Master's thesis

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# Exploring the factors that influence end-users intention to use digital communication technology in a smart city context

Master's thesis in International Business and Marketing

Supervisor: Mark Pasquine

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*Martin Skulstad* *Aalesund, 08th of July 2020*

## Abstract

In recent years, the concept of smart cities has come to the fore. And it is rapidly gaining momentum and worldwide attention as a promising response to the challenge of urban sustainability. Based on extensive reading from previous literature many local communities and cities are seeing an increased potential in collaborative and participatory community-driven initiatives in order to create future Smart Cities. Researchers has seen that one of the most important factors for succeeding with a Smart City project is by putting the citizens at the centre. By mapping and listen to the citizen's views on how smarter, safer and more sustainable communities can be developed. Identifying measures and solutions that can improve with the help of new technology and streamline the provision of services, and which contributes to better and greener living and work environments.

This study integrates the substantial literature on technology acceptance modelling into the Smart City discourse to begin to address this need. Hereby looking into citizens intention to adopt and use digital communication technology through their smartphones in order to improve communication and citizen participation in the context of Smart City. A quantitative research strategy was applied in this study, investigating a data sample from 121 respondents.

A proposed conceptual framework containing ten propositions is presented and tested on this sample. However, this study found no support for this framework as nine out of ten factors had no significant impact on intention to use. Evidence obtained from the study revealed significant support for the well-established TAM variables and a new parsimonious model was established and tested. The proposed model is developed and tested with specific reference to a small city in Norway. The paper will help in understanding the key issues surrounding end-user's adoption of mobile applications that may support the successful development of future Smart Cities.

# Table of Contents

# Figures



# Tables

# Chapter 1 Introduction

Urban development has over the last couple of decades been affected by major changes. A rapid urbanisation and increasing population have put a lot of strains on city infrastructures and service deliveries. These challenges are often connected with ICT (information and communications technology), land use, transportation, lifestyle and consumption, which combined creates 50 – 60 % of the total greenhouse gas emissions (Wyckmans et al., 2017). The United Nations estimates that by 2050 68 % of the world's population will live in cities. The continuing urbanization and overall growth of the world's population is projected to add 2.5 billion people to the urban population by 2050 (2019). Furthermore, the pace of development seems to change due to the global effects of digitalization and new technology. At the same time, the need for sustainable development is on the agenda both nationally and globally. To address the problem at a supranational level, most state leaders, the United Nations and other large organizations have engaged to create an official policy of contributing to environmental improvement.

In the smart city era, governments intend to provide easily accessible, accurate, real-time, high-quality services and information to their citizens using smart devices, particularly their smartphones. And in this thesis the focus on digital communication technology will be of interest by looking into citizens acceptance and usage of this technology. A theoretical foundation has been laid with the insights of Davis (1989) technology acceptance model (TAM), with the goal of broadening the understanding of the different factors that affect citizens or end-users intention to use/adopt new technology. This study seeks to examine citizens intention to use a mobile application from their smart phones in order for local municipalities to reach out more broadly and easier communicate with their citizens in a smart city context.

For cities, and even small municipalities, to select and develop appropriate citizen focused technology, they must understand their citizens and develop appropriate technologies which will be well received. Hence, technology acceptance by citizens is consequently an important consideration for governments and essential for the successful development of future smart cities. Technology acceptance models can therefore strengthen ties between residents,

companies and governments and improve the quality and effectiveness of service operations (Sepasgozar et al., 2019).

Nonetheless, to be successful with these smart government initiatives, citizens need to recognize and accept this type of technology. Successful implementation of smart government services depends on how the citizens perceive these types of services, since the technology available may not be welcomed by end-users (Almuraqab and Jasimuddin, 2017).

## 1.1 Purpose of the study

The concept of smart cities has come to the fore. And it is rapidly gaining momentum and worldwide attention as a promising response to the challenge of urban sustainability. Based on extensive reading from previous literature many local communities and cities are seeing an increased potential in collaborative and participatory community-driven initiatives in order to create future Smart Cities. Researchers has seen that one of the most important factors for succeeding with a Smart City project is by putting the citizens at the centre. By mapping and listening to the citizen's views on how smarter, safer and more sustainable communities can be developed. Identifying measures and solutions that can improve with the help of new technology and streamline the provision of services, which contributes to better and greener living and work environments.

In this study I will look into citizens perceptions and intention of using digital communication technology, in particular through smart phones, in order to connect with their local community to improve communication and citizen participation. Hereby checking their trust in both technology and government technology, risks, acceptance of technology, social influence and other factors. This will be done through a proposed conceptual framework that was developed based on reviewed existing work, and work as an extension of Davis's technology acceptance model (TAM) . With the purpose of addressing and highlight the key factors that influence user acceptance of digital communication technology, and thereby guide the successful implementation of smart government. The conceptual model is developed by Nasser A. Saif Almuraqab and Sajjad M. Jasimuddin (2017) and proposed as a framework to be used in the United Arab Emirates (UAE). As of June 2020, the proposed framework has never been tested on a sample of a population, and only work as a theoretical guidance which

identifies determinants of smart government adoption to avoid failure in the implementation of smart government.

Furthermore, a clear and understandable definition of a Smart City is not easy to provide. There is no single template for framing a Smart City, nor a one-size-fits-all definition of it (O'Grady and O'Hare, 2012). However, I would like to build this thesis with the perception that Smart Cities consists of many technological innovations that must be accepted by the citizens in order to be implemented and put into use. On the basis of this, a research question has been developed:

*"Which factors influence citizen intention to use digital communication technology?"*

## 1.2 Theoretical Contribution

In this study I will test the proposed model in a European context, a developed country and on a smaller scale.

By testing the model one can validate its results to see citizens intentions to use digital communication technology. If support for the proposed model is found it will help strengthen the model's validity. Furthermore, it will also contribute to strengthen the model to be more universal by testing it in another country and continent, additionally on smaller cities and populations.

## 1.3 Relevance of topic

Urbanization, demographic change, resource scarcity, climate change, globalization, and digitalization have increased the focus on smart cities and communities in recent years. The idea is that technology and data sharing can make communities more viable, improve living conditions for citizens, and help create a more sustainable and resource efficient future.
The European Union established a rapport that were ordered to provide background information and advice regarding smart cities, called "Mapping Smart Cities in the EU". Based on thorough case analyses studies, they found several key factors for good practice in implementing a Smart City. An important element for success was citizen involvement. "A Smart City is more than the sum of its projects. Rather, it needs a fertile environment guided

by a clear vision, the participation of relevant actors (people), and the efficient and effective organisation of its processes" (Manville et al., 2014). They highlight participation of people as a key for success where you create smart, well-equipped citizens through active participation. "A Smart City consists of not only components but also people. Securing the participation of citizens and relevant stakeholders in the Smart City is therefore another success factor" (Manville et al., 2014). As we can see from figure 1 there is a difference if the participation follows a top-down or bottom-up approach. With a bottom-up approach one allows more opportunities for people to participate directly and be more involved. Whereas a top-down approach promotes a high degree of coordination.

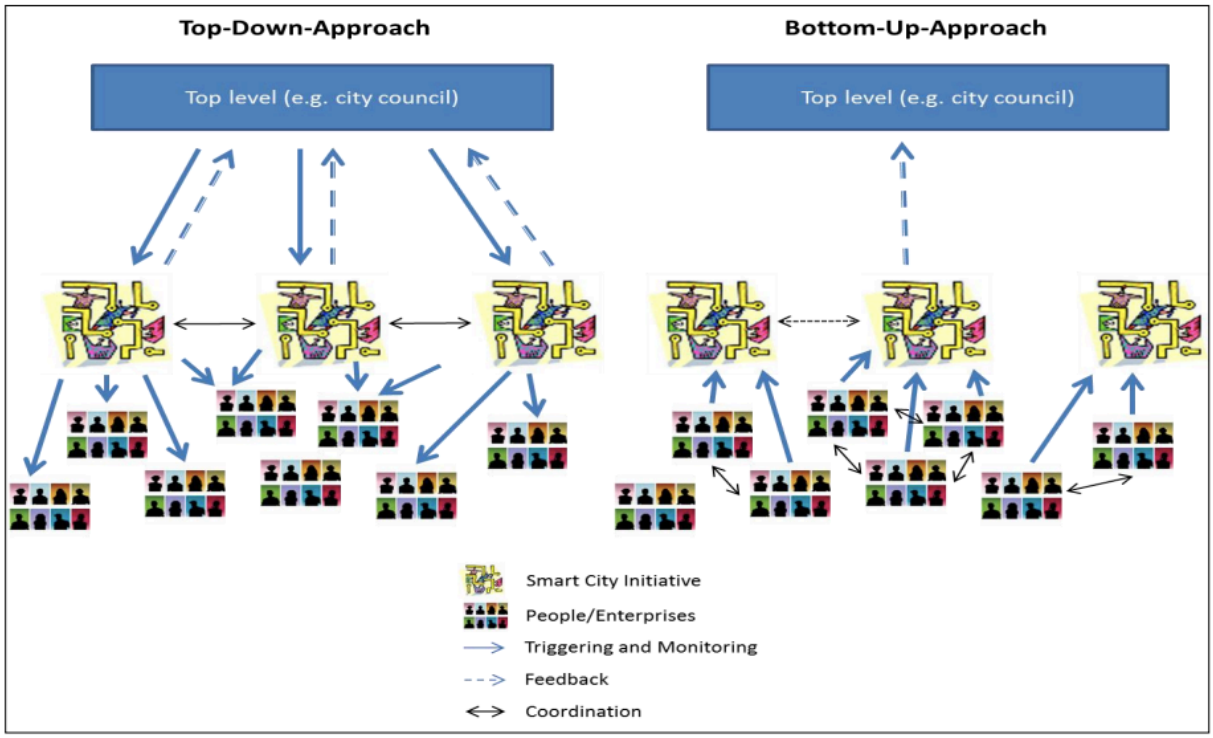



*Figure 1: Top-down and bottom-up approaches*

*Figure 1: Top-down and bottom-up approaches to encouraging the participation of citizens and stakeholders in Smart Cities (Mapping Smart Cities in the EU, 2014)*

Much of the smart city's purpose lies precisely in its inevitability – smart technology should be at the heart of an efficient city, and citizens should not notice is to a greater extent than they can flow through the city without having to think too much about logistics. It is difficult to argue about reversing the trend where data equipment placed around the city is getting smaller, e.g. Smartphones, Internet of things and sensors, but making it clear where data is being collected, why, and what this data is used for is still an important task. Decisions are

made about what and whom should be prioritized in urban development, and how to work in order to create the best possible city. The questions raised are complex and have several possible answers and will therefore lose the fact that “most people” have no interest in engaging in them. This thesis will try to look into the factors that potentially could affect citizens intention to use a service which could potentially lead to more citizen involvement.

## 1.4 Outline of the thesis

An outline of the thesis is presented to give the reader a better overview of this study.
This study consists of 7 chapters.

Chapter 2: This chapter presents the theoretical background of the thesis and gives an understanding of the context and includes a clarification of the different concepts and elements in Smart City.

Chapter 3: It presents the conceptual framework of the thesis and its theoretical fundament. With the goal of identifying the factors that affect the successful adoption of digital communication technology relating to the implementation of future smart city development.

Chapter 4: It presents the methodology approach used in this thesis, it also presents the strategy, design, data collection and framework for analysis, as well as validity and reliability of the study.

Chapter 5: This chapter presents the findings of this studies research.

Chapter 6: This part includes an interpretation of the statistical findings from the survey and statistical analysis will be presented along with the studies limitations and directions for future research.

Chapter 7: Presents a brief conclusion of the study.

# Chapter 2 Theoretical background

This part of the thesis includes review of existing literature on the smart city concepts which forms the context of this study. This provides definitions and explanations of the various concepts that is important for the purpose of this thesis.

## 2.1 Smart City

The concept Smart City is for many a vague nation and often subject to personal interpretation. While there is no single accepted definition, the common contemporary understanding of a Smart City assumes a coherent urban development strategy developed and managed by city governments seeking to plan and align in the long term the management of the various city's infrastructural assets and municipal services with the sole objective of improving the quality of life for the citizens (Dustdar et al., 2017).
Others define it as "A "Smart City" is intended as an urban environment which, supported by pervasive ICT systems, is able to offer advanced and innovative services to citizens in order to improve the overall quality of their life (Piro et al., 2013). The European Commission states that "A smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business" (2019).

As previously mentioned, the concept of Smart City has not been easy, and to some extent, impossible to define. There have been several working definitions that's been put forward and adopted in both academical and practical use. According to Chourabi et al. (2012) "the concept of a Smart City itself is still emerging, and the work of defining and conceptualizing it is in progress". This statement was made in January 2012, over eight years ago, and one can safely say that the concept of Smart City has evolved into a global phenomenon throughout the last couple of years.

Both scholars and professionals focus on how to best apply ICT and Information Systems (IS) methodology in order to enable environmental and social sustainability, public service improvement, business development, the rapid change from rural to urban areas, and creating urban communities with "smart citizens" is just a small portion of associated benefits. Other

researchers show evidence that suggests that the first generation of top-down, techno-economic smart cities is giving way to an emerging model emphasising citizen needs and participation and have termed this emerging model Smart City 2.0 (Baccarne et al., 2014, Glasmeier and Nebiolo, 2016). Gregory Trencher contributes to debates around human-centred smart cities and how smart urbanisation can serve as a tool for addressing social problems, meeting residents needs and improving wellbeing. He also states that "Until recently, a smart city referred to an idealized, technologically-driven, largely automated city that was developed from top-down in conjunction with large data and technology companies. (…) As the smart cities market has continued to evolve, cities are supporting what we call Smart Cities 2.0 strategies that put people first and stresses technology as a tool to use predominantly in service of citizens" (Trencher, 2019).

Smart City has therefore evolved from being presented as a global phenomenon with little attention to local contexts and factors (Söderström et al., 2014) and highly emphasize creating technology that helps improving citizens needs and quality of life.
"What is new about the contemporary smart city narrative is the emphasis on places transformed by the application of technologies rather than, as in the case of Silicon Valley, places where sectors such as microelectronics and computers drive the urban economy. Smart cities are not just where new technologies might be born. They are the receptacles for technology, the target of its applications" (Glasmeier and Christopherson, 2015)

## 2.2 Smart City Size

Giffinger says that a smart city is a well performing city built on the "smart" combination of endowments and activities of self-decisive, independent and aware citizens (2007), and according to Angelidou "Smart cities represent conceptual urban development model based on the utilization of human, collective and technological capital for the enhancement of development and prosperity in urban agglomerations" (2014). By trying to give a better understanding of the word "Smart" previous research shows that it includes various features as inter-connected and technological, but at the same time factors as sustainable, comfortable, attractive and safe (Riva Sanseverino et al., 2014).

We do know that city size can be relevant for the development of patterns of smart city initiatives for a variety of reasons. Larger and major cities attract more human capital, it has

critical masses of ICT users which may favour a more rapid scaling up and breaking-even for digital services and can usually rely on a greater implementation of infrastructural resources for telecommunication infrastructures, water and electricity (Neirotti et al., 2014). On the other hand, it can also be associated with barriers for smart city initiatives, for example small towns might be ideal for settings for pilot projects. The Mumbai-based Tata Consultancy Services provided real-time data and predictive models to optimize public transportation in Belfort, a small city of 50 000 inhabitants in eastern France. By using smart technology and combining existing data about bus payments, speed, location and GPS technology deployed on buses, they managed to get a picture of congestion across the city and passenger flow (Kosowatz, 2017). As a result of gathering and analyse existing data the city officials optimized bus schedules to reduce crowding, determine the savings from new road construction projects and reported dramatic improvements in the transportation networks, as well as cost savings.

Kumar and Dahiya discusses that urbanization is different in terms of city size. In Europe, 67 % of urban inhabitants live in medium-sized cities (i.e. smaller than 500 000 inhabitants), while just 9,6 % are located in cities having more than five million inhabitants. Europe is also characterised by a more polycentric and less concentrated urban structure compared to, for instance, the USA, India or China. Furthermore, we do know that several member states in EU have no single city bigger than 500 000 inhabitants (for example Estonia and Slovenia) and that other states have only one metropolitan city, usually the capital (for example Hungary, Lithuania, Slovakia, Norway (Not EU member) or Latvia). Thus, there is a strong indication that population size of city matters, especially in EU member states, concerning its urban economy and smart city development (Kumar and Dahiya, 2017)
Nevertheless, based on an extensive literature review and research on the field of Smart City, small sized cities have received relatively little attention by researchers in comparison to big cities and countries and deserves exploration.

