bias or misrepresentation. The quality of an AI is strongly connected to the quality of data used to develop it.

Power of explanation and reporting refers to the black box problem. The issue of transparency is especially prevalent in the public sector, as public organizations have a greater responsibility of transparency towards its citizens than private organizations typically have towards its customers and other stakeholders.

Proper chain of responsibility refers to whom should be responsible for decisions made using AI. This question is especially prevalent when an AI fails, i.e. if an autonomous car causes a crash. Is the owner of the car then responsible for the crash? The car manufacturer? The supplier of the failing component? The car itself? Virginia is of the opinion that a person should be responsible for decisions made with the support of AI, even if the decision is fully automated.

According to Virginia, participation and openness about purposes, design decisions, and implementation choices is the key for public organizations to overcome these issues. The greater the understanding is for how AIs are developed and utilized, the abler our society will be to address these new challenges.

4.10.3 Regulatory Challenges of Utilizing AI in the Public Sector

In terms of regulation, Virginia points toward data usage, technical design, and practical utilization, as key areas. The law must determine how data can be used, algorithms be designed, and the technology be utilized.

Virginia is also a strong believer in auditing mechanisms and certifications as a means of promoting trust in AI systems from society. Nor public organizations or individual citizens can be expected to possess enough expertise to fully understand and evaluate the quality of an AI system in the foreseeable future. Therefore, certification systems, similar to those i.e. identifying environmental-friendly products, can serve as a bridge between AI technology and society by creating trust.

5 Analysis

This chapter presents the analysis of gathered data. It synthesizes the empirical findings and theoretical framework, aiming to identify patterns and drawing conclusions.

5.1 How Should Public Organizations Detect Potential AI Applications and Decide Whether They Should Be Implemented?

The non-competitive environment of public organizations leads to a unique innovation challenge. While almost half of the largest private companies in the United States end in bankruptcy due to an inability innovate at sufficient pace (Nanterme, 2016), public organizations have no competition and face a minimal risk of bankruptcy. This means that private organizations are forced to innovate in order not to be disrupted by competition, while public organizations can largely decide their own pace of change. However, with many interviewees describing a situation with fewer taxpayers per capita and increased demand for public services, there seems to be a widespread acceptance among public sector employees in Sweden that innovation is necessary to maintain, and improve, quality and accessibility in the coming decades. From a societal perspective, this leads to a situation where public organizations must be experts at innovation. When private sector companies become outdated, customers can often easily switch to better competitors, causing little societal impact. However, because public organizations are often sole providers of their services, citizens cannot turn to other alternatives if public services are failing due to insufficient innovation, which in turn can have a strong societal impact.

Another facet of the unique innovation challenge for public organizations is the possibility to collaborate. While innovation is a competitive edge which is important to protect in the private sector, collaboration and knowledge sharing is nothing but positive in the public sector. However, Tomas, Michael, and Leif, explicitly criticize the lack of cooperation between public organizations. The municipal independence in particular appears to have contributed to a situation where 290 municipalities are doing the same thing in 290 different ways. This being said, the empirical findings also include examples of constructive cooperation. Virtually every interview subject mentions external monitoring of other public organizations as a means of identifying new technology, and there is a collective view that public organizations are willing to share information with others. Michael mentions collaboration in the Västerbotten region, where especially Umeå and Skellefteå attempt to share knowledge and competence with smaller municipalities in the region. The Municipality of Stockholm has several events specifically aimed at promoting cooperation, though the majority of these events are aimed at staff within the own municipal organization, citizens, and the private sector. Collaboration between academia and public organizations have also proven fruitful. The water and sewage pipe maintenance aid is one of the few concrete applications of AI found in the study and the result of collaboration between a student and the municipality. The Municipality of Hörby and their collaborations within eldercare shows that even small municipalities can be innovative by collaborating with universities. However, despite these positive examples, there is a clear lack of extensive coordinated efforts within Sweden’s public sector in regard to digitalization and AI. Coordinating efforts could have a strong positive impact on public sector innovation as it would consolidate resources and avoid duplicate efforts, i.e. several public organizations developing their own chatbot from scratch.

The Social Insurance Agency is the only interviewed organization with a clear method specifically designed to approach AI, rather than treating it as part of general digitalization efforts. It could be argued that the Municipality of Skellefteå, through their CIO Michael's clear focus on generating high-quality data, is also taking concrete steps to enable future use of the technology. However, a clear majority of organizations included in the study viewed AI as part of their general digitalization efforts, whether this supports Vinnova's (2018) claim that only a fraction of public entities have a strategic approach to AI is debatable. Either way, general digitalization efforts and AI are clearly connected. Leif at the Social Insurance Agency stated that their AI efforts have highlighted deficiencies in their general digitalization efforts, as the application of AI requires a certain level of digitization in the concerned processes. Similarly, the issues regarding the use of incontinence guards in the Municipality of Hörby is an example of how deficiencies in the digital structure can inhibit the use of new technology. Katarina at the Municipality of Umeå also describes similar issues when likening the perspective on digitalization with Maslow's hierarchy of needs, where issues with seemingly basic functions such as Wi-Fi limits the view of what can be achieved with today's technology. These findings all point to successful utilization of AI is dependent on the organization being sufficiently digitalized as a whole.

Beyond enhancing the digital transformation of public organizations overall, a clear need for gathering high-quality data in order to enable future AI applications has been stated by several interviewees. These observations align with Vinnova's (2018) and Vanian's (2018) claims that the availability of high-quality data is vital for the efficient utilization of AI. Several of the studied organizations are already underway with such efforts. The municipalities of Stockholm, Skellefteå, and Hörby, along with the Social Insurance Agency, are all in the process of expanding data collection, storage, and classification efforts. Several of the interviewees have also emphasized the importance of utilizing the operational knowledge of staff within the organizations to properly categorize the data, which in turn is vital for enabling supervised learning (Mohammed, Khan, & Bashier, 2017).

