ADOPTING THE INTERNET OF THINGS

A QUALITATIVE STUDY ON ADOPTING THE INTERNET OF THINGS IN SWEDISH MUNICIPALITIES

ISABELLE HE

CARL TENGBLAD

Bachelor Thesis
Stockholm School of Economics
2020

Adopting the Internet of Things

Abstract:

Internet of things (IoT) is the future of digitalization and it is already here, disrupting industries in this very moment. One industry where IoT is changing the way managers run their business is within vehicle fleet management. The connected fleet market is maturing at a revolutionizing pace, being forecasted to grow at a compounded annual growth rate of 21.26 percent until 2021. Naturally, management research has mainly focused on organizations acting in a competitive market with focus on maintaining or increasing competitive advantages. This leaves organizations working outside this frame, such as the public sector, in absence. Swedish municipalities are all dependent on a fleet to some extent to provide social services, and municipality fleets have become a growing customer for different IoT systems. In contrast to previous research, our thesis addresses municipalities by exploring necessary factors that need to be present if municipalities are to adopt IoT solutions in their vehicle fleet. This could further shed light on the uneven spread of IoT adoption between different municipalities. By using an abductive research strategy, we engaged six representatives from three different municipalities as well as two employees at relevant professional agencies in in-depth interviews. Our findings suggest that there are primary four drivers of IoT adoption: technological compatibility, the fleet manager's personal interest, top political support and an identified need for change. Our thesis' contribution to the academic debate accounts for a further understanding of the organizational IoT-adoption process in the public sector, by looking at the relevant factors found in the context of municipalities. This could further induce the diffusion of IoT technology within the public sector.

Keywords:

Internet of Things, Technological Adoption, Vehicle Management Systems, Fleet Management, Public Sector, Municipality

Authors:

Isabelle He (24267)

Carl Tengblad (23949)

Supervisor:

Marijane Luistro Jonsson, Affiliated Researcher, Department of Entrepreneurship, Innovation and Technology

Examiner:

Laurence Romani, Associate Professor, Department of Management and Organization

Bachelor Thesis

Bachelor Program in Business and Economics

Stockholm School of Economics

Thank you.

This thesis has been a journey filled with challenges, doubt, inspiration, purposefulness and new friendships. Throughout the process we have seen a newborn, fragile idea been grinded and sharpened to become what it is today. This would not have been possible without the incredible support that we have received. We would therefore like to dedicate this thesis to all of you who has contributed to this thesis.

We would like to thank the Department of Management and Organization at Stockholm School of Economics with special gratitude:

To our supervisor, **Marijane Luistro Jonsson**. Thank you for your continuous guidance, presence and support throughout the entire process.

To our examiner **Laurence Romani**. For always challenging us to improve and for your enthusiasm in the classroom.

To our supervision group for your honest and constructive feedback. Thank you, **Fredrik** and **Elvira**, **Sara** and **Maria**, **Lucas** and **Kristoffer**.

We would also like to express our gratitude towards every interviewed representative who has shared their time, experiences and insights with us. You are the entire foundation of our thesis.

Contents

Definitions

Word	**Definition**	**Source**
Adoption	Accepting or starting to use something new	(Cambridge Dictionary)
Efficiency	The good use of time and energy in a way that does not waste any. The ability to avoid wasting materials, energy, money, time and other inputs.	(Cambridge Dictionary)
Fleet Manager	The administrator of the vehicle fleet	(Authors)
Internet of Things (IoT)	System of interrelated computing devices or objects that are able to transfer data over a network without requiring human-to-human or human-to-computer interaction	(Lasi et. Al 2014)
IoT Technology	Any technology or system using IoT, in this thesis used interchangeably with *VMS*	(Authors)
Municipalities	290 administrative departments distributed over 21 counties (län) in Sweden. Each municipality is governed by a publicly elected assembly (Kommunfullmäktige) that makes decisions on behalf of the municipality. The municipalities are in charge of social services, health care, education i.e. within their specific areas	(Kullander, 2019)
Professional agency	In this thesis, we will refer to *Sveriges Kommuner och Regioner* (SKR) and *Kommunal* (the municipality employee's union) as the two opposing professional agencies within municipalities	(Authors)
Units (municipality units)	The separate functions/units within the municipality, such as schools, elderly care or road maintenance	(Kullander, 2019)
Vehicle fleet	A pool of vehicles such as cars, vans, trucks etc.	(Authors)
Vehicle Management System (VMS)	The software or systems that are used within fleet management. In this thesis used interchangeably with *IoT technology*	(TelliQ, 2019)

1. Introduction

1.1. Background

Internet of things (IoT) is the face of today's societal digital transformation and it is already here. Although it might seem like a new term, it was actually coined in 1999 by Kevin Ashton during his work at Procter & Gamble in an attempt to attract attention to a new exciting technology – RFID (radio-frequency identification) (IoT Analytics, 2014). RFID is a form of wireless communication of radio frequency to transfer data. By tagging items with RFID-tags, users can automatically track inventory and assets (ETMM, 2019). IoT has since then developed beyond RFID technology. In the broadest sense, IoT encompasses every device that is connected to the internet and thus allows the devices to communicate with each other (Wired, 2018). Commercially, this ranges from smart mirrors, fitness collars for dogs, smart light bulbs and refrigerators that can keep track of when to refill groceries (Prospero, 2019).

IoT is not only used to create futuristic gadgets but is also disrupting industries and altering management as we know it. One industry where IoT has become increasingly important is within transportation fleet management. Fleet management is an administrative approach to how companies organize and coordinate commercial motor vehicles such as cars, vans and trucks. The purpose is often to improve the efficiency of distribution, maintenance and tracking while increasing the accessibility and quality of the vehicles (Deloitte 2018). Areas of use within vehicle fleets could be the ability to track and record driving activities, use data from vehicles to set rates by analyzing driving behavior, usage and other variables to name a few. Some managers have also applied price setting models such as user-based insurance (UBI), pay as you drive (PAYD) and pay how you drive (PHYD) (Telenor Connexion, 2020). The connected fleet market is maturing at a revolutionizing pace, being forecasted to grow at a compounded annual growth rate of 21.26 percent from $3.16b in 2016 to $8.28b in 2021 (Markets and Markets, 2020). The overall growth in the IoT market can be derived from the increasing supply of *vehicle management systems* (VMS) and from managers recognizing the huge impact and benefits connected devices can have on their operations and growth in the form of efficiency, safety and control.

A slowly growing customer base for VMS is Swedish municipalities. The municipalities are responsible for delivering a considerable amount of services to their inhabitants as efficiently as possible without compromising quality. These services include elderly care, schools and waste management to name a few. In order to fulfil their mission they need a dependable fleet to supply vehicles to all the units within the municipality (SKR, 2017). Although Sveriges Kommuner och Regioner (SKR) encourages municipalities to adopt IoT technology, few have gone through with the transition (SKR, 2020). In order to understand how to increase municipalities' adoption of IoT technology, we must explore the underlying triggers of the municipalities that have transformed their fleets.

1.2. Purpose and Research Question

This study explores various factors that need to be present if municipalities are to adopt IoT technologies in their vehicle fleet. The purpose of our research is to gain knowledge about how the adoption rate can be accelerated in other municipalities. As the spread of IoT adoption in the public sector is highly uneven and, in most cases, lagging (SKR, 2017), the quality and efficiency of service provided can vary a lot between municipalities. We believe that by exploring necessary factors for adopting IoT, we will gain an understanding of how to accelerate the spread of innovation to other municipalities.

Furthermore, the research question that will be investigated is:

Which factors are necessary in order for municipalities to adopt IoT technology in their vehicle fleets?

1.3. Research Gap and Expected Research Contribution

The extensive previous research on IoT has been conducted within several fields such as engineering and computer science. Within the field of management, existing research mainly focuses on the implementation process of IoT (D Despa et al. 2018), strategies and challenges with IoT (Borgia, 2014; Balte et al. 2015; Weinberg et al. 2015; Yuchen et al. 2017) and ways to increase usage of IoT (Brown et al, 2019; Crook, 2018). Previous studies that are addressing factors influencing the adoption of IoT are mainly focused on private enterprises (Brous et al, 2017) or on adoption factors of specific devices by individual end-consumers (Kao et al, 2019; AlHolgail, 2018). In contrast to previous studies, our research focuses on triggering factors for IoT adoption within the public sector.

