Citizens' Perception and Adoption of Smart Solution. A Study of Citizens in Smart Cities

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Preface

This master's thesis marks the end of the master's degree in Information Systems at the University of Agder 2021. It has been a rewarding journey, while at times challenging.

The topic of smart cities is interesting and very relevant as we move towards a smarter everyday life. To be able to work on this topic has been a rewarding opportunity, and hopefully, the findings from this study can give relevant smart city actors an insight into citizens' perspective on smart cities and why the focus on citizens' is important.

The completion of this thesis has been possible thanks to the support, help and guidance of our supervisors. We would like to thank Professor Ilias O. Pappas and Professor Devendra. B. Thapa. Thank you for dedicating your time and patience to help and guide us through this thesis, and all the feedback to make it better. We would also like to thank all the participants partaking in this study.

This master's thesis was made possible thanks to all of you.

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Abstract

The smart city topic has gained increased popularity in the last decade, and many cities want to take part in this city transformation through digitalization. The benefits of smart city solutions and applications are considered as a strategic means to cope with multiple global and local challenges such as pollution, energy expenditure and digitalization to name a few. Although these smart solutions are driven by advanced information technologies such as IoT and Big data, the technologies alone are not enough for it to be successful. Smart solutions are highly dependent on user engagement and trust in technology as an enabler for their intention to use.

This thesis aims to investigate the research question of "*How do citizens' familiarity and concerns of smart cities affect their trust and adoption of smart solutions?"* To answer this, we conducted a research study in Norway. A literature review was conducted to get an understanding of what topics past literature covered on smart cities, this helped to develop constructs and hypotheses. We proceeded with both a quantitative and qualitative research approach. This entailed a survey receiving 102 respondents and conducting 12 semi-structured interviews. The collected data was analyzed using SPSS statistics, SmartPLS and data field notes. Findings were presented by using figures, tables, and texts. Results show that Familiarity, concern, and trust towards smart city technologies influences the user adoption. The analysis of data showed interesting findings that correlates to past literatures and gave insight into the citizens' perceptions of smart technologies. This is then discussed in further details by looking at the effect these factors have on the adoption of smart solutions. The main contribution through this study is to emphasize the importance of citizens' role in a smart city and its initiatives. Attention should be paid to Citizens' perspectives as they will determine whether a smart solution will be successful or not.

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1. Introduction

Smart city is an interesting topic with a high degree of relevance today. The term is used to describe the usage of data, information, and communication technologies (ICT), different sensors and internet of things (IoT) to improve the quality of life for the citizens (Chourabi et al., 2012). Modern technology has made data collection more efficient, leading to improved possibilities to benefit from the data. According to Coletta et al. (2018), we are already living in a Smart-city-age, where an assembly of networked technologies are used to mediate plenty of everyday-life aspects.

As technology becomes more central in our everyday lives, concerns have been raised regarding the development and implementation of smart city technologies. Coletta et al. (2018) points out that “Smart city technologies and initiatives are often created with little or no critical reflection on consequences beyond their desired effects” (Coletta et al., 2018, p. 3). On the other hand, researcher have also looked at a certain consequence of smart city technologies in a positive manner, for example the large amount of data generated from smart services.

As the digitalization of cities has led to the concept of smart city gaining more popularity, plenty of attention has been placed on the digital transformation. For this digital transformation to take place the role of smart cities and smart city services are key for its success. Through digitalization of services and transformation of contemporary business models, the creation of a sustainable society is accelerated (Pappas et al., 2018). Big data has been pointed out to be of importance in the creation of a sustainable society (Pappas et al., 2018), and the collection of this type of data through smart city services based on IoT and ICT is possible as IoT generates plenty of data. As digital transformation and the creation of sustainable societies requires the analysis of large amount of data to create successful digital transformations and sustainable societies, smart city services play an important role as it aids digital transformation while providing large amount of data that can be analyzed for the benefit of societies.

Smart city designers are utilizing modern technologies to create the cooperation and interaction between smart city components and the network architecture. The complexity of the changes and the new methods needed for citizen interaction leads to changes in existing infrastructure (Ismagilova et al., 2020). A current key challenge with smart city development is the processing and management of data which can impact security and privacy (Van Zoonen, 2016). The success of a smart solution is therefore dependent on how well the technological challenges are resolved. Another factor of smart solution success is the dependency on the engagement of citizens as potential service users (Peng et al., 2017).

Some researchers have recognized the shortcomings of the technological focus of smart city initiatives, and as mentioned by Gooch et al. (2015), smart cities must start with people rather than believing that technologies can by itself improve cities. Van Zoonen (2016), says that the issue with focusing on technical solutions is that citizens themselves and their privacy concerns are not addressed, further on she mentions that research on actual citizen behavior in smart cities are scared. Some research has looked at the citizen's awareness of the smart city concept in a country where the concept is still relatively new, and found out that the majority of citizens do not know the term (Cagáňová et al., 2019). Likewise in a country with a similar situation, a study was performed to look at citizens' perception of smart cities, with findings indicating that citizens are interested in how smart cities could improve their quality of life even though they do not have any experience with it (Georgiadis et al., 2021).

The purpose of this study is to connect literature about smart cities with data from quantitative research of the citizens of Norway. A literature review is conducted to get the theoretical background needed to address the challenges. Using this knowledge, we will find out more about the perspectives of the citizens regarding awareness of the smart city concept, potential concerns and to what degree they are adapting the smart city concept. To make this possible a survey is conducted, and a qualitative interview will be performed to gain more insight on the citizens, this leads us to the following research question:

"*How do citizens' familiarity and concerns of smart cities affect their trust and adoption of smart solutions?"*

The topic of smart city has gained increased popularity in the last decade. The development of city initiatives has focused on using technology to improve quality of life for the citizens. Privacy concerns have been stated for the increased connectivity of objects to the internet (IoT), and the citizens using these services are the ones that could be most heavily affected. To find out how these concerns might affect the citizens' adoption of such technologies, we decided to investigate how the citizens perceive the concept of smart city. The relevance of the smart city topic in combination with our interest for how smart cities will advance in the future has been a driving force for this study.

Several literatures are looking at the issues and concerns of smart cities, however few are looking at it from the citizens' perspective (Ijaz et al., 2016; Rubisz, 2020; Wu et al., 2018). One main goal of a smart city is to improve the quality of life of its citizens. It would therefore be beneficial to look at the situation from the perspective of citizens of a smart city. Getting a better understanding from the citizens could result in better smart city services that targets the citizens' needs, or the findings could showcase what concerns citizens have regarding privacy and/or security. These findings can be helpful for smart city actors to find solutions on how to get citizens involved in smart city services by easing their concerns and fears for digital changes.

2. Theoretical Background

The theoretical background presented in this section is based on a systematic literature review. The literature review was done using the online database (i.e., Scopus and google scholar) to look for relevant research. Smart city, privacy, concerns, trust, and adoption were some of the few keywords used to find relevant literature. The literature was aimed to be from the year 2015 and newer, to give us the most updated research available.

This section will start off by looking at the definition of the smart city topic and the technologies related to the topic. Secondly, we will look at the importance ofcitizens' role in smart cities. Lastly, we will connect the smart city topic with citizens-centric views, in order to answer the research question of how aware are the citizens of smart city concept, how such technologies are valued and if this affects their adoption of smart city initiatives.

2.1 Smart Cities

The smart city concept is gaining increased popularity worldwide as the need for optimization of cities and urban spaces becomes of importance. The current global demographic trend indicates the need for efficient management of urban spaces to guarantee a sustainable environment for the citizens (Hernández-Ramos et al., 2021). The term smart city has seen an increased rate of usage, however, there is still not a consistent understanding of the concept among practitioners and academia (Chourabi et al., 2012).

Several definitions were found during the conduction of the literature reviewfor this study. The definitions were either adopted from other research, while some tried to define the term in their own research. Looking at all these definitions, some common keywords repeatedly used for describing smart cities have been identifiedas, sustainability, quality of life, ICT, technology, etc. (Fernandez-Anez, 2016). Fernandez-Anez (2016), mentions that the quality of life is the most important objective of smart cities, and further on provide a definition based on analysis of other smart city definitions,

A Smart City is a system that enhances human and social capital wisely using and interacting with natural and economic resources via technology-based solutions and innovation to address public issues and efficiently achieve sustainable development and a high quality of life on the basis of a multi-stakeholder, municipally based partnership (pp. 164).

A proper definition of smart city might be difficult to achieve, because of the field's multidisciplinary nature, however, there are multiple existing frameworks that define relevant factors which make up a smart city. Chourabi et al. (2012) suggest such a framework consisting of nine factors (figure 1). In the context of this paper, the focus point will be on people and their perception of technology as a factor for their willingness to adopt a smart city and its initiatives. Several concerns regarding increased usage of technology in the character of IoT, ICT and sensors relates to privacy and security concerns (Abosaq, 2019). Though smart cities will bring benefitsto its citizens, the smart city initiatives and solutions still pose technical, social, and legal challenges which must be addressed (Hernandez-Ramos et al., 2020). Another challenge is the engagement of citizens to use smart services to realize itsfull potential, which relates to citizens having knowledge about the possibilities and a willingness to use them (Peng et al., 2017). To increase the knowledge about technologies and its effects on citizens it is important to try to understand some of the terms used in conjunction with the topic of smart city.

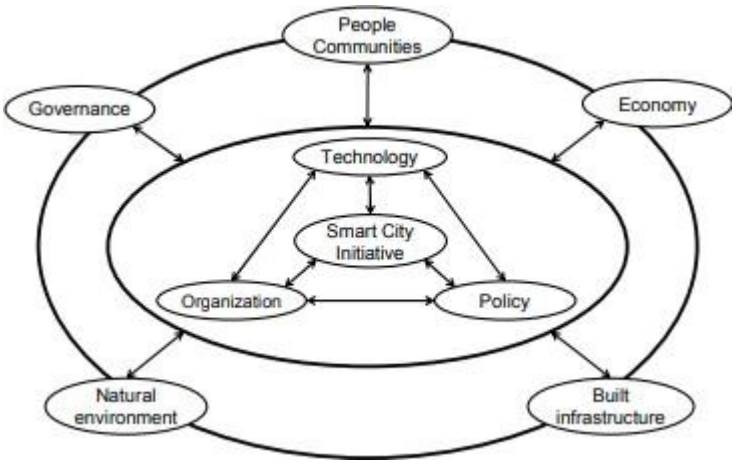

Figure 1 Smart city initiatives framework (Chourabi et al. 2012).