## 2.3 Smart Government

In this thesis I will look into citizens perceptions and intention to use digital communication technology. This in the form of a mobile application in order to connect with their local municipality, with the potential benefit of achieving a better two-way communication and citizens participation.  However, in order to do so we need more insight in the definitions and

relationship between Smart Government and *technology, citizen-centricity* and *service improvement* in the context of creating future Smart cities.

The focus on smart cities and societies has led to renewed interest in citizen involvement, especially as new technology opens up new forms of communication and interaction with citizens.
The fact that most people are equipped with a smartphone has a lot to say about the possibilities of a closer connection between local governments/communities and citizens. Citizens involvement is a key element in the development of smart cities and communities. What makes a city or community a Smart community is the amount of ICT one uses to optimize the impact and implementation of the necessary processes, activities and services in the smart ecosystem. This optimization is usually achieved by linking different elements and actors to a seamless, interactive and intelligent interaction. Therefore, a smart community will always involve good innovation systems and digital/analogue infrastructures. The concept of a Smart City can be seen as a recognition of the ever-growing and massive amount of information needed to improve the city's competitiveness, as well as ensure a more sustainable future across all different networks of people, businesses, technologies, infrastructure, consumption, energy and urban space. In a smart city, these networks are interconnected and support one another in a good way.

Over the last few years, Smart City as a concept has changed fundamentally in view of the approach that cities and communities have used for their urban change. As already mentioned, in the early years, it was driven by the players which offered the technology, while leaders and local authorities gradually understood that technology is just a tool for achieving political, economic and social goals. Today, scholars and strategists still consider technology to only be a provider, but at the same time, the authorities have acknowledged that the "top down" attitude or having a "master plan" alone is not good enough to succeed in this endeavour. Drivers for success are today identified as a collaborative and participatory community-driven initiative. If a city or community wants to become smarter, they should address the needs and challenges that consumers, citizens, workers/commuters, entrepreneurs and NGOs are facing. Linders et al. (2018) contributes to this discussion by saying that ICT innovations changes the way government works, delivers services, and solves public problems in collaboration with citizens, but also addresses social impact and citizen empowerment. With the advent of social media, mobile networking and big and accessible data pushes governments to create a vision

of ICT-facilitated governance that is more transparent, collaborative and responsive to citizens' needs and aspirations.

### 2.3.1 The role of technology

Cities around the world are currently undergoing important changes. Governments are being challenged to become more innovative while saving costs, operate in a connected environment while engaging stakeholders in solving societal problems (Janssen and Estevez, 2013). Smart Government is often referred to or defined as the government's comprehensive use of technology, following two important trends: the open data movement and the ubiquity of technology that helps to better understand societal problems and strengthen government relationships with citizens, private organizations, NGO's and other governments (Mellouli et al., 2014). However, with more innovative solutions and new technology there is always a risk that digital divides will arise as a result of different technology understandings. Several authors have highlighted that particularly among elderly people, there is a concern that technology and the digital divide could lead to exclusion of certain categories of the general population. On the other hand, others emphasize that the use of ICT, data and effective strategies could help to reduce social exclusion and promote social justice (Picazo-Vela et al., 2012, Burkhardt et al., 2014, Jaeger, 2011) This is also a concern in this study, which I will come back to in the methodology chapter.

Recent technological trends including mobile computing, cloud computing, social media and the Internet of Things, have converged to stimulate radical technological growth (Greenfield, 2017). Despite the popularity of the smart city concept, technological acceptance modelling has not caught up with the smart cities trend and the integration of technology with cities. As Yigitcanalar et al. point out, much of the knowledge generated on smart cities "is singularly technological in nature – thus lacking social intelligence, cultural artefacts and environmental attributes" (2018). Technological acceptance is therefore critical because smart technologies that support the development of smart cities are a powerful way to support the diffusion and delivery of urban services in our increasingly urban world (Sepasgozar et al., 2019)

We do know that technology plays a key role in smart cities, moving beyond conventional objectives of supporting the optimization by public infrastructure and improve quality of life. According to Castelnovo et al. (2016) ICT-enabled solutions can be especially applied to

enhance the quality of the government's relationship with its constituency and to create networks that enable people to connect to government through electronic public service. These types of services are often called "smart city services" and contribute to enhance one city's competitiveness and citizens' quality of life by using ICT in city planning and management.

### 2.3.2 Service improvement

Further on, with improved ICT investment in city planning and management it is expected to have an impact on service improvement and the availability to citizens, which I will look closer into now. This theme relates to the increasing demand of citizens for e-service provision and experiences with ICT-savvy governments, including improved access to (public) services and information, online applications and transactions, shorter response times, and cost savings for citizens. This type of service if often characterised by improving the delivery of public information and services and include; reducing errors and increasing accuracy of data, reduce human errors, reducing costs associated with registration and submission of forms (e.g. regarding permits), increased ability to communicate directly with your local government and institutions, while removing the need for time-consuming face to face appointments at the local office; providing citizens services 24/7, 7 days a week. Another important factor is that these types of services are now available from any place and any device. In this sense, mobile technology has become crucial in improving user-to-government communication effectiveness and in this way strengthen the relationship between citizens and government (Hung et al., 2013). M-government (mobile-application-based government services) adds value to the smart government initiative, where citizens will be able to access government services using mobile technologies such as mobile phones, Wi-fi-enabled devices and wireless networks (Almuraqab and Jasimuddin, 2017, Ghyasi and Kushchu, 2004) According to Almuraqab and Jasimuddin "the successful implementation of smart governments services depends on how end-users perceive the m-government initiative. The technologies available may not be welcomed by end-users. If m-government services are not effectively utilized by end-users, then claims of the existence of a smart city are meaningless. The success of m-government projects depends on citizens' acceptance and usage." (2017)

### 2.3.3 Citizen-centricity

We know that one of the most important factors for succeeding with a smart city project is by putting the citizens at centre, and that citizen engagement is a fundamental cornerstone for smart city governance (Castelnovo et al., 2016). Traditional engagement approaches usually involve stimulating citizen participation in decision-making, where citizens point of view and suggestions is collected on how to improve public services, a typical top-down decision-making process. However, in order to give a voice to individuals who are not usually willing to participate in public debates, ICT-based applications, and especially Social Media, are used to widen the number of participants. This in order to help decision makers to make better decisions that fit with citizens' needs (Castelnovo et al., 2016).

A valid example where citizens in a smart city plays a central role in the public value creation and management process was in Boston. The city administration provided an ICT platform where every citizen could report unsolved issues, inefficiencies and failures detected in their urban environment and related services, propose solutions and even act together with other citizens. Representing new ways which citizen participation starts from the bottom in spontaneous ways (Castelnovo et al., 2016). Increased focus on citizens enables stronger citizen engagement based on participation, collaboration and community empowerment. The new approach towards citizen engagement could consequently lead to greater transparency towards government and citizen satisfaction and trust (Bertot et al., 2010). We do know that citizens are generally satisfied when they can accomplish tasks for themselves, as long as the information is available and there is a service that solves their problems (Reddick and Roy, 2013).

Cities around the world are growing at a very fast pace. For the first time in history, there are more people living in urban areas than in the countryside. This new way of living puts a lot of pressure on cities and has led to more citizen engagement in order to create future smart cities. Governments gather and analyse large amounts of data to automate processes, improve service quality, receive market signals directly from users/citizens in order to improve the effectiveness of public policies and programs, and thus make far better decisions. According to Pereira et al. (2018), this last dimension is seen as one of the most important and characterising aspects of smart governments. Other researchers point out that citizens tend to participate more when they notice that their governments are open to engagement and their input in decision-making, and also when they have access to valuable, relevant and complete set of information (Pereira et al., 2018, Bonson et al., 2015).

# Chapter 3 Theory and Framework

In this chapter I will take a closer look at the theoretical framework that forms the basis of this thesis. Initially, I will look at adoption theories, “Theory of Reasoned Action” and “Theory of Planned Behaviour”. These are presented because they support the “Technology Acceptance Model” (Davis, 1989) .

Furthermore, with the insight of Davis’s acceptance model Almuraqab and Jasimuddin has proposed a conceptual framework relating to the successful implementation of smart government and Smart Cities in the UAE (United Arab Emirates). Their study attempts to extend TAM by incorporating perceived compatibility, perceived risk, trust in technology, trust in government technology, awareness, social influence, facilitating conditions and perceived cost as the independent variables that influence behavioural intention to use smart-Government services (dependent variable).

However, in this study I will test their proposed framework in a much smaller scale than the UAE, in a developed country. The goal of the framework is to identify the factors that affect the successful adoption of digital communication technology relating to the implementation of future smart city development.

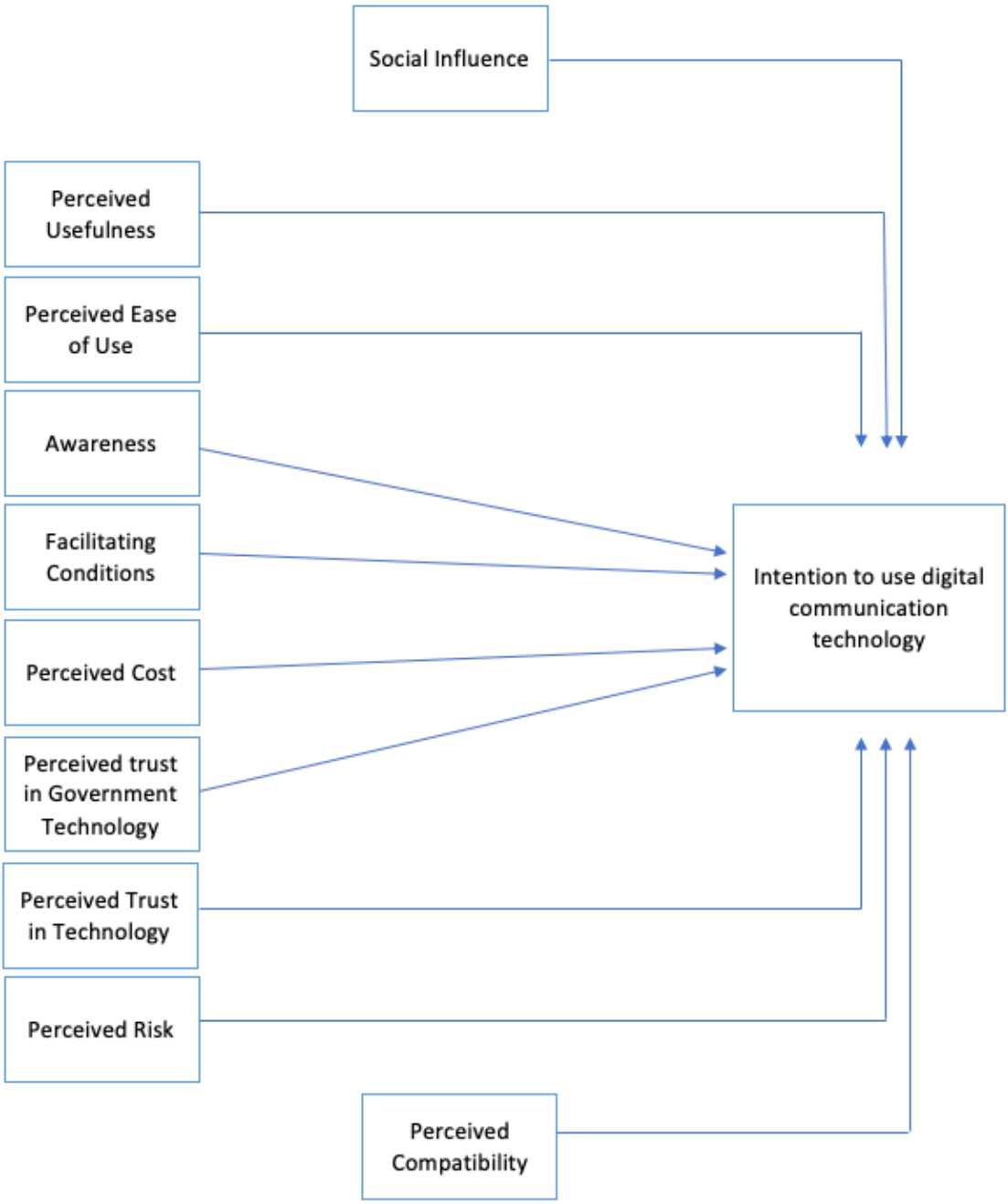



*Figure 2: Conceptual framework of Citizen intention to use digital communication technology*

One way to look at the technological acceptance model (TAM) is that it seeks to explain how users of a technology come to accept and use this technology (Christensen, 2013). Technology acceptance models emerged from the need to understand which technologies

would be accepted by individuals before substantiate investment were made (Sepasgozar et al., 2019). It is used because it uses *intention to use* as the explanatory variable of actual use, which fits well with the research problem. In addition, it is a carefully tested model that is often chosen when technological innovations need investigation. It is also recognized for its high predictive power and ability to be used in various situations (Guriting and Ndubisi, 2006). The TAM model is an empirical model that that has been tested by many scholars and researchers in regard to citizens acceptance of new innovations and technologies in a smart city context (Sepasgozar et al. (2019), (Almuraqab and Jasimuddin, 2017).
However, the proposed model has never before been tested and has only served as a conceptual framework.

## 3.1 Theory of Reasoned Action (TRA)

With the Theory of Reasoned Action (TRA) model, Martin Fishbein and Icak Ajzen seek to explain which factors are crucial to people's adoption of new technology (1975). Technological adoption can be explained by four concepts, namely attitude towards behaviour, subjective norm, intention to use and actual use. Fishbein and Ajzen argue that it is a person's attitude to a given behaviour, as well as its subjective norm that determines the person's intention to adopt a new technology. In other words, the more positively an individual considers a certain behaviour or action and the more they perceive the behaviour as important to their family, friends or society, the more likely they are to form intentions to participate in the behaviour (LaCaille, 2013). E.g. "My friends think I should get a sports watch and start exercising". These beliefs contribute to the perception of social pressure and contribute to motivation to comply. E.g. "I want what they have, and I want to fit in with my friends and family".

While the intention to use means the person's purpose in using the technology, actual use measures the person's specific use. Meaning that if the intention of use is strong enough, it can eventually lead to actual use of the technology (Fishbein and Ajzen, 1975)

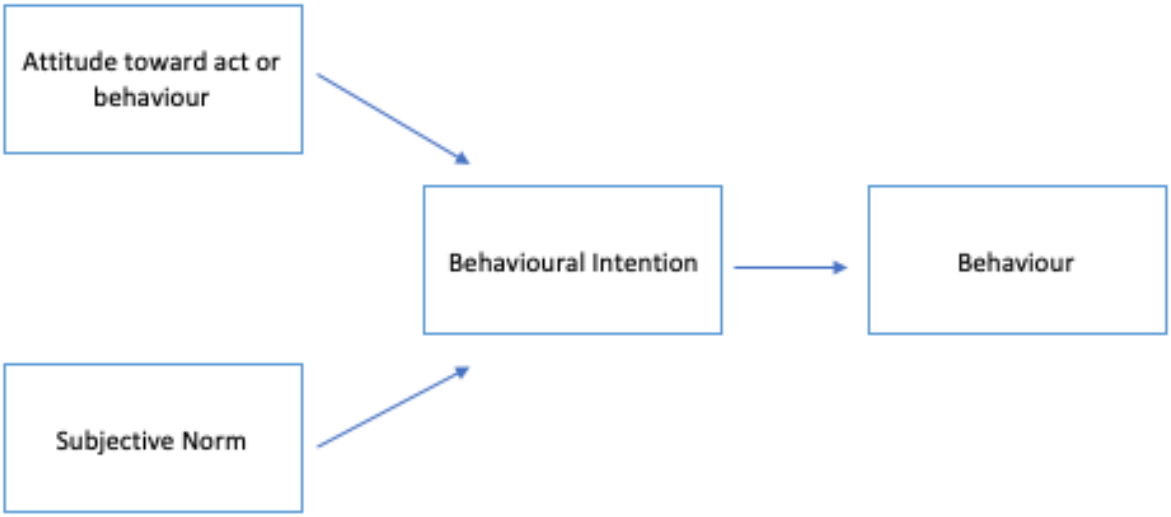



*Figure 3: Theory of Reasoned Action*

Fishbein and Ajzen define attitude as "a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object" (1975). One forms a belief about the outcomes of a given behaviour – e.g. "By exercising, my health will be improved, I will lose weight and become more attractive". Contributing to a person's attitude towards the outcome of a behaviour.
Meaning that an attitude is thus a person's opinion or thought about a technology, which is basically learned. Consequently, an attitude could change. It is important to understand consumer attitudes, as it is these, together with subjective norms, that form the basis for whether or not to choose to use the technology.