While there is increasing attention to IoT in the private sector, empirical analyses are still scarce when it comes to IoT adoption in the public sector. This study is, consequently, addressing an un-researched area, where the parties are not acting in a traditionally competitive market. With the identified gap, the study aims to contribute within the scope of technological innovation adoption and IoT implementation in the public sector.

1.4. Delimitations

The thesis is limited to exploring IoT adoption in the Swedish public sector, specifically municipalities. Regional or governmental decisions to implement IoT technology is outside the scope of this study. We will however consider governmental incentives and other stimulations as possible triggers for municipalities to adopt IoT as the external environment is relevant within the scope of the theoretical framework.

The focus will be solely on municipalities' vehicle fleets and not on other units, functions or departments within the municipalities. The reason being that *VMS* (*see section 1.1*) is a mature IoT technology and almost all Swedish municipalities are dependent on a fleet in order to provide satisfactory services. Focusing on a single function, fleet management, enables the study to identify and address similarities and differences to a greater extent.

Moreover, it will be more transferable as the implementation and use of IoT within different functions may vary substantially.

The thesis will examine a number of municipalities located in different parts of Sweden, with different populations and governing political parties. However, we will not study every municipality in Sweden and present a complete coverage. By including the most dominant professional organizations in the sector, the study increases the scope of data and incorporates more general information regarding municipalities. Further the municipalities should be considered representative as they vary in size, fleet size and political governance.

Lastly, we have not taken any consideration to which political party is currently governing the municipality, which party implemented a given system nor the political agenda for which the implementation was made. The reason why the political governance is denoted (*see section 3.3.1*) is to present the representability of Swedish municipalities and promote transferability.

2. Theoretical framework

As the world is becoming more dependent on technology there have been a growing number of studies conducted on IT and innovation in organizations. In this section we will review existing research and literature on topics related to IoT. As technology is ever evolving, we have found past research to be varying in their degree of relevance to the modern technological landscape. To guide the reader throughout the literature review, we have included criticism that have been directed to the original studies. Furthermore, we have presented and argued for our choice of theoretical reference. Lastly, these theories will then be explained in more detail (*see section 2.2.1 and 2.2.2*).

2.1. Previous Research

Regarding studies within management, existing research and theories are primarily about the implementation process of IoT (D Despa et al. 2018), strategies and challenges within IoT (Borgia, 2014; Balte et al. 2015; Weinberg et al. 2015; Yang et al. 2017) and ways to increase the usage of IoT (Brown et al., 2019; Crook, 2018). Although these studies have been of high importance for us in understanding the current IoT landscape, we believe that they are more relevant for industries that have reached a higher degree of maturity in their IoT journey. Since many municipalities have not yet adopted IoT, it is of greater importance to discuss studies that address the earlier stages of IoT adoption. In other words, we want to emphasize theories on IoT adoption and not IoT implementation.

The few papers addressing factors that influence the adoption of IoT are mainly based on systematic literature reviews in private enterprises (Brous et al, 2017) or focusing on adoption factors of specific devices by individual end-consumers (Kao et al, 2019; AlHolgail, 2018). The primary learnings from these studies were that the consumers' trust to the innovation plays a crucial role to their adoption decision which makes it important to for the supplier of technology to reduce any uncertainties related to the innovation (AlHolgail, 2018). However, it is important to make a distinction between innovation adoption of individual consumers and larger organizations such as municipalities in terms of risk aversion. Larger firms can take on greater risk associated to adoption of innovation due to their larger pool of resources and economies of scale (Hoti, 2015).

One of the earliest and most influential theories that can be applied on organizations is the *Technology Acceptance Model* (Davis et al, 1989). They suggested that there are mainly two factors at play when it comes to acceptance of new IT: *perceived ease of use* and *perceived usefulness*. For example, if the individual perceives digital games to be too difficult to play or a waste of time, they are unlikely to adopt this technology (ScienceDirect, 2016). The theory has received criticism for neglecting the social and psychological parameters (Agarwal & Prasad, 1998: Venkatesh & Bala, 2018). Furthermore, Kim et al. (2007) claimed that the model was limited in explaining new *Information and Communications Technology (ICT)*. As a result, Kim et al. proposed an elaboration of the *TAM* model – the *Value-based Adoption model* (*VAM*). Instead of seeing intention to adopt technology as depending on *usefulness* and *ease of use*, the *VAM* model considers *benefits* (*usefulness* and *enjoyment*) and *sacrifice* (*technicality* and *perceived fee*) as the primary drivers.

Closely linked to IoT adoption theories are *diffusion of innovation theories*. These are theories that explain how a new innovation gains momentum and eventually spreads (diffuses) through a social system (LaMorte, 2019). After reviewing several studies conducted on diffusion of innovation, it has been confirmed that most theories are based on the *Diffusion of Innovation theory* (DOI), a conceptual framework by Everett Rogers, first introduced in 1962. The theory has since then been revisited and updated in his fifth edition (2003). The revised DOI framework has been able to identify important attributes which are perceived to be critical for innovation to spread. According to Rogers, the rate of adoption of innovation depends on the speed of diffusion. Important attributes to the innovation that influence the adoption are *relative advantage*, *compatibility*, *complexity*, *trialability* and *observability*.

Rogers model has since been criticized, with researchers claiming that it lacks consideration of the external environment such as how governmental and industry pressure affect the rate of innovation. Continuing on the DOI model, Tornatzky and Fleischer (1990) introduced a more developed version, the *Technology-Organization-Environment* (*TOE*) framework, which considers the external environment as an important factor for adopting technological innovation.

2.2. Use of Theory

In order to understand which factors are necessary for adopting IoT in Swedish municipalities, we considered various theories on *IT acceptance* and *innovation diffusion*. The theoretical focus has been on studies that explain the background to why organizations adopt new innovations and critical factors that influence the adoption of innovation. After reviewing several studies, we found that the most relevant and comprehensive theories are the VAM and TOE frameworks. By combining these, a more holistic theoretical framework can aid in explaining the research question. While the TOE model can shed light on important factors for adopting innovation, the VAM theory proposes an understanding of how these factors are translated into an actual intention to adopt the innovation or not.

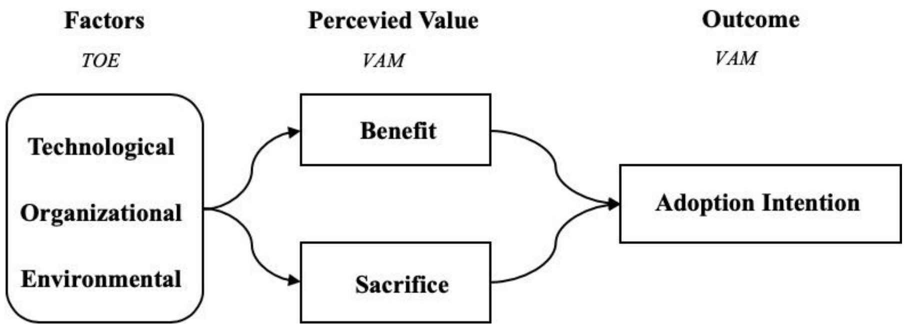

Figure 1. A theoretical framework combining the Technology-Organization-Environment framework (TOE) and the Value-Based Adoption Model (VAM)

Since the TOE model is based on private enterprises with firms acting in a competitive environment, the model may be somewhat incomplete in explaining organizations acting in the public sector. The main reason for this assumption is due to the competitive nature of private enterprises and the external pressure they face. The environmental context may be different for municipalities in terms of how they compete. However, the TOE framework is still a highly extensive framework which can provide a good basis for further analysis.

2.2.1. The Technology-Organization-Environment Framework (TOE)

The Technology-Organization-Environment framework, developed by Tornatzky and Fleischer in 1990, identifies three contexts that influence the process in which organizations decide to adopt and implement technological innovations: the *technological context*, the *organizational context* and the *environmental context*. They argue that the internal and external organizational factors are the key drivers for deciding to adopt new technology. These factors are described in more detail in Table 1 (Hoti, 2015).