In the studied organizations, digitalization efforts appear to revolve around how technology can help improve current processes, mainly benefitting the own organization. Paul and Michael both describe a situation where many managers are tasked with continuous management first and foremost, while also being responsible for innovation. Because continuous management often takes precedence, innovation efforts are pushed aside. Paul phrases it as managers getting stuck in an operational perspective, rather than strategic, as a result of continuous management requiring almost all their attention. Katarina and Emil both describe a culture of mainly searching for plug and play solutions aimed at incrementally improving current processes, when discussing digitalization efforts at the Municipality of Umeå. These statements support Schreck et al.'s (2018) claims that most organizations view technology as a separate entity, rather than integrating it into their process design, which according to the authors will make it difficult for these organizations to fully leverage the potential of AI. Almost every interviewee agrees that lacking competence, regarding technology in general and AI in particular, within the organization further limits the perspective of the potential of digitalization within their organization. The most obvious example of lacking technical understanding among empirical findings is the digital test platform recently acquired by the Municipality of Umeå. Municipal officials were unsure whether it was realistic for the platform to separate minor spelling errors of correct answers from completely wrong answers, despite spell check in basic programs such as Word have been able to detect what word the user intended to write since

the 90s. The apparent importance of combining technical and organizational understanding is also emphasized by Vinnova (2018) and part of the holistic approach to AI presented by Evans, Hu, Kuchembuck & Gervet's (2017). A majority of organizations included in the study have efforts specifically designed to increase the technical competence of their managers and directors. Many also extend these efforts to operational staff. Such efforts typically entail demos and workshops relating to new technology, aiming to identify new applications and expand the view of what is actually possible.

Another obstacle in lifting the perspective of digitalization and AI from operational to strategic level is the limited focus on needs. As previously mentioned, digitalization efforts in the studied organizations seem to revolve around their own operations. A plausible explanation for this is that staff within the organization understand their own needs better than those of i.e. their citizens. Both the municipalities of Stockholm and Skellefteå are making specific efforts to ensure that the citizen's perspective is included to a larger degree in their innovation efforts. The Municipality of Hörby also shows a strong focus on citizen benefit in their e-health innovation efforts. However, the Municipality of Trelleborg appears to be the only organization in the study where the needs of citizens are systematically placed at the center of innovation efforts throughout the organization. In their innovation process, which is illustrated in section 4.7.1 Figure 8, identifying the needs of citizens is at the core. This difference in perspective has become especially clear when discussing Trelleborgsmodellen, the financial support bot. As it is one of Sweden's most famous examples of successful digitalization within the public sector, Trelleborgsmodellen has been a recurrent topic of discussion in many interviews. Most people focus on shortened lead time, the elimination of a tedious administrative task for employees, and an economical rationalization, when discussing the success of Trelleborgsmodellen. Eleonore, the manager of Trelleborg's Financial Support Unit, instead focused on how it fulfills the needs of citizens. Applying for financial support indicates that the citizen is lacking income, which in turn means that the citizen needs to have the financial aid application processed quickly in order to get clarity regarding his or her financial situation, and that the citizen is likely in need of securing a job. Trelleborgsmodellen has helped fulfill both these needs. The former by providing decisions within 24 hours and the latter by enabling reallocation of resources from application processing to employment support. As a result of these efforts, the total amount of financial aid paid by the municipality has decreased by 15%, indicating that more citizens have obtained employment and are now financially independent, likely enjoying a higher quality of life. Despite this perhaps being the biggest societal benefit of Trelleborgsmodellen, it appears as if most public employees familiar with the case either do not know about the citizen perspective at all or views the organizational benefits as more important. Either way, the discrepancy points toward a different perspective in Trelleborg compared to other organizations in the study. Michael, Tomas, and Paul all emphasized the importance of understanding how to leverage the impact of technology beyond incrementally increasing operational efficiency. Trelleborg's innovation process appears as a great example of how public organizations can lift their perspective to a strategic level, by shifting focus from process efficiency to the needs of citizens and improving their quality of life. This logic aligns with the holistic approach to AI advocated by Evans, Hu, Kuchembuck & Gervet (2017).

In terms of conveying needs, several interviewees describe a disconnect between operations and organizational development within the organizations. Michael describes a situation in Skellefteå where operations often identify and request specific systems, rather than approaching the Innovation Unit with their needs and collaborating to find the best solution together. As a result, solutions often limited by the technical understanding of staff within the operations, rather than having leveraged the Innovation Unit's technical understanding. The template being developed by the organizational development team at Umeå's Office for Social Services, aiming to standardize the format in which their operations formulate their needs, is an example of how organizations can improve the communication of needs. The tool under development by the Municipality of Stockholm, designed to evaluate the benefits of automating processes, is a similar example focusing on how operations can be helped to identify and communicate needs. Eleonore points to the strong culture of daring to question current processes and well-established process as two keys behind the Municipality of Trelleborg's successful identification and communication of needs. By focusing on culture, the municipality has also made most, if not all, of its staff engaged in its innovation efforts.