Having a particular attitude does not necessarily mean action. As mentioned, subjective norm will also affect the intention to directly use. Subjective norm thus addresses the social consequences of behaviour and is about the consumer's willingness to conform to what others think, as well as the expectations the person thinks others have for their own actions (Fishbein and Ajzen, 1975). Nevertheless, Azjen acknowledged the value of behaviour being under volitional control in both shaping thoughts and engaging in actual behaviour. Hence, he applied perceived behavioural control to the model, now known as the Planned Behaviour Theory (LaCaille, 2013).

## 3.2 Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is an extension of the TRA model. TPB was introduced by Ajzen as a result of a desire to moderate the original model. The background is that TRA will poorly predict how a person acts if he or she does not have complete control over his or her own actions (Ajzen, 1991). In addition to the factors attitude towards behaviour and subjective norm discussed in the previous section, perceived perceptual behavioural control will therefore help to determine a person's intention to adopt new technology.

As described in TRA, when a person has complete control over their own actions, intention alone is enough to predict a pattern of action. However, with little or no control the behaviour will be strongly influenced by perceived behavioural control, namely self-confidence in the ability to perform the action. This view is also consistent with Banduras  concept of self-efficacy theory, which can be described as a personal judgement of "How well one can execute courses of action required to deal with prospective situations" (1991). However, what separate these two concepts is that behavioural control not only reflects on individuals' beliefs about their internal control or competence, it also incorporates other external/environmental factors (E.g. resources, time, social support) (LaCaille, 2013).

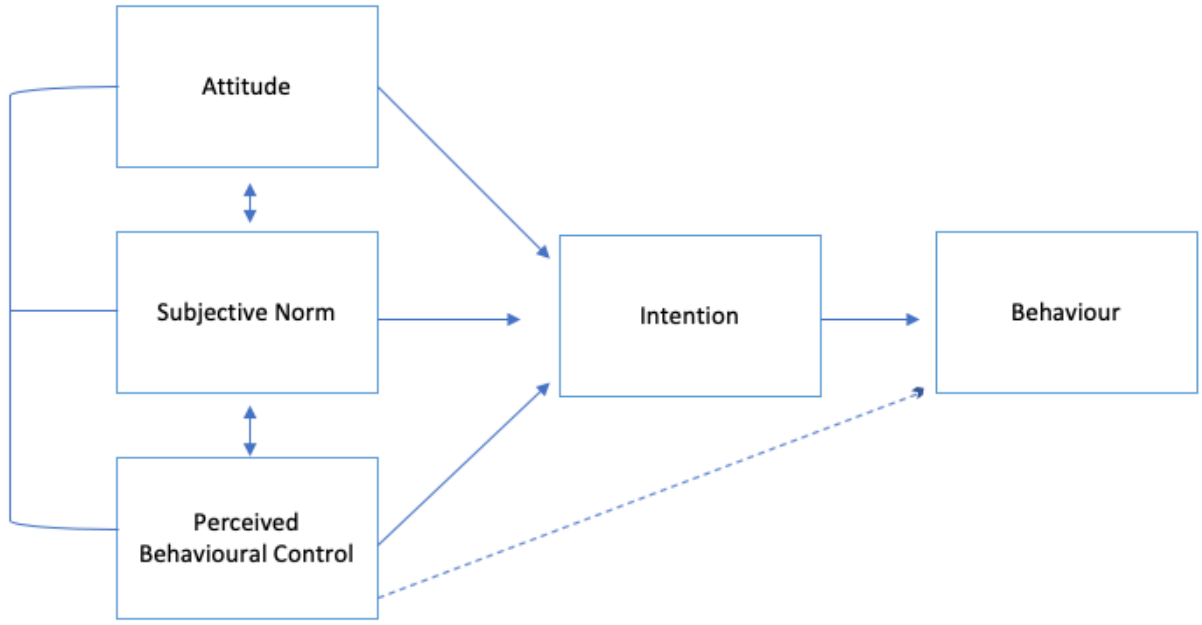



*Figure 4: Theory of Planned Behaviour*

Perceived behavioural control includes how simple or difficult a person perceives that the execution of the action will be, which is influenced by the person's previous experience in similar situations. In addition to directly influencing actual use, perceived behavioural control will have both an effect on the intention to adopt a new technology, as well as affect subjective norms and attitudes towards behaviour.

The theory usually accounts for about 40-50 percent of the variance in intentions and 20-40 percent of the behavioural variance. The relative value of each of the three factors differs across behaviours and circumstances (attitudes, norms, perceived behavioural control). Whereas subjective norms are usually the weakest predictor, but this can indicate measuring difficulties or ignorance of the impact of social factors by individuals (LaCaille, 2013). Although TPB is widely used and provides one of the most robust collection of human behaviour predictors, it has been criticized for failing to include emotional variables, such as perceptions of threat, mood and affect, which may restrict predictive power. Others have argued that many behaviours are not rationale and that one's affect can be contradictory to one's cognitions of engaging in a particular behaviour. And thereby, attitude can be influenced by affect in addition to beliefs (LaCaille, 2013).

## 3.3 Technology Acceptance Model

The model itself was firstly introduced by Fred D. Davis (1989) in the 1980's with the focus on identifying the determinants of technology acceptance in many contexts.
The TAM model was developed from the social psychology Theory of Reasoned Action (TRA) which posited that human behavioural intentions affected by attitude and subjective norm (Ajzen and Fishbein, 1977). The model, which was initially designed for use at the organizational level, has subsequently been validated through a series of empirical tests. According to Christensen "The TAM posits that when a user is considering use of a new technology, the user forms two key perceptions (beliefs) regarding the technology: perceived usefulness and perceived ease-of-use. These beliefs are formed from external and internal influences at the individual (i.e., experience) and social level (culture, organizational policy, group norms, etc.). From these beliefs, an attitude toward using is formed by the user. Finally, intention to use is theorized as a key determinant of actual use. External variables, such as

specific technology characteristics and individual attributes, are posited to be mediated by, and even antecedents to, beliefs"(2013).

In addition to perceived usefulness and perceived ease of use, the TAM model includes external variables. These are explained by Davis as factors that " provide the bridge between the internal beliefs, attitudes and intentions represented in TAM and the various individual differences, situational constraints and managerially controllable interventions impinging on behaviour" (1989)

The model introduces two new concepts compared to TRA and TPB; *perceived usefulness* and *perceived ease of use*. Together, these are determinants of user acceptance, as well as the actual use of a product, mediated by the attitude towards use and intention of use.

### 3.3.1 Perceived Usefulness

PU is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance".* In other words, this will be the belief that the new product will facilitate a user's work life and thus have a value. Through a number of empirical test of the TAM framework, perceived benefit has been validated as a strong determinant of intention to use with a standard regression coefficient typically of 0.6 (Venkatesh and Davis, 2000)

In this study perceived usefulness will be the degree to which a citizen (i.e. end-user) believes that using digital communication technology in the form of a mobile application will help them to get what they want and increase quality of life by making it stress-free. According to Althunibat et al. (2011) perceived usefulness is one of the strongest signs of technology adoption since it reflects a significant effect across technologies and applications . And based on previous research shows that perceived usefulness has a significant impact on the adoption of m-government services, which is relatively similar to what this study measures (Almuraqab and Jasimuddin, 2017).

Alomari et al. (2012) also note that increased intention to use e-government portals is correlated with a higher degree of perceived usefulness. This finding indicates that citizens will be keener to accept e-government if the services launched on the portals increase

transaction efficiency and effectiveness. In relation to the smart government services via the latest technology, such as smartphones and smart devices, it is therefore of interest to test the significance level and direction of perceived use towards the adoption of these services.

### 3.3.2 Perceived Ease of Use

PEOU is defined as "*the degree to which using the technology will be free of effort"* (Davis, 1989). Meaning that even if a user sees the utility of the system, the system can be perceived as impossible or difficult to use. Then an effort is required to achieve the potential benefit. PEOU is the second main construct of TAM and has been used in several technology adoption and e-government adoption studies. Studies have shown that citizens or end-users might prefer to use a service because it is easy to use, easy to access, practical and simple, and hassle free (Althunibat et al., 2011, Almuraqab and Jasimuddin, 2017). Indicating that the easier the application or digital service the municipality delivers, the more likely it is that the citizens will adopt and make use of such a service. Indeed, it is important to make these services easy to use. Based on the following arguments this study will see if PEOU will have a positive impact on citizens intention to use a mobile application to potentially connect better and easier with its' local municipality.

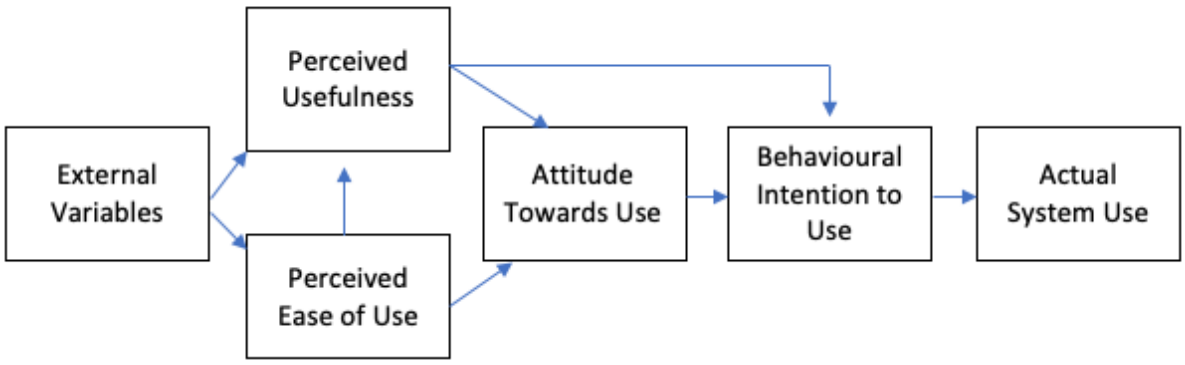



*Figure 5: Technology Acceptance Model*

The TAM model has often been criticised for not taking into consideration stakeholders' perceptions, but also because of its parsimony, and the reliability of such a simple and deterministic model. Nevertheless, it seems unreasonably to expect that a single model would explain such a variety of behaviours in such a wide range of situations. As a result of this

several authors have adapted the TAM model to specific contexts by incorporating specific variables (Bagozzi, 2007). This will also be done in this study.
The model, which was initially designed for use at the organizational level, has subsequently been validated through a series of empirical tests. This has consistently been shown to explain about 40 percent of the variance in users' intention to use, as well as actual use (Venkatesh and Davis, 2000).

## 3.4 Developing the conceptual model

During the last decades strong theoretical models for technology acceptance models have been developed. Nonetheless, adapting these models for smart cities is difficult, as insufficient empirical studies are available in emerging smart cities to forecast their performance (Sepasgozar et al., 2019). Different researchers consider different factors to measure users' acceptance. Some suggest the need for acceptance models that are adapted to specific technologies (Althunibat et al., 2011). While others argue that TAM may not be sufficient to explain the adoption and usage of various types of technologies and service channels, as it does not take into account other issues like risk, trust and social influence (Almuraqab and Jasimuddin, 2017). Consequently, there are several variables that appear in different models and theories which are similar to the ones used in the technology acceptance model. This study tries to extend TAM by incorporating perceived trust in technology and government technology, awareness, facilitating conditions, perceived cost, social influence, perceived risk and compatibility. The factors used in this study to examine citizens intention to use digital communication technology will be described in the following sections.

### 3.4.1 Perceived trust in Technology

According to Fukuyama, trust is a major determinant in people's decision making, as well as in their adoption of new technology (1995). Due to the last decades increasing online use and electronic service delivery, the importance of including trust in adoption models has been of great value to better understand the user acceptance of electronic services (Carter and Weerakkody, 2008). Indeed, trust in electronic services has been deeply analysed in both e-commerce and e-government (Belanche et al., 2012). Many scholars have stated that appropriate use of ICTs, particularly the Internet, by governments could improve the quality

of public service/information delivery and enable easier communication with citizens. It is believed that improved communication and service channels based on ICTs enable more transparent and open government systems, more efficient service delivery, and easier and more interactive communication between citizens and government, which can assist in restoring and improving trust in the government (Kim et al., 2017).

Based on Belanche et al's. research on integrating trust as a variable in the technology acceptance model their results, showed that trust was totally connected to the TAM framework by significant and strong direct effects on both attitude and intention to use (2012). Analogously, focusing on practical implications, e-government services managers should take into account the importance of citizen trust on the provision of these services.

A relevant example might be: Due to the recent events from the Corona Virus the Norwegian Institute of Public Health (NIPH) developed a mobile application called Smittestopp, an app that will help the health authorities to limit the transmission of coronavirus. Anonymised data about movement patterns in society from the app are used to develop effective infection control measures. For citizens to activate and fully use this app one must accept to share personal data in the form of GPS tracking and Bluetooth sharing. According to NIPH (Norwegian Institute of Public Health) around 1.5 million people downloaded the app, but only one out of five have agreed to share their data (2020).
With this in mind one can see that citizens trust and acceptance in a given technology will have a positive/negative affect on their intention to use the technology.

### 3.4.2 Perceived trust in Government Technology

However, when facing difficult decisions, gaining people's trust can effectively reduce the related complexity of the process (Hoffman et al., 1999). The literature has suggested various concepts of trust, with different theoretical viewpoints, academic interests and analytical levels. Trust, however, is generally expressed as one party's willingness to rely on others' behaviours, especially when the former is potentially in a vulnerable position. Trust often means embracing a certain amount of risk and being vulnerable to a trusted party (Hosmer, 1995). People accept this risk based on the expectation that the trusted party act in their best behalf and perform actions that are beneficial or important to the vulnerable party. Which in this study will be determined as *Perceived Trust in Government Technology*. Citizens must

have confidence that their local government act in their best interest and provide m-government services  for the purpose of benefiting and not monitoring and policing them (Althunibat et al., 2011).  Since trust is a major determinant in people's decision making and largely explain their attitude and intention to use a service the model is constructed to have a relationship to the user's intention to use digital communication technology.

### 3.4.3 Awareness

Awareness is people's knowledge of technology and the availability of electronic services (Almuraqab and Jasimuddin, 2017, Venkatesh et al., 2003) According to Abdelghaffar and Magdy awareness is usually the first step towards citizens recognizing that the government provides its services over internet (2012). Without awareness of a service available it will be impossible for users to see the need of it. Others has also found that awareness is the factor that decreases all aspects of perceived risk, which can be interesting to see since both factors are present in the proposed model (Hanafizadeh and Khedmatgozar, 2012).

Another factor is that the government won't achieve its objectives of providing digital technology to its citizens. Lack of awareness has also been seen as one of the major obstacles of successful adoption of m-government services (Almuraqab and Jasimuddin, 2017). With a lack of interest, it also led to a negative impact on citizens intention to adopt e-government and m-government services.

Previously research suggests that the increase of awareness significantly contribute to increasing citizens' willingness and intention to adopt and use digital technology (Alonazi et al., 2020). Hence, awareness is proposed as an independent variable to measure users' intention to use digital communication technology.

### 3.4.4 Facilitating Conditions

Another variable in this study that could influence citizens intention to use digital technology is facilitating conditions. Facilitating conditions refer to the degree to which an individual believes that organizational and technical infrastructure exists to support the use of a system (Venkatesh et al., 2003). Simply put, facilitating condition is the state in which a person has

all the necessary facilities, resources, equipment and assistance provided to support the use of a system. Thus, facilitating conditions is assumed to be a determinant of behavioral intention to use a system (Kabir et al., 2017). It is also a construct similar to "perceived behaviorual control" and "compatibility" from Ajzen (1991) theory of planned behavior. In a similar research it was found that there is a significant relationship between facilitating conditions and intention to use wireless connectivity on mobile phones technology (Lu et al., 2003)

Furthermore, in this study the conditions facilitating technology, in particular digital communication technology, or services are essential to encourage and support use and will be of interest.

### 3.4.5 Perceived Cost

Perceived cost is defined as the extent to which an individual believes that using a particular technology will cost money (Phonthanukitithaworn et al., 2015). Others define it as an individual's perception of cost. This is a secondary attribute as it is how the consumer considers price relative to his or her disposable income that is important (Adams, 2008) According to El Kiki and Lawrence the cost of mobile services is one of the main factors that affects end-users intention to use m-government services (2007). Indicating that perceived cost will have a negative effect on users' intention to adopt m-government services and digital technology. Ideally access devices should be affordable, and access costs for m-government services should be low. Since price is considered a very important factor in the context of citizens' behaviour, government should pay more attention to this issue (Almuraqab and Jasimuddin, 2017) and is therefore included in this model.