Table 1. Key contexts and factors for adopting new technology in organizations

Technological context	
Relative advantage	Degree to which an innovation is perceived as being better than the idea it supersedes
Compatibility	Degree to which an innovation is perceived as consistent with existing values, past experiences and adopter needs
Complexity	Degree to which an innovation is perceived as relatively difficult to understand and use
Organizational context	
Top management support	Support of the top management (CEO) to the adoption initiative
Organizational size	Limitation of resources
Information intensity and product characteristics	Degree to which information is present in the product or service of a business, reflects the level of information intensity of that product or service
Managerial time	Time required to plan and implement the new innovation
Environmental context	
Industry pressure	Competition and high rivalry increase the likelihood of innovation adaption for the purpose of gaining competitive advantage
Governmental pressure	Government strategies or initiatives that encourage organizations to adopt new innovations
Consumer readiness	Lack of customer readiness influences the adoption process and is an inhibitor towards new innovation use

2.2.2. The Value-Based Adoption Model

The Value-Based Adoption Model was elaborated from the Technology-Acceptance Model (1989) and other theories on motivation. The model specifies the casual relationship between perceived benefits, perceived sacrifices, perceived value and actual outcome. The model tries to achieve parsimony by capturing a small number of factors that account for most of the variance in the adoption intention (Kwon & Seo, 2013).

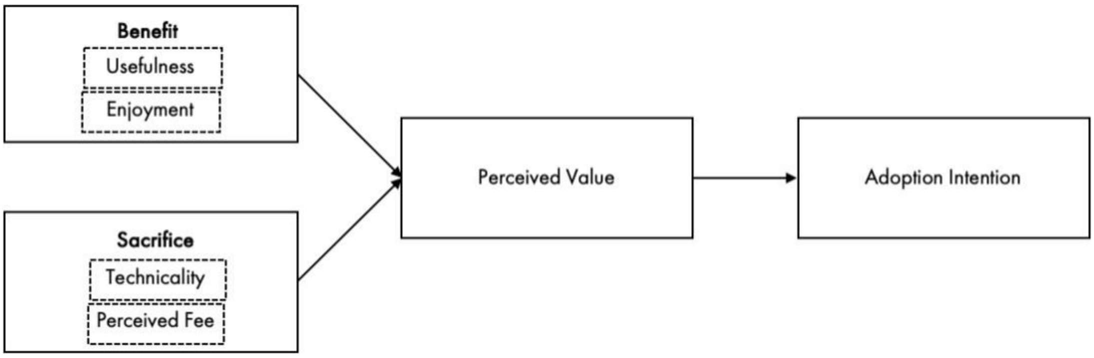

Figure 2. The Value-Based Adoption Model (VAM), Kim et al., 2007

The model has been heavily influenced by the cognitive evaluation theory (Deci & Ryan, 1985) which suggests that perceived benefits can be classified in extrinsic and intrinsic motivational subsystems. Extrinsic motivation appears when performance is linked to reaching a specific goal while intrinsic motivation is gained from performing the mere performance itself. Both these types of motivations have been found to influence perceived benefit.

Perceived sacrifices can be both monetary and non-monetary in nature. The perceived sacrifice of monetary investments can include the payment of the actual innovation while non-monetary sacrifices refers to the time, efforts, and unsatisfactory spending for purchasing and consuming the innovation. It is further suggested that customers on general try to achieve the maximum utility or perceived value which means that the perceived value reflects the balance between perceived benefits and perceived sacrifices.

3. Method

3.1. Research Strategy

The research question is explored with a qualitative approach on municipalities that has implemented IoT in their vehicle fleet. Qualitative research consists of the use of qualitative data, such as interviews, documents and observations to understand and explain social phenomena (Myers, 1997). We apply the ontological position of constructionism since we try to understand the adoption intention and the fleet management teams as processes of social actions and personal experiences (Bell at al., 2019). To reach this level of comprehension we assume the subjectivist paradigm to understand the municipal respondents' experiences and personal view of both the adoption process and the municipality.

The thesis takes an abductive approach where the narrative is moving back and forth between the empirical findings and previous literature in order to enable theoretical development (Bell et al., 2019). The theoretical framework was materialized from the literature review and then altered by the findings that emerged in the empirical material.

An interpretivist approach was considered favorable as it allows us to study the subjective meaning of social actions (Bell, et al., 2019) and thereby presents an opportunity to address the *how* and *why* of these actions. In contrast to positivist research, that rather entails an objectivist position, this study aims to understand municipalities as a social entity by identifying social actions and analyzing the process that eventually leads to the adoption of IoT (Bell et al., 2019).

3.2. Research Design

The research question was approached with a cross-sectional design where we conducted six semi-structured in-depth interviews with representatives from municipalities that are using IoT in their management of the fleet. This was further complemented with interviews with representatives from the professional agencies. The cross-sectional approach was chosen as it allowed us to identify common factors between municipalities and understand which were crucial for IoT adoption in general (Bell et al., 2019). Semi-structured interviews enabled us to ask more open-ended questions where the respondents could speak freely and provide more nuanced answers.

3.3. Data Selection

3.3.1. Study subjects

The primary data presented in this study originates from three Swedish municipalities: Big Town, Middle Town and Little Town that all, to some extent, have implemented IoT in their municipal fleets. As we wanted to promote transferability, we approached municipalities that, in terms of population, geographical location and political governing could be considered representative for Swedish municipalities in general. The municipalities have been anonymized throughout the thesis (*see section 3.6.1*). Table 3.1 and 3.2 presents some general data about the municipalities and their fleet that is relevant in order to understand the organizational differences.

Table 3.1. General demographic data about each municipality

Municipality	Location	Population	Governing Party*
Big Town	Svealand	153,000	S, KD, C
Middle Town	Götaland	68,000	M, L, C, KD, MP
Little Town	Svealand	14,000	S

Note: The table indicates the population of each municipality to the nearest thousand. The population data is collected from Statistiska Centralbyrån. The lands (landsdelar) is used instead of provinces (landskap) in order to ensure anonymity. *The letters indicate different political parties in Sweden

Table 3.2. Data about each municipality's vehicle fleet

Municipality	Fleet Size	Connected Vehicles	Management Team	External Leasing
Big Town	1,000	600	8	Yes
Middle Town	270-300	270	3	Yes
Little Town	95-100	90	1	No

Note: The table displays the fleet size as total number of vehicles, connected vehicles as number of vehicles that are connected to a VMS, management team as number of employees managing the fleet, and external leasing as whether or not the municipality lease any vehicles to external parties (private companies)

3.3.2. Selection of Interviewees

Interviews were conducted with one to three representatives from each municipality (see Table 4). To receive more relevant data, we interviewed representatives who were involved in the adoption process, managed the vehicles as well as the VMS technology on a daily basis. The respondents' names are coded throughout the thesis to achieve anonymity of the respondents (*see section 3.6.1*).

Table 4. Information about interviewees

Interviewee	Municipality	Title
Adam	Big Town	Vehicle manager
Axel	Big Town	Vehicle manager
Anders	Big Town	Head of IoT
Björn	Middle Town	Vehicle manager
Ben	Middle Town	Vehicle manager
Charles	Little Town	Vehicle manager
Simon	Sveriges Kommuner och Regioner (SKR)	Head of growth and civil engineering

Karin	Kommunal	Investigator

Note: The titles are not official working titles but areas of responsibility translated from Swedish to English (see *Appendix* for detailed information)

Firstly, we considered interviewing more representatives from each municipality but since no additional factors emerged in the interviews with the second or third representative from Big Town, it indicated that the representatives shared similar views. Regarding Little Town, the team only consisted of one person why we did not interview any others. Middle Town's team consisted of three persons, of which we interviewed two (the third was not available to participate in the study).

In order to receive more comprehensive and complete information, we conducted in-depth interviews with professional agencies who work directly with municipalities. To receive impartial information that covers a wider range of municipalities, we interviewed both *Kommunal,* the union representing individuals working at municipalities and *SKR* that represents the employers. Although the professional agencies may lack experience in fleet management, they could provide knowledge about how and why municipalities engage in digitalization and technological innovation in general. Moreover, their insights may give a non-biased perspective of different municipalities, although they undoubtable have interests in terms of who they represent.

The selection of study subjects entails a purposive sampling with features of criterion sampling. The selection was determined by looking at municipalities that have invested in at least one VMS and where the study subjects allow the theoretical framework to be tested.