External analysis has emerged as the most common method for the studied organizations to identify new technology. While the non-competitive environment of the public sector allows for extensive information sharing, external analysis could also be argued not to be an innovative process at all. Even in an environment where perfect information sharing was taking place, where every public organization could emulate everything every other public organization did, no innovation would take place unless at least one of the organizations were innovating using some other method than external analysis. This being said, external analysis can help diffuse innovations. One example is Trelleborgsmodellen, which is being replicated across the country. Michael also expressed the need for standardizing and improving external monitoring in order to reduce the randomness in what technologies are identified. Similarly, Louise expressed that there is room for improvement and standardization in the Municipality of Stockholm's external analysis process. Proper external analysis can help reduce duplicate efforts where several public organizations attempt to do the same thing in parallel without cooperation. However, this requires deeper collaboration than simply sharing what each organization is doing. Today's shallow collaboration instead seems to spur duplicate efforts, as many organizations identify the same technology as interesting and then develops their own version of it individually.

The Social Insurance Agency's AI efforts appear different from those of other organizations in the study, almost exclusively driven by three technically competent individuals. Their efforts show that, contrary to popular belief, AI innovation projects can be very cost efficient compared to traditional IT projects. At a cost largely limited to hours worked by a handful of employees, Leif and his team have established what appears to be the most systemized process of successfully developing AI applications for public organizations. Their method of developing separate abilities using AI via open source tools, and then combining these abilities to create useful functions, appears both cost-efficient and flexible. According to Leif, the key to their approach has been management's establishment of the innovation center, finding individuals willing to challenge the status quo, and learning to leverage open source AI tools. Through the innovation center, management has given Leif and his team the ability to innovate without the traditional public sector constraints of predefined goals and pressure to create instant gains. The availability of open source tools has enabled the development of AI applications without incurring costs beyond hours worked by the innovation unit. As a result, the overall costs are

low, which has likely been important for management to accept the removal of short-term benefit requirements. Individuals willing to challenge the current structures and processes are also vital for this innovative process, as it requires both creativity and risk-taking in order to overcome i.e. legal challenges. This collaborative socio-technical process, where technical and operational staff cooperate to identify how the AI abilities can be applied, is the key to transform technical abilities into practical applications. This appears somewhat similar to the culture within Trelleborg's municipal organization of daring to challenge current processes, willingness to change, and result orientation. Paul also stressed the importance of understanding that an organization cannot expect to have perfect information about new technology prior to testing it. A possible critique of the Social Insurance Agency's innovation process is what appears to be a lack of connection between innovation and needs. The efforts focus on expanding technical abilities and then finding ways of incorporating them into the organization, rather than how they can fulfill the needs of citizens. It should also be pointed out that despite Leif and his team possessing enough technical competence to experiment with AI tools, they are still leveraging solutions provided by true AI experts, rather than developing the technology themselves.

In terms of the decision-making process, deciding whether or not to move forward with full-scale implementations of new technology, the process appears to be fairly similar throughout the studied organizations. If tests and case studies of an interesting technology are deemed successful, managers of the departments who would be affected by a full-scale implementation together decide whether to move forward. An observation is that these groups of final decision-makers often exclude the technical experts who have been part of developing the proposed solution. This lack of technical expertise in among final decision-makers could indicate a lack of understanding regarding proposed technical solutions, which in turn could have a negative impact on the quality of decisions. This is supported by Henrik's impression that managers with lower technical competence are less prone to support new ideas related to technology. The notion is also supported by the story regarding the reading and writing analysis tool in the Municipality of Stockholm. The aid was dismissed despite being far superior to traditional methods, until the manager was convinced that the technology worked by a complete fluke.

It is also important to appreciate that AI and technology is not always the appropriate solution. In the case of Trelleborgsmodellen, the initial goal of processing applications within 24 hours was achieved by other changes than the bot. As advocated by Evans, Hu, Kuchembuck & Gervet (2017) and their model describing the interplay between technology, data, process design, team structure, and change management, visualized in section 2.6 Figure 4, technology is merely one of the factors to take into consideration in order to efficiently leverage AI.

To summarize, the key factors for public organizations to successfully identify available technology and understanding how it can be applied are:

- Ensuring that the underlying digitalization of the organization is advanced enough to facilitate new technologies such as AI, and that there is a sufficient amount of accessible high-quality data to train AI applications.
- Lifting the perspective of innovation from incremental improvement of current operations to the needs of citizens and how they can be fulfilled.
- Sufficient technical understanding to grasp what technology is available and how it can be applied.
- Designating resources for testing of new ideas in order to discover new ways of applying technology.
- Approaching innovation holistically, mixing technology with i.e. organizational tools to solve problems, rather than approaching technology as a separate entity.

5.2 How Can Public Organizations Leverage AI Within Their Operations?

Several examples of how AI can be leveraged by public organizations have been identified in the study. The examples range from customer service chatbots, establishing biorhythm of patients, detecting dental fraud, improving sewage and water pipe maintenance, to classifying documents and detecting dyslexia. The wide variety of applications shows that AI can be utilized beneficially in virtually any organization.

Most of the AI applications are in a stage of testing. This supports Vinnova's (2018) claim that few public organizations have come further than initial testing of AI. The only AI application seeming close to full-scale use in multiple municipalities is chatbots.

The identified applications all act within limited domains specializing on specific tasks. This supports claims made by Lindjsö (2017), Vinnova (2018), and Evans, Hu, Kuchembuck & Gervet (2017), that today's AI applications are to be regarded as ANIs, or narrow. The examples also include all three of Daugherty & Purdy's (2016) main functions of AI: sense, comprehend, and act.

Overall, it appears that the identified applications of AI can be divided into two main functions: automation and decision support. The abilities to sense and comprehend, as described by Daugherty & Purdy (2016), can be utilized to automate information gathering and processing. The Social Insurance Agency's interpretation of x-rays and text in dental fraud detection is an example of automation enabled by computer vision and natural language processing. AI's ability to act by utilizing ML and DL has mainly been utilized for decision support. Warning for potential fraud cases, recommending pipe maintenance, and alerting caregivers that a patient should be escorted to a bathroom shortly, are some examples of such actions. In plain terms: sensing allows AIs to gather information, while comprehension allows AIs to understand information, and acting allows AIs to draw conclusions based on the information. The ability to act could eventually fully automate decision-making as well, depending on legal developments.