2.1.1 Technologies

The ambition of smart cities is the drive to adopt new technologies, to ensure that their critical infrastructure and utilities are managed more efficiently (Oliveria & Campolargo, 2015). Changes are happening quickly and on a significant scale in cities to cope with the challenges such as demographic shifts, mobility, environmental impact, sustainability, quality of life, etc. (Fernandez-Anez, 2016; Oliveira & Campolargo, 2015), these changes in turn pressures the municipalities to incorporate smart technologies (Jin et al., 2014). Technologies have without a doubt improved the aspect of quality of life, though several concerns about privacy and security have been raised by researchers (see, e.g., Abosaq, 2019; Hernández-Ramos et al. 2021; Ismagilova et al., 2020; Van Zoonen, 2016).

It is possible to say that the citizens intention for using a digitized or electronic service (e-services) depends on their willingness to adopt such services, this leads to the need of understanding factors citizens perceive to be of importance when deciding whether to use or not to use this type of e-services (Carter & Bélanger, 2005). Carter & Bélanger (2005) highlights three such factors that impact a citizen's intention to use e-services as, compatibility, ease of use, and perceived trustworthiness. It will be of interest to look at how these factors in combination with the technological concerns could affect the citizens' adoption of smart city technologies.

At the core of smart cities, large volumes of data can be found, this is known as big data. Big data offers the city the potential to obtain valuable insights. To be able to gather, store and move the data, technologies such as IoT are necessary as it provides interconnection of objects and things so that smart environments are created (Arasteh et al., 2016). This digitalization of societies due to technological trends, enables new ways for living and knowledge sharing (Oliveira & Campolargo, 2015).

For the context of this paper, the technologies of IoT and big data are deemed to be most relevant. Although smart cities consist of other technologies, such as ICTs which are key drivers of smart city initiatives (Chourabi et al., 2012), we find it unnecessary to elaborate on ICT. This is because the importance of ICT is emphasized in the context of IoT, regarding the interconnectivity of objects with communication technologies.

Internet of Things

IoT is recognized as one of the most important areas of future technology and has gained increased attention from a wide range of industries (Lee & Lee, 2015). The ability of IoT to utilize the internet to incorporate heterogeneous devices with each other (Arasteh et al., 2016), enables the devices and machines to communicate and interact with each other (Lee & Lee, 2015). IoT enables several possibilities for smart cities, one such example is the ground heating system SMELT in Kristiansand. This is done by using data from the weather forecaster Yr.no to control ground heating to melt snow and ice during winter, this automatization helps reduce the energy consumption by automatically regulating itself based on the information from the weather forecaster (Eilertsen, 2018).

A more recent example of a smart solution based on IoT, is the capacity indicator for busses at Agder kollektivtrafikk (AKT) as a response to Covid-19. This technology uses sensors to count the passengers of the bus then deliver this information to the “AKT reise” application and the digital bus tables makes it easier for passengers to decide whether to board the coming bus or the next (Morvik, n.d).

Through the usage of IoT, a large amount of data can be collected. When the volume of the data becomes too large for traditional data-processing applications, it then becomes classified as big data. Having access to this amount of data gives the possibility to extract information and make it into knowledge, thus big data can be used to create value.

Big Data

With smarter cities, more IoT will be used which in turn leads to an exponential increase in data generated. The enormous volumes of data are what big data is about (Hashem et al., 2016). An estimation on the amount of IoT devices is said to reach 24 billion by 2020, thus suggesting that IoT will be one of the main sources of big data (Botta et al., 2016). The benefit of big data is that it offers potential value to cities as large amount of data can be stored and analyzed to obtain value. By utilizing the correct tools, big data can advance the services in smart cities, resulting in benefits for many sectors in a smart city (Hashem et al., 2016). Hashem et al. (2016) shares two examples on how big data can benefit smart cities:

1. Healthcare can be enhanced by improving preventive care services, diagnosis and treatment tools, healthcare records management, and patient care.
2. Transportation systems can greatly benefit from big data to optimize routes and schedules, accommodate varying demands, and increase environmental friendliness.

2.1.2 Smart City Services

With a rapid advancement and utilization of smart ICT, the smart city services are becoming more of a norm. Many cities are expanding their efforts to become “more digitized”, “more intelligent” and “smarter” to be more competitive (Lee & Lee, 2014). By investing in their infrastructure, cities are trying to improve the performance of the relevant city services to become more efficient, sustainable, and friendlier for citizens by improving their quality of life (Weber & Zarko, 2019). Weber & Zarko (2019) gives two examples of typical smart city services: smart metering, used for monitoring of household energy consumption in real time; and smart parking which can significantly reduce traffic jams, and is often one of the first services to be deployed in a city.

Although smart city services can give the citizens plenty of benefits, an important factor highlighted by Jararweh et al. (2020) is on the adoption and trust the stakeholders have on such services and solutions. A city is a complex entity that plays multiple roles in serving various aspects of citizens’ lives, smart city services therefore need to cover several different areas. A typology is created by grouping functionally related services together for administrative convenience (Lee & Lee, 2014), with the most notable areas of smart cities being:

- Transportation,
- Healthcare,
- Energy,
- Public security,
- Building management,
- Waste management and,
- Education

(Peng et al., 2017).

Smart city services can bring several benefits to a city, for example under the umbrella of smart transportation we find smart parking. With smart parking services, drivers can find parking quicker which in turn can help reduce pollution, fuel consumption, and alleviate traffic congestions (Lin et al.,2017). With the help of sensors placed around unauthorized areas to detect illegal parking, fewer resources are needed to be spent on patrolling such areas which in turns benefits the city's economy (Lin et al., 2017).

Another example to look at is the smart waste management in the form of smart bins from Guardforce. By using IoT and sensors a smart bin can detect how full the bin is, and automatically engages a mechanism that compresses the trash to optimize the space of the bin. The advantages of smart bins include reduction of waste collection by up to 80%, reduction of number of waste bins needed, analytic data to manage collection routes based on which bins are full, and improved environment in the form of no overflowing bins (Guardforce, 2019).

Both examples mentioned above are types of Smart city services that can help solve future and current demands and thus result in improvement of citizens' life and the environment. On the other hand, a questionable smart city service is surfacing in China. The Chinese government is trying to implement a social credit system as a smart service. As Síthigh & Siems (2019) says, this system will change the fundamental life of the Chinese citizens. The system is based on placing a score on the citizens, which is used to measure citizens' sincerity, honesty, and integrity, which in turn will be a major determinant for their lives. This rating system will impact their possibility to get a credit, rent a flat, purchase plane tickets or even be given preferred access to hospitals, universities, and government services (Síthigh & Siems, 2019).

The example of scoring its citizens' highlights first and foremost surveillance and other ethical issues, which is of great importance to consider when developing smart city services. Utilization of technologies can bring both benefits, and challenges which must be addressed. Privacy and security aspects need to be considered toensure integrity and safety for the citizens.

2.1.3 Privacy

With the introduction of newer and smarter city services, an increment of technology usage takes place. The increased usage of technologies could lead to issues or concerns regarding different aspects of technology. One such example is privacy concerns which has been regarded as a key challenge. Privacy has been identified by several national and international organizations as a key policy, regulatory, and legislation challenge of the 21st century (Van Zoonen, 2016). As IoT advances and transforms current urban spaces, the interconnection of physical and everyday devices impacts privacy more significantly. This change also dictates that the attack surface for hackers increases, which could result in citizens' safety being compromised (Hernández-Ramos et al., 2021).

Even though people show concerns for their privacy getting affected, the “privacy paradox” seems to get the better of them. According to Van Zoonen (2016), the privacy paradox is used to describe the situation where people clearly express concerns about their privacy, but simultaneously lack the appropriate secure behavior. Examples of such behavior is the sharing of personal information on social media sites, even though they do not feel secure on it or the fact that the most popular pin code used is 1234, or that the same passwords are used on multiple accounts (Van Zoonen, 2016).

Privacy and security challenges are emulated in all types of technology, the complex and interdependent nature of smart city makes it even more important and raises political, sociotechnical, and technical challenges for the stakeholders involved (Ismagilova et al., 2020). The users of these technologies can vary, it therefore becomes necessary to understand the concept of how privacy can be understood (Kitchin, 2016). This can vary between cultures and contexts, and from everyday use and legal concepts. Privacy relates to the concerns of practices regarding disclosing, using, and accessing sensitive and personal information about individuals (Kitchin, 2016). When trying to figure out smart cities’ privacy and security challenges, it is important to realize that many of the same challenges exist today, but not as frequently as when these technologies become fully interconnected (Braun et al., 2018).

This might indicate that current solutions and attempts to solve security and privacy challenges in technology, can lead the way to understanding how smart cities can be securely developed in the future. Security and privacy of information in a smart city has been an interesting topic for researchers. To ensure the continuity of critical services like health care, governance and energy/utility issues in a smart city, the individuals’ privacy and information security must be foolproof due to the amount of information shared. Ijaz et al. (2016), identifies three factors that are taken under consideration to identify the issues in information security in a smart city. These factors include governance factors, socio-economic factors, and most importantly technological factors (Ijaz et al., 2016).

Data collection should be done lawfully and the citizens' rights to privacy needs to be considered. Regarding respecting the rights of citizens, a solution is toseek permission to collect data. The data collected should not be used for other purposes than what it is intended for, meaning that only relevant data specified beforehand are collected. Norwegian citizens are protected by the Data Protection Regulation (GDPR), implemented in 2018 where it was made into Norwegian law (Regjeringen, 2019).

2.1.4 Security

Security is about the protection of both physical or digital data, the goal of information security therefore consists of the protection of information from attacks, viruses, frauds, and other vicious activities that may cause harm (Ijaz et al., 2016). To ensure the security of information, the CIA Triad is used. The CIA Triad is a model forinformation security described with the three characteristics of Confidentiality, Integrity, and Availability (CIA). The CIA model is sometimes extended with the addition of accountability as well (Warkentin & Orgeron, 2020). Warkentin & Orgeron(2020), gives a short explanation of the four parts of the CIA triad as:

1. Confidentiality relates to the protection of data from unauthorized access

2. Integrity concerns the protection of data validity against undesired changes.

3. Availability refers to the accessibility of information (and systems) to authorized individuals and processes in the form and format needed.

4. Accountability refers to the ability to trace performed activities to a specific individual or process which cannot be repudiated.

To assess the security levels of the devices or systems used in smart cities, there is a need for techniques complemented with continuous and automated security evaluation methods on a certain level. The reason is to be able to automatically react against potential threats or attacks. There are also legal restrictions that are determined by complying with the GDPR and other regulatory aspects that must be addressed to secure the ecosystem of smart cities. These are some of the few challenges on the technical and legal requirement aspect which must be addressed according to Hernández-Ramos et al. (2021). Some other security and privacy issues in smart cities that are worth mentioning are unauthorized access, and weak encryption schemes *(Abdulghani et al., 2019)*. Abdulghani et al. (2019) highlights two situations where this occurrence can take place as:

1. IoT objects have limited capabilities such as, computer power, memory, and bandwidth. Because of this, direct implementations of security mechanisms in IoT objects can be difficult.