3.4. Data Collection

The interviews were conducted in a semi-structured fashion over the phone between late February and mid-April. Our initial ambition was to visit most of the municipalities and conduct the interviews in a suitable space at their offices. The exception was Middle Town which is located farthest away from Stockholm, why we arranged for a phone interview. However, this proved to be difficult as the accessibility decreased significantly due to the Covid-19 outbreak. Therefore, we conducted all of our interviews with the municipalities over the phone. There are both advantages and disadvantages with conducting interviews over the phone which have been addressed in section 3.6.2. However, we would have preferred to conduct our interviews face-to-face, making this set-up merely practical. Videoconferences could be an alternative as it allows for a visual element of face-to-face interaction but still being as flexible as interviews over the phone. There are obvious limitations, however, such as potential technological problems (Bell et al., 2019). We did not consider the disadvantages of a phone interview to have any significant effect on the quality of the interviews (*see section 3.6.2*).

Kommunal and *SKR* requested the questions in advance, which we approved. All of the interviews were recorded with permission from the interviewees. We took notes during the interview and all the interviews were later transcribed.

3.5. Data analysis

The data was collected over approximately one and a half month. During the time period, no additional IoT investments were made in either municipality's vehicle fleet. Since all of the municipalities are considered to be in the same phase in their IoT adoption journey (finalized adoption), the time frame for the collection of data makes the empirical material comparable.

After the interviews, we discussed whether or not we had received sufficient information from the respondent and transcribed the interviews shortly after they were conducted.

The data was analyzed with the thematic approach of *similarities* and *differences* (Bell et al., 2019). Different factors were identified based on how they related to the research question and thereafter explored further. Moreover, we looked for *linguistic connectors* to be identified as indicators of causal connections for the adoption process (Bell et al., 2019). We applied a grounded theory when analyzing the data and used coding as a tool to identify the different concepts that subsequently could be divided into components. These components emerged into categories or *factors* that could represent the identified phenomena (Bell et al., 2019).

3.6. Method Discussion

3.6.1. Ethical Considerations

In terms of ethical considerations, the study follows the ethical principles composed by Diener and Crandall (1978). We addressed issues of potential harm to the participants, possible lack of informed consent, if any invasion of privacy occurred and avoidance of deception (Bell et al., 2019). To address these principles properly, the interviewees, as well as the municipalities, have been anonymized throughout the thesis. Participation was voluntary, they had the ability to end the interview whenever they wanted to and the interviewees were able to address any concerns that they might have throughout the interview. To further ensure consent from the respondents, they were given the opportunity to address statements that is used in the thesis. Consent to record the interviews was agreed upon before the interviews.

The professional agencies were not anonymized as the purpose would not reach any effect. There are only two well-established organizations in Sweden making them easy to identify. The professional agencies were never informed of which municipalities took part in the study.

3.6.2. Discussion of Research design

As an alternative to a cross-sectional design, a comparative design could have been considered in order to identify, for instance, cultural differences between the municipalities, the fleet management teams or the individuals within the teams. However, it would in that case be more relevant to study municipalities that have adopted IoT and compare them with municipalities that have not engaged in *IoT* activities at all. Furthermore, the level of analysis would possibly be an issue with a comparative design as we examined factors on both an individual and a municipal (organizational) level. Our level of analysis enables us to understand the practices and outcomes of different municipalities in a way that ties the views of employees, the units, the municipality as a whole as well as other municipalities together. We considered the chosen approach better as the results would be more transferable.

3.6.3. Method Credibility and Criticism

The relatively scarce number of municipalities that have adopted IoT in their fleets somewhat limits the validity of the thesis. Preferably we would have sought out more municipalities that have engaged in the adoption process but instead of focusing on a greater sample of municipalities, we wanted to focus on the quality and depth of each interview held (*see section 6.4*).

Another way to increase validity would have been to include the municipal units that are using the vehicles. This would add respondents who could support, or present other thoughts. However, since their involvement in the adoption process was non-existent in our chosen municipalities, this was not acknowledged. Alternatively, we could have investigated the adoption of IoT within other municipal departments to get a broader understanding of the adoption process. However, this could affect the transferability negatively as the systems and the usage of the systems would vary substantially. To support the validity, we used *triangulation* by incorporating the professional agencies as another source of data to support our findings (Bell et al., 2019: Guba and Lincoln, 2019).

All the interviews were conducted over the phone and there are some disadvantages with phone interviews. For instance, the length of the interview is less likely to be well-functioning beyond 20-25 minutes, which we experienced in some cases (Frey, 2004). In terms of more sensitive questions, evidence suggests that interviews over the phone are less effective. This did not affect us to any greater extent as we tried to avoid all sensitive questions and the ethical considerations were considered rigorously. Conducting interviews over the phone may, on the other hand, have some advantages in terms of time and cost efficiency. Our alternative would have been to travel across Sweden to meet the respondents in person. Further, there are evidence indicating that personal interviews may affect the respondent depending on the characteristics of the interviewer (Bell et al., 2019). By conducting interviews over the phone, this risk is mitigated.

As the municipal representatives were interviewed sometime after the IoT adoption took place, it may be relevant to question the degree to which they are able to recapitulate the perceived usefulness, the perceived value and other relevant factors. That is why the professional agencies have a crucial part in the study. They present more recent but general data, and by comparing and linking the results we were able to present a more complete coverage of the necessary factors and resources in their adoption of IoT technology.

Considering the absence of municipalities located in the northern part of Sweden, the accessibility of IoT and other technological solutions could be an issue that is not fully addressed. Most suppliers are located in the middle and southern parts of Sweden which could imply less accessibility in the north. However, given the resources and attention the public sector focuses on digitalization of municipalities nationally, this should not be an issue.

4. Empirics

4.1. The Use of Vehicle Management Systems

All the municipalities in the study have adopted an *intelligent driving journal* in their fleets. An intelligent driving journal is a VMS used for various purposes: tracking the vehicles' position, monitor usage and maintenance. The respondents explained how the alternative to an *intelligent driving journal* would be to document each journey manually.

> "Before, everyone who used a vehicle needed to write a driving journal manually. The journal contained detailed information about distances, fuel consumption, driver etc." (Ben, Middle Town)

He continued to explain that tracking vehicles was not everything they used the VMS technology for. They had numerous areas of use meaning that the system was applicable in different ways depending on what the purpose was, the size of the fleet and the municipal ambitions. In Table 4. we have compiled a list of ways the municipalities use the VMS technology.

Table 4. How municipalities use VMS technology

Areas of Use	**Explanation**
Tracking	Track where the vehicles are at any given time
Invoicing	How much fuel each car consumes (which is used as a basis for debiting the customer)
Usage	How much the customer is using their vehicle(s)
Service and Maintenance	Administering the servicing of the vehicles
Environment	How many vehicles the municipality need, how many units need *all wheel drive* on their vehicles

Note: The areas of use presented above are findings accumulated from the interview. The table is not exhaustive.

4.2. Motives for Investing in IoT

After understanding *how* they used the IoT technology, we wanted to know *why* they used it.

4.2.1. Gain Control over a Growing Fleet

Before implementing the new VMS technology, Big Town and Middle Town experienced a loss of control as their fleets grew. The vehicle managers realized that the long-term leasing contracts with the customer meant that they rarely saw the vehicle which became a problem as the fleets increased in size.

> “We have more than 900 cars. 900! That’s a lot and it felt like we never saw the cars […] We did not know how, when or by whom the cars were driven. We didn’t know if the cars were safe.” (Adam, Big Town)

His colleague, Axel shared Adam’s experience and added,

> “After we bought a car, we rented it to the customer and did not see it (the car) in a very long time. Before, we did not know how much the cars were driven, when they were driven or if the units used the cars at all.” (Axel, Big Town)

Big Town later implemented the IoT system widely, meaning that the intelligent driving journal was used for several purposes. For instance, Big Town used the system to predict vehicle demand from the units as well as invoicing and maintenance.

> “By analyzing the driving behavior, how much the car is being driven etc., the system (VMS) can tell me when the customer needs a new vehicle before they know it themselves. We can purchase and replace cars without having the units placing any orders. In a way, we’re taking control over the supply and demand instead of being controlled.” (Adam, Big Town)

Middle Town also realized that their fleet was not functioning to the best of its ability.

> “Before, we had to keep track of everything manually by going through stored journals and approximate when the cars should be serviced. It was a lot of work and it happened that some cars had not been serviced for over two years.” (Ben, Middle Town)

The work was also highly inefficient and would often end up not being correct either.