Another observation is that many of the interviews tended to move from examples of AI applications to examples of other digital aids, as a result of lacking AI initiatives within the studied organizations. However, many of the digital aids, i.e. patient monitoring bracelets, are designed to gather data. As discussed in the previous section, gathering data and enhancing the overall digitalization of organizations will help enable future leveraging of AI.

Looking beyond the current utilization of AI in public organizations, there appears to be great unfulfilled potential in leveraging today's AI technology. Tomas suggestion of utilizing personas is one such example. Several instances, especially in the municipalities of Hörby and Skellefteå, show how municipalities can gather information within healthcare to analyze and predict patient behavior and health. It is clear that several municipalities are understanding that analyzing behavior using AI can increase the quality of care. Similar processes should be applicable within i.e. education. Learning materials with prepackaged self-grading tests and recommendation mechanisms, providing further rehearsal material based on test results, could be improved by determining students' learning style. If all students are tested to determine whether they learn best through reading, hearing, or doing, the aids could be adjusted to best suit the students' individual learning style. Using personas, an AI system could also identify students with similar learning styles, determine which learning materials appear to work best for this group based on historical data, and then provide the students with tailored learning materials. The analysis could also be used by teachers to tailor lessons according to the learning style of his or her class.

The AI-powered screening test for reading and writing difficulties in the Municipality of Stockholm, increasing time efficiency by 12 000%, shows that today's technology is capable of creating immense value if utilized correctly. The fact that the test was dismissed by the municipality underlines the notion that it is not the technology itself that constrains new applications creating more value.

To summarize, the analysis indicates the following regarding how public organizations can leverage AI:

- The study clearly establishes that public organizations can increase operational efficiency and quality of service by utilizing AI.
- The wide variety of settings in which AI is utilized today indicates that the technology can be beneficial throughout organizations, not just in isolated departments with i.e. heavy administrative duties.
- Few, if any, organizations in Sweden's public sector have come further than testing AI applications.
- The true potential of AI technology already available today appears to be far from realized in Sweden's public sector. Constraints of the technology itself is not the limiting factor in its utilization.

5.3 What Are the Critical Factors for Successful Implementation of Technology-Based Projects in Public Organizations?

Two main factors for successful implementation were mentioned in some form by almost every interviewee with insight into his or her organization's implementation efforts. These two factors are proper communication and a clear organization for continuous management. The findings align with Russ (2008) who argues communication to be a key activity in change management, whether the process is planned or emergent.

Good communication entails involving all stakeholders who will be affected by the project and creating a clear common understanding of what is being done and why. Katarina emphasizes that there should not be any confusion regarding which problem is being solved and, as importantly, which problem is not being solved by the change. One of the main goals of communication is building engagement and support from the organization (Russ, 2018; Rafferty & Restubog, 2010). Employee engagement is also a recurring theme in the interviews. Eleonore identifies it as the key to successful implementation in the Municipality of Trelleborg. The engagement is achieved by involving the employees in the implementation by engaging with goals, monitoring, and feedback of the change, as well as transparent communication. Michael, Louise, Eleonore, and Leif all describe the importance of engagement from staff within the affected parts of the organizations, but calls it ownership rather than engagement. In the Municipality of Skellefteå, a conscious effort to put operations at the center of attention for praise relating to innovation has encouraged the operational staff to own and drive implementation processes. These statements align with Rafferty & Restubog's (2010) claims that making employees active participants in the change process helps build support for the change within the organization.

Establishing a clear organization for continuous management means clearly defining who is responsible for doing what, when, and using which resources. According to Katarina, this is important not just to ensure that the change is implemented correctly, but also that the full benefits of the change are obtained throughout the entire lifecycle of the project. Similarly, Paul identified the transition from implementation to continuous management as the single most sensitive process in order to ensure that the full benefit of a change is obtained. Katarina, Emil, Louise, and Paul all point back to early and clear communication and definition of responsibilities as the key to ensuring that the continuous management will be successful. Leif points out that ensuring the quality of algorithms, i.e. by adjusting recommendations according to new laws, is part of the continuous management of AI and vital to ensure that it remains efficient over time.

Michael and Paul both mention low-level managers as keys to successful implementation. Paul identifies these managers and supervisors as the main source of resistance to change and believes that it is a result of stress from operational responsibilities. Michael has made similar observations and drawn the same conclusion. While Michael and Paul view low-level managers and supervisors as sources of resistance, Voet, Kuipers & Groeneveld (2016) view these individuals as possible catalysts for generating support and engagement. Despite not fully agreeing on the role of these managers, all three sources agree that they are important for successful implementation.

To summarize, the following factors have been identified as critical for the successful implementation in the public sector:

- Proper communication with all relevant stakeholders is critical to foster engagement and ultimately conduct successful implementations.
- A clearly defined organization for continuous management is critical to ensure that the implemented change creates the anticipated benefit throughout its entire lifecycle.
- The commitment of low-level managers and supervisors can be critical for the outcome of implementation processes.

5.4 What Ethical, Regulatory, and Security Challenges Does AI Present for Public Organizations, and How Can They Be Overcome?

Ethical and regulatory ambiguity of how public organizations can apply technology and what data they can utilize have been a recurring theme throughout the conducted interviews. This finding aligns with OECD's (2017) and Vinnova's (2018) claims that regulations are on pace with the development of AI and must adjust to cope.