### 3.4.6 Social Influence

According to Almuraqab and Sajjad it is vital to realize the importance of the influence of friends and family on decisions to use technology (2017). An important factor will be what our closest people choose. Social influence is mentioned by Fishbein and Ajzen as one of the most important forms of influence, and involves information about what family and friends do, and what they expect us to do, which in this case will be adoption of digital communication technology (1977). Furthermore, information about what most people do can

affect one's behavior. Knowing what others think one should do, or even what most people do can have a major impact on what one chooses to do. One can therefore assume that as users we are exposed to social influences from friends, family and acquaintances who activate a need to keep up to date on technology that are advantageous and can increase quality of life. And from a marketing perspective one of the most powerful forms of advertising is by word of mouth from family and friends.

Furthermore, social influence has been tested and proved to be a significant factor in many studies in the m-government domain (Almuraqab and Jasimuddin, 2017). Studies have showed that the more people utilize and successfully use online m-government services the more encouraged they will be to use them. Thus, social influence serves as a major independent variable in people's intention to use digital communication technology.

### 3.4.7 Perceived Risk

Perceived risk is defined as a consumer's perceptions of the uncertainty and the possible undesirable consequences of buying a product or service (Fagih, 2011). While Carter and Belanger defines it as citizens' subjective expectation of suffering a loss in pursuit of a favoured outcome (2005). The behaviour of citizens is heavily affected by perception of risk. End-users are frequently uncertain as to the implications or consequences of a decision or action (Almuraqab and Jasimuddin, 2017). In addition, it was revealed that end-users attempt to minimize risk rather than maximize utility. The subjective perception of risk by an end-user can explain his or her behaviour strongly (Mitchell, 1999). When an end-user lacks the latest technology expertise then he/she finds him/herself in a high-risk situation. Risk reduction should in fact be given more priority, particularly during the early stages of the introduction of digital technology services (Almuraqab and Jasimuddin, 2017).

Typical concerns regarding digital technology in the form of a mobile application is often identity theft, hacking and most importantly sharing of personal data. These are common phenomena that affect end-user's intention to adopt an unfamiliar service option.
Users of new smart devices appear to have unauthorized access to data, intrusive monitoring of user habits and data manipulation. Based on the analysis above one can say that perceived risk will have a negative impact on users' intention to use a smart mobile application.

### 3.4.8 Perceived Compatibility

Rogers (1995) defines perceived compatibility as "the degree to which an innovation is consistent with existing values, past experiences and needs of potential adopters." Compatibility refers to whether an end-user perceives an application/service to be compatible with his/her requirements or life routine (Almuraqab and Jasimuddin, 2017). Although the individual is able to see the benefit of an innovation, in this study the benefit of using mobile application, there is no automaticity that it is compatible with its own values and the prospective user's lifestyle.

The more compatible the technology is to users; the less uncertain potential adopters will be. Another point is that the more compatible an innovation is, the less of a change in behavior would be required. Therefore, the design and services provided by the local government is critical to ensuring the acceptance of its citizens (Almuraqab and Jasimuddin, 2017). Hence, the compatibility of using mobile technology services should be flawlessly integrated into citizens' transactions without the extra effort from unnecessary steps, extensive training in usage or the equipment needed.

## 3.5 Summary of theory

The theory presented has provided a starting point for the understanding of the underlying mechanisms that could affect citizens intention to use digital communication technology in order to increase citizen involvement. Furthermore, literature related to both the application of Davis's TAM model, as well as eight other theoretical concepts, has been a pinpoint to possible underlying variables that may affect the aforementioned adoption of digital communication technology.

# Chapter 4 Methodology

There are certain major steps that a researcher needs to go through when doing research. In this chapter I am going to present and explain which choices that were made in regard to the structure of the thesis. The structure is based on the research question and the purpose of the thesis, this will form the basis of a good analysis further. Initially, a stepwise process will present the research design at an overall level, and then go into more detail on the specific method that were chosen. Furthermore, there will be given a more detailed elaboration on the construction of the survey and the scales. Lastly, an assessment of the validity and reliability of the chosen method will be presented, as well as an overview of the data analysis

| **Research methods** | |
|---|---|
| Strategy | *Quantitative* |
| Design | *Survey* |
| Data Collection | *Survey Data Collection (Self-administrated Questionnaire)* |
| Framework for analysis | *Examination of various factors using SPSS and Structural Equation Model* |

*Table 1: The principle methods applied in this study*

## 4.1 Research Design

According to Saunders et. Al. (2009), a research design can be described as an overall plan for how the research question should be answered. It reveals the type of and the priorities of the researcher (Ghauri and Grønhaug, 2010). The design can further be used as a guide for collecting and analysing data, and furthermore, say something about which strategy to use in order to obtain the information needed. One usually divide research design into three categories based on the nature of the problem: exploratory design, descriptive design and explanatory (causal) design (Saunders et al., 2009). The choice of research design emphasizes the validity of the research, meaning; the validity and relevance of the study, as well as reliability (Selnes, 1999).

Exploratory design is used when the considered problem is relatively unstructured, and it is unclear which variables to study in order to explain or describe a phenomenon. The purpose of this is to provide insight into a phenomenon and to create understanding. Descriptive design on the other hand, is chosen when the problem is considered as rather structured. One has a profound understanding of the phenomenon and a strong understanding of the factors that explain it. There is also relatively clear hypothesis on how the variables affect one another. The design is used for mapping variables, deciding frequency or describing relationships among variables. It is well suited to describe characteristics, correlations and categories of what is being studied, however, it cannot demonstrate causal relationships (Saunders et al., 2009, Selnes, 1999). If one wants to demonstrate causal relationship between variables, an explanatory (causal) design must be used. The purpose of this design is to investigate the effect of one or more independent variable on a dependent variable. Hypothesis are usually made in order to investigate such relationships. One usually tests these by using an experiment (Selnes, 1999).

### 4.1.1 Choice of Research Design

Research design is largely governed by the problem and purpose of the thesis, which sets the framework for the entire study. When choosing a design, the access to existing and relevant theory must be taken into account (Saunders et al., 2009). In order to obtain information, one must look at the connection between the aforementioned factors and the intention to use such services, as these factors have a likely effect on end-users' intention to use.

In this thesis, a descriptive design will be used and approached in a deductive way. Since I want to study and describe the relationships between the concepts in the model, it will be natural to look at the correlations between these, among other things. This means that, with the theory of technology adoption anchored, one move towards what is new about the study, namely citizens perceptions of using digital communication technology, in particular their smartphones, to connect and have a better two-way communication with their local municipality. This will be done by gathering information, testing the conceptual framework and describing the relationships between the concepts in the model.

## 4.2 Research Method

Research methods refer to the systematic, focused, and orderly collection of data for the purpose of obtaining information from them, to solve/answer a particular research problem or question (Ghauri and Grønhaug, 2010).

There are two approaches for collecting data, quantitative or qualitative approach. The purpose of a quantitative method is that it can give an explanatory description of people's personal experience of phenomena and to map their distribution (Johnson and Christensen, 2008). A qualitative method on the other hand wants to understand human actions rather than explain them (Johannessen, 2011). Since I want to gather information in order to test the proposed framework a quantitative method for data collection will be used.
There will always be pros and cons for choosing one over the other. One advantage of a quantitative approach is that one will be able to do statistical analyses and generalisations. A disadvantage on the other hand is that it will be more difficult to delve into the topic and to investigate the causes of each specific case (Johnson and Christensen, 2008). This is natural however, since the information received from each respondent is limited.

### 4.2.1 Data Collection

In this study, a survey was conducted. The reasoning for choosing survey for collection of data was a natural choice since a questionnaire is a widespread form of testing the relationships in TAM. TAM also supports better recognition of the relationships between many important constructs of this study, such as perceived risk, perceived usefulness, ease of use, awareness, trust and behavioural intention (Sepasgozar et al., 2019, Almuraqab and Jasimuddin, 2017). A survey was also used when the originally TAM was first developed in 1989 (Davis). By conducting a survey one can easily collect information, as well as being a relatively time and cost-effectively method. As a student at NTNU one can use the free program "Nettskjema" in order to easily design your questionnaire.

The questionnaire is a self-administrated questionnaire which gives the respondents the ability to answer whenever and wherever they want. The questionnaire was pre-tested on beforehand,

to see if there would be any problem to answer the survey on a computer, a smartphone or a tablet. However, this will be elaborated on later in this chapter.
A key issue is how to administrate the survey. There are four main methods for obtaining survey data according to Ghauri and Grønhaug: (2010)

- Mail Questionnaires;
- E-mail or website questionnaires
- Personal interviews
- Telephone/Video interviews

There is also a possibility of outscoring the service to a market analysis firm. However, this is often very costly and since there were no money in the budget for this study it was not an option.

The survey was uploaded to the social media Facebook, which is an effective way of reaching many respondents in a short period of time. The information that were given was that it would take 5-6 minutes to complete the survey, it would be totally anonymous and that I wanted respondents preferably living in Aalesund municipality. One major benefit of uploading and sharing surveys and other information on social media is that it can reach a lot of respondents in a short amount of time. By encouraging people to share your Facebook post you have the possibility to reach many more than just your "inner-circle" of Facebook friends and in that way reach respondents from all age groups. An added benefit with this type of method is that the respondent's answers are coded automatically and easy to work with afterwards.
However, a disadvantage is that by not being present one cannot assure that the respondents don't misinterpret the questions in the survey, or if others work together. Which may impair the validity of the survey.
In order to compensate for not being present as interviewer it is important to have a clear and understandable survey that is easy to interpret. The questions related to the survey are well rooted in other empirical tests related to TAM and *Intention to use* but have been modified in order to test people's intention to use smart government applications.

### 4.2.2 Sampling

When carrying out a project one wants to collect data and information from a population.

The term Population, as used here refers to all the possible units of observation, and these units may be people, firms, products, or countries, depending upon the context of the project. A sample is a subset of the population, meaning that it comprises some members selected from it (Sekaran, 2003). Furthermore, in order for the researcher to construct a representative sample; a sampling frame is essential for probability sampling, so that each unit has a known non-zero probability of being included in the sample (Ghauri and Grønhaug, 2010).

### 4.2.3 Population

In this study the term population refers to the unit people.
The sample in this thesis were 121 respondents, whereas 106 of the respondents answered that they live in Aalesund municipality, while 15 respondents did not. However, this is just a subgroup or a subset of the population. The reason for collecting data from smaller sample of a population is self-evident. Although it would be preferable to collect data from all 65 633 residents, it would be practically impossible. Even if it were possible it would be prohibitive in terms of cost, time and human resources.

This study is conducted in a small city in developed country Norway, where the Smart City concept embraces widely. Where meeting climate and environmental challenges is often the most important focus area. Several Smart City initiatives are based on the UN's overall sustainability goals. These sustainability goals describe 17 different pillars, or areas of focus. Whereas Aalesund municipality as a city and region are especially focusing on sustainability goal nr. 11 "Sustainable Cities and Communities". This is a recognition that most of the world's population lives - and will live - in a city or a town. Ensuring equal access to good social and economic well-being for residents of the world's cities and towns, while not degrading the climate and the environment (2019c). Aalesund municipality also has the world's second UN lab for smart and sustainable development, with the goal to develop and implement sustainability projects, in for example health, education, mobility and energy, infrastructure, in addition to accelerating new projects. "The innovative lab will be an arena for connecting people, ideas and sustainability initiatives - both physically and tangibly in interconnection spaces, as well as via digital platforms. This will be an arena where the public sector, business, residents, academia, research, non-profit organizations and the voluntary community will meet, and create sustainable solutions for improved quality of life as well as reduced environmental and climate footprint." (2019c).

This indicates that the city and the region is relatively technologically minded and the focus on smart and sustainable cities are high in the local government.

However, the purpose of this study is to look into resident's intention to use a mobile application in order to create a better citizen engagement, which we know is considered a foundation of smart city government.

In collaboration with Smartbyene, Nordic Edge and selected public and private players from all over the Norwegian country, DOGA prepared a national smart city road map. A road map with eight principles that will help municipalities and counties prioritize and direct their smart city development (2019b). The first principle in this highlights the importance of putting the citizens in center as the most important player. This involves, among other things, mapping and listening to citizens' views on how to develop smarter, safer and more sustainable communities. This includes to identify measures and solutions with the help from modern technology in order to improve and streamline services offered to all types of residents.

The basic idea about the smart government service is a mobile application where citizens can easily interact and receive important information from and to their municipality. Working as a digital tool where one collects ideas, rapports and makes it easier for residents to make input which can be discussed with the local government. As well as the opportunity for self-service to various forms, pages and overviews. E.g. applying for kindergarten placement, public school holidays, information about waste disposal, report a problem (potholes, graffiti, broken streetlights) etc. This is also supported by the findings of Reddick and Roy (2013) where citizens are generally satisfied when they can accomplish tasks for themselves, as long as the information is available and there is a service that solves their problems.

According to Kleinhans et al. (2015) in order to increase the number of participants in public debate and to include those excluded or not attracted by traditional participation instruments, ICT-based applications, such as a mobile app or social media, can help decision-makers make better decisions that fit the needs of the population.
Indicating that city planning, and management can be improved and be more relevant to the residents of the cities through new technologies by connecting people to places in smart city context.

### 4.2.4 Selection Strategy

There are two major types of sampling designs: *Probability* and *Nonprobability sampling*. Each of these two strategies has different sampling strategies.
Probability sampling are often used when the representativeness of the sample is of importance in the interests of wider generalizability. When time, costs or other factors, rather than generalizability, become critical, nonprobability sampling is generally used. When using a probability sample each element in a population has an equal chance of being chosen as subject in a sample. The benefits of this type of sampling is that the sampling is random, which gives a high probability of a representative sample and low generalizability (Sekaran, 2003).
There are several techniques of probability sampling, however, the most common techniques are:

- Simple random sampling
- Systematic sampling
- Stratified random sampling
- Cluster sampling

Since I will not use probability sampling strategy in this study, but it is relevant for the understanding of the chosen method, I will not go into further detail on each technique.

In Nonprobability sampling design the probability of being included in the sample is unknown, and it is therefore not possible to assess the extent to which the sample is representative of the population. Meaning that the findings from the study cannot be confidentially generalized to the population. However, as stated earlier, researchers may occasionally be less concerned about generalizability than obtaining preliminary information in a inexpensive and quick way (Sekaran, 2003).

In this study a *convenience sample* has been used. As the name implies, this means that convenience sampling refers to the collection of information from members of the population who are conveniently available to provide it (Sekaran, 2003). The advantages of convenience sampling are that it is quick, convenient and less expensive than other sampling methods. It can be considered convenient since the survey were distributed through the social media,

Facebook. As previously mentioned, this is a practical method that makes it easy to collect and reach many respondents in a short amount of time, which was ideally based on the purpose of the study.

Although being practical and convenience, the biggest disadvantage is that the probability of having a representative sample is small and it is not generalizable. Meaning that it will be difficult to generalize the findings of the study to other segments of the population. The sample will therefore be diligent Facebook or internet users. This must be taken into account when analyzing the findings from the study. However, one can also justify the choice of method since 98 % of Norwegians has access to internet from their homes and that 95 % of Norwegians has a Smartphone, whereas 85 % of phone usage is to browse the internet (2019a). With this in mind one can make the assumption that many of the smartphone users also have a Facebook profile and may be the right segment that makes use of digital communication technology. One can therefore draw some conclusions about the given population, based on the response of respondents.

According to Ghauri and Grønhaug a potential threat to the validity of results from sampling surveys is non-response. This could be a problem since those who do not respond are usually different from the ones who do respond, hence there will be no guarantee that the sample is representative of the population (2010). In this study this could potentially lead to non-response bias since the older generation is not so present on Facebook and the internet as the younger generation, as well as those who are non-tech savvy. However, this will always be a potential problem when doing surveys on the internet or by e-mail.

Since a convenience sample has been used and the survey was available on Facebook one has relatively little control over who is included in the sample and who chooses to answer or not. It is conceivable that there is a weakness that the distribution within the sample cannot be controlled and that this could lead to skewness. On the other hand, the fact that the sample is relatively random could be positive, as it is a random selection that one is trying to accomplish when doing market research.

### 4.2.5 Sample Size

An important and frequent question is: What sample size is needed?

As a rule of thumb, sample sizes between 30 and 500 could be effective depending on the type of sampling design used and the research question investigated (Sekaran, 2003). In this study the minimum required respondents were 50 and with the hope of collecting around 150-200 respondents. The survey was published on Facebook from Friday 8 of may till Wednesday 13 of May. During the six days there were registered 124 respondents who had finished the survey. From these there were only three respondents that had to be removed from the data set, since the first three respondents were used in a pre-test of the survey. Throughout the survey each question was mandatory to answer in order to continue the survey. By doing so one receive sufficient answers for all the questions and there will be no errors in the data set.
As already mentioned, out of the 121 respondents 106 answered that they live in Aalesund municipality. And for further analysis I will proceed with the 121 respondents.
In consultation with the supervisor 121 respondents were sufficient as a sample in this study.