2. The lack of security and privacy guidelines for IoT along with appropriate mitigation techniques.

To improve the IoT security and privacy designs, guidelines are needed. These guidelines give IoT stakeholders the opportunity to learn and use countermeasures from early stages of IoT system development. Overlooking these guidelines when dealing with IoT data at rest, can increase the likelihood of attacks and threats *(Abdulghani et al., 2019).*

The conception of smart cities is still under evolution and researchers have taken an interest in the security of information. As the need to identify the core threats of information security is of importance for the various technologies, IoT has been the key interest of researchers as it is the core technology which smart cities are being developed and maintained on (Ijaz et al., 2016). Several security threats and issues in smart cities are highlighted by Ijaz et al. (2016), and a figure visualizing has beenprovided at figure 2.

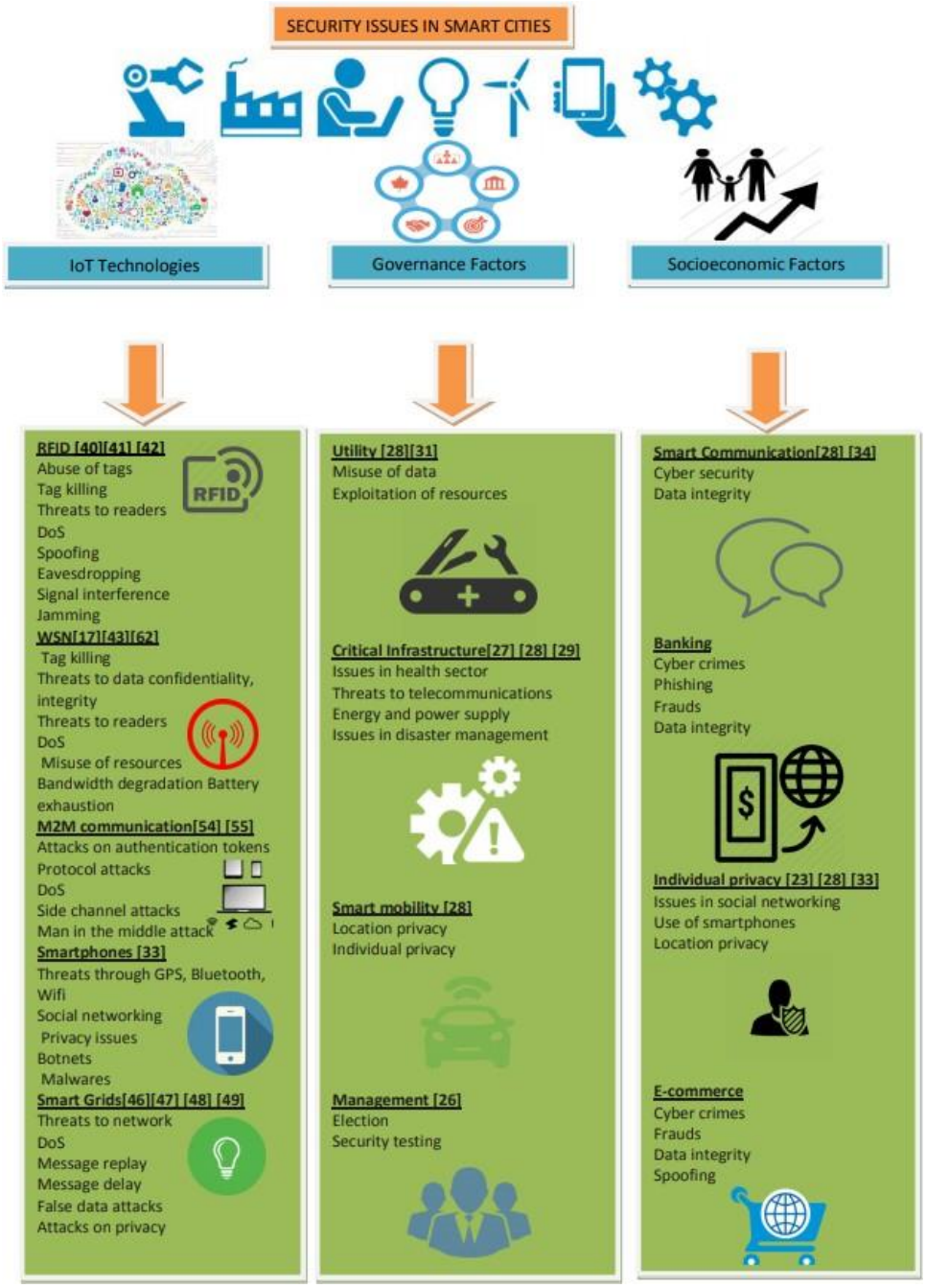

Figure 2 Security issues in smart cities (Ijaz et al., 2016).

Finally, it is important to mention that the concept of information security and privacy is closely connected, and thus hard to exclude from each other. An example could be that the information system is secure, but the data is not private, in the sense that data could be collected without the consent of the subject. This situation couldgo both ways, for example if consent were given for gathering of data, but the storingof data is done poorly which then could lead to potential unauthorized access or system being breached. The interconnection between security and privacy could be the reason why several authors give focus to them both (e.g., Abdulghani et al., 2019; Atlam & Wills, 2020; Braun et al., 2018; Hernández-Ramos et al., 2021; Ijaz et al., 2016; Ismagilova et al., 2020).

2.2 Familiarity of Smart Services

The concept of smart city has become more widespread in recent years, and smart services are becoming more available in both public and private sectors. This change indicates a transition from traditional to digital solutions and will be the new way to carry out tasks. Smart services related to governmental, and municipality are becoming digitized and thus transforming into smarter solutions and services, which are in most cases what most citizens in a smart city have utilized. Literature highlights that familiarity with smart services could play an important role in increasing citizens' use of such services, and as stated by Vidiasova et al. (2019), low interest in the use of new technologies may be caused by low awareness from citizens about the possibilities of smart cities. Multiple studies have pointed out that lack of awareness of smart cities among its residents is a challenge of smart cities (Cagáňováet al., 2019; Khan et al., 2020; Vidiasova et al., 2019;). Vidiasova et al. (2019) showcases in their study results demonstrating that the majority of respondents do not have a clear understanding of what a smart city is and how it could improve their life. At the same time, the respondents from their survey identified some main areas that should be improved by using modern technologies such as: Housing and communal services, public health, transport, etc (Vidiasova et al., 2019). These findings are interesting as literature has indicated that those areas the respondents perceived to need improvement through technologies are in fact central issues smart city initiatives aim to conquer (Hong & Anh, 2020; Peng et al., 2017).

As stated by previous literature, citizens are lacking awareness of what the smart city concept is about, and what these changes could mean for them. The resultof low awareness could therefore impact their recognition of what a smart service or solution is and thereby reduce an individual's familiarity with existing smart solutions. As residents' awareness level on services of smart cities play an important role in the social acceptance of smart cities, marketing of the benefits of smart services could increase the citizens' awareness as well as social acceptance of changes (Khan et al., 2020). To improve citizens' awareness of smart city benefits, trusted actors could promote these benefits as there might be a higher likelihood that citizens will listen to information from actors, they place more trust in such as government or municipalities.

2.3 Trust

In a broad sense, trust can be seen as the confidence a person has on expectations of what other people will do, in many cases it is based on previous interactions. Meaning a person's previous interactions in which the individual behaved as expected, will increase trust towards them (Gefan, 2000). Without trusting others in this manner, some people would be questioning every possible eventuality of every person around them before deciding what to do and how to interact with them. For some people, this would be so overwhelming that, in many cases, they would choose to refrain from acting due to their lack of trust (Gefan, 2000). According to Gao et al. (2013) having a high level of trust is one of the most effective tools for reducing uncertainty and risks, and generate a sense of safety for users. Therefore, a user's trust towards IoT technologies and service providers is arguably a pivotal role in their adoption and intention to use technologies (Gao et al., 2013). This is further backed by Habib et al. (2019) which mentions that trust in technology has shown to influence both consumer intention to buy as well as their purchasing behavior, in addition to their intention to use e-government services according to their pilot study (Habib et al., 2019). This puts a lot of pressure on service providers and organizations that in general have a lot of responsibility as they can affect users' trust if they neglect solutions and ways to reduce user's anxiety or if they have insufficient privacy tools to protect their users' data (Alraja et al., 2019).

2.4 Smart Citizens

When thinking about the smart city concept, technologies are what we think of. Many experts stress the importance of shifting the mindsets to embrace the fact that smart cities are not only about technologies but mainly the people (Vácha et al., 2016). Various suggestions have been made and explored to integrate a widergroup of citizens into smart city design and policies, for instance through citizen participation, crowdsourcing, citizen-centered approaches, or co-creation and living labs (Van Zoonen, 2016). The European city authorities have started claiming that smart citizens are as important to a successful smart city program as data and technology. Smart citizens should therefore be considered decision-makers rather than users and/or data providers (Calzada, 2018).

Citizen's participation is important for the smart projects of a city, as the participation can significantly change citizens' attitude towards city projects. The citizens perspective of the project could shift from "it is their change" to "it is our change", thus improving the success of the project as citizens tend to accept projects easier if they took part in its realization. Vácha et al. (2016) further highlights three basic principles of participations as:

1. To inform citizens by providing accessible and understandable information about planned changes. As humans tend to fear changes or new things theydo not understand, providing information as soon as possible can ease this fear of the unknown.
2. To listen to citizens shows that they are cared about, it also creates a spacewhere people can express their needs, attitude, and preferences.
3. To actively involve citizens is the highest level of participation where citizens are actively involved in the projects' initiation, realization and in disseminationof its results.

Although smart cities aim to improve the places that people live, all too oftenthis comes in the form of top-down innovation which leads to failure of capturing the citizens' needs and thus may not serve their best interest (Gooch et al., 2015). Smart cities must start with people rather than believing that technology alone can improve cities. The idea here is to go beyond thinking of the citizens as a source of data but utilizing them as a source for ideas (Gooch et al., 2015).

2.5 Smart City and Citizens' Adoption

When it comes to citizens' adoption of smart services multiple factors needs to be considered, for example, perceived security and privacy have been found to significantly affect the use and adoption of smart services by citizens (Ismagilova et al., 2020), or the fact that smart city technologies requiring a smartphone to access and use, can end up bypassing several people of the world's population (Sepasgozar et al., 2019). Sepasgozar et al. (2019) highlights the issue that close to 2 billion people do not owna phone, and the understanding of the human dimensions of technology acceptanceare particularly important for those cities in the initial stages of adopting smart technologies. Sepasgozar et al. (2019) concern regarding technology acceptance of smart devices might not be as big of a concern in Norway, as the statistics from Statistisk sentralbyrå/statistics Norway (SSB) indicates that in 2019: 98% has access to internet at home; 99% owns a mobile phone, and 95% owns a smartphone (SSB, n.d). Although the vast majority of the norwegian population has access to smart devices, technology acceptance should not be disregarded. The reason why, has been highlighted by Sepasgozar et al. (2019) as: Technology acceptance by citizens is consequently an important consideration for governments and essential for the successful development of future smart cities.