Tomas, Michael, and Emil all point to ambiguity and restrictions of current laws as an obstacle in their innovation efforts. Emil identifies it as one of the biggest inhibitors of progress. Henrik describes how even the Swedish Public Employment Service, a government agency, often backs away from technological applications altogether if they realize that it entails legal considerations. The legality of Trelleborgsmodellen is another example of ambiguity, where the consensus appears to be that fully automated decisions in municipal organizations are in fact illegal. Yet the Municipality of Trelleborg continues to make fully automated decisions with no repercussions.

Similar regulatory ambiguity appears to surround the collection and use of data. Leif describes what he views a general taboo within the public sector regarding the use of public data. Virginia emphasizes the importance of data quality in order for AIs to properly function within a public context, i.e. ensuring that the data is representative of the entire population, including minorities. This view aligns with Vinnova's (2018) claim that the availability of high-quality data is vital for the progress of AI.

Virginia, Leif, and Michael also point towards the importance of clarifying a chain of responsibility regarding AI. New laws or interpretations must help determine who is responsible for an AI and its actions. Michael also argues that managers and directors must increase their understanding of AI, as they will likely become responsible to some degree for actions of AIs within their organizations. Without such clarifications, it seems likely that involving AI in truly important processes will involve too much risk, as there would be ambiguity regarding who is responsible for what.

Laws pertaining to public acquisition have also been identified by numerous interviewees as an obstacle in digitalization and AI efforts. Emil's skepticism towards pilot testing with respect to competition stipulations, Michael's concern with compatibility between separately acquired solutions, and Leif's reliance on open source tools, are all examples of how current public acquisition laws inhibit the development of AI in Sweden's public sector.

Ethical aspects also appear to affect how AI is approached. Many interviewees describe a trade-off between progress and privacy. According to Tomas, privacy has historically taken strong precedence. However, he and several other interviewees are under the impression that this mentality is shifting. Michael, Paul, and Tomas all describe how health care patients have responded positively to i.e. video monitoring. All three interviewees believe that a growing number of people are willing to sacrifice some privacy in exchange for higher quality of care. It should be pointed out that most of the tests mentioned during the interviews regard home care patients. It is possible that these individuals, who are in greater need of relatively invasive public services than an average person, are likely to be more open for privacy infringement in exchange for better assistance than the more independent general population.

Virginia, Michael, and Leif all discuss the importance of deciding in which processes AI can be utilized. Leif focuses on the impact on citizens, stating that i.e. AI-powered search engines which only processes large quantities of openly published documents are of little concern from an ethical perspective, while processes involving personal information and decisions with strong implication on people's lives must be approached much more carefully. Virginia and Michael focus on the black box problem, as described by Lei, Chen & Zhao (2018). Michael and Virginia both stress that the lack of explanation behind the decisions made by an AI poses serious issues for public organizations in terms of transparency and by extension creating trust. Virginia and Nanterme (2016) both emphasize the importance of trust from society in order to realize the potential of AI systems. Virginia is a strong proponent of certifications as a means of building trust in AI systems. She argues that private citizens and most organizations will not possess enough technical knowledge to meaningfully the quality of an AI anytime soon. Therefore, certifications, similar to those i.e. identifying environmental-friendly products, could help create trust between society and AI. This solution aligns with Nanterme's view that trust should be built by demanding high standards from organizations in their AI efforts.

Virginia, Michael, Emil, and Leif all concur that there must be greater clarity in laws and their interpretation. Michael stresses the potential benefits of dealing with these issues collectively, especially among municipalities due to the similarity of operations. This would likely help reduce the fear and uncertainty hampering digital advancement among many public organizations. The fact that even government agencies are afraid to approach regulatory and ethical aspects of AI indicates a great need for centralized efforts. Such effort must include clarification and modernization of current regulation, as well as promoting collective ethical guidelines regarding the use of technology and data. Louise is perhaps most clear in her view of what must be done: *we must have an ethical discussion about what society we want with respect to these issues and create clear regulations which facilitate development towards that society. In doing so, we can consciously create the society we want, starting now.*

A possible solution could be assigning a government agency, i.e. the Agency for Digital Government, with the responsibility of coordinating and performing these efforts. If a public organization has any doubt whether they are allowed to gather or use a certain type of information, they should be able to simply ask this government agency. If there is a lack of precedence regarding the gathering or use of the particular type of data, the agency should be responsible for creating this precedence as quickly as possible, removing the responsibility and risk related to making such judgements from individual organizations. This will create an environment where public organizations can innovate without the risk of facing individual criticism for tough decisions and create a central framework for these issues, avoiding situations like the ambiguous legality of Trelleborgsmodellen. The agency could also proactively promote innovation by i.e. compiling lists of data which municipalities are allowed to gather, provide methods of how to gather the data and ensure sufficient quality. Centralized efforts could become even more proactive by actively encouraging public organizations to collect approved types of data and compiling it in a governmental data lake. Such an effort could improve public AI applications by increasing the amount of data available and avoiding duplicate efforts in terms of creating or buying similar training data. These efforts could also promote innovation in the private sector and create new governmental revenue streams by sharing non-sensitive information with the public, either for free or at a price.

Considering the benefits of creating a national data lake, it appears likely that it will be done sooner or later. If this is true, the cost of not initiating that process soon could be tremendous. As presented in the study, public organizations are starting to initiate their own data gathering and storage efforts. If these efforts are not coordinated early, a situation may arise where most of Sweden's public organizations have invested in incompatible data infrastructures. Consolidating public data could at that point become very costly as recently acquired sensors, licenses, and other investments would be rendered useless due to incompatibility. Therefore, getting ahead of this issue before public organizations become too invested in separate data architectures could prove very beneficial.