> “We were two guys who kept track of every vehicle in the fleet. To bill the units correctly, we had to estimate the distances the cars had been driven by looking at the receipts from the gas stations. We basically ended up guessing a lot.” (Björn, Middle Town)

Björn was aware of the issues with the fleet but became convinced that something needed to change by coincidence, after reading his daily newspaper.

> “I read in the newspaper that Skatteverket (the Swedish tax agency) had conducted spot-checks on several municipalities and looked if the driving journals matched the information they had shared with the agency. I knew that there were potentially a lot of errors in our reports, so we started to investigate different alternatives to avoid any discretion in our reporting.” (Björn, Middle Town)

Middle Town finally landed in the decision to implement the VMS technology. Björn explained that they immediately saw clear benefits with the VMS. Now, a lot have changed.

> “We use one system as a driving journal and the other to extract information about the vehicle from Transportstyrelsen. […] We mainly use the journal to keep track of when the vehicles need service and track where they are when someone needs it.” (Björn, Middle Town)

4.2.2. Increase Revenue through correct invoicing

The degree that the systems were used seemed to vary between municipalities. Charles from Little Town, who manage the vehicle fleet by himself explained that in his case, the fleet had not really outgrown him yet. Instead, Little Town adopted the system because they needed a system for bookings and to debit customers.

> "Our main purpose wasn't to localize the vehicles' positions, but rather to keep track of service appointments." (Charles, Little Town)

Charles described that the ease of use was the most relevant factor when *Little Town* considered different options.

> "The most important for us is that the systems are easy to use. It should neither be difficult to set up the system nor to operate them. If it was too difficult, people would not use them. The implementation went smoothly, without any complications […] The provided services were close to hand since we had collaborated with them before and that was very comforting." (Charles, Little Town)

Similar to Little Town, Big Town also saw opportunities to increase revenue by debiting the vehicles more correctly.

> "Before (implementing the IoT), they (the units who rent the cars) guessed how much the car would be driven on average and the initial cost was then based on a standard template. It (the price) was wrong more often than not." (Anders, Big Town)

4.2.3. Vehicle Manager's Personal Interest

Ben from Middle Town explained that their vehicle management team was small and autonomous, which made their opinions and ideas important.

> "The perceived complexity of the systems is solely dependent on the individual's perception [...] Our thoughts were highly valued by the top (municipal council)" (Ben, Middle Town)

All the managers expressed a sincere interest in innovative and technical projects. Moreover, the teams devoted much effort in the adoption and further indicated a clear personal interest in the systems. It was therefore important to include relevant individual aspects.

Charles explained his thoughts on why Little Town had come so far in their adoption process, even though they were a considerably small municipality.

> "I think it comes down to personal interests, I am a trained technician and would consider myself to be innovative, I think it is fun which is why I wanted to try it (the VMS) out." (Charles, Little Town)

However, Simon at SKR, explained how the individual factors of influence are beginning to decrease somewhat.

> "A decisive factor has been the enthusiasts, who have worked with digitalization regardless of the support from the top management or the political agenda. This aspect is, however, slowly decreasing." (Simon, SKR)

Simon continues:

> "The driving force is still the enthusiasts. The top management are acquainted with the issues (concerning digitalization and use of IoT) and the different projects but the sufficient knowledge about the systems and their implications are simply not there yet." (Simon, SKR)

4.2.4. Top Political Support

When the respondents addressed the organizational context of municipalities they emphasized the difference between them and private companies. A municipality is an organization of publicly elected officials representing the population, a majority of officials must support any greater decision being made.

The top political support naturally varies between municipalities but Big Town experienced a lot of support in this matter.

> "Investing (in VMS) is a political decision. The fleet managers give their recommendations to the politicians who vote on it, then there is a public tendering. We did not experience any setbacks. It was easy to get the necessary support." (Anders, Big Town)

Despite the case of Big Town, Simon highlights his thoughts on why some municipalities do not engage in any IoT activities.

> "There are a lot of insecurities in what will happen in the future. A lot of municipalities experience that they do not receive enough leadership, support and consideration from the state in how they should administer and govern the digitization process." (Simon, SKR)

He further highlighted organizational aspects concerning the size of the municipality and their ability to engage in innovation projects.

> "We have noticed that the municipalities that are best at digitalization and innovation are those who are big enough to have the financial resources but are small enough to have a fast and direct communication with the political governance (of the municipality)." (Simon, SKR)

The size of the municipality (in terms of employees within governance, administration and the units) naturally correspond with the size of the population in the municipality. Ben at Middle Town experienced that the size of the municipality had been a decisive factor for whether or not the adoption would be necessary or not.

> "Since we have a unit (Transportcentral) working exclusively with vehicle management, we are eager to operate as efficiently as possible. Other smaller municipalities have other arrangements, (of how they manage their fleets) where each unit manage their own fleet and the VMS's might be superfluous. This is not the case in Middle Town." (Ben, Middle Town)

Simon gave some context about how the population varied across different municipalities in Sweden:

> "200 of the 290 municipalities in Sweden has fewer inhabitants than Stockholm municipality has employees. The median population in Swedish municipalities is around 16 000 so the conditions and abilities differ significantly." (Simon, SKR)

There are other aspects that affect the direction of the adoption, meaning how different areas of use are being focused on depending on municipal priorities. To better understand, Simon explained how the municipalities are obliged by law to provide a certain amount of services for the population within the municipality, regardless of political focus or priorities. However, the direction to which some functions are being developed is highly influenced by other aspects such as political agenda, interests or needs. Little Town puts a lot of focus on environmental aspects and use the VMS to better understand and make well-informed decisions about environmentally related issues.

> "I manage the environmental aspects rigidly, trying to purchase more environmentally friendly vehicles and decide on whether a unit should have studded tires or friction tires, if they need AWD etc. It all comes down to priorities." (Charles, Little Town)

4.2.5. External Pressure

Both professional agencies pointed out that municipal innovation and digitalization are mostly encouraged from the government. However, a lot of municipalities did not experience this support sufficiently and are concerned with how they should adopt.

> "A lot of issues should be handled centrally in order to present efficient solutions that works for every municipality, but the government has been cautious so far" (Simon, SKR)

Since the municipalities are not engaging in competition as other companies might do, Karin from Kommunal explained how the need to gain competitive advantage is not as present as it might be in the private sector. However, industry pressure occurs in other ways. She explained how external actors put pressure and informs municipalities about the alternatives and their advantages.

> "The development has primarily been driven by the suppliers and companies that develop the systems" (Karin, Kommunal)

4.3. Perceived Risks

Karin explained that there is some resistance towards digitalization within the public sector. The general attitude towards digitalization varies substantially but everything boils down to how individuals perceive the technology and what its implications are.

> "A lot of people are excited while others are more skeptical and afraid that they might lose their job. The amount of resistance is mainly depending on the personal attitudes and how the adoption is administered by the organization and the management." (Karin, Kommunal)

The level of understanding and knowledge seems to be critical as many report significant improvements after the implementations. Simon shared his experiences on the implications for the employees.

> “In a lot of cases the adoption has resulted in a better working environment, where the employees find their tasks more fulfilling and fun.” (Simon, SKR)

Simon also brought up the financial aspects, reminding us that municipalities are mainly financed through taxation and their job is to provide satisfactory services efficiently with their limited resources.

> “The municipalities have experienced financial prosperity over the last years but in the coming years this will decline due to demographic challenges. There is an increasing amount of people who benefit from the well-fare services while the employment rate is not increasing correspondingly. Consequently, there are increasing costs for the municipalities but the taxation (amount of tax being paid in any given municipality) is static.” (Simon, SKR)

4.3.1. Big Town

In terms of maintenance, Big Town experience some difficulties. As the vehicles were distributed over the municipality, they could not communicate through the VMS, but their customers had to engage as well to achieve maximal benefits from the system.

> “Some customers do not report when a car has been serviced, so the meter in the system does not restart from 1 500 (Cars need service every 1 500 km). If the customer uses the municipal workshop, they could report the service, but some customers use external shops.” (Anders, Big Town)

> “We also experience some difficulties with generating the automatic reports to our customers. A lot of customers are not aware of the different functions.” (Adam, Big Town)

4.3.2. Middle Town

The most significant risk Middle Town experienced was the potential clash between the management and the employees at the different units. Ben described how the resistance was evident when they installed the systems on a few cars on trial before making the investment.

> “The employees did not like it at all. They felt monitored and described the system as a tool for surveillance.” (Ben, Middle Town)

However, this changed after the implementation.