While on the topic of acceptance of technology, Davis Technology acceptance model (TAM) should be mentioned. The TAM has been widely used to predict user acceptance and use based on perceived ease of use and usefulness. Given that millions of dollars have been wasted on unsuccessful system implementations in businesses due to poor ease of use (usability), it

showcases the importance of understanding the determinants for ease of use (Venkatesh & Davis, 1996). The TAM shown as figure 3. showcases the two specific beliefs of: perceived ease of use as the user's perception of the amount of effort needed to use the system, and perceived usefulness as the user's perception of the degree to which using the system will improve his or her performance (Venkatesh & Davis, 1996). While perceived usefulness and perceived ease of use are important factors for usage of a system, Carter & Bélanger (2005) also include the perceptions of trustworthiness. Citizens must have confidence in both the government and the enabling technologies, and the fear of privacy and security issues in e-commerce and e-government can affectcitizens' trust (Carter & Bélanger, 2005).

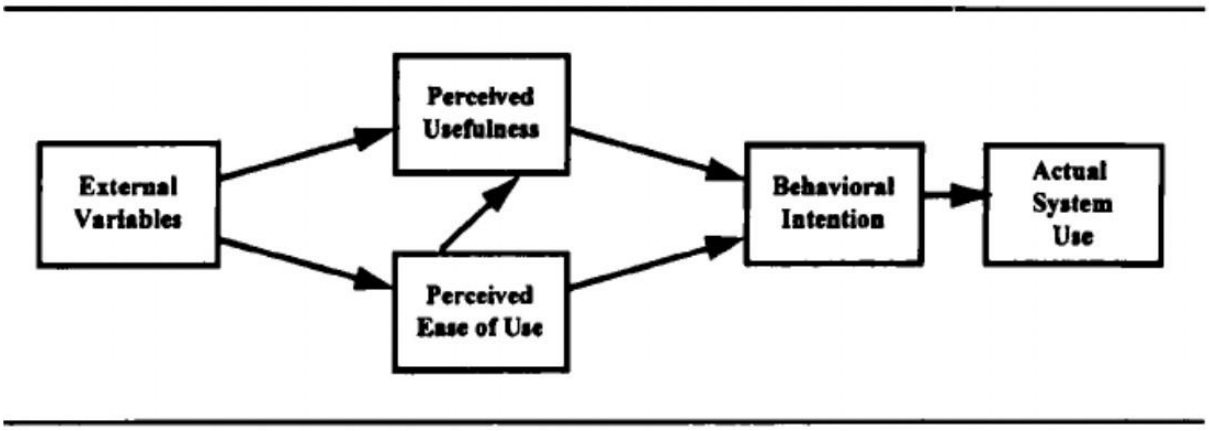

Figure 3 Technology acceptance model -TAM (Venkatesh & Davis 1996)

2.5.1 Intention to Use Smart Services

Although intentions to use smart services are not the same as adoption of such services they are still closely related, in the sense that citizens must be willing to use or try it out for them to proceed to adapt it into everyday life. Though there seems to be substantial growth in the development of e-government initiatives, it is not clear whether citizens will embrace those services. The reason being that the success and acceptance of e-government initiatives are contingent upon citizens' willingness to adopt these services (Carter & Bélanger, 2005). An individual's decision on whether to use a technology is based on the perception of the technology such as compatibility, relative advantage, image, and complexity. Therefore, if the individual perceives an innovation to be inconsistent with his/her current practice, the benefits are perceived as more uncertain (Lean et al., 2009). Lean et al. (2009) also use e-government services as an example to highlight how the level of trust affects willingness to adopt services as: Poor coordination in the development and application of relevant services as well as a too low level of trust in e-government are the main barriers in the e-government adoption by citizens (Lean et al., 2009).

Perceived value and risk are also factoring which could affect an individual's decision-making behavior for using a service. The perceived value being the overall evaluation of what is received (perceived benefits or gains) and what is given (perceived sacrifices or costs). Perceived risk consists of two components, namely, uncertainty (the possibility of adverse consequences) and losses (the seriousness of consequences) (Wang et al., 2019).

2.6 Conceptual Framework

Numerous conceptual models have been designed to investigate citizens' behavior in the information technology literature. The research model to be developed and tested in this study draws on findings from relevant prior research primarily based on the TAM (Venkatesh et al., 1996) but also on the focus of trustworthiness as Carter et al. (2005) highlights. Due to the importance of trust in terms of reducing risk and facilitating adoption usage behavior, we incorporate trust in our model. Figure 4 (Framework) presented below is trying to highlight interdependencies between the many identified variables and challenges within smart cities and integrates these into a single model. The key challenges identified for smart cities represent the factors people consider (Familiarity, concern, and trust) before using smart city initiatives. The bulk of these relations can have significant effects on the citizens and their adoption of these technologies.

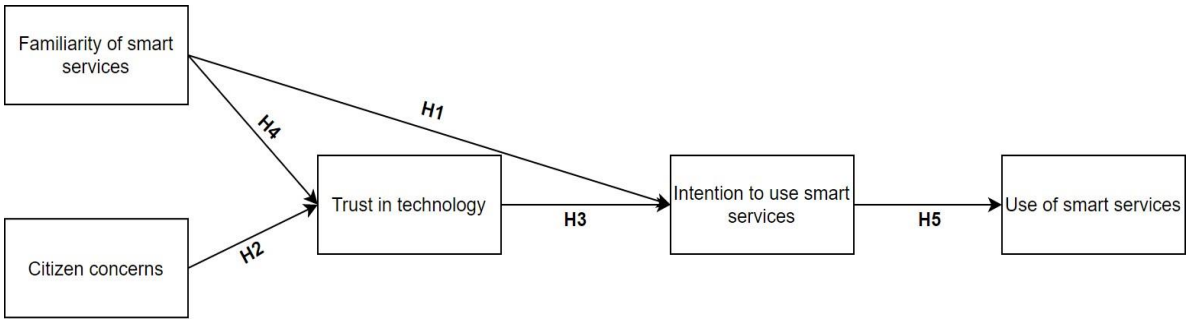

Figure 4 Framework

2.6.1 Development of Hypothesis

When creating the constructs (Table 1) and developing the hypothesis, we proceeded by doing one of the three methods. First method was by directly applyingthe constructs and items into our study; this was done if the description of the constructs in the given article was good enough. The second method was by applying some of the described constructs, where we convert it to fit our study. This was doneby looking at articles with similar issues. The third method was by reading articles and out of the information accumulated, we created the constructs and items. This was done due to some articles not providing us with constructs or items.

Table 1 Constructs

Construct	**Definition**	**Source**
Citizens' concerns	Rankings of concern regarding a series of scenarios related to IoT/smart city deployments	Cottrill et al. (2020)
Trust in technology	peoples trust in technology regarding information handling and security	Habib et al. (2019)
Familiarity with smart services	An individual’s familiarity with smart city technologies	Peng et al. (2017)
Intention to use	Tendencies of using new digital-solutions for task that used to be none-digital	Carter et al. (2005)
Use of smart services	To what extent people use smart city services	Woetzel et al. (2018)

Peng et al. (2017) argues that although smart city services are driven by advanced information technologies, the success of these initiatives are highly dependent on the user's engagement and participation. One user related factor is the user awareness, this factor will affect the overall usage of these technologies and the results of this can identify if a given solution is successful (Peng et al., 2017). Familiarity with technology should remove some of the difficulties people have when it comes to understanding it, and thus can result in increased use. If people are overwhelmed by the complexity of an application interface, they are likely to give up on the use of it only because they do not understand how to do so. Familiarity addresses a different type of complexity that many vendors and organizations seem to acknowledge the importance of, and by increasing familiarity accordingly will result in increased use (Gefan, 2000). This hypothesis aims to measure how familiarity with smart services positively affects their intention to use smart city services.

- ***H1:*** *Citizen's familiarity of smart services has a positive effect on their intention to use.*

IoT devices and other technologies allow organizations and governments to collect and analyze big data about their citizens. This may cause fear in residents, thinking of the government's ability to track them and override the public interest that may cause a lack of trust (Habib et al., 2019). Trust in relation to IoT technologies is argued to have a major impact on the adoption and use of these types of technologies (Gao et al., 2013). It has also shown to influence the intention to use e-government services (Habib et al., 2019). According to Braun et al., (2018) trust must also address the citizens' concern regarding security and privacy of their information before successfully adopting smart city technologies. Further on, they mention that solutions must focus on preserving the trust of their smart city inhabitants to sustain the smart city (Braun et al., 2018). They also mention that users of smart city technologies will interact with the smart solutions when their personal threshold of privacy and security is achieved. (Braun et al., 2018). E-government has the potential to improve the way a government operates, but people show concerns when it comes to sharing personal information with the government over the internet because of their fear that the data can be misused (Carter et al., 2005).

- ***H2:*** *Citizens' concerns have a negative effect on their trust in technology*
- ***H3:*** *Trust in technologies has a positive effect citizens intention to use smart services*

Gefen (2000) talks about familiarity in the sense that it can be based on previous and current interactions, experiences, and learnings with technology and trust is the confidence a person has in his or her expectations of what other people will do, based on different cases and previous inter-actions (Gefen, 2000). Further on, Gefen (2000) highlights that familiarity and trust complement each other as complexity-reduction methods. Familiarity can reduce a person's

uncertainty by establishing a structure and trust can reduce uncertainty by having people hold reliable expectations regarding other people's actions. So, in a sense, they are distinctly different but related (Gefen, 2000). Gefen (200) explains this as trust is built when the other person or organization behaves in accordance with one's own favorable expectations of them. Since these behavioral expectations (Trust) are context-dependent, understanding the given context involved (familiarity). Without familiarity within the context, trust cannot be sufficiently tied to specific favorable behaviors and therefore cannot be conferred. (Gefen, 2000). Citizen's familiarity aims to measure how their familiarity with smart services can positively affect their trust in technology with handling their information.

- ***H4:*** *Citizen's familiarity of smart services, has a positive effect on their trust in technology*

Although the growth in the development of e-government initiatives is increasing, it is not clear whether citizens will accept those services to be the new norm. It is relying on the citizens' intentions and decision to adopt these services (Carter et al 2005). There is a need to identify what factors that can influencing citizen adoption of smart city services. This hypothesis aims to measure citizens' tendencies when it comes to using digital-solutions for tasks that used to be none-digital and if this has an actual effect on their use of smart services.