Because many decisions of sensitive nature will have to be made in the near future as a result of AI, it appears reasonable that the process should be done with transparency by a government agency, rather than by hundreds of individual public organizations. If regulators remain reactive to these issues, rather than proactive, it appears unlikely that Sweden will meet its goal of becoming a global leader in realizing the potential of AI, along with obtaining the resulting increased welfare and competitiveness.

While regulation and ethical discussions try to catch up with the development of AI, some means of circumventing these problems have been identified in the study. The utilization of open data in early development phases has allowed Leif and his team to build knowledge and understanding of their applications before consulting with legal experts. Using open data poses no issues regarding i.e. privacy. Meanwhile, the increased understanding has allowed the team to successfully take on legal issues regarding the utilization of their applications.

Utilizing open source tools has allowed Leif and his team to be innovative despite the restrictions of public acquisition law. However, their approach still requires the support of management through the innovation center.

In order to ensure that their algorithms are accurate and unbiased, the Swedish Public Employment Agency publish all their AI algorithms openly. In doing so, they can be tested by anyone to detect bias or other unwanted results.

Given current uncertainties, understanding which processes are suitable for AI from a legal and ethical perspective appears to be one of the most difficult challenges for public organizations. Based on the examples of public AI applications found in the study, especially the precedence set by the Social Insurance Agency, it appears that some informal guidelines can be established. AI systems utilizing non-controversial data to enhance non-sensitive processes, i.e. the Municipality of Stockholm using pipe and soil data for pipe maintenance, appear more or less completely uncontroversial. There also appears to be room for utilizing AI in more sensitive processes using sensitive data, i.e. fraud screenings at the Social Insurance Agency. However, considering the black box problem and the transparency issues it causes, the utilization must be well thought through to avoid unwanted biases affecting the system. Consider utilizing AI to support airport security. One alternative would be gathering as much data as possible about all passengers, and then allowing a DL to identify high-risk passengers. However, such an application would need data in order to be developed and tested, which could be affected by human bias. Examples of such biases could be nationality and gender, where human stereotyping may have an impact. Furthermore, if a passenger questions why they have been identified as high-risk, the black box problem would make it virtually impossible for security to provide an answer. However, by restricting what data the AI system analyzes and in what context it is used, it becomes easier to defend its conclusions. Imagine instead that the AI only screens luggage, after being trained to identify weapons and bombs using only x-rays. The answer now becomes radically different if a passenger questions why he or she has become subject of extended screening. Security can say that x-ray analysis indicated that you carried illegal item x in your luggage with y percentage certainty. This appears as much more acceptable, despite not necessarily being able to explain exactly how the AI arrived at this conclusion. In time, certification of AI systems may help increase the trust in AI systems and their conclusions, as suggested by Virginia.

Regarding digital security, there is some disagreement among interviewees. Emil believes that AI does not necessarily change the nature of the municipality's digital security challenge. In contrast, Michael and Louise both state the AI and the progress of digitalization will entail new challenges within digital security, with Michael especially pointing to IoT as a source of complexity. His example of how thieves managed to rob a casino by hacking a sensor inside a fish tank makes a compelling case for his stance. As a significant increase of sensors is required for the progress of AI, it appears likely that Michael and Louise are correct. This conclusion is supported by Vinnova (2018) and Brundage et al. (2018) who both argue that AI will create new issues in terms of digital security. Brundage suggests that collaboration between policymakers and technical researches is the key to overcoming these challenges.

To summarize, the following challenges and possible solutions have been identified regarding regulation, ethics, and security:

- A severe lack of guidelines establishing how AI and data can be utilized, especially regarding integrity and transparency, hinders utilization of the technology.
- In a short-term perspective, these challenges can often be circumvented by carefully choosing what data the AI utilizes and what processes it affects. In a long-term perspective, there is a great need for centralized efforts to create laws and guidelines to promote responsible innovation and utilization.
- The findings suggest that the increase of sensors and other digital devices may cause new digital security challenges. Collaboration between policymakers and technical researches could be a key to overcoming these challenges.

6 Conclusions & Implications

This chapter will present the conclusions and final recommendations of the study. It will present some general observations regarding AI in Sweden's public sector, the FINT-model as a suggestion for how public organizations can approach the technology and suggest future research topics.

6.1 General Observations

The study indicates that Sweden's public sector faces a great challenge to provide high-quality service for its citizens despite an aging population and fewer taxpayers per capita. AI may prove to be an important factor in overcoming this challenge, but it will likely require an extensive transformation throughout the sector. As a result, public organizations must become experts at innovation.

Overall, the findings appear to support Vinnova's (2018) conclusion that most public organizations in Sweden are either in the early stages of testing AI, or not approaching the technology at all. However, findings also indicate that many public organizations are attempting to establish a strategic approach, but that these attempts have been unsuccessful so far.

None of the studied organizations appear to have established an innovation process which leverages the full potential of AI. While some have established processes to successfully develop AI applications, and others have models to guide their innovation efforts toward fulfilling the needs of their citizens, nobody appears to have successfully combined the two.