## 4.3 Construction of the questionnaire

In order to analyze the data, one must operationalize the concepts. According to Saunders et al. to operationalize means "the translation of concepts into tangible indicators of their existence" (2009). This means that the concepts (independent variables) that has been defined in the model will be made measurable. In this section I will go over the concepts from the theoretical model of intention to use digital communication technology, and then explain which claims that are chosen to measure these.

**Perceived Ease of Use**

The concepts that were chosen to measure PEOU has been modified and previously tested by Alonazi et al. (2020) and Almarashdeh and Alsmadi in their research (2017).

Alonazi et al's study explores the determinants of citizens' intention to adopt and use Mobile government services (M-government), in order to increase the adoption rate.
With the robust theories from TAM they looked at citizens behavioral intention to use and adopte M-Government services. While Almarashdeh and Alsmadi's research looked into

citizens acceptance of M-government services by looking at their usage behavior and behavioral intention to use these services.
Alonazi et al:

1. Learning to use mobile government services would be easy for me
2. I believe my interaction with mobile government services to access government services would be clear and understandable
3. Using mobile government services does not require a lot of skills and efforts
4. I believe that mobile government services are easy to use

Almarashdeh and Alsmadi:

1. I found M-Government services easy to use
2. Learning to use M-government services would be easy for me
3. M-Government services are clear and understandable
4. It would be easy for me to get services I need from M-government services

One can see from the questionnaire items from the two studies that the they are related to how easy it is to use a system or a service. Furthermore, is the system controllable in a way of making it do as one pleases. Hence, the questions related to perceived ease of use in this study are:

1. A mobile application is simple and easy to use
2. I can learn how to use a mobile application without help
3. Using a mobile application does not require much mental effort
4. By using a mobile application through your smartphone, it would be easier to communicate directly with your local municipality

**Perceived Usefulness**

The concepts that were used to measure perceived usefulness have been translated and modified based on Sepasgozar et.al. (2019) and Almarashdeh and Alsmadi (2017) study. The questions related to perceived usefulness is if the service will be meaningful, informative, relevant, helpful and significant to the users.

1. The service will be useful in my everyday life
2. The service will make me save time
3. The service will be valuable to me
4. The service will be an effective way of having a two-way communication with the municipality

**Trust in technology and government technology**

For the concept trust in technology and trust in government technology, seven statements were translated and modified based on Almarashdeh and Alsmadis (2017) research. Four questions were developed related to trust in technology and three questions related to trust in government technology. Statement 4 was not related to previously research and I made my own claim for the curiosity of the study, seeing this as a relevant question.
Hence, these seven statements were developed to illustrate trust in government and trust in government technology:

*Trust in technology*

1. I expect the quality of mobile applications offered by the municipality to be good
2. I trust that the municipality has my best interests in mind
3. I do not need to provide any sensitive information to make use of mobile from the municipality
4. I allow the municipality to retrieve (my) data that can be used to develop the smart city of the future/better municipal services

*Trust in Government Technology*

1. I trust the technology that the municipality offers me
2. I trust the municipality's services when available at all times
3. I trust the municipality's services when the user interface is attractive

**Social Influence**

Furthermore, the concept that were intended to cover social influence were translated and modified on the basis of Almarashdeh and Alsmadi and (2017) and Alonazi et al. (2020) research:

1. People like me are expected to use such a service
2. People who are important to me would consider this service beneficial/easy
3. I would use such a service if friends/family recommend it

**Perceived Risk**

The concepts for perceived risk were translated and modified to fit the purpose of this study on the basis of Givonais et al (2012) research. Three statements were proposed related to Perceived risk:

1. Mobile services offered by the municipality seems safe
2. I think there is a danger that sensitive information may end up with the wrong person
3. I believe that services offered by the municipality will keep my personal information safe from unauthorized persons

**Facilitating Conditions**

The statements related to facilitating conditions were translated and modified from a published master thesis (Mohammed, 2016), whereas the components in the questionnaire were adapted from Venkatesh et al study (2003) . These statements were proposed since they highlight many of the facilitating conditions that are necessary in order to measure *intention to use digital technology services*. Two statements were proposed related to Facilitating conditions:

1. I have the necessary knowledge to use a mobile application
2. I have the necessary resources to use a mobile application

**Awareness**

Furthermore, the concepts for awareness were translated and modified on the basis of Alonazi et al. (2020) research. These statements were related to the respondents previously experience with similar services and technologies (e.g EasyPark, Smittestopp etc.).

1. I feel I have a good knowledge of the benefits, features and services of mobile municipal services
2. I have received enough information and guidance on how to use mobile municipal services
3. Overall, I am satisfied with the current awareness campaigns and announcements about mobile municipal services in Aalesund

**Perceived Cost**

Since this study will be conducted in a developed country, the access cost for mobile services is low and individuals have higher financial resources, leading to higher behavioural intention to use digital communication technology through their smartphones. In a European context, Norwegians have good digital skills and nine out of ten sends e-mails regularly and uses net banking (2017). 95 % of the population also has access to a smartphone (2019a) which could mean that a high cost for accessing mobile services from the local community will have a negative effect on their intention to use these types of services.

Hence, the question related to cost were not given as much attention as the other variables. The cost of service might affect user's access to the government services and information either positively or negatively (Almarashdeh and Alsmadi, 2017) Hence, it is interesting to see if citizens perceived cost will have an impact on their intention of use, and relevant to know if the services provided by the municipality should be cost free or not. Based on this one statement were developed:

1. Mobile applications offered by the municipality shall be free of charge

**Perceived Compatibility**

Perceived compatibility was measured by three statements. This factor focuses on how the citizens perceive the compatibility of using a mobile application service with their lifestyle and behavior, and how this encourages their intention of use. The statements were translated and modified based on Sepasgozar et al. and Alonazi et al's. research. Three statements were asked in the questionnaire:

1. Using such a service means that I can communicate with the municipality around the clock
2. I want to use such a service when it can save my time
3. I want to such a service when it can save my expenses

**Intention to use digital communication technology**

The last question is related to citizens intention to actually use mobile application services. This works as the dependent variable in the proposed framework and is highlighted with only one but major question regarding citizen adoption and intention to use.

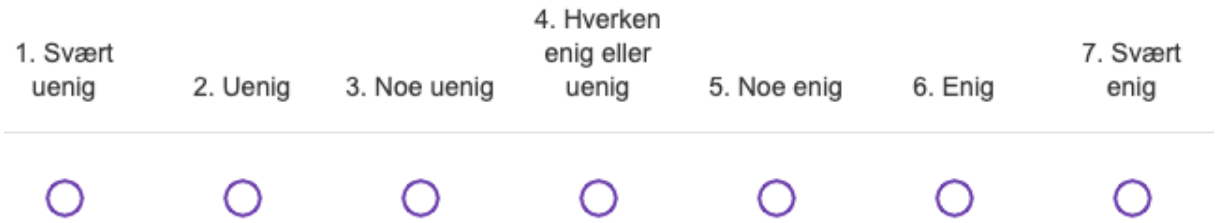
1. How likely are you to use such a service?

### 4.3.1 Measurement scale

The survey questionnaire contains 37 items, where all questionnaire items were developed and modified from items used in previously published research related to citizens intention to use a service or product. All items were measured with a 7-point Likert scale, besides the items related to personal information (age, sex and residence). Respondents age was an open question where they filled out their age while the others were simple yes and no questions. Likert scale is a scale that is often used in market research to collect data on the opinion of consumers. Theses scales usually ranges from five, seven- or ten-point scale. This invites respondents to express his/her opinion about how much s/he agrees or disagrees with a particular statement. Usually it involves a finite number of pre-coded levels, each with its own label, and where the middle level is "neutral" (Ghauri and Grønhaug, 2010).

In this study the respondents were asked to express their opinions on 34 out of 37 items with seven levels ranging from "Totally disagree" to "Totally agree". Since the questions are pre-

coded the respondents must choose between already defined and coded answer options. This makes it easier for the respondents to answer and in that way gives a higher response rate on the survey.




### 4.3.2 Pre-test

Before the survey was published on Facebook a pre-test was conducted. This means that one can test the survey in a smaller scale before the final version are published. One should go through the questionnaire critically or have a friend or colleague to do this and give comments. In a pre-test one should check whether the abovementioned issues such as understanding, the level of difficulty, the willingness to answer sensitive questions as well as the time it takes to answer the questionnaire (Ghauri and Grønhaug, 2010).

In this study a pre-test was conducted on four respondents. Two fellow students and two who had no relation to either smart city or the background of the survey. Based on the pre-test two questions were removed since they explained the same thing, a few errors in the text were corrected and a new question were added to explore citizens adoption and intention to use digital technology in the form of a mobile application. The pre-test indicated that the survey took approximately 5-6 minutes to finish.

## 4.4 Validity

As previously mentioned, the choice of research design involves and assessment of what makes the results valid and relevant, as well as reliable. Validity is defined as the extent to which a concept is accurately measured in a quantitative study. For example, a survey is designed to explore depression, but which actually measures anxiety would not be considered valid. In other words, the extent to which a research instrument consistently has the same

results if it is used in the same situation on repeated occasions (Heale and Twycross, 2015). The validity shows the extent to which we have data that is valid or relevant to the issues to be elucidated.

There are several types of validity tests that are used to test the goodness of measures. The most common tests however are content validity, face validity, criterion-related validity and construct validity (Sekaran, 2003).

### 4.4.1 Content Validity

Content validity looks at whether the instrument adequately covers all the content that is should with respect to the variable. Meaning that the questionnaire includes adequate set of items that tap all the concepts. According to Shekaran & Bougie (2016) the more the scale items represent the domain of the concept being measured, the greater the content validity. As previously mentioned, this study conducted a survey based on a proposed framework with ten independent variables. These ten variables were based on previously published literature in order to understand the factors affecting citizen adoption of mobile government services via smartphones (dependent variable). With all research and models there are several ways of finding a solution to your proposed research question; fewer independent variables could simplify an already proposed model, while more independent variables could extend and enhance the validity of a proposed model. In this case, the validity and reliability of the proposed framework of Almuraqab and Jasimuddin (2017) will work as an extension to the TAM and through this study it will be tested as a valid framework to use on a small city or not, in a smart city context.

Furthermore, a subset of content validity is *face validity,* this is where experts measures their opinion about whether an instrument measures the concept intended (Sekaran, 2003). It also indicates that the survey at “first glance” must seem reasonable to the respondents. However, this will of course be a subjective assessment case to each respondent. As mentioned, the survey was tested through a pre-test and based on the feedback received the survey looked reasonable, easy to understand and logical. Previously tested questionnaires from similar studies were used to create the questionnaire, assuring that the questionnaire has a high degree of face validity.

### 4.4.2 Construct validity

Construct validity testifies to how well the results obtained from the use of the measure fit the theories around which the test is designed. This is assessed through *convergent* and *discriminant* validity (Sekaran, 2003). One establishes a convergent validity when the scores obtained with two different instruments measuring the same concepts are highly correlated. Easily put; it is the degree to which two variables measured separately bear a relationship to one another. Discriminant validity on the other hand is established when, based on theory, two variables are indeed empirically found to be so (Sekaran, 2003). In this study a factor analysis will be conducted to analyze the dependency relationship between the concepts in the model, which explain the concepts common underlying dimensions, the factors. The correct choice of data analysis method could also help strengthen the statistical validity. However, I will go into more detail on methods for analyzing data in a later section.

Furthermore, the biggest disadvantage in this study is the population sample that has been convenient chosen and thus reduces the likelihood of having a representative sample. Which consequently could reduce the external validity of the survey. External validity shows whether the results given by the study are transferable to other groups of interest (Sekaran, 2003). It will therefore be difficult to generalize the findings in the study to other groups that are not represented in the sample since the survey is likely to have a low external validity. This must be accounted for when applying knowledge from the results.

## 4.5 Reliability

In quantitative research, reliability refers to stability, consistency repeatability of results and trustworthiness of a research, that is, the result of a researcher is considered reliable if consistent results have been obtained in identical situations but different circumstances (Haradhan, 2017). In a research setting one need both validity and reliability. The easiest explanation of the two is given by Altheide & Johnson (1994): Reliability is referred to the stability of findings, whereas validity is represented the truthfulness of findings. There are several ways to secure the reliability of a study; *test-retest reliability*, *control questions* and *consistency tests* are just a few of them.

In this study an investigation of the degree of internal consistency between the indicators from the independent variables were conducted through a consistency test. This is done by studying the Cronbach Alpha Value. Cronbach's Alpha is an estimated score between 0 and 1 which indicates how many percentages of the variance that is being explained by a composite score. A rule of thumb about Chronbach-Alpha coefficient size is that 0.6 to <0.7 is seen as moderate, 0.7 to <0.8 is good, 0.8 to <0.9 is very good and >=0.9 is excellent. Which means that the higher the score, the more reliable the scale is (Sekaran, 2003).

In this study a test for Chronbach's Alpha has been conducted in SPSS to test the reliability to the independent variables in the study. However, a more detailed explanation to this analysis will be done later in the results chapter.

## 4.6 Data analysis

After receiving a sufficient sample from the survey, the questionnaire is closed for respondents to answer. The answers received is then pre-coded in Nettskjema before it is exported into SPSS. However, before one start to analyse the results the data file must be prepared in the form of screening and cleaning the data for errors or potential outliers.

First and foremost a descriptive analysis will be conducted in order to describe the basic features of data, for example, the number and percentage of males and females in the sample, the range and mean of ages etc (Pallant, 2016). Furthermore, a reliability analysis, factor analysis and structural equation modeling will be conducted.

### 4.6.1 Reliability analysis

When selecting scales to include in a study, it is important that they are reliable. Easily put, a reliability analysis refers to the fact that a scale should consistently reflect the construct it is measuring. Do the items that make up the scale "hang together" and measure the same underlying construct? The best and most commonly used indicators on internal consistency is Cronbach's Alpha coefficient and ideally the Alpha coefficient of a scale should be above 0.7 (Pallant, 2016).

### 4.6.2 Factor Analysis

The questionnaire consisted of 33 questions related to ten factors that has an impact on the dependent variable, citizens intention to use digital technology in the form of a mobile application. When conducting a factor analysis, one wants to comprise a series of statements that measure the same construct or variable to which respondents indicate their degree of agreement/disagreement (Pallant, 2016). This type of scaling is called summated rating scale and will be done in this analysis.

Factor analysis is a technique that is used to reduce a large number of variables into fewer numbers of factors. It does this by looking for "clumps" or groups among the intercorrelations of a set of variables. Easily put; it is a "data reduction" technique. There are two main approaches to factor analysis – *exploratory and confirmatory.* An exploratory analysis will often be used when it is unclear how many factors that are present in the dataset (Pallant, 2016). Often in the early stages of a research to explore the interrelationships among a set of variables. Since an already existing model is being used in this study a confirmatory factor analysis will be conducted too see whether the proposed model measure what it was intended to do.

### 4.6.3 Structural Equation Modelling

The regression analysis will be conducted through the software program SPSS AMOS and by using Structural Equation Modeling, or SEM. This method is presumed to provide a viable estimation of the set of causal pathways between observed variables and the dependent variable. Easily put it can be seen as a combination of factor analysis and regression or path analysis. It provides a very general and convenient framework that allows you to visualize a proposed model through a graphical path diagram where the model fit, issues of estimation and statistical assumptions are provided as output (Hox and .Bechger, 1998). The rationale for choosing this model is based on the belief that such a model is more representative of real and actual conditions than models that do not permit multiple dependent relationships simultaneously. Perhaps the most important strength of SEM is that it can examine the relationships among numerous latent constructs in a way that reduces the model error. This function allows evaluation and ultimately elimination of variables characterized by weak measurements (Jr et al., 2013). Another valid point is that this technique allows a

simultaneous examination on the impact of several independent variables on a dependent variable. Which is the case in this study.

# Chapter 5 Results

In this chapter the results from the questionnaire and the analysis from the data set will be investigated. Firstly, the results from the descriptive analysis will be highlighted. Furthermore, a reliability test and a factor analysis will be conducted. And finally, the conceptual framework will be tested using structural equation modelling in SPSS AMOS.

## 5.1 Descriptive Statistics

Based on the questionnaire a lot of material and data were received. Through a descriptive analysis I have received information from the 121 respondents, ranging in age from 18 to 71 years old, with a mean of 34.41 and a standard deviation of 13.49. The frequencies of sex were 49 men (40.5 %) and 72 women (59.5 %).