- ***H5:*** *Intention to use smart services has a positive effect on use of smart services.*

3. Research Approach

This study is engaged in hypothesis testing since the study goes beyond merely describing the characteristics of the phenomena smart city and of the topics discussed. We attempt to examine whether the presumed relationships have been validated as well as obtaining an answer to the research question. The intention of this study is to explore the relationships that exists among the variables. Which means that this is a correlational study where it is conducted in the natural environment of a community (Gogtay et al., 2017). This section will describe our chosen research approach, and why this approach is fitting to our research question. We will explain the study's chosen strategy, with justification of our choice. and later, we present our research design and how we conducted the study.

3.1 Quantitative Method

Our primary method of choice was the quantitative research method. Oates (2006) has argued that the quantitative research method is conducted in a general or public fashion because of its clear objective and guidelines and has a chance to be repeated at any other time or place and still get the same results. But there are also other reasons for why the quantitative research method is beneficial. For instance, by doing quantitative research, we enable ourselves to save time and resources because of how statistical tools can be used for data analysis. Also, this research method makes it possible for the result to be generalized (Oates 2006). Which means, the data can be quantified because the data collected are large and they are often considered representative of a bigger target group (e.g., a population). In addition, a quantitative method allows us to focus on observing public opinion regarding smart cities and for large amounts of data to be collected which will most likely indicate a variety of viewpoints. This type of research adopts structured procedures and formal instruments for data collection, which means the data are collected objectively and systematically.

3.2 Qualitative Method

Our secondary approach was the qualitative interviews, this allowed us to use data field notes to collect data from participants in their natural settings. The interviews focused on creating a wider understanding of the behavior of participants in certain situations. Hence, this provides plenty of data about real life people and their thoughts in relation to our research topic. The reason for proceeding with this method also, was ultimately to increase the knowledge and validity of our research. This approach is sufficient enough to achieve multiple validities legitimation, given the goal of answering the research question. In addition, it strengthens our overall study and provides improved discussions by allowing for more sources. The interviews will result in a complementary fashion, where we seek clarification and elaboration from one method with the result from the other method.

3.3 Research Design

This process began with defining the goal and objectives for the research. In other words, by determining our research question for this study, and finding the potential target audience. We conducted a literature review and discussions with professors, to get an understanding of what topics past literature covered on smart cities (Table 1). We identified patterns based on a comparison between the collected data and the findings from literature to look for differences or similarities. Both quantitative and qualitative data was gathered and analyzed. SmartPLS 3.0 and SPSS Statistics were used for our data analysis section. Tables, figures, charts. in addition to field notes were also used for the presentation of the data.

3.3.1 Questionnaire Design

The survey participants for this study were selected based on our research question, which is to gather information from the citizens. The collection of data was done digitally, and the respondents were anonymous. The tool used for the survey was SurveyXact provided by UiA. The participants gained access to the survey through a web link. We distributed the survey through contacting people through emails, social media, and private messages. In addition, we contacted multiple businesses to ask if they were willing to distribute our survey internally with their employees. This approach made it easier to reach out to larger groups of people

The questionnaire consisted of questions to identify possible factors that may affect the use of smart city services. All the items were modified for this study to fit our research topic. There were (4) questions placed in the beginning of the questionnaire to collect descriptive data on the respondents', these were related to age, gender, highest academic qualification and field of work. After that we proceeded by asking about their familiarity with smart services, consisting of (6) items. Then we asked about their use of smart services (7) items, followed up by (4) items regarding citizens' concern. Lasty, we asked about their intentions of using new digital-solutions for tasks that used to be none-digital (8) items, and finished with asking about their trust in technology (3) items.

3.3.2 Interview Design

For the interviews, we got in touch with people willing to participate in the interviews. We constructed a semi-structured interview guide (Appendix B) which consisted of (12) questions. The questions were related to our findings from our questionnaire regarding their familiarity with smart services, concern, trust, use and the effect smart solutions have on their daily life. Follow up questions were asked if we felt the need for the participant to elaborate on some of their answers. We also asked additional questions when the interviewee brought up question we had not prepared. The interviews had to be conducted digitally due to covid-19 restrictions.

3.4 Limitations

3.4.1 Limitations Survey

Even though surveys are a good method for data collection it does have its disadvantages. For example, the response received through a survey will not be as detailed in comparison to an interview and securing a high response rate will be hard to control (Kelley et al., 2003). Some survey questions might be leading questions meaning the response is biased. It is also important to notice that closed-ended questions may have lower validity rate compared to other question types. Oates (2006), points out that the sample size is of importance to ensure accuracy of the survey, meaning that we must stay within the correct range and that the respondent should be enough for it to count towards the population (Oates, 2006, p. 100-101).

3.4.2 Limitations Interviews

Since this is characterized by personal reports from the interviews, we cannot give full reliable and consistent data. Every respondent has had different personal experiences which can affect the answers and makes it difficult to simplify our findings. In addition, explanations and analysis are based on the interpretations from us as researchers. Meaning there is a chance of the research analysis to show different results if conducted by someone else.

3.5 Ethics in Research

This research implies following the general rules and ethics guidelines in NSD. The data collection method needs to adhere to two important rules, which is having a confidentiality agreement between us the researcher and the respondents, and to preserve the object's anonymity and privacy. The other is having informed consent, where the objects allow us to collect their data (Kelley et al., 2003). It is also important that we are neutral and professional when it comes to the conduct of the data gathering methods, this also means to not present biased and manipulated datato help strengthen our case and rather reflect on what we could have done differently for a better outcome. We will ensure that the rights of participants are held to the highest degree possible. To achieve this, we follow the guidelines of Oates (2006), mainly the right to withdraw, right to give informed consent, right to anonymity and confidentiality (Oates, 2006, p. 56).

3.5.1 Validity and Reliability

Ensuring validity for our research requires several elements that must be in place. Among other things, several areas are useful to achieve higher forms of validity for our research. For example, it is important that the results of a survey can be generalized, i.e., to what extent the findings from the survey represent a people group, this is known as external validity (Oates, 2006). Internal validity is also important, here we must ensure that the questionnaire generates the data we are interested in (*Content Validity*). In addition, ensuring that the questions asked to give us ameasurement for what we want to

measure (*Construct validity*) (Oates, 2006). Another important factor is that our sample must represent citizens of cities with smart solutions, as this study revolves around the SC initiatives of this city. We will accommodate for the views of different age groups, the background of the respondent regarding occupation will also be of interest, and establishing this, will help us gain credibility, quality of data and define the characteristics of the population. The more respondents the better, but we must account for people not taking part and difficulties in distributing the survey. According to Oates (2006), a response rate of 10 percent is not uncommon and getting 30 percent is equivalent to doing well (Oates, 2006, p. 99).

For interviews, validity can be measured by whether research findings present a true and trusted view of our subjects, and it will heavily rely on our subjective interpretation as researchers (Oates, 2006). With that in mind, like with the questionnaire, we have tried to make the questions in the interview guide as concrete as possible and correspond to our research question to avoid misinterpretation and influencing the answers.

Ensuring reliability is concerned with whether our questionnaire is accurate and reliable, and that it would yield the same results if given multiple times to the same respondents (Oates, 2006). But Oates (2006) also highlights that it is a difficult task, as respondents' views and opinions can change over time, or they can change their answers deliberately (Oates, 2006). For the interviews, we must rely on the respondents to not answer questions out of their self-interest, but rather honestly according to the interview questions.

4. Data Analysis

4.1 Analysis of Survey

The survey was distributed by using the convenience-sampling method, and was done in two manners, 1. as an online survey through social media, and 2. as a message through emails and direct messages. The survey was distributed to 700 internet users and the total number of respondents for this survey was 271, however,

169 of these respondents have only partially or not completed the survey which dragged the total valid responses down to 102 which ended up becoming our sample. The gender distribution based on the sample are: 66 Males - 65%, 35 females - 34%, and 1 categorized as other - 1%.

As the method of choice for distributing our survey was through convenience sampling, a large number of the respondents are from the younger age groups of 18-25 and 26-33 (Table 2). Because of the audience most convenient for us to reach out to were other students, friends, and individuals with personal connection to us. Although some respondents are from the higher age groups, the variance is quite low which results in the perspectives and opinions of the younger age groups to be highly influential on the data.

Table 2 Age distribution

Age Group	Number of People
Under 18	1
18-25	42
26-33	31
34-41	12
42-49	9
50-57	2
Over 58	5

Through the survey, information about the highest level of education from the respondents were collected, and the results are shown in the diagram below (Table 3). The diagram shows that 78% of the respondents are in the category of higher education, which could be a result from reaching out to a large number of students when distributing the survey.

Table 3 Highest level of education

Education level	Number of People
Lower secondary (Ungdomsskole)	1
Upper secodary (videregående)	17
Some higher education (universitet/høgskole)	20
Bacherlor's degree	39
Master's degree	21
Doctorate	4
Total	**102**

4.2 Connection Between Variables

In this section, analysis will be performed to understand the relationship between variables. Based on the observations of the data from the sample, different tests will be performed to assess the connections between them. To do so a structural equation model (SEM) has been created through SmartPLS software (figure 5) and the SPSS software has also been used. A normality test was performed with the results shown in table 4, and because the sample size for this study is above 100, we turned to Kolmogorov-Smirnov for testing the normality of the two new variables (Obezip Universal Statisticals (OBUS), 2021). From the table we can see that all constructs are not normally distributed as the Sig. (p-value) is less than 0.05 indicating that they are statistically significant (which is desired). As the variables are not normally distributed, we can proceed to use ordinal regression for performing the analysis. The rest of this section will consist of tables showcasing Model Fitting, Goodness-of-Fit and Pseudo R-Square.

Table 4 Test of normality

Construct	**Komogorov-Smirnov Statistic**	**Sig.**	**Shapiro-Wilk Statistic**	**Sig.**
CitCo**	0.1	Significant	0.96	Significant
TrustT*	0.15	Significant	0.94	Significant
FamSS*	0.14	Significant	0.94	Significant
Int**	0.12	Significant	0.95	Significant
Use*	0.15	Significant	0.92	Significant

Note: * = P ≤ 0.001. ** = p < 0.05.

Reliability and Validity

The descriptive statistics (Table 5) shows the computed variables and statistics used to determine their reliability through Cronbach's alpha. This analysis is used to evaluate the reliability and validity of the constructs used in this research. As shown in the table all constructs exceed Cronbach's alpha threshold of 0.7 by staying within the range of 0.72 and 0.90. The highest value of 0.90 is also within the maximum recommended value for Cronbach's alpha (Tavakol & Dennick, 2011). Next the average variance extracted (AVE) must be looked at, and as indicated all constructs are within the range of 0.64 and 0.86, exceeding the AVE's threshold of 0.50. The values in bold are the square root of the AVE and off-diagonal is the correlations between constructs. By using Fornel-Larcker criterion, assessment of the discriminant validity has been done by comparing the square root of each AVE (values in bold) with the correlation coefficients (values off-diagonal) for each construct in their relevant rows and columns (Ab Hamid et al., 2017). As the correlation coefficients are all below their respective square root of AVE, validity can be assumed for this model and the discriminant validity between the constructs are supported.