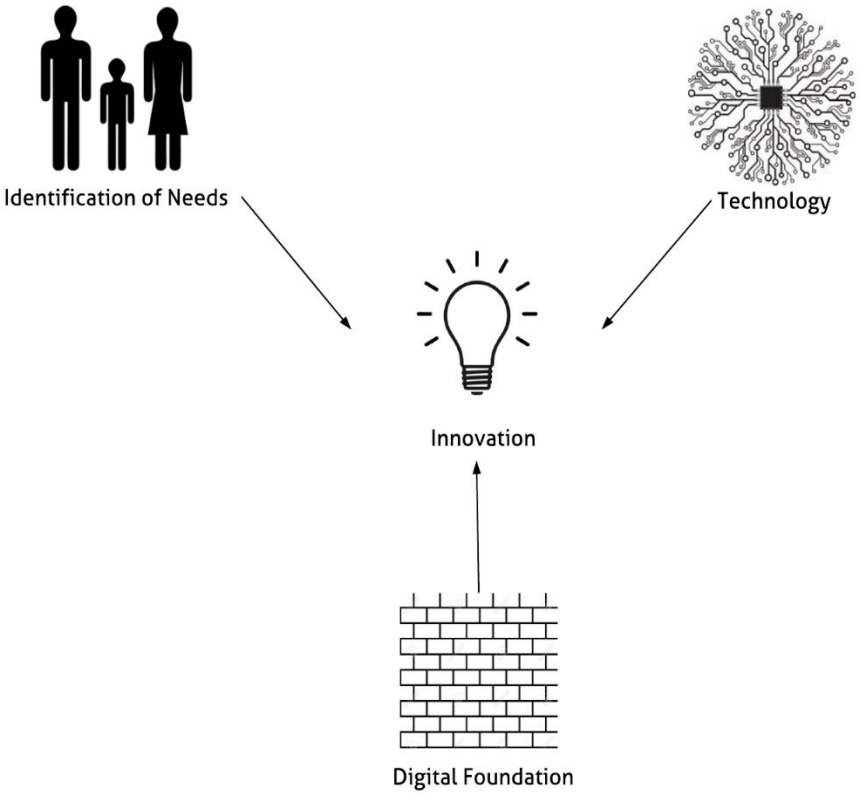
Findings have also strengthened the notion put forward by Vinnova (2018) and OECD (2017) that current regulation, legal ambiguities, and ethical dilemmas, are a severe obstacle for the development of AI. These uncertainties concern gathering and handling of data, the chain of responsibility, as well as determining for what purposes and to what extent AI can be applied. While some of these uncertainties can be circumvented by individual organizations, there is clearly an urgent need for national guidelines and consensus in these matters.

Once national guidelines have been established, broad initiatives can be initiated to proactively promote utilization of AI. Such initiatives could include a national data lake and a centralized collection of AI abilities. Creating a solid national infrastructure for AI would likely help public organizations adopt the technology faster and avoid duplicate efforts. Such measures appear necessary if Sweden is to reach its goal of becoming a world leader in utilizing the potential of AI.

6.2 The FINT-Model for Approaching AI

Based on the strengths of various innovation approaches identified in the study, a model is proposed for how public organizations can strategically approach AI. Following the suggested model may enable public organizations to create a structured approach to AI, leveraging the technology to fulfill the needs of their citizens. It combines the Municipality of Trelleborg's focus on needs, the Municipality of Skellefteå's effort to create a solid digital foundation, and the Social Insurance Agency's understanding of possible applications, with the Municipality of Stockholm's resource dedication to innovation. The model has been named FINT, combining its four elements: foundation, innovation, needs, and technology. The FINT-model is visualized in Figure 9.

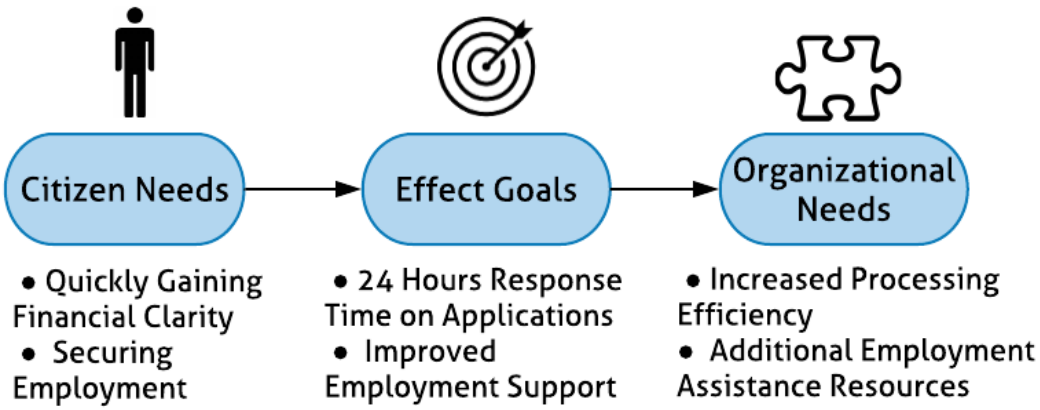
Figure 9. Visualizes the proposed FINT-Model.



Digital Foundation is the first element of the model. The fundamental goal is to enable the use of AI. As previously discussed, an organization must be digitalized to a certain degree before AI can be utilized. While analog processes can theoretically be made digital using i.e. image recognition and natural language processing, it appears more efficient to i.e. ensure that applications are online rather than physical. Digital Foundation also entails data gathering and storage. AI requires data, both for development and utilization. Therefore, organizations must ensure that data of sufficient quality and quantity is available in accessible formats. However, data gathering and storage must be approached carefully, taking into account regulatory and ethical aspects, again calling for national initiatives to create guidelines.