**Descriptive Statistics**

| | N | Minimum | Maximum | Mean | | Std. Deviation |
|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic |
| Hvor gammel er du? | 121 | 18 | 71 | 34.41 | 1.226 | 13.491 |
| Valid N (listwise) | 121 | | | | | |

*Figure 6: Age descriptive*

**Kjønn?**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Mann | 49 | 40.5 | 40.5 | 40.5 |
| | Kvinne | 72 | 59.5 | 59.5 | 100.0 |
| | Total | 121 | 100.0 | 100.0 | |

*Figure 7: Sex descriptive*

Descriptive analysis also provides some information concerning the distribution of scores on continuous variables (skewness and kurtosis). The skewness value provides an indication of the symmetry of the distribution. While Kurtosis on the other hand provides information about the "peakedness" of the distribution. Simply put, if the distribution is perfectly normal,

you would obtain a skewness and kurtosis value of 0. However, this is rather uncommon in social sciences (Pallant, 2016).

From appendix 1 one can see that the mean score for each of the claims are well above the average score of 4, indicating that most of the respondents "agree" or "totally agree" to the claims. A general guideline for skewness is that if the number is greater than +1 or lower than -1, it could be an indication of a substantially skewed distribution. For Kurtosis on the other hand, a number greater than +1 indicates that the distribution is too peaked, and a kurtosis of less than -1 indicates a distribution that is too flat.

Based on this one can see that the distribution of skewness values indicates a clustering of scores at the high-end rate on most of the claims. As wells as relatively high positive Kurtosis values indicating that the distribution is rather peaked with long thin nails (Pallant, 2016). In this study this indicates that many of the respondents have answered relatively equal. The question related to facilitating conditions (FC2) for example has a very high Kurtosis. However, this can be explained by looking at the mean column which indicates that most of the respondent's answers are close to maximum. In order to test the normality of the distribution of scores Kolmogorov-Smirnov statistics were run, giving it a non-significant result of .000.

### 5.1.1 Familiarity to the Smart City Concept

By asking the question "How familiar are you with the Smart City concept?" one can form an opinion on how well the sample knows about the concept. Based on the respondents answers one can see that 57 % of the respondents are not particularly familiar with the Smart City concept, and with a mean score of 3.23 this confirms that.

Furthermore, out of curiosity the question "Do you think Smart City is a good idea?" was introduced at the ending of the questionnaire. Ironically, based on the little information provided about Smart City in the questionnaire, lead to 92,6 % of the respondents saying that Smart City is a good idea with a mean value of 6.12.

Based on the descriptive analysis one can see that the average age on the respondents are approximately 34 years old and mostly female respondents. This indicates that there is a good

spread between younger and older respondents well represented from both genders. However, as previously mentioned due to a convenience sample and the fact that the survey was posted on Facebook one could miss out on the older generations and those non-tech savvy's opinions. This will be taken into account for the discussion of the study.

## 5.2 Testing of Measurement model

### 5.2.1 Reliability Analysis

Before proceeding with a factor analysis, a reliability test was conducted in SPSS. This in order to measure the Chronbach's Alpha value and see if each factor is stable enough to be used as a scale. From appendix 2 one can see that the Chronbach's value of each factor is above the acceptable value of .7, besides Trust in government technology.

The constructs Chronbach's value were: *PEOU = .712, PU = .921, FC = .764, Trust in Government Technology = .651, Trust in Technology = .807, Social Influence = .737, Risk = .758, Compatibility = .859 and Awareness = .769.*

In addition to calculate the Chronbach's value a reliability analysis investigates if the factors will increase if a question is deleted from the factors. This was the case for the factors *Trust in government technology* and *compatibility* where one question was removed from each factor in order to increase the Chronbach's value. This must be taken into account for the rest of the study. Furthermore, based on a negative Chronbach's value the Risk2 question was negatively worded and needed reversing to help prevent response bias.

The Cost factor is left out of the figure since this was only measured by one question in the survey, which gives a value of 1.

### 5.2.2 Factor analysis

Since a proposed framework, established from previously published literature was used in this study a confirmative factor analysis was conducted with the assumption of finding 9 factors.

Keeping in mind that the Cost factor is only measured by one question, hence it is not included in the analysis.

A separate factor analysis was conducted on each of the independent variables to see if each question correlated to what you are trying to measure. To verify if the data is suitable for a factor analysis one checks the Kayser-Meyer-Olkin Measure (KMO) and the Bartlett's test of Spehricity value if it is significant or not. 7 out of 9 factors had an acceptable value above .6, while Facilitating Conditions and Perceived Compatibility had a KMO level of .5. Ideally it should be higher, however, it is not at an unacceptable level to proceed with the analysis (Cerny and Kaiser, 1977). From the Bartlett's test all of the factors were significant. See appendix 3 for results.

Based on the analysis one can see the results of the item loadings related to each question in appendix 4. It is ideally with high factor loadings since this indicates that each question has a strong association against the factor and thus it is clear which factor it belongs to. Furthermore, the factor analysis confirms the assumption that each question is well connected to the 10 independent variables proposed in the model.

Based on the results from the factor analysis summated scales were created on each of the 9 factors and keeping Cost as an independent variable without summating. The two questions that was removed in the reliability analysis were not included in neither the factor analysis nor the summated scales.

## 5.3 Structural Equation Modelling

After testing the data sets reliability (Chronbach's Alpha) and validity (factor analysis) the research model in this study was tested using the structural equation modelling (SEM), using the computer software program SPSS AMOS 25. With regard to selecting model fit statistics to report Kline (2016) recommends reporting the Chi-Squared test, the Root mean Square error of approximation (RMSEA) and the Comparative fit index (CFI), this will be highlighted throughout the results chapter.

By running a Chi-squared test of absolute model of fit one can see the difference between observed and expected covariance matrices. Whereas values closer to zero indicate a better fit. The Chi-Square test of the original model has a value of 464.853 with 306 degrees of freedom, returning a probability level smaller than .05 and one can reject the null hypothesis that the model fits the data. A relative ($X^2$/d*f*) Chi-Square is also calculated as a measure of model fit, with values of 5 or less being used as benchmark, which in this study is 1.519.

Since the Chi-Square test of absolute model fit is sensitive to sample size and non-normality, researchers often turn to various descriptive fit statistics to assess the overall fit of model to the data. The RMSEA and CFI are usually two very informative measures to report since they indicate how close the model corresponds with the data. The RMSEA ranges from 0 to 1, with smaller values indicating better model fit. A cut-off value close to .06 or a stringer upper limit of .07 seems to be the general consensus amongst researchers (Hooper et al., 2008) and will also be the limit in this study. The RMSEA measured in the original model were 0.66. A value of CFI ≥ 0.95 is recognised as an indicative of a good fit and has progressed to be one of the measures least effected by sample sizes and is therefore reported in this study (Hooper et al., 2008).

| Model fit Indices | Values | Recommended Guidelines |
|---|---|---|
| $X^2$ | 464.853, p < = .001 | Non-significant |
| $X^2$ /d*f* | 1.519 | < 5 |
| RMSEA | .066 (90 % Confidence Interval: .053, .078) | < .07 |
| CFI | .923 | > .95 |
| | | |

*Table 2: Fit Indices for the original Measurement Model*

Results from the estimation of the original model yielded a relatively adequate fit of the data (Chi-Square $X^2$ = 464.853, df = 306, p = .000, $X^2$/df = 1.519, RMSEA = .066, 90% Confidence interval: .053, .078, CFI = .923)

When evaluating the model as a whole one look at the models R square. Due to a small sample size the adjusted R square ($R^2$) will be measured since the R square value tends to be a

rather optimistic overestimation of the true value in the estimation (Pallant, 2016). In this study, the $R^2$ value is .80 on citizens intention to use. Expressed as percentage this means that our model explains 80 % of the variance as a whole. This indicates that the model fits the data and does a good job explaining changes in the dependent variable. However, the $R^2$ does not indicate if the regression model provides an adequate fit to this study's data. So, even though the R Square value is high, it does not necessary mean that the data fits the model, especially since this study try to interpret and explain human behaviour. A good model can have a low $R^2$. One should keep this in mind when interpreting the results.

Results from the estimation of the original model yielded a relatively adequate fit of the data. However, although the model indicates there is a good fit one must look at the P value for the independent variables to see if they have a statistically significant unique contribution to the equation. Based on the results from the regression weights of the SEM one can see that Perceived Usefulness (PU) is the only independent variable that has a significant impact on citizens intention to use digital communication technology in the form of a mobile application. In other words, the regression weight for PU in the prediction of IntentionUse is significantly different from zero at the 0,001 level (two-tailed). The other independent variables made a contribution to Intention to use, however, they did not have a significant impact. Indicating that the model does not adequately work in this context.

| | | ESTIMATE | S.E | C.R | P |
|---|---|---|---|---|---|
| **INTENTIONUSE** | ←SocialInfluence | .370 | 1.180 | .313 | .754 |
| **INTENTIONUSE** | ←PEOU | .572 | 2.831 | -.203 | .839 |
| **INTENTIONUSE** | ←PU | .998 | .291 | 3.434 | *** |
| **INTENTIONUSE** | ←Awareness | -.087 | .115 | -.758 | .448 |
| **INTENTIONUSE** | ←FacilitatingCond | .387 | 1.355 | .286 | .775 |
| **INTENTIONUSE** | ←TrustGovTech | 1.194 | 2.516 | .475 | .635 |
| **INTENTIONUSE** | ←TrustTech | .543 | 2.816 | .193 | .847 |
| **INTENTIONUSE** | ←Risk | -.994 | 3.550 | -.280 | .779 |
| **INTENTIONUSE** | ←Compatibility | .068 | .203 | .335 | .738 |

*Table 3: Regression Weights*

**Perceived cost is removed from the model due to no mediating effect*

# Chapter 6 Discussion

In this chapter, an interpretation of the statistical findings from the survey and statistical analysis will be presented. Furthermore, a parsimonious model will be delivered in order to simplify the given model that had never been tested, up until now. Finally, the study's limitations will be presented along with suggestions for further research.

The main contribution in this study has been to see citizens intention to use digital communication technology in the form of a mobile application in a smart city context. With a proposed framework, developed by Almuraqab and Jasimuddin (2017), citizens intention to use were tested on a small city in Norway. The original framework led to ten propositions that present the key factors that influence the successful implementation of smart government services. The model is built on the already well-established TAM (Perceived ease of use & Perceived usefulness) and on existing literature.

Since the model has never been tested before it will be difficult to compare the results from this study's findings to previous findings. However, the model fits the data and does a good job explaining changes in the dependent variable. This indicates that the model as a whole is relatively good, but it does not provide an adequate fit to this study's data. This is also clear when we look at the P (significance) value of each of the independent variables in the model. Only one out of nine independent variables have a significant contribution on citizens intention to use. The rest have no significant effect. Based on this information one can say that the proposed framework does not work in the context of measuring citizens intention to use digital communication technology. The original model initially has room for improvement.

The model does not work in this context since there are too many factors that do not have any significant relationship between each other. In addition, they have no statistical significance on citizens intention to use (dependent variable). A good example can be highlighted by looking at the well tested variables Perceived ease of use (PEOU) and Perceived usefulness (PU) from Davis's TAM. From table 2 one can see that PEOU is not statistically significant when the whole model is run simultaneously. However, running structural modelig with only PEOU and PU, the original TAM model, each of the variables has a unique significant

contribution to the equation and with an $R^2 = .78$. This indicates that just as much of the model is explained using just two variables instead of nine, making it a more parsimonious model. Support for the concepts of TAM have been carefully tested and validated in countless studies that have produced the same result (Davis, 1989, Venkatesh and Davis, 2000). Hence, the two variables are expected to have a sig. value below .05. PU still has the highest impact on citizens intention to use (.768) and PEOU with a lesser impact (.158). This is in line with previous research that also shows that the strongest determinants of intention to use is PU (Venkatesh and Davis, 2000).

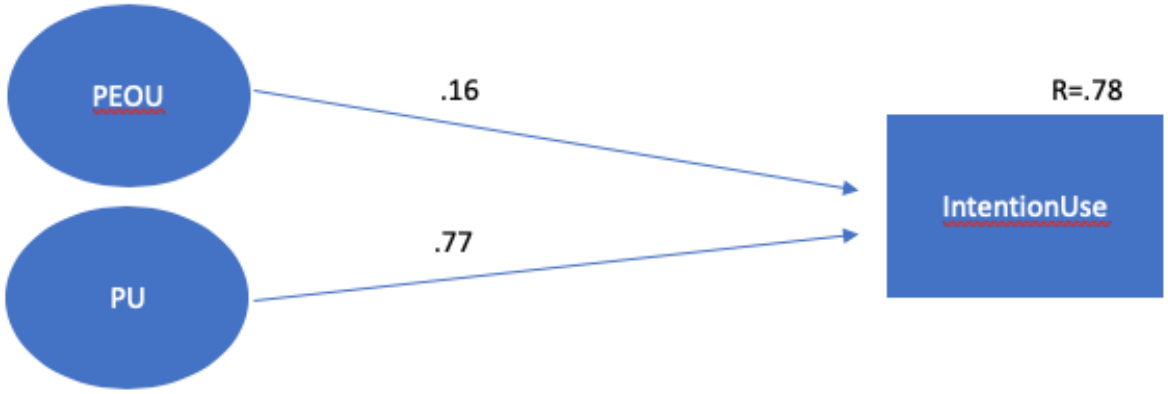



*Figure 8: Original TAM Model*

*(Chi-Square $X^2 = 45.243$, $df = 25$, $p = .008$, $X^2/df = 1.810$, RMSEA = 0.82, 90 % Confidence Interval: .042, .120, CFI = 970)*

Based on the information provided from the original model and the TAM one can see that the model fit is adequate for each of the models. However, there are too many independent variables that have no significant influence on the dependent variable and leads to collinearity between the variables. E.g. causing the TAM variables to have the wrong P value.

Easily put, the original model as a whole explained almost the same as with only two independent variables (PU and PEOU). This indicates that the other independent variables should not have a direct influence on the dependent variable, but rather as antecedents perhaps to PEOU and PU. It can therefore be argued that the model strengthens the validity of Davis's original TAM model. Furthermore, a parsimonious model is presented. Meaning that one should use the right amount of predictors needed to explain the model well.

Hence, instead of ten independent variables, as it were in the original model, a new and revised model is presented using Structural Equation Modelling.

## 6.1 New Revised model

The revised model will continue to strengthen Davis's original TAM model as the only two independent variables that has a significant contribution to citizens intention to use. However, this does not mean that the other variables are useless but may rather play a role as antecedents to PEOU and PU. By looking at figure 8 one can see a visualisation on how these variables might play a role and how they influence each other.

One can logically explain why *Awareness, Risk, Trust in Technology and Trust in Government Technology* had no significant and direct influence on citizens intention to use, which was the case in the original model. As previously mentioned, without awareness of a service available, it will be difficult for users to see the need of it. Awareness is people's knowledge of technology and the availability of electronic services (Venkatesh et al., 2003). Since the mobile application referred to in this study is a service that has not been experienced and that people are not fully aware of it will be difficult to have a direct link to their intention to use the service. And without the awareness of a service it will be difficult for the end-user to have an opinion if they have the necessary facilities, resources, equipment and assistance to support the use of the mobile application. This is also the case for its compatibility, without awareness about the service, it is difficult to say if the technology is compatible to the end-user. Hence, awareness has an impact on Facilitating Conditions and Compatibility.

Perceived risk is defined as a consumer's perceptions of the uncertainty and the possible undesirable consequences of buying a product or service (Fagih, 2011). In this model one sees that perceived risk has a direct impact on end-user's trust in technology and their social influence. The behaviour of citizens is heavily affected by perception of risk. End-users are frequently uncertain as to the implications or consequences of a decision or action (Almuraqab and Jasimuddin, 2017). Referring to the Corona example from the theory chapter one could see that end-users didn't want to share their personal data due to the risk and trust in the given technology. Referring to appendix 6 one can see that with higher risk involved it has a significant impact on their social influence.

Trust in technology and trust in government technology has a significant impact on each other and is not surprising since these factors measures a correlated concept.
With rationale thinking one can argue that without trust in technology you will most likely not have trust in the technology provided by the government or local municipality. Easily put, you need trust in technology in order to have trust in government technology. This is also statistically proved in this study. A government that faces greater mistrust and suspicion may discover its citizens find ways to ignore and resist its actions and are suspicious of its pronouncements and policies. Previously research has also found a higher level of trust in government correlate with more intensive e-government service use, indicating that those who are satisfied with such services are also more trusting of government. Hence, citizens are less reluctant to provide information if they are confident that it will not be misused by authorities, obtained by private parties through security failure, corruption or used in ways not intended by, and against the interests of them (Horsburgh et al., 2011). Trust in technology and government technology is therefore an important factor for governments and local municipalities when providing services and new technology to its citizens. This was also tested in the revised model by incorporating trust in technology and trust in government technology to the TAM variables. However, based on tests from the new model trust in government technology only had an influence on PU and not PEOU, and can therefore play a role as an antecedent to PU. Again, the example with the mobile application Smittestopp gives an indication on how reluctant citizens can be in sharing their personal information and trustworthiness into the given technology, and also shows that both risk, trust in technology and trust in government technology have an impact on the TAM framework on both attitude and intention to use. This also supports Belanche's (2012) findings of integrating Trust in the TAM framework.