> “Shortly after the implementation, the employees understood how we used the technique and the purpose with the VMS. They realized that we were not interested in tracking 270 vehicles every move.” (Ben, Middle Town)

4.3.3. Little Town

However, Little Town’s rather small fleet made the implementation phase easy and quick since they only use one system, a lot of administration is still done manually.

> “Even though we can track the vehicles we still need to log the fuel consumption manually and cross-check with statistics from the fuel supplier. The same goes for maintenance.” (Charles, Little Town)

With the investments that has been done, however, Daniel explains that he is satisfied with the performance.

> “I am the only one monitoring these systems and it works perfectly for me. If anything, we are trying to decrease the fleet further, but I believe the systems will be just as favorable.” (Charles, Little Town)

5. Analysis

The empirical material has presented a lot of insights from the different municipalities': prerequisites, decision-making and adoption intention. By looking through the lens of the theoretical framework, introduced in section 2.2 we can see the causality between factors and the IoT adoption intention. Firstly, we will analyze the scenarios in the different municipalities by comparing them to the three contexts proposed in the TOE framework. Subsequently, we will use the VAM framework to form a link between the observed factors and the intention to adopt IoT. By understanding what factors were critical for their decision to implement IoT, the study's research question can be answered.

5.1. Technological Aspects

5.1.1. Ease of Use

It is evident from the empirical material that all fleet managers had a highly positive attitude towards IoT, even after the implementation of the system. Initially, they recognized both a need for change and the benefits that IoT can have on a vehicle fleet.

However, their positive outlook on this technology was dependent on the ease of use. If the technology was too difficult to learn, understand and use – it would not be worth adopting the technology. It was clear that although they faced many inefficiencies and concerns without the technology, they still preferred status quo over a situation where the inefficiencies depended on the difficulty using a new technology. Their line of thought is supported by the *complexity* and *compatibility* factor suggested by the TOE framework. If the IoT is too complex for the team to work with or if it is not compatible with their needs, then the fleet will not invest in IoT.

Since the supply side of IoT technology has grown a lot in recent year, there is a great variety of VMS that customers can choose form. Therefore, the factor of user friendliness is mostly affecting which supplier is chosen and which is not given the interest of adopting IoT. This would mean that customers can overcome a *user-unfriendly* technology by switching supplier, thus overcoming this inhibitor of adoption intention. Consequently, the lack of the factor can be an inhibitor but is not single-handedly triggering the adoption intention.

5.1.2. Size of the Fleet – an Important Factor in Identifying a Need for Change

Nonetheless, it is important to mention that not all municipalities perceived the degree of user-friendliness as equal. From the empirics, it is suggested that the bigger the fleet is, the more difficult it becomes to transition into this kind of technological innovation. Comparing Big Town to Little Town, adopting the IoT system required more managerial time in terms of manually connecting each vehicle and attend to an increasing amount of system failures. Interestingly, Big Town was still positive to the technology which, following the TOE theory, suggests that they saw a greater *relative advantage* by adopting the IoT technology than Little Town did. The net effect of adopting the technology still made Big Town better off from their previous situation.

5.1.3. Sub Conclusion (1)

It is important that the IoT technology is perceived as easy to use and technological compatible. The greater the size of the fleet, the more work was demanded by the technology but since the relative advantage of using the technology superseded other alternatives it did not affect perceived ease of use in a substantial way.

5.2. Organizational aspects

The empirical material also shed light on the organizational structure within municipalities and its effect on the management of the fleet. The TOE framework suggests that *top management support* is an important driver for the adoption intention. In the case of municipalities, it became evident that the management of the fleet were highly dependent of the politicians higher up in the hierarchy to fund and approve of decisions about the fleet. We can see two layers of this support aiding the municipalities' IoT developments. Firstly, all fleet managers agreed that their respective political representatives have been highly supportive of their IoT suggestions. Since they have the final say, they can be seen as enablers of IoT adoption. Secondly, the ideas have to come from somewhere and that is where the individual fleet managers come into play. Since the management teams are quite small in all the municipalities, the fleet manager has the strongest influence over the direction of the fleet development. They have a strong impact on whether or not the suggestions of adopting IoT will ever reach the top politicians. What is common for several of the interviewed fleet managers is that they have a personal interest in the IoT technology. This personal interest and passion for innovative technology seem to be an important driver for IoT adoption and was further supported by the professional agencies. Together with the flat structure in the smaller municipalities, the journey from suggesting an idea to the approval of the idea becomes shorter.

5.2.1. Sub Conclusion (2)

Top management support is highly important for IoT adoption and it needs to appear both in the top political level as well as within the fleet management teams. While the top politicians are enabling IoT adoption by approving and funding, the initial idea usually comes from the fleet team. In all the observed cases, fleet managers have had a personal interest and passion for IoT which seem to be the main driver for IoT adoption.

5.3. Environmental Aspects

Another interesting aspect derived from the empirics where how municipalities regarded competition. Since the municipality's vehicle fleets are mainly used for the municipality's own units, the various fleets are not competing for the same customers. According to the TOE framework, high rivalry and competitive advantages increase the likelihood for adoption. This lack of rivalry between fleets might be an important reason why the public sector is not as developed as the private sector in the regard of IoT adoption. However, since municipalities are controlled by politicians who are democratically elected, it may be in their best interest to provide as good services as possible in order to be re-elected in the future. That may put an internal pressure on the units to improve their services. However, although there is a governmental pressure to digitize municipalities, it was not regarded by the fleet managers as having a motivating effect on them. Instead, the decision came from within the fleet, taking only internal considerations into account. Moreover, the governmental support was suggested to be lacking in general when it comes to digitalization. This suggest that the governmental encouragements have had little effect on the IoT decision making in the fleets.

5.3.1. Sub Conclusion (3)

The environmental context seems to overall have little effect on the IoT intention behavior within the municipalities' fleets. This might be due to the fleets only serving their respective municipalities which decrease rivalry and industry pressure to outcompete each other. Although the government has pressured municipalities to digitalize, this have had little effect on the initial idea to adopt IoT in the fleets.

5.4. Identifying a Need – Important for Perceiving Value

The VAM framework helps us to connect the dots between the identified factors and *how* they in turn lead to an adoption intention. It is important to understand that the factors for driving adoption intention proposed by the TOE framework are not static, nor are they criteria that can be checked up. The reality is much more complex than that. To exemplify, Big Town's relationship with the technology was not always straightforward. They saw many benefits, but also several inefficiencies and issues. These issues were of such great importance that the TOE framework would suggest decreases the adoption intention. In the end, it appeared that they perceived the technology to be overall valuable. The VAM framework suggest that this is what in the end truly affects the intention to adopt.

When analyzing both Big Town and Middle Town further, it seemed that the reason why the technology was perceived as valuable was because it fulfilled a defined need within the fleet. Their fleet had grown too large for the teams to handle without jeopardizing the safety of their customers. Adopting the technology was not driven by the wish to improve, compete or grow - it was a way to sustain the survival of the fleet. Therefore, the value the technology created - ensuring the continuation of the unit - was immense. Regarding Little Town, the defined need was not a question of survival but rather a question on efficient management and personal interest. Charles engagement was decisive in their decision to adopt IoT and compared to Big Town and Middle Town, the need for change was not as clear which can explain why Little Town had not implemented the IoT systems as extensively as the other municipalities.

5.4.1. Sub Conclusion (4)

Identifying the need for change that the IoT technology can potentially fulfill has the biggest impact on the perceived value. For larger municipalities, the lack of control that comes from having large fleets is the main factor forcing managers to consider change.

5.5. Conclusion

This study has explored what factors are important in order for municipalities to adopt IoT technology in their vehicle fleets. The theoretical framework has been developed using theory and empirical material to conclude that there are primarily four drivers for IoT adoption (see Figure 3).