Identification of Needs is the second element. The fundamental goal of this element is to guide innovation efforts toward creating maximum societal impact. In order to achieve maximum impact, the perspective of innovation must be shifted from incremental improvement of current processes, to fulfilling the needs of citizens in better ways. Settling for utilizing AI to incrementally improve current processes, would be like using electricity to better transport firewood, instead of inventing light bulbs and heaters. In order to elevate the perspective of innovation, the model emulates the Municipality of Trelleborg's three initial innovation steps, starting with the identification of needs among citizens. Once a need has been identified, the organization must establish effect goals, defining what output must be delivered in order to fulfill that need. Finally, organizational goals are generated by determining what new capabilities the organization requires to fulfill the effect goals. Exemplifying with Trelleborgsmodellen, the citizen needs were quickly gaining financial clarity and securing an income, the effect goals were 24 hours response time on financial aid applications and better job finding support, and the organizational goals increased application processing efficiency and additional job seeking assistance resources. The process and example are visualized in Figure 10.

Figure 10. Visualizes the transformation from citizen to organizational needs, and exemplifies the process using Trelleborgsmodellen.



One would hope that public organizations are already experts at identifying needs among their citizens. If not, this is a competence that would be of great value regardless of AI efforts. Furthermore, due to the non-competitive nature of public organizations, the result of this process could be publicly available. Publishing needs and goals could promote collaboration with suppliers, academia, and other public organizations, as anyone is invited to consider possible solutions. By also using the model to cultivate an innovation culture throughout the organization of challenging old ways, operational staff could become more engaged in the process. Engaging operational staff in early phases of the innovation effort could foster an increased openness to change and facilitate implementation efforts.

Technology is the third element. The fundamental goal of this element is to ensure that the organization has a sufficient understanding of available technology and how it can be applied. It is important to emphasize that this does not entail developing AI, but rather understanding how it can be utilized. The key to this element appears to be employees dedicated to identifying how technology can be applied, without operational responsibilities. Leif, Michael, and Paul are all examples of such employees. While the study does not provide a single unifying best practice for how to best identify new technology and its applications, some examples have been presented. If there is a lack of understanding regarding new technology, the organization will likely struggle in identifying the best ways of fulfilling organizational needs.

Innovation is the fourth and final element. The fundamental goal of this element is to enable a truly innovative process where the three previous elements meet. By combining needs, technology, and an enabling infrastructure, solutions can be created which leverage AI to actively create a positive societal impact. Dedicating resources specifically for exploring new ideas appears vital to creating novel solutions. It is also important to remember that the perspective of general operations development should also be included, as AI and new technology is not the solution to every problem. Finally, it is also important to emphasize that innovation does not have to be an exclusively internal matter. Academia, suppliers, and other external entities can all contribute in searching for solutions. As long as the problems are grounded in the needs of citizens, all added perspectives in developing solutions can be constructive.

6.3 Suggestions for Future Research

The study has identified a number of interesting research areas in the intersection between innovation management and AI. Below follows a brief discussion regarding which of these areas are most interesting and relevant for future research.

The first and perhaps most pressing suggestion is further exploring the legal and ethical dilemmas relating to AI. As stated above, there is a severe lack of guidelines regarding these issues, which inhibits the development of AI. Studying these issues in an academic setting may help promote the establishment of such guidelines and facilitate the progress of AI utilization.

The second suggestion relates to the process of understanding how to utilize AI and other novel technologies. As the digital transformation sweeps through our society, the need for applying technology grows far beyond IT departments. While not everyone will need to create technology anytime soon, there will be a large demand for understanding how to utilize it efficiently. Establishing best practices for this process could create tremendous value.

Further elaboration of the FINT-model could also be of interest. As the model is developed through a relatively small sample of empirical findings using broad inferences, additional research into its assumptions and approaches to each element could be beneficial. Since the model mainly concerns focus areas and general strategies, rather than concrete methods, investigating how the model can move from strategy to operation could also prove beneficial.

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Appendix I: General Interview Guide

1. Interview Subject Background
    a. Organization & Unit?
    b. Title?
    c. Responsibilities?
2. How are applications of AI identified by your organization?
3. How is the decision made to implement AI applications?
4. How does your organization utilize AI today?
5. What critical success factors have you identified during implementation efforts? Any pitfalls?
6. Have you encountered any regulatory, ethical, or security challenges during your AI efforts?

Appendix II: Virginia Dignum Interview Questions

1. In which areas do you see the biggest potential for AI? Particularly in the context of public organizations such as government and municipalities.

2. What are the biggest ethical challenges in utilizing AI in public organization? Do you believe that public organizations are doing what they should to overcome these challenges? How can public organizations improve their approach to these challenges?

3. What are the biggest regulatory challenges in utilizing AI in the public sector? Do you believe that public organizations are doing what they should to overcome these challenges? How can public organizations improve their approach to these challenges? From international, national, and individual, perspectives.

Appendix III: Calculating Cost of Grading

Katarina estimated that roughly 2 000 teachers regularly perform grading within the Municipality of Umeå. These teachers spend an average of three to four hours on grading during each of the thirty-seven weeks that school is in session. The total number of hours spent on correcting each year within the municipality should thus be between 222 000 (2000*37*3) and 296 000 (2000*37*4) hours.

Katarina also estimated that the average salary of a teacher in the municipality is between 30 0000 and 35 000 SEK per month. Assuming four forty-hour work weeks each month, this gives an hourly salary between 187.5 (30 000/160) and 218.75 (35 000/160) SEK.

Combining the hourly wage with the total number of hours spent on correcting gives a total yearly cost between 41 625 250 (222 000*187.5) and 64 750 000 (296 000*218.75) SEK in the Municipality of Umeå.

Assuming that this number is proportional by number of citizens between the municipality and the rest of the country, Umeå has 125 080 inhabitants and Sweden's total population is 10 171 524 inhabitants (SCB, 2018), this would indicate that all municipalities in Sweden together spend between 3 384 971 450 (41 625 250*10 171 524/125 080) and 5 265 479 525 (64 750 000*10 171 524/125 080) SEK per year on grading.