The other antecedents are not logically connected to the TAM variables but have been tested and proved to have an impact based on previously research. According to Venkatesh et al (2008) facilitating conditions have limitations in capturing the effects of external impediments to system use. Facilitating conditions does not directly affect the use of the system, because this variable reflects recognition of the existence of (or lack of) favourable conditions. They argue that the use of the system depends on whether and to what degree an individual expects that facilitating conditions will enable system use, considering other potential behavioural impediments. The measure of facilitating conditions in this study mainly focuses on support

and assistance for users, however, it does not take into account individual's beliefs about the ease of use and usefulness of a given technology. Thus, in the new model facilitating conditions are evaluated in the light of technological impediments which can be captured both through perceived ease of use and perceived usefulness. However, since FC had no significant impact on PU, it was removed from the model.

Venkatesh et. Al (2003) define social influence as the degree to which an individual perceives that "important others believe" (for example friends and family) they should use the technology and that social influence is crucial in shaping user behaviour. The paper of Sathye et al (2018) found SI to have a significant positive association with intention to use. However, they did not only demonstrate that SI had a positively impact on intention to use, but that its impact gets transmitted through the constructs of PU and PEOU. This is also the case in the new revised model as it indicates that social networks (family and friends) has a positively and significantly impact on PU and PEOU. Indicating that their findings support the findings of the new model. Social influences significantly impact individual perceptions about usefulness and perceived ease of use of technology (Sathye et al., 2018).

Since Perceived compatibility had no significant impact on citizen intention to use in the original model, I have argued that it may be seen as an antecedent to the strongly supported TAM variables. From my findings one can see that Compatibility has a significant impact on PU and not far from a significant impact on PEOU (.017) with a 95 % confidence interval, see appendix 6.
These findings are supported by the research of Isaac et al. Their findings validated perceived compatibility as an antecedent variable on TAM (2016). Indicating that the more the citizens found the mobile application and technology to be consistent and compatible with their beliefs, values, lifestyle and needs, the more they would see the application as easy to use, flexible, understandable and can be used to accomplish their tasks quicker and easier.

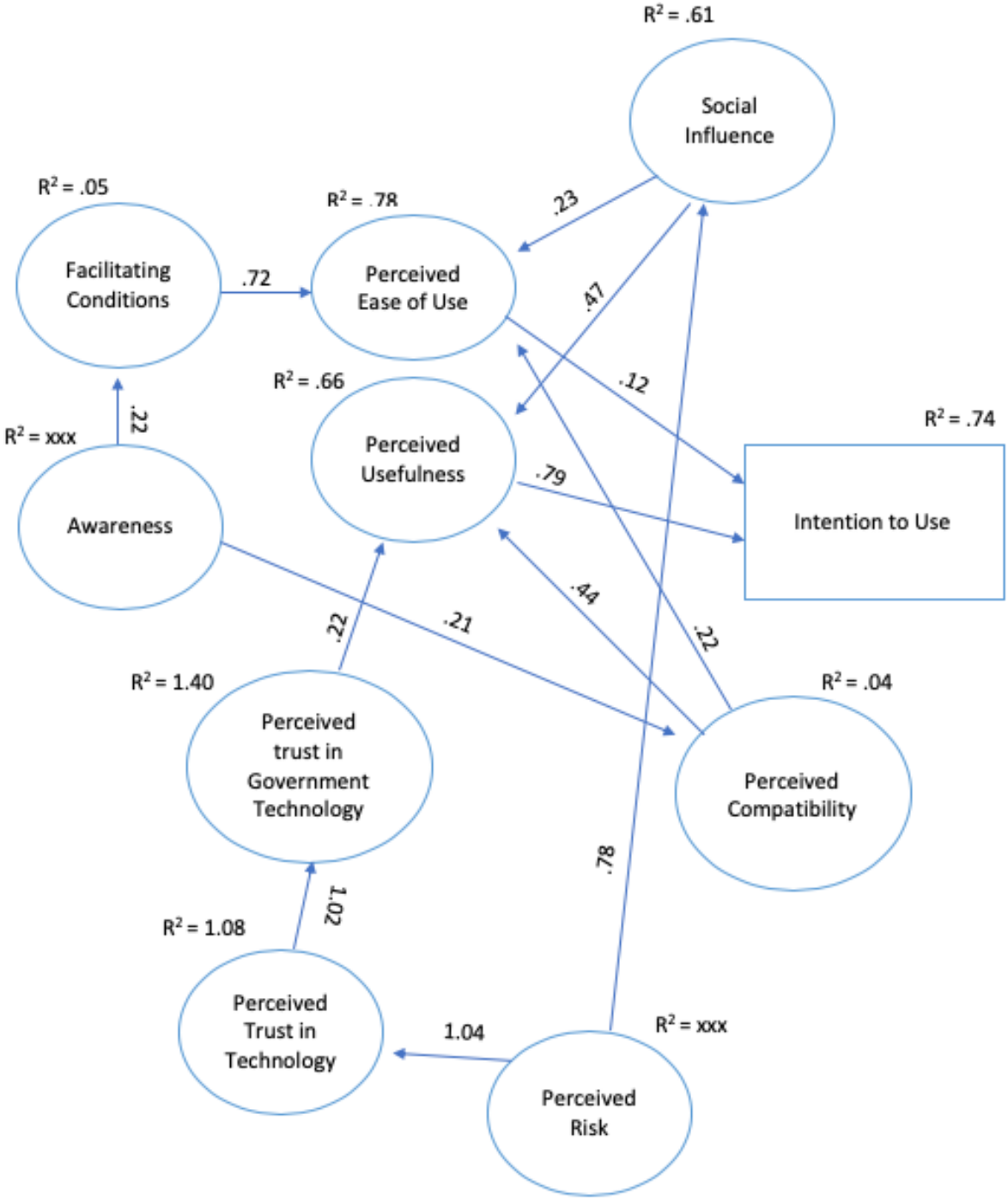



*Figure 9: New Revised Model*

*(Chi-Square $X^2$ = 510.655, df = 332, p = .000, $X^2$/df = 1.538, RMSEA = 0.67, 90 % Confidence Interval: .055, .078, CFI = 913)*

From the new and revised model one can see that there is support for the TAM variables PU and PEOU on citizens intention to use digital communication technology. However, PEOU

has a P level of .072 on intention to use which means that it is not significant with a 95 % confidence level. Nonetheless, it does not mean that one rejects it's influence on intention to use but rather focus on it as a measure of precision. According to Hardy and Bryman "as when setting confidence intervals, there is nothing sacrosanct or magical about these numbers, either Z or alpha. They are entirely conventional choices, and one is free to select a different number. Typically, one begins with a value of alpha that is personally acceptable and that will be acceptable to one's audience" (2009). "Increasing the significance level to a higher value (e.g. .10) allows for a larger chance for being wrong, but also makes it easier to conclude that the coefficient is different from zero" (Joseph F. Hair et al., 2009)
In this new revised model, a confidence interval of 90 % is set. Keeping in mind that the study measures citizens intention to use a service, and not a health study for example where an Alpha above 0.01 (99%) would not be accepted.

## 6.3 Summary Discussion

The original model has now been tested in a European context on a smaller scale. Based on the results from the structural equation modeling one can say that in the context of measuring citizens/end-user's intention to use a digital communication technology, through their smartphones, it does not work. As a result of this a new parsimonious model was created and tested based on the variables used in the original model. What this research found was that 7 out of 10 independent variables rather play a role as antecedents to the already well-established TAM model, due to the fact that they had no significant impact on intention to use (Dependent variable).
Measuring end-user's intention to use the service is not a question that one can easily answer, but it's a variable that plays a significant role in the user decision that needs to be explored.

The respondents were asked "How likely are you to use such a service?" and 95 % of the 121 respondents agreed that this was a service they would like to use with a mean score of 6.06. Indicating that there is a potential market for this type of service, and it receives support from the respondents for using a mobile application to improve communication between the local municipality and its citizens. Possibly making it easier to encourage to more citizens involvement and collaboration in order to create future smart cities.

The study's implications are directed at implementers and developers or governments. These bodies need to guarantee the usefulness, the ease of using a mobile application, the secured trust in both technology and government technology, increase awareness and be aware of the citizens facilitating conditions among others. These factors will improve the real usage of mobile government by smartphone users and stimulate citizen's desire to use mobile government services. That will enhance the performance of the government and save both citizens and organizations' costs, time and availability. Gaining citizen trust in technology and government technology is the key to encouraging society to use and speak about the mobile government service, initially increasing the intention to use it. This is also supported from the findings of Almarashdeh and Alsamadi research on citizens acceptance of mobile government services (2017).

The main contribution of this paper is that it focuses on the acceptance and intention to use of digital communication technology, which is considered a foundation for smart city development. A new and validated model were developed which can support citizen centric smart city implementation in a developed European city. The present paper contributed to both research and practice in the context of technology acceptance of digital communication technology.  First and foremost, the paper contributes to the smart city literature by testing a proposed framework, hence making a parsimonious model, by relating the technology acceptance model in a smart city context. The study identified additional antecedents to perceived usefulness and perceived ease of use such as social influence, perceived compatibility, facilitating conditions and perceived trust in government technology. In addition, perceived risk, awareness and trust in technology were found to not have a significant impact on the TAM variables. However, they were found to influence indirectly through correlations between those independent variables that had a direct influence on the TAM, leading to citizens intention to use (dependent variable).

## 6.4 Limitations and Directions for Future Research

As with any research, this study is not without limitations. The biggest limitation in this study is the small sample size. Although there is nothing wrong with conducting well-designed small studies, one must interpret the results carefully. One major benefit is that it can give you quick results, however it may not yield reliable or precise estimates. As a result, one should

be careful about making strong conclusions about risk factors or trial intervention, whether the results are positive or not. However, data from this study can be used as a base layer for designing larger confirmatory studies (Hackshaw, 2008). For example, by testing the new revised model on the Asian continent with a larger sample from the United Arab Emirates. Which was the purpose of the proposed conceptual framework to begin with.

Further on, the lack of knowledge about the characteristics of the respondents, and thus the sample may be a limitation. Since no person characteristic questions were asked and the questionnaire were completely anonymous it will be difficult to generalize their answers to the entire population. The studies choice of distribution method may also contribute to the fact that people in the researcher's network were those who responded to the survey. This may have led to a smaller spread in age than is desirable in order to represent the population of Aalesund municipality, as well as missing out on the opinions of the older generation and those non-tech savvy. This could lead to a sample that has high technological capabilities, which may lead to a ceiling-effect. Attempting to extend the sample to include multiple respondents from all age groups, and including personal characteristics, (e.g. family situation, education and job description) could complement future research and increase the overall reliability and validity.

A final limitation, the choice of the TAM model. The original model was developed at the organizational level where it was assumed that people had used the system before. Meaning that they had some degree of experience with the system and had already made up their mind about the usability of the system. However, in this study the respondents were introduced to a service they had never experienced before. This in itself is a weakness since the respondent's prerequisite for making statements about usefulness and ease of use is weakened. To compensate for this, some information about what the mobile application could provide were given to the respondents before answering the questions. Furthermore, in order to contribute to increased understanding of the applications services, questions related to previous experience with mobile services provided by the local municipalities were asked.

Although the study presents strong evidence regarding the factors that affect citizens intention to use a mobile service in a smart city context, it does not comprehensively cover all the factors. Future studies should take into account other important variables. E.g. the effect of cultures since different elements have a dissimilar impact on diverse cultures.

One of the interesting things about this study is the time it was completed. With the Corona Virus affecting many people's lives, both in terms of perceived risk, trust in technology and social influence from family, friends, society and governmental restrictions. With this in mind it would be interesting to see if the perceived trust in governmental technology would be the same in another small city in Norway and if this situation had an impact on their opinions. Either positive or negative. And not only in Norway and Europe, but also in other continents.

# Chapter 7 Conclusion

In recent years, the concept of smart cities has come to the fore. And it is rapidly gaining momentum and worldwide attention as a promising response to the challenge of urban sustainability. Through extensive literature on both smart city, smart government, technology acceptance models and theories one can see that one of the most important factors for succeeding with smart city projects is by putting citizens at the center. By mapping and listening to the citizen's views on how smarter, safer and more sustainable communities can be developed. The purpose of this thesis is to address and highlight the key factors that influence citizens intention to use digital communication technology in the form of a mobile application, and thereby guide the successful implementation of smart government. The overall research question stated in this thesis is:
*"Which factors influence citizen intention to use digital communication technology?"*

Through the collection of data from 121 respondents in Aalesund city this study has tried to answer this question. A proposed framework was presented and tested on this sample, whereas several factors supposedly had a direct influence on Intention to use digital communication technology (Dependent variable). However, this study found no support for the proposed framework as nine out of ten independent variables had no significant impact on intention to use.

Based on structural equation modeling support for the two TAM variables, Perceived Ease of Use and Perceived Usefulness, were found to explain almost as much of the variance as a whole as the original model. This is also in line with previous research and application of the TAM model and continuous to strengthen the predicative power of the model. Hence, a new parsimonious model was developed through this thesis, seeing the other independent variables play a role as antecedents to PEOU and PU, either through direct effect or indirectly.

The findings help to facilitate the process of smart city transformation by understanding the key behavioural factors that influence and affect citizens intention to use and adopt technology acceptance. These factors can provide a deeper understanding of citizens behavior towards the adoption of digital communication technologies, particularly through smart government services.

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# Appendix

## Appendix 1: Descriptive Statistics Variable Level

| | Minimum | Maximum | Mean | Std.dev | Skewness | Kurtosis | N |
|---|---|---|---|---|---|---|---|
| Perceived Ease of Use | | | | | | | |
| PEOU1 | 3 | 7 | 6.27 | .837 | -1.507 | 3.154 | 121 |
| PEOU2 | 3 | 7 | 6.37 | .941 | -1.909 | 3.893 | 121 |
| PEOU3 | 1 | 7 | 5.90 | 1.121 | -1.606 | 3.253 | 121 |
| PEOU4 | 2 | 7 | 5.93 | 1.104 | -1.399 | 2.108 | 121 |
| | | | | | | | |
| Facilitating Conditions | | | | | | | |
| FC1 | 1 | 7 | 6.40 | 1.013 | -2.548 | 8.277 | 121 |
| FC2 | 2 | 7 | 6.55 | .730 | --2.741 | 12.447 | 121 |
| | | | | | | | |
| Perceived Usefulness | | | | | | | |
| PU1 | 2 | 7 | 6.07 | .989 | -1.184 | 1.812 | 121 |
| PU2 | 2 | 7 | 6.02 | 1.060 | -1.457 | 2.736 | 121 |
| PU3 | 1 | 7 | 5.93 | 1.058 | -1.352 | 3.232 | 121 |
| PU4 | 1 | 7 | 6.02 | 1.125 | -2.031 | 5.873 | 121 |
| | | | | | | | |
| Trust in Technology | | | | | | | |
| TrustTech1 | 1 | 7 | 5.70 | 1.054 | -1.591 | 4.355 | 121 |
| TrustTech2 | 1 | 7 | 5.45 | 1.265 | -1.071 | 1.179 | 121 |
| TrustTech3 | 2 | 7 | 5.51 | 1.205 | -.785 | .478 | 121 |
| | | | | | | | |
| Trust in GovTech | | | | | | | |
| TrustGov1 | 2 | 7 | 6.39 | .943 | -2.489 | 7.957 | 121 |
| TrustGov2 | 1 | 7 | 5.69 | 1.210 | -1.284 | 2.021 | 121 |
| TrustGov3 | 2 | 7 | 5.27 | 1.197 | -.277 | -.787 | 121 |
| TrustGov4 | 1 | 7 | 5.13 | 1.466 | -.927 | .374 | 121 |
| | | | | | | | |
| Social Influence | | | | | | | |
| Social Influence1 | 2 | 7 | 5.95 | .965 | -1.088 | 1.812 | 121 |
| Social Influence2 | 3 | 7 | 5.68 | 1.010 | -.794 | .196 | 121 |
| Social Influence3 | 2 | 7 | 5.88 | 1.050 | -1.081 | 1.292 | 121 |
| | | | | | | | |
| Risk | | | | | | | |
| Risk1 | 1 | 7 | 5.57 | 1.203 | -1.103 | 1.517 | 121 |
| Risk2 | 1 | 7 | 3.90 | 1.463 | .305 | -.920 | 121 |
| Risk3 | 2 | 7 | 5.02 | 1.313 | -.653 | -.332 | 121 |
| | | | | | | | |
| Cost | 3 | 7 | 6.58 | .739 | -2.419 | 7.840 | 121 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Compatibility | | | | | | | |
| Comp1 | 1 | 7 | 5.48 | 1.379 | -.994 | .520 | 121 |
| Comp2 | 2 | 7 | 6.31 | .857 | -1.789 | 5.080 | 121 |
| Comp3 | 2 | 7 | 6.35 | .863 | -1.688 | 4.489 | 121 |
| Intention to Use | 2 | 7 | 6.06 | 1.098 | -1.730 | 4.095 | 121 |