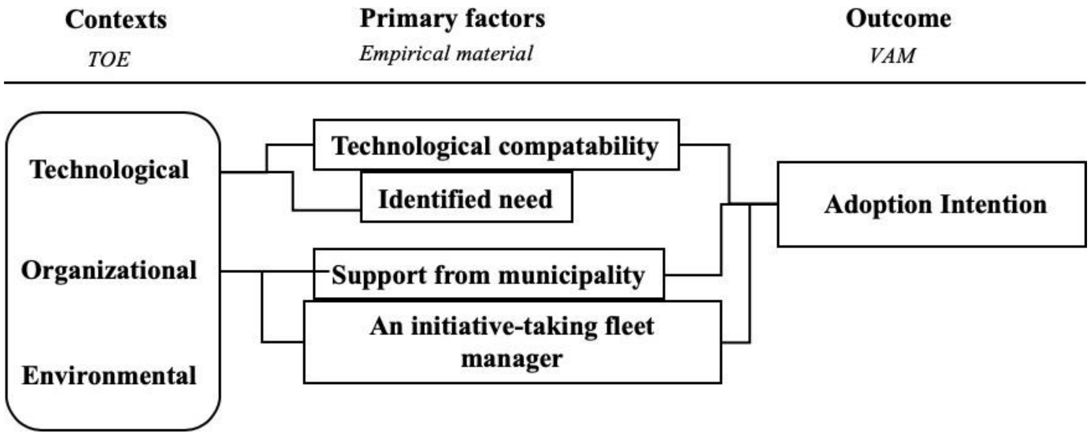

Figure 3. An illustration of the four main factors for IoT adoption in municipal vehicle fleets

The IoT systems need to be **technologically compatible** and require little personal investment in terms of learning and maintaining. Since the supply side of IoT technology has grown a lot in recent year, there is a great variety of VMS that customers can choose form. Therefore, this factor is mostly affecting which supplier is picked and which is not.

At the same time, even if the supplied IoT systems are easy to use, it will still not be adopted if there is not a clearly identified **need for change**. Examples of such needs are if the fleet has grown too large to be handled manually without jeopardizing safety or new environmental regulations that IoT systems can aid with.

The fleet managers personal interest and willingness to adopt IoT has one of the biggest impacts on the IoT process. Since most management teams have a flat structure, decision making is quick and efficient. Although the government has launched initiatives to encourage the digitalization of municipalities, suggestions are still expected to come from a bottom-up approach. Therefore, an **active and initiative-taking fleet manager** who pushes for IoT adoption is a crucial trigger.

A **supportive municipality** is another important factor for IoT adoption since they are the ultimate enabler. Since all the major decisions within the fleet needs to be approved by the municipality's politicians it is important that they are supportive of IoT initiatives.

6. Discussion

6.1. Implications of the Study

Our approach and empirical findings provide a framework to a new context where the conditions are different. The four primary factors identified can aid decision makers in their quest to increase the adoption rate of technology within Swedish municipal fleets. Since a main driver is the fleet manager's personal interests, educating fleet managers or recruiting IoT enthusiasts in the fleet can be an efficient way to increase IoT adoption. Since top political support is an enabler, ensuring that the politicians are provided with relevant inforamtion and convinced is important in order to ensure that nothing is inhibiting the adoption process.

Our findings are also useful in identifying which municipality that can benefit the most from IoT adoption. An important factor was to have an identified need for change. Municipalities with larger fleets experienced more positive effects from adopting IoT which can be convincing argument when addressing if the fleet should adopt IoT or not.

Moreover, our study has theoretical implications as well. Although our study has a theoretical stance in Tornatzky and Fleischer's TOE framework, we found that the environmental context was not as applicable for municipalities since they did not engage in competition, thus having little external pressure on them. Instead, the greatest pressure came from within the organization. This entails a modification of the framework that can be taken into consideration for the context of municipalities.

Further our study contributes in explaining why some municipalities are further behind in their IoT development. Through identifying the relevant factors and motives behind some more ambitious municipalities adoption, we were able to further understand the other end of our research question. The municipalities shared their thoughts on why some municipalities are behind, and the professional agencies presented their views of why some municipalities engage while other do not. This resulted in understanding on why some municipalities have adopted whilst others have not.

6.2. Limitations of the Study

Our ambition was to identify the relevant factors that are necessary for municipalities in order to adopt IoT into their fleet management. The decision to only focus on municipal fleets limits our study to some extent as innovation within fleet management only constitute one part of municipal digitalization and the ability to adopt IoT into other functions may differ. The range of the thesis, including only three municipalities, further limits the study as there are 290 in total. This implied a need to investigate the subjects thoroughly in order to present credible findings. The relatively small sample could be thought of as an issue, however, the number of municipalities that have adopted IoT in their fleet is significantly less and are mainly concerning municipalities located around the greater cities in Sweden. Moreover, the level of technological development within the municipal fleet does not necessarily reflect the overall development within the municipalities. Even though our focus was on the municipal fleet, this limits our study to some extent. Further, the international relevance is limited as the structure of public governance varies substantially between countries.

The method (see section 3.1), assumes subjectivism and holds an interpretivist stance which entail a certain level of interpretation of the data. Moreover, the respondents' contributions may be positively biased towards their own municipality which could be a risk. We addressed this by including the professional agencies as non-biased parties in the study. This somewhat reduced this risk. However, by interviewing additional municipalities we could have reduced the risks further.

6.3. The Transferability of the Study

With a qualitative study, the transferability may be limited as the findings may be oriented towards the respective municipal context. The findings might not hold in other municipalities, organizations, or even in the studied municipalities at another point in time. It was therefore important to present data with strong internal validity as well as detailed information about the different cultures and experiences in each municipality, allowing others to evaluate the possible transferability and adaptability of the findings to their context.

To solely focus on municipality fleets allowed us to compare the findings to a greater extent, and by analyzing municipalities that are different in terms of population, location, fleet size, level of adoption and areas of IoT-use within the scope of the fleet, the transferability should be considered effective in that regard. However, the results are based on interviews which might limit the ability to replicate the study. The study's transferability depends on the assumption that our samples are representative for all municipalities and by incorporating the professional agencies, we were able to further generalize our findings effectively.

The transferability is somewhat affected negatively by not including other municipal functions and other actors where the process may have differed. To promote transferability, not only for municipal digitalization but for actors in the private sector as well, we developed the framework to be as general as possible in explaining the adoption for all types of technological innovation. The aspects presented in the theoretical framework are adaptable depending on the organizational context and our findings are, in many regards, transferable to other contexts within the scope of the framework. Therefore, the study should to some extent be applicable on other units within municipalities as well as within private enterprises.

The framework developed for this study is general for adopting all types of technological innovation. Therefore, it would be applicable on other units within municipalities and within private enterprises as well.

6.4. Suggested Future Research

In this study we have only focused on the unit managing the fleet of municipalities but there are many other units within municipalities that can benefit from IoT implementation.

The study is based on interviews of a relatively small sample of municipalities. The conclusions assume that these samples are representative for all Swedish municipalities. It would be interesting to conduct a quantitative study that investigates the actual level of IoT-implementation over several municipal units allowing for future research to specifically explore why some municipalities are left behind.

This study has also excluded the political environment within the individual municipalities as potential variables for affecting IoT adoption (see section 1.4). Since we concluded that the top politicians' support is an important enabler of the fleet's decision making, it would be interesting to study how the political climate can inhibit such initiatives. In the future, it would be interesting to explore different political parties' stance on digitalization and how this in turn affects the adoption of IoT innovations, both nationally and locally.

7. References

7.1. Published Articles

AlHolgail, Agereej. (2018). Improving IoT Technology Adoption through Improving Consumer Trust. Technologies. Vol., 6. P., 64.

Agarwal, R., & Prasad, J. (1998). *A conceptual and operational definition of personal innovativeness in the domain of information technology*. Information Systems Research.

Vol., 9. P., 204–215.

Annegård, Malin. (2017). *Sakernas internet: Möjligheter för välfärd och samhällsbyggnad*. Sveriges Kommuner och Landsting.

Balte, Anup, Satish. Kashid, Asmita. Patil, B., P. (2015). *Security Issues in Internet of Things (IoT): A Survey*. International Journal of Advanced Research in Computer Science and Software Engineering, Vol., 4. P., 533 - 546

Borgia, Eleonora. (2014). *The Internet of Things vision: Key features, applications and open issues*. Computer Communications. Vol., 54. P., 1 - 31.

Brous, Paul. Janssen, Marijn, Schraven, Daan. Spiegeler, Jasper. Duzgun, Baris, Can. (2017). *Factors Influencing Adoption of IoT for Data-driven Decision Making in Asset Management Organizations*. In Proceedings of the 2nd International Conference on Internet of Things, Big Data and Security. SCITEPRESS - Science and Technology Publications (IoTBDS 2017).

Davis, D., Fred. (1989). *Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology*. MIS Quarterly. Vol., 13. P., 319 - 339.