Table 5 Descriptive statistics and correlations of latent variables

				Construct				
Construct	**Mean (SD)**	**Cronbach's α**	**AVE**	**CitCo**	**FamSS**	**Int**	**TrustT**	**Use**
CitCo	3.99 (1.45)	0,85	0,70	**0.83**				
FamSS	4.04 (1.71)	0,74	0,66	-0.11	**0.81**			
Int	5.10 (1.16)	0,84	0,86	-0.14	0.43	**0.92**		
TrustT	4 .00 (1.32)	0,90	0,84	-0.42	0.20	0.35	**0.91**	
Use	4.42 (1.79)	0,72	0,64	0.00	0.48	0.39	0.15	**0.80**

Goodness of fit describes how well the model fits its data, and the Goodness-of-Fit test as shown in table 6 indicates that the data fits the model well. The criteria looked at for the Goodness-of-Fit test is to have a nonsignificant P-value which means a value higher than 0.05 is what we are looking for. A statistical significance is not desired here because it would indicate a difference between the final model and a perfect model (Petrucci, 2009). A point of interest is the Sig-value of 0.04 (TrustT on Int) for the Pearson test indicating significance. Although the Pearson value shows the opposite result desired, the Deviance value of the connection is above 0.05 indicating non-significance. This occurrence is called a mixed result and is a situation that might occur but does not impair the rest of the analysis. We can therefore confirm that the data is fitting the model created and proceed with the analysis (Obezip Universal Statisticals (OBUS), 2021).

Table 6 Goodness-of-Fit

Model	**Test-criterion**	**Chi-Square**	**df**	**Sig.**
FamSS om Int	Pearson Deviance	45.13 51.37	59	0.90 0.74
CitCo on TrustT	Pearson Deviance	70.86 68.64	71	0.48 0.55
TrustT on Int	Pearson Deviance	78.18 55.43	59	0.04 0.60
Famss on TrustT	Pearson Deviance	25.67 26.21	35	0.87 0.85
Int on Use	Pearson Deviance	51.76 47.80	59	0.90 0.74

For Pseudo R-Square, we will pay attention to the Nagelkerke values which indicate what degree of change the dependent variable can experience due to the independent variable. As table 7 indicates, the R-squared values are between 0.06 to 0.24 and it is worth noting that FamSS on TrustT has the value of 0.06. A value of 0.06 is quite low and indicates that approximately 6% of changes in TrustT is explained by FamSS.

Table 7 Pseudo R-Square

Construct	Nagelkerke
FamSS on Int	0.19
CitCo on TrustT	0.17
TrustT on Int	0.1
FamSS on TrustT	0.06
Int on Use	0.13

The model fitting information contains the -2 Log likelihood for a null model and the full (final) model. The Chi-Square test is for testing whether there is a significant improvement in fit of the final model relative to the null model (Crowson, 2019). As the table shows, we have significance for every connection indicating a significant improvement in fit of the final model over the null model. Model Fitting Information shows how well the model fits the data, and in this case all models fit the data well and the significance for every model is achieved as shown in Table 8.

Table 8 Model Fitting Information

Connection	Model	-2 Log Likelihood	Chi-Square	df	Sig.
FamSS om Int	Null model Final	157.88 136.72	21.15	1	Significant
CitCo on TrustT	Null model Final	152.82 133.52	19.3	1	Significant
TrustT on Int	Null model Final	144.30 132.93	11.37	1	Significant
Famss on TrustT	Null model Final	100.56 94.49	6.06	1	Significant*
Int on Use	Null model Final	139.72 124.86	14.86	1	Significant

Note: Significant = P-value ≤ 0.001. * = P-value < 0.05

4.2.1 Creation of Constructs

In appendix A the table showcases the data for all items of each construct. To run analysis of constructs with just the relevant items, a computation was done in SPSS to summarize them. e.g., the construct FamSS (familiarity of smart services) consist of familiarity to smart transport services (famss_1), smart energy services (famss_3) and smart building management services (famss_5). The items chosen for the construct were done based on their loading-values. Through SmartPLS the factor loadings for each item were tested, and all loadings had to be above the threshold of 0.7. A loading higher than 0.70 indicates reliability and that sufficient variance is extracted from the item to the construct. Table 9 below showcases which items have been included for each of the constructs.

Table 9 computation of items

Construct	Items included
CitCo	citco_1, citco_2, citco_3 & citco_4
FamSS	famss_1, famss_3 & famss_5
TrustT	trustt_1, trustt_2 & trustt_3
Use	use_1, use_2 & use_3
Int	int_1 & int_2

4.3 Research Model Assessment

PLS Algorithm

The research model presented, is a structural equation model (SEM) that has been created and tested through SmartPLS. By running this model through PLS Algorithm (function in SmartPLS) we get presented by values of their connections (Figure 5). The values on the lines pointing from left to right represent the standardized regression coefficient (regression weight), which indicates the expected change one construct has on another (Siegel, 2016). An example for this case is the change on the Intention to use smart services due to an increment of one unit in the Familiarity of smart services is expected to be 0.37. The R^2 value within the Trust in technology, Intention to use smart services, and use of smart services is the R-square, which represents the percentage of variance explained by the explanatory variables (Lowry & Gaskin, 2014). An example from the model would be that 15% ($R^2 = 0.15$) of the variance of the construct Use of smart services, is explained by Intention to use smart services. The structural estimates of this model are shown in table 10.

Bootstrapping

Through the Bootstrapping function in SmartPLS, the construct's reliability and validity are tested. Table 5. presents the results, and as mentioned in section 4.2 all values are within their respective thresholds for reliability and validity. Since all the values are above the thresholds, we can claim that all constructs have met the required reliability (Purwanti et al., 2021).

The Structural estimates table below (Table 10), shows us the regression weightof each connection. This value also shows if the effect is positive or negative, e.g., CitCo to TrustT have a negative value of -0.40 which means that when CitCo increases by one unit, it will affect TrustT with -0.40. The T-statistics, which are an indication for significance are also shown in this table. To identify if the T-valueis significant we will have to look for values that are greater than the threshold of 1.96, which indicates that it is significant at a 95% confidence level (Lowry & Gaskin, 2014). Another point of interest in this statistic is the P-values. By looking at the third row in table 10 (FamSS -> TrustT), we can see that the P-Value is 0.13, which indicates that FamSS do not have a significant impact on TrustT as the value exceeds the thresholdvalue of less than 0.05.

Table 10 Structural estimates

Connection	Regression weight	T-Statistics	P-Values
CitCo -> TrustT	-0.40	4.61	0.00
FamSS -> Int	0.37	4.29	0.00
FamSS -> TrustT	0.15	1.49	0.13
Int -> Use	0.39	5.02	0.00
TrustT -> Int	0.28	3.25	0.00

5. Findings

This section presents the findings from the quantitative research conducted. The findings are presented according to the research objective presented in section 1.

The path coefficients of SEM (figure 5) were examined to evaluate the hypotheses in this research. All direct relations are significant except for H4. Both Familiarity of smart services and Trust in technology have a positive effect on Intention to use smart services, thus supporting H1 & H3. H2 is also supported as the effect of citizen concern affects trust in technology negatively (as we assumed). Finally, Intention to use smart services affects Use of smart services positively supporting H5. The R^2 is also presented in figure 5, and as shown Trust in technology has the value of 0.20, Intention to use smart services is 0.26, and Use of smart services is 0.15. Values higher than 0.26 imply high effect of the predictors of the aforementioned factors (Pappas et al., 2017), the value of 0.20 and 0.15 is therefore below the desired threshold for high effect. Regarding the mediating effects of the model, the bootstrapping function in SmartPLS is used to find the estimations. The indirect effect of Familiarity of smart services on Intention to use through Trust in technology is not significant as the P-value is 0.19, exceeding the threshold of 0.05. The indirect effect of Familiarity of smart services on Use of services through Trust in technology is also non significant with a P-value of 0.25. All the other mediating effects are significant with a P-value less than 0.05, and in the range of 0.007 - 0.031.

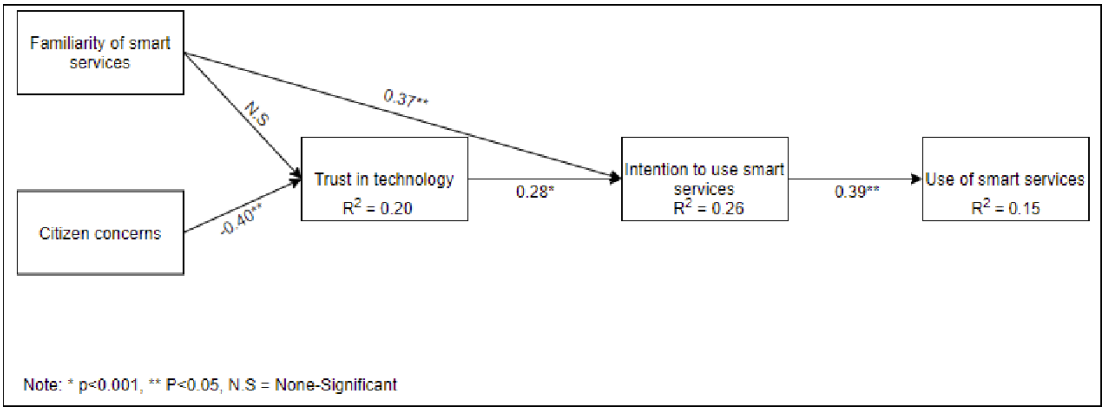

Figure 5 SEM

To get a better understanding of the citizens' views of smart city and smart services, interviews were performed in addition to the survey. The goal was to get more data from respondents and more of their thoughts about this study's topic. The data below are from the appendix A.

Concerns

When looking at citizens' concern regarding their personal information, data shows that a bigger majority of respondents are less concerned with leakage of personal information (CitCo 1. Mean = 3.74). However, at the same time the respondents show a bigger concern with personal information being misused (CitCo 2. Mean = 4.12), as well as the storage of personal information on the web (CitCo 3. Mean = 4.16). This is an interesting finding and raises the question why the respondents are not more concerned with the leakage of information (CitCo 1) when CitCo 2 and 3 shows concerns for how their information is stored and used. Through the interviews, 9 out of 12 indicated no concern regarding usage of smart services for the first time, while 3 mentioned surveillances as a concern, and the last subject showed concerns over privacy. An interesting finding is that a subject said that there was no concern for usage of smart services, however, when given a specific example (smittestopp) they mentioned concern for location tracking which is also a reason whythat subject did not use the application.