## Appendix 2: Results Reliability Test Chronbach's Alpha

| **Scale** | **Chronbach's Alpha** | **Mean (Min, Max)** | **Including** |
|---|---|---|---|
| PEOU | .712 | | PEOU1, PEOU2, PEOU3, PEOU4 |
| Perceived Usefulness | .921 | | PU1, PU2, PU3, PU4 |
| Facilitating Conditions | .764 | | FC1, FC2 |
| Trust in government technology | .651 | | TrustGov1, TrustGov2, ,TrustGov4 |
| Trust in technology | .807 | | TrustTech1, TrustTech2, TrustTech3 |
| Social Influence | .737 | | SocialInfluence1, SocialInfluence2, SocialInfluence3 |
| Risk | .758 | | Risk1, Risk2, Risk3 |
| Compatibility | .859 | | Compatibility2, Compatibility3 |
| Awareness | .769 | | Awareness1, Awareness2, Awareness3 |

## Appendix 3: KMO and Bartlett's Test

| | KMO AND BARTLETT'S TEST |
|---|---|
| **PEOU** | .711 |
| **PU** | .855 |
| **FACILITATING CONDITIONS** | .500 |
| **TRUST IN GOVERNMENT TECH** | .615 |
| **TRUST IN TECHNOLOGY** | .640 |
| **SOCIAL INFLUENCE** | .686 |
| **RISK** | .661 |
| **COMPATIBILITY** | .570 |
| **AWARENESS** | .668 |

## Appendix 4: Pattern Matrix

| **Pattern Matrix** | **Factor** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Perceived Ease of Use1 | .849 | | | | | | | | |
| Perceived Ease of Use2 | .784 | | | | | | | | |
| Perceived Ease of Use3 | .668 | | | | | | | | |
| Perceived Ease of Use4 | .670 | | | | | | | | |
| Facilitating Conditions1 | | .909 | | | | | | | |
| Facilitating Conditions2 | | .909 | | | | | | | |
| Perceived Usefulness1 | | | .889 | | | | | | |
| Perceived Usefulness2 | | | .911 | | | | | | |
| Perceived Usefulness3 | | | .925 | | | | | | |
| Perceived Usefulness4 | | | .873 | | | | | | |
| Trust in Government Tech1 | | | | .664 | | | | | |
| Trust in Government Tech2 | | | | .834 | | | | | |
| Trust in Government Tech4 | | | | .804 | | | | | |
| Trust in Technology1 | | | | | .807 | | | | |
| Trust in Technology2 | | | | | .914 | | | | |
| Trust in Technology3 | | | | | .825 | | | | |
| Social Influence1 | | | | | | .823 | | | |
| Social Influence2 | | | | | | .803 | | | |
| Social Influence3 | | | | | | .803 | | | |
| Perceived Risk1 | | | | | | | .867 | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Perceived Risk2 | | | | | | | .746 | | |
| Perceived Risk3 | | | | | | | .863 | | |
| | | | | | | | | | |
| Perceived Compatibility2 | | | | | | | | .936 | |
| Perceived Compatibility3 | | | | | | | | .936 | |
| | | | | | | | | | |
| Awareness1 | | | | | | | | | |
| Awareness2 | | | | | | | | | .825 |
| Awareness3 | | | | | | | | | .877 |
| | | | | | | | | | .783 |

## Appendix 5: Summated Scales Syntax

```
COMPUTE PEOU=(PEOU1+PEOU2+PEOU3+PEU4)/4.
EXECUTE.
COMPUTE FacilitatingConditions=(FacilitatingConditions1+FacilitatingConditions2)/2.
EXECUTE.
COMPUTE PerceivedUsefulness=(PU1+PU2+PU3+PU4)/4.
EXECUTE.
COMPUTE TrustGovTech=(TrustGov1+TrustGov2+TrustGov4)/3.
EXECUTE.
COMPUTE TrustTech=(TrustTech1+TrustTech2+TrustTech3)/3.
EXECUTE.
COMPUTE SocialInflu=(SocialInfluence1+SocialInfluence2+SocialInfluence3)/3.
EXECUTE.
COMPUTE Risk=(Risk1+Risk2+Risk3)/3.
EXECUTE.
COMPUTE Compatibility=(Compatibility2+Compatibility3)/2.
EXECUTE.
COMPUTE Awareness=(Awareness1+Awareness2+Awareness3)/3.
EXECUTE.
```

## Appendix 6: Regression Weights New revised model

| | | ESTIMATE | S.E | C.R | P |
|---|---|---|---|---|---|
| **TRUSTTECH** | ←Risk | .798 | .064 | 12.534 | *** |
| **TRUSTGOVTECH** | ←TrustTech | .560 | .085 | 6.557 | *** |
| **FC** | ←Awareness | .185 | .097 | 1.911 | .056 |
| **COMPATIBILITY** | ←Awareness | .186 | .093 | 2.007 | .045 |
| **SOCIALINFLUENCE** | ←Risk | .504 | .068 | 7.410 | *** |
| **PEOU** | ←FC | .510 | .090 | 5.647 | *** |
| **PU** | ←TrustGovTech | .342 | .165 | 2.070 | .038 |
| **PU** | ←Compatibility | .371 | .067 | 2.386 | *** |
| **PEOU** | ←Compatibility | .144 | .060 | 2.386 | .017 |
| **PEOU** | ←SocialInfluence | .185 | .066 | 2.806 | .005 |
| **PU** | ←SocialInfluence | .473 | .137 | 3.444 | *** |
| **INTENTIONUSE** | ←PEOU | .212 | .118 | 1.802 | .072 |
| **INTENTIONUSE** | ←PU | 1.084 | .117 | 9.275 | *** |

## Appendix 7: Model fit statistics New revised Model

**CMIN**

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 102 | 510,655 | 332 | ,000 | 1,538 |
| Saturated model | 434 | ,000 | 0 | | |
| Independence model | 56 | 2430,772 | 378 | ,000 | 6,431 |

**Baseline Comparisons**

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | ,790 | ,761 | ,915 | ,901 | ,913 |
| Saturated model | 1,000 | | 1,000 | | 1,000 |
| Independence model | ,000 | ,000 | ,000 | ,000 | ,000 |

**RMSEA**

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | ,067 | ,055 | ,078 | ,010 |
| Independence model | ,213 | ,205 | ,221 | ,000 |

## Appendix 8: The Survey

### Smart City Ålesund

Side 1

### Innbyggerinvolvering i Smart City

Kjære respondent.

Denne spørreundersøkelsen er en del av min masteroppgave ved Norges teknisk-naturvitenskapelige universitet (NTNU). Undersøkelsen handler om innbyggerinvolvering for smarte og bærekraftige kommuner og lokalsamfunn ved bruk av digitale verktøy.

Det vil ta ca. 5 minutter å gjennomføre undersøkelsen og den er fullstendig anonym.

Hvis du har spørsmål til undersøkelsen ta kontakt med:

Martin Skulstad (student) på e-post:

martskul@stud.ntnu.no

På forhånd takk!

Sideskift

Side 2

Mobile digitale tjenester har et enormt potensial til å bli et av regjeringens mest effektive verktøy for å tilby sine tjenester til publikum. Mobilen er nå viktigste digitale kanal for mange, og en brobygger mellom den fysiske verden og digital informasjon.

Fokuset på smarte byer og samfunn har ført til fornyet interesse for innbyggerinvolvering, da særlig med utgangspunkt i at ny teknologi åpner opp for nye former for kommunikasjon og samhandling med innbyggerne.

Eksempel på tidligere tilbudte løsninger er:

FRAM-appen, Min renovasjon, EasyPark, Smittestopp

Side 3

Smart City er i følge Smarte Byer Norge definert som:

En smart by/kommune bruker digital teknologi og innovative metoder for å gjøre kommunen bedre for innbyggerne og kommunen mer produktiv.

Hvor kjent er du med konseptet Smart City? *

- ○ Helt ukjent
- ○ Ganske ukjent
- ○ Ukjent
- ○ Hverken kjent eller ukjent
- ○ Kjent
- ○ Ganske kjent
- ○ Helt kjent

Hvor ofte benytter du en Smarttelefon? *

- ○ Aldri
- ○ Sjelden
- ○ Av og til
- ○ Nøytral
- ○ Ofte
- ○ Svært ofte
- ○ Alltid

Side 4

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| En mobilapplikasjon er lett og enkel å ta i bruk * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg kan lære meg å benytte en mobilapplikasjon uten hjelp * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Å bruke en mobilapplikasjon krever ikke mye mental innsats * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ved å ta i bruk i en mobilapplikasjon gjennom din Smarttelefon, ville det vært enklere å kommunisere direkte med din lokale kommune * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg har de nødvendige kunnskapene for å ta i bruk en mobilapplikasjon * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg har de nødvendige ressursene for å ta i bruk en mobilapplikasjon * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Side 5

Gitt at du hadde en mobilapplikasjon hvor all kommunal informasjon ble lagt ut for å holde seg oppdatert, samt selvbetjeningsløsninger til ulike skjemaer, sider og oversikter. For eksempel søknad om barnehageplass, informasjon om avfallshenting, ledige parkeringsplasser, stillingsannonser, rapportering av dårlige veier og lignende.

Kommunikasjonen vil da gå begge veier og en kan som innbygger rapportere feil og mangler med bilde og posisjon direkte til kommunen.

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Tjenesten vil være nyttig i min hverdag * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Tjenesten vil gjøre at jeg sparer tid * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Tjenesten vil være verdifull for meg * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Tjenesten vil være en effektiv måte å ha en to-veis kommunikasjon med kommunen * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Jeg forventer at kvaliteten på mobil-applikasjoner tilbudt av kommunen er god * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg stoler på teknologien som kommunen tilbyr meg * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg stoler på at kommunen har mine beste interesser i tankene * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg behøver ikke oppgi noe sensitiv informasjon for å benytte meg av mobilapplikasjoner fra kommunen * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Side 7

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Jeg tillater kommunen å hente ut (mine) data som kan benyttes til utvikling av fremtidens smartby/bedre kommunalt tilbud. * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg stoler på kommunens tjenester når det er tilgjengelig til enhver tid * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg stoler på kommunens tjenester når brukergrensesnittet er attraktivt * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Sideskift

Side 8

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Det er forventet at personer som meg bruker en slik tjeneste * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Personer som er viktige for meg vil anse denne tjenesten som fordelaktig/enkel * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg vil bruke en slik tjeneste der-som venner/familie anbefaler dette * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Side 9

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Mobiltjenester tilbudt av kommunen virker trygt * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg tror det er fare for at sensitiv informasjon kan havne hos feil person * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg tror at tjenester tilbudt av kommunen vil holde mine personlige opplysninger trygge fra uautoriserte personer * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Mobiltjenester tilbudt av kommunen skal være kostnadsfritt * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Sideskift

Side 10

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Å benytte seg av en slik tjeneste gjør at jeg kan kommunisere med kommunen hele døgnet * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg vil benytte meg av en slik tjeneste når det kan spare tiden min * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg vil benytte meg av en slik tjeneste når det kan spare utgiftene mine * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Side 11

## På en skala fra 1-7, hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Hvor sannsynlig er det at du vil ta i bruk en slik tjeneste? * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Sideskift

Side 12

## På en skala fra 1-7, hvor enig er du i følgende påstand?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Tror du Smart City er en god ide? * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Side 13

## Basert på tidligere erfaring med mobiltjenester tilbudt av kommunen (FRAM-appen, Min renovasjon, EasyPark, Smittestopp), hvor enig er du i følgende påstander?

| | 1. Svært uenig | 2. Uenig | 3. Noe uenig | 4. Hverken enig eller uenig | 5. Noe enig | 6. Enig | 7. Svært enig |
|---|---|---|---|---|---|---|---|
| Jeg føler jeg har god kunnskap om fordeler, funksjoner og tjenester for mobile kommunale tjenester * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Jeg har fått nok informasjon og veiledning om hvordan jeg bruker mobile kommunale tjenester * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Generelt sett er jeg fornøyd med de nåværende bevissthetskampanjene og annonseringene om mobile kommunale tjenester i Ålesund * | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

Litt om deg:

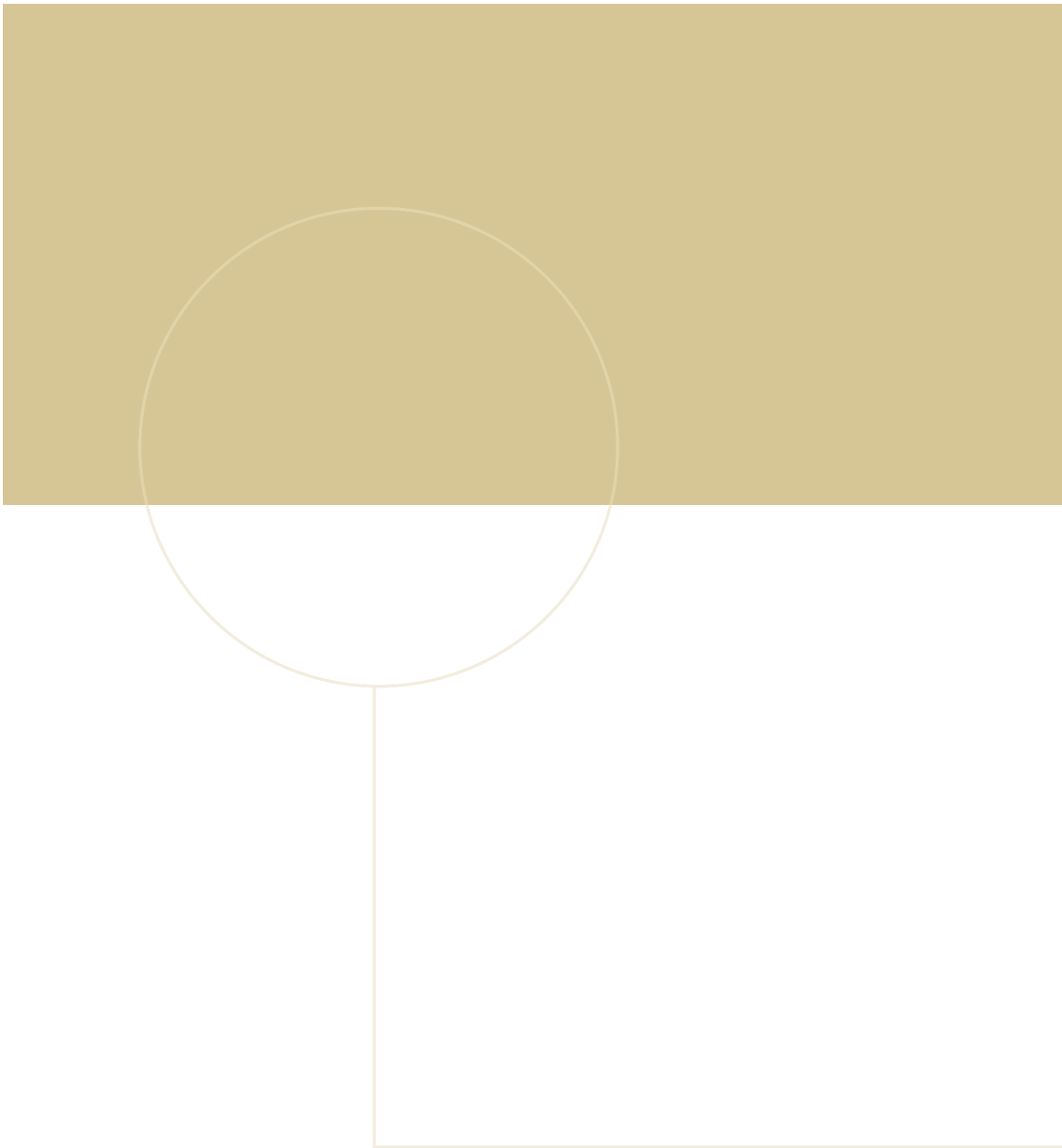
Hvor gammel er du? *

Kjønn? *

- Mann
- Kvinne

Bor du i Ålesund kommune? *

- Ja
- Nei



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