Despa, D. (2018). *The Implementation Internet of Things (IoT) Technology in Real Time Monitoring of Electrical Quantities*. IOP Conference Series: Materials Science and Engineering. Vol., 335. P., 012063.

Hoti, Erind. (2015). *The technological, organizational and environmental framework of IS innovation adaption in small and medium enterprises. Evidence from research over the last 10 years*. International Journal of Business and Management. Vol., 3. P., 1 - 14.

Kao, Yu-Sheng. Nawata, Kazumitsu. Huang, Chi-Yo. (2019). *An Exploration and Confirmation of the Factors Influencing Adoption of IoT-Based Wearable Fitness Trackers*. International Journal of Environmental Research and Public Health. Vol, 16(18).

Kim, Hee-Wong. Chan, Hock, Chuan. Gupta, Sumseet. (2007). *Value-based adoption of mobile internet: An empirical investigation*. Decision Support Systems. Vol., 43. P., 11 - 126.

Kwon, Hong-Kyu. Seo, Kwang-Kuyu. (2013). *Application of Value-based Adoption Model to Analyze SaaS Adoption Behavior in Korean B2B Cloud Market*. International Journal of Smart Home. Vol., 7. P., 155 - 164.

Lasi, Heiner, Fettke, Peter. Kemper Hans, Georg. Feld, Thomas. Hoffman, Michael. (2014) *Industry 4.0.* Business & Information Systems Engineering. Vol., 6. P., 239-242.

Myers, D. Michael. (1997). *Qualitative Research in Information Systems.* MIS Quarterly. Vol., 21. P., 241 - 242.

Venkatesh, V., Bala, H. (2008). *Technology acceptance model 3 and a research agenda on interventions.* Decision Sciences. Vol., 39. P., 273 – 315.

Weinberg, Bruce. Milne, George. Andonova, Yana. Hajjat, Fatima. (2015). *Internet of Things: Convenience vs. Privacy and secrecy.* Business Horizons. Vol., 58. P., 615 – 624.

Yang, Yuchen. Wu, Longfei. Yin, Guisheng. Li, Lijie. Zhao, Hongbin. (2017). *A survey on Security and Privacy Issues in Internet-of-Things*. IEEE Internet of Things Journal. Vol., 4. P., 1250-1258

7.2. Literature and Collection of Works

Boot, R, Walter. Charness, Neill. (2016). *Technology, Gaming and Social networking*. In Schaie, K. Warner and Willis, L. Sherry (Eds.). Handbook of the Psychology of Aging, 8th edition. Academic Press. P., 389 - 407.

Bell, Emma. Bryman, Alan. Harley Bill. (2019). *Business Research Methods,* 5th edition. New York: Oxford University Press.

Desci, Edward, L. Ryan, Richard, M. (1985). *Intrinsic Motivation and Self-Determination in Human Behavior*. Rochester University. Springer. Boston, MA.

DePietro, Rocco, Wiarda, Edith & Fleischer, Mitchell (1990). *The context for change: Organization, technology and environment*. In Tornatzky, Louis. G. and Fleischer, Mitchell. (Eds.). The processes of technological innovation, Lexington Books: Lexington, MA., P. 151-175.

Frey, J. H. (2004). Telephone Surveys'. In Bell, Emma. Bryman, Alan. Harley, Bill. (eds.) *Business Research Methods*, 5th edition. New York: Oxford University Press. P., 213

Rogers, Everett, M. (2003). Diffusion of innovations, Fifth Edition ed., New York: Simon and Schuster

7.3. Digital Resources

Aharon, Dan. Bisson, Peter. Bughin, Jacques. Chui, Michael. Dobbs, Richard. Manyika, James. (2015). *Unlocking the potential of the Internet of Things.* McKinsey & Company. [Accessed: 2020-03-02].
https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world

Brown, Aaron. Chitty, Bill. Dhaval, Ravi. Peasly, Sean. (2019). *Increase IoT adoption through a secure cloud approach*. Deloitte. [Accessed: 2020-03-09].
https://www2.deloitte.com/content/dam/Deloitte/us/Documents/risk/us-increase-iot-adoption-through-secure-cloud-approach.pdf

Burgess, Matt. (2018). *What is the Internet of Things?* WIRED explains. [Accessed: 2020-02-15]. https://www.wired.co.uk/article/internet-of-things-what-is-explained-iot

Cambridge Dictionary. [Accessed: 2020-03-30]
https://dictionary.cambridge.org/dictionary/english/efficiency
https://dictionary.cambridge.org/dictionary/english/adoption?fbclid=IwAR1h0aXBguM5avCEdB46eeVADYz5gEAgO5TIS6P6-boZG-BqnTEngG93mEM

Crook, Stacy. (2018). *Overcoming the Challenges of Enterprise IoT Adoption*. IDC Technology Spotlight. [Accessed: 2019-02-25]. https://www.commscope.com/globalassets/digizuite/62515-wp-challenges-of-enterprise-iot.pdf

Lueth, Knud, Lasse. (2019). *Why it is called Internet of Things: Definition, history, disambiguation*. IOT analytics. [Accessed: 2020-02-15]. https://iot-analytics.com/internet-of-things-definition/

Pettigrew, Chris. *How IoT will Alter Project Management Landscape*. Hitachi Solutions. [Accessed: 2020-03-04] https://us.hitachi-solutions.com/blog/ushering-new-era-iot-will-alter-project-management-landscape/

Pfeifle, Sebastian. Ley Christopher. Tauschek, Florian. Enderle Philipp. (2018). *Fleet leasing & management in North America: Key enabler for the future of mobility*. Deloitte. [Accessed: 2020-03-02]. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consumer-business/us-cp-fleet-leasing-and-management-in-north-america.pdf

Prospero, Mike. (2019). *What IS a Smart Refrigerator, and Is It Woth It?.* Tom's Guide. [Accessed: 2020-04-10]. https://www.tomsguide.com/us/what-is-a-smart-refrigerator,review-6307.html

Kullander, Björn. (2019). *Kommuner och Regioner*. Sveriges Kommuner och Regioner. [Accessed: 2020-03-02] https://skr.se/tjanster/kommunerochregioner.431.html

LaMorte, W. Wayne. (2019). *Diffusion of Innovation theory*. Boston University School of Public Health. [Accessed: 2020-03-09] http://sphweb.bumc.bu.edu/otlt/MPH-Modules/SB/BehavioralChangeTheories/BehavioralChangeTheories4.html

IoT-Market. (2020). *IoT Fleet Management Market Size, Share, Forecast Report – 2021*. Marketsandmarkets.com. [Accessed: 2020-03-10] https://www.marketsandmarkets.com/Market-Reports/iot-fleet-management-market-246122062.html

Scherf, Jonas. (2019). *What is RFID? - Definition & Function in detail*. ETMM. [Accessed: 2020-03-02] https://www.etmm-online.com/what-is-rfid-definition-function-in-detail-a-824632/

Telenor, Connexion. (2020). *Connecting things. It's all about people.* [Accessed: 2020-03-03] https://www.telenorconnexion.com

8. Appendix

8.1. List of Interviewees

Date	Time	Format	Transcribed	Municipality/org	Coded Name
2020-02-24	10:30 - 11:32	Phone	Yes	Big Town	Adam
2020-03-03	9:30 -10:00	Phone	Yes	Big Town	Axel
2020-03-03	13:00-13:40	Phone	Yes	Big Town	Anders
2020-04-04	12:00-12:30	Phone	Yes	Middle Town	Björn
2020-04-22	13:30-14:15	Phone	Yes	Middle Town	Ben
2020-03-17	13:00 - 14:15	Phone	Yes	Little Town	Charles
2020-03-31	10:00 - 10:40	Phone	Yes	Kommunal	Karin
2020-04-01	13:00 – 14:00	Phone	Yes	SKR	Simon

8.2. Roles of interviewees

Municipality/Org	Coded name	Title/Role
Big Town	Adam	Vagnparkschef
Big Town	Axel	Employee Teknik- och fordonsenheten
Big Town	Anders	Employee Teknik- och fordonsenheten
Middle town	Ben	Transportledare
Middle Town	Björn	Transportledare
Little Town	Charles	Trafik- och gatutekniker
SKR	Simon	Programansvarig för tillväxt och samhällsbyggnad
Kommunal	Karin	Utredare - Utredningsenheten