Trust

Looking at figure 5 of SEM, the connection between citizens' concern and trust in technology is negative, showcasing that a higher degree of concern induces a reduced trust in technology. From the survey the average response regarding trust in technology is quite close to neutral (Mean of 4.00), the values for TrustT 1-3 are 4.19, 3.93 and 3.9 in that order. From the interviews, four subjects stated that they are skeptical of solutions that track their positions or in some way monitor them. The trust in technologies is also somewhat affected by who the provider of the service is, as five out of five said that they would trust the municipality/public sector with their personal information more than a private organization. An interesting answer from subject 1, points out the possibility that a country can be a factor affecting trust in public/private sectors.

> "In Norway it would be the municipality. Feel like the municipality has the people's best interest in mind and they don't want to make money off of it" Subject 1 (personal interview).

As TrustT 1 has the mean value of 4.19, the assumption that the respondents have quite a neutral standing when it comes to trusting the security of smart city services has been identified. Through interviews, we got a closer look at a possible factor for losing trust in a technology they use. The question "If a smart service you are using gets a security breach, would you lose trust and stop using it or switch to a different one?" was given to seven of the subjects. Five out of the seven subjects answered that they would not lose trust in the technology because of a security breach, however, some claimed that they will

be more alert, and others mentioned that depending on how it is handled they will give them a new chance. Subject 7's answer to this question highlighted an important factor to consider, as the subject said:

"Google lekket passord, jeg vet at det ikke er google sin feil. Skjønner at det er vanskelig. Jeg kan jo ikke bytte til noe annet. Google har jo alt, må jo brukes, finnes ikke noen alternativer." Subject 7 (personal interview).

The fact that one single provider might be the sole provider of an infrastructure of services can make it difficult to stop using their services. The effect of such a situation could affect the individual's choice to stop using it, as there are no substitutes.

Familiarity to Smart Services

When looking at the statistics for familiarity of smart services, smart transportation services (FamSS 1) is the category the respondents were more familiar with (Mean = 4.27). Smart building management services (FamSS 5) with a mean of 3.92 follows behind, and with a value of 3.82, familiarity of smart energy (FamSS 3) is third. The service the respondents were least familiar with, was the smart waste management (FamSS 6) which scored the lowest with a value of 3.07.

From the interviews the most common answer to "what is a smart city" was, "cities using technologies". The list below showcases the different answers from the interview subjects, and how often each category has been mentioned. The findings of the interviews revealed that all subjects use some sort of smart solutions, although several of them did not know that it was categorized as a smart solution before an explanation of the concept was given. Only subject 7 and 4 out of the 12 subjects said they knew what the smart city concept was about and could give specific examples (in bold) compared to the other subjects.

"Yes, Det er å ha smarte løsning I byen for å gjør ting mer digital. Et eksempelpå smart løsning er søppel med tanke på store container under bakken, buss apper som viser tiden og når bussen kommer, digitale løsning på nett fra kommunale tjenester. Digitalisering som slipper papir" Subject 7 (personal interview).

"Regner med at det er nåtidens ide på fremtidens by, hvor alt som kan blir koblet opp til et nett for å enkelt kunne overvåke for eksempel ulike type Grids. Inkluderer også hjem, by, parkering, shopping. Alt blir overvåket" Subject 4 (Personal interview).

Applications on phone	3
Automatization	2
Cities' usage of technologies	4
Digitalization of governmental into e-services	1
Digitalization of traditional methods	2
Connecting everything to a network for easier supervision of e.g., different types of grids	**1**
Optimization of infrastructure	1
Infrastructure, waste, transport, e-services	**1**

Intention

The findings from the interviews indicated that all subjects have adopted the usage of digitized solutions and different types of e-services. The finding regarding usage of e-services was as expected, as the data from the survey pointed to a higher degree of intention to use e-services provided by organizations (Mean = 5.11) as well as their intention to interact with services electronically (Mean = 5.1). Ease of life has been mentioned seven times as a factor for using smart services and solutions. Time saving has been mentioned five times, and in general all subjects have found themselves performing tasks in a new manner because of digitalization and automation compared to the traditional and more manual approaches. Three of the subject's state that the reason they are not using smart services is because of lack of awareness around the possibilities.

"Hovedgrunnen for at jeg ikke har brukt noe er fordi jeg ikke vet om det." Subject 2 (personal interview).

"Nei, iallfall ikke med vilje, valgt å ikke bruker scooter, heller sykkel applikasjon ovenfor sparkesykkel" subject 4 personal interview).

"Main reason why I'm not using it is because I don't know about it" Subject 1 (personal interview).

Use

The findings from the survey indicates that online government services (Use 2) is the smart service used by more respondents compared to other services listed (Use1 and 3-7), scoring 4.79 on the mean value. The use of smart parking applications (Use 7) scores 4.69 and comes in second, whilst the least used is civic-engagement tools (use 5) with a score of 2.38. From the interviews done, it is evident that every subject uses some form of smart solutions. The majority of subjects mentioned usage of public transport solutions AKT, and for many this was the service used most frequently.

> “Parkering, bompenger, buss noen ganger bruker alltid apper” subject 8 (personal interview).

> “i hovedsak easypark, AKT reise har jeg brukt mye før i tiden” subject 9 (personalinterview).

> “Use it quite often, the AKT app I use all the time when I take the transport” subject 1 (personal interview).

From the findings of the survey and the interviews, the smart city element of transportation and mobility seems to be the most familiar smart service for the respondents and interview subjects. Which is supported by literature that points outthis element of smart city to often be the first implementations in a city (Weber & Zarko, 2019). A highly interesting finding from the survey is on the daily usage of smart services. As previously mentioned, all subjects showed indication of having adapted to usage of digitized solutions and e-services, however, data from the survey indicated otherwise. The responses on the daily usage of smart service showed that half of the respondents have answered that they *never* use smart services on a daily basis (figure 6). According to the interview findings, all subjects use smart services, however, the frequencies are varying from once to twice a week to every single day, and it depends on the type of services. As an example, one subject mentions AKT is used daily while services such as leasing of electric scooters is used far less. The response from the survey therefore contradicts with the findings from the interviews.

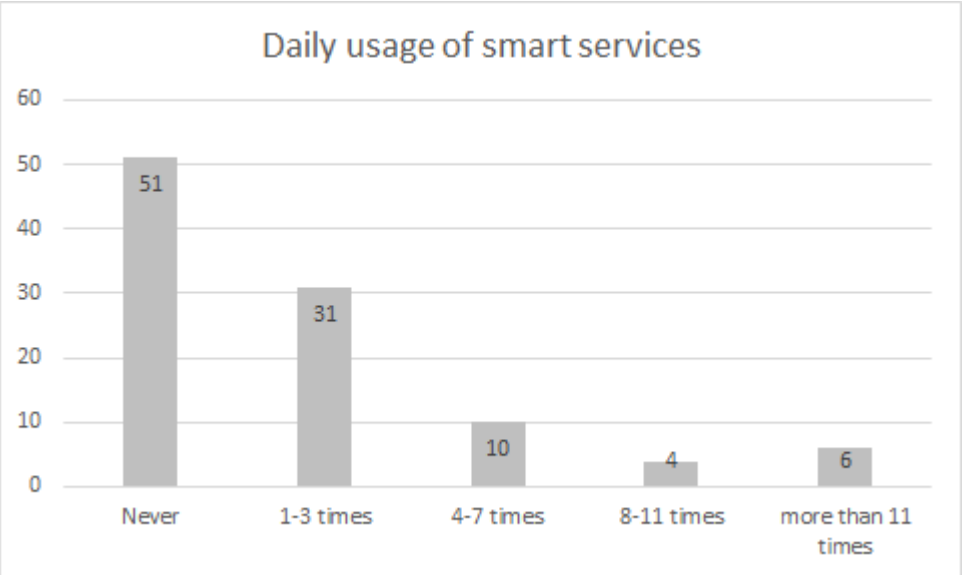

Figure 6 Frequencies of daily usage of smart services

6. Discussion

This section discusses the findings according to our main research question and objective of the study stated in section one. The discussions revolve around the findings from the 102 survey participants and 12 interviews. The five hypotheses from this study will be discussed to try to reject the null hypothesis.

As mentioned in section 4.1, the survey was distributed to approximately 700 individuals, with 102 out of 271 responses being valid and thus becoming the final sample size. The response rate is difficult to calculate as the survey was shared through large social media groups consisting of 5-40’000 members, resulting in difficulties to get a precise number unless we assume that the final sample size is just from the 700 individuals we reached out to. In that case the response rate would be about 14%, which according to Oates (2016) is what we can expect. Initially in the survey respondents were asked to state their age, level of education and field of work. This led to most of our respondents to be between the age of 18- 25, 40% having a bachelor's degree and approximately 30% working inthe field of science, technology, and engineering.

H1: *Citizen’s familiarity of smart services, has a positive effect on their intention to use*

We were looking at how the level of familiarity had an effect on the respondents' intention to use new digital-solutions for tasks that used to benone-digital, more specifically common e-solutions that are available for most citizens with access to a smart device. The factors, intention to use e-services by organizations (int_1) and intention to interact with services electronically (int_2) have a high Mean value of 5.11 and 5.10 as shown in Appendix A. This value indicates that the respondents lean more towards the maximum value of 7, in other words there are more people willing to use it compared to those that are

not willing. From appendix A, we can see that no respondents have answered with “never” regarding usage of said services. The assumption is that even though the respondents do not intend to use such services, they are compelled to do so, as services are becoming more digital, hence why no respondents marked the lowest score of 1 (never).

The R-square of 0.19 (19%) shown in the analysis section (Table 7) indicates the degree of change in Int due to FamSS. Through interviews we have seen that the subjects are using smart city services that benefit them, regardless of if they understandor are familiar that it is a smart service. Therefore, one could argue that familiarity of smart services might be less of an indicator when assessing intention to use smart services compared to their perceived benefits of use. Nevertheless, the model shows that familiarity towards smart city services can have a positive effect towards their intention to use smart city services, with a high significance value. Intention was measured by their intention to use e-services by organizations and intention to interact with services electronically (Appendix A). So, what the model tells us is, if a person has a high level of familiarity towards smart services, there would be a higher chance for that person to use it. As a result of the analysis, we can keep H1. Additionally, from the interviews collected, ease of life was seen as a possible variable that can affect intention to use smart city services.

H2: *Citizens' concerns have a negative effect on their trust in technology*

In the survey the respondents were given the chance to indicate what level of concern they have for a series of scenarios related to internet of things and smart city initiatives. We asked about concern towards personal information being leaked, personal information being misused, personal information being stored in the web and concern with position tracking by organizations through smart services. They were also asked to respond to their level of trust regarding how technology handles their information and security. The R-Square of CitCo → TrustT, shows a value of 0.17 meaning, the trust in technology variable can be explained by the citizens concern variable of about 17%, while the remaining is explained by other variables.

The relationship between citizens' concern and trust of technology based on the results of the analysis in (Table 10), it shows that the T Statistics of 4.61 > 1.96 and P-Values of 0.00 < 0.05 meaning that citizen concern has a significant effect on trustin technology. With that, we can conclude that H2 is accepted. What is important to note is that the connection is negative, meaning a reversed directional effect. If we look at Figure 5, an increase in the level of concern will decrease the level of trust in technology. This is somewhat contradictory when it comes to the interviews. Our findings indicate that the respondents were more likely to use smart city services as long as they see some form of benefit from it.

H3: *Trust in technologies has a positive effect on citizens intention to use smart services*

The findings of the survey regarding TrustT 1 (Trust in security of smart services), TrustT 2 (Trust of devices that collect and process data) and TrustT 3 (Trust in smart services to protect information), showcased a Mean value really close to neutral (Appendix A). This finding suggests that the respondents could be tipped towards either side and could signify that both public and private organizations should try to prove their trustworthiness, to heighten the individuals' trust in their services, which in turn could lead to a higher intention to use such services.

The statistics for TrustT on Int shows good results apart from the Goodness-of-Fit test (Table 6) which showed a mixed result. If both the Person and Deviance test were significant, we would have to reject our H3 and use H3's null hypothesis instead. The Nagelkerke value from Pseudo R-Square (Table 7) of 0.10 indicates that about 10% of changes in Int-variable is due to the TrustT-variable. As with other R-Squared values of Nagelkerke compared to the R-Squared of the SEM (Figure 5) we can assume that there is a small variance on the value. The T-value between TrustT-variable and Int-variable (Table 10) shows 3.25 indicating significance (>1.96) which conveys that this is a valid connection. Further on we can see the regression weight of 0.28 is shown between the same variable, indicating a positive relationship where an increment in TrustT will have an 0.23 effect on int.

From the interview findings, trust in technologies seems to be dependable on what type of functionality it has. Who the provider of the technology is also affecting the subjects trust, as five out of five said that they would trust the government more than a private company, which corresponds to the research done by Cottrill et al. (2020) where slightly higher trust in government agencies compared to private companies was reported. A study by Li et al. (2008) also points out that trust plays an important role to help users overcome perceived risks and uncertainty for using and accepting new technology (Li et al., 2008).

Three interview subjects showed a high degree of trust in technologies as they were very willing to entrust their personal information to technologies. These three subjects therefore make a good example of individuals with a high degree of trust in technologies, for better or worse in the sense that they say: "Why would someone use my personal information" (Subject 2 personal interview) or "I don't care about my privacy" (Subject 4 personal interview). This finding could also be related to what Joinson et al. (2010) mentioned about privacy and trust at a situational level interacts such that high trust compensates for low privacy, and vice versa (Joinson et al., 2010). The common trait with the three subjects is that they all are very much open minded towards using new smart solutions because they see more value in it compared to disadvantages

The analysis of the data from the survey and interviews all showed good results for keeping the H3 and rejecting H3's null hypothesis. We can therefore assume that there is a correlation between trust in technology and intention to use smart services. Attention should also be paid to the actors behind technologies as data shows this as a factor which influences the citizens trust in technology, and literature has also pointed out that trust in an actor and their practices could lead to greater willingness to share information (Wirtz & Lwin, 2009).

H4*: Citizen's familiarity of smart services has a positive effect on their trust in technology*

The respondents were given multiple examples of smart city services and were asked to indicate to what degree they were familiar with the given type of service. We were looking for how their level of familiarities had an effect on their trust regarding the technologies they use and the level of trust they had regarding the handling of information and security.

The items with highest load were familiarity to smart transport, energy and building management services. In the analysis, the R-square value of 0.06 as shown in Table 7, tells us that the degree of change in the TrustT variable has only 6% of it explained by FamSS, which indicates that the connection is very weak. With that in mind, when asking interview subjects if they would lose trust and stop using a service because of a security breach, most answered that they were likely to keep using the smart service if they saw some form of benefit from using it, regardless of their trust.A possible reason could be due to the subjects getting accustomed to technology not being reliable in the sense that malfunctioning of technology can occur at any point. Frustration or incomplete tasks affecting users' experiences are results of such issues (Ferreri & Mayhorn, 2020), and it is possible that the perceived benefits overweighs the disadvantage hence the continuous usage. In addition, the model results showed that the level of familiarity regarding smart city services does not have an effect on their level of trust towards technology (figure 5). This was further affirmed by our findings from the interviews. Therefore, trust would not be a considerable factor for them, by that we reject H4 and keep H4's null hypothesis: *familiarity has no effect on citizens' trustin technology.*

H5: *Intention to use smart services has a positive effect on use of smart services*

When looking at the statistics for use of smart services (appendix A), we can see that the average value (Mean) has quite a bit of fluctuation. The lowest value is on item Use 5 which regards use of civic-engagement tools on 2.38 while the highest value is item Use 2 which regards use of online government services on 4.79. The items used for our model are Use 1 (use of E-hailing services), Use 2 (Use of online government services), and Use 3 (Use of digital

booking of health services), which are the items with the best loadings. The statistics shows that online government services are used the most often with the average value of 4.79, which could make sense as more and more government services are becoming electronic services, e.g., tax returns, application for expansionof residency and several other government applications are now becoming e-services (Skatteetaten, n.d; *Kristiansand kommune*, n.d).

Both results from the survey and interviews have given usable data to get a closer look at the connection between intention to use and actual usage. Through the interview's findings, all subjects are open minded for the idea of using new solutions. Ease of life has also been identified a big factor for why some of the respondents wish to adapt to these services and solutions, and time savings seems to be an important factor contributing to ease of life.

An interesting finding from the survey on the “use of smart services”, showed that 50% answered they never use it, meaning that 51 out of 102 respondents reported that they never use smart services on a daily basis. From the interviews in stage one, however, a frequent usage of smart service was observed among the subjects. The public transport solutions AKT were identified as an application frequently used and as often as every day. The subject with the least usage of smart solutions still said that the weekly average would be 1-3 times. The statistics from the figure 6 indicating very low daily usage could likely be wrong or not an actual representation of their actual usage of smart services/solutions. Possible reason for the high number of respondents saying they never use smart services daily, could be due to a less frequent usage behavior such as on a weekly, or even monthly basis rather than daily. The possibility that respondents are lacking knowledge about what a smart solution is, could also be a highly likely factor for the statistics. Lack of knowledge should therefore be taken into consideration as a potential reason for the results presented. According to Penget al. (2017), lack of knowledge regarding smart solutions could be caused by insufficient marketing campaigns or inappropriate design of advertising material. Low awareness of what smart services/solutions are, could also affect the actual usage of services, which in turn could impact both citizens and cities reaping the benefits intended from the usage of the service (Peng et al., 2017).

In table 7 we can see the Pseudo R-Square value of 0.13 (Int on Use) which indicates that the degree of change the Int-variable has on the Use-variable is about 13%. In similarity to the other Pseudo R-Square values, there is a small variance between the values presented in the Nagelkerke-test compared to the values in SEM which is 15% (Figure 5). Table 10 shows that the T-value of Int on Use is significant (5.02), meaning that the connection between intention to use (Int) and use of smart service (Use) is valid. Through this validation we can assume that there is a connection between intention to use and the actual use of smart services. In the same table we can see that the regression weight for this connection is 0.39, which indicates a positive change

in the Use-variable (citizens' usage of smart services) when the Int-variable (intention to use smart services) increases. From the interview subject 2 answered the question "Are there any specific smart applications/solutions you are not using or choosing not to use?" With, "Main reason I haven't used something is because I don't know about it". This is a good example on how an individual's lack of awareness of available smart services/solutions could hinder the actual use behavior and therefore, impairing the individual's usage of new or existing services/solutions even though they have high intention to use such services.

As the results from the tests performed showed positive results, and findings from interviews displayed data that correlates to the findings from the survey, we can keep H5 and discard H5's null hypothesis. As H5 is kept, the citizens' intention to use smart service as a factor affecting the actual usage can be assumed. The findings showed indicators which point to ease of life as an applicable variable affecting an individual's intention to use such services.

7. Conclusion

This thesis has been a contribution to increase the understanding on how citizens perceive smart city initiatives, their familiarity and willingness to adopt such technologies. The following research question was formulated:

How do citizens' familiarity and concerns of smart cities affect their trust and adoption of smart solutions?

We answered the research question by conducting a questionnaire with 102 respondents and 12 participants from the interviews. The respondents were living in cities who are affected by the smart city initiatives. The literature review conducted revealed that there are multiple factors such as concern, trust, familiarity, intentions, ease of life to name a few, that can influence citizens' use of smart city services. Some of our results can add to existing literature on how citizens perceive and value these technologies, as ease of life was shown to be an important factor to why people would use smart city initiatives.

7.1 Implications

Our main goal for this study was to address the lack of research done on smart cities from the citizens' perspective. Many studies have talked about the privacy and security issues/concerns of smart city initiatives (e.g., Braun et al., 2018; Cottrill et al., 2020; Ismagilova et al., 2020; Sookhak et al., 2019), however, there seems to be lacking research that looks at it from the perspectives of citizens. Accordingly, our research has contributed with an insight into citizens' thoughts and knowledge about the smart city concept as well as their use behavior and use intention of smart services. This information is valuable in the sense that few past research has looked at challenges of smart city from a citizens' point of view. Some literature has looked at the importance of involving citizens in smart city projects as well as citizens' role in it, and how smart city development should be more citizen-centric (Gooch et al., 2015; Sepasgozar et al., 2019; Vácha et al., 2016;). Public and private organizations working on smart cities should focus on the thoughts and needs of its citizens' and educate them about the changes that are taking place in their city, to ensure participation on a high enough level to allow the smart solutions to reach their full potential. The goal of a smart city is to improve the life and wellbeing of its citizens'; smart city initiatives should take citizens' views into consideration as they will become the audience for such projects. We tried to highlight that citizens' views and awareness of smart cities should be accounted for, and how their knowledge and perspective on smart solutions can affect their intention to use either positively or negatively, which therefore affects the actual usage.

The findings from this research may be utilized by different actors in public or private sectors and city planners, to get a better understanding of the importance of involving and educating citizens on the concept of smart city. This study provides insight on citizens' perspectives on smart city as well as their familiarity of smart city services. The country of Norway is a leader in implementation of smart city technologies on a large scale (The explorer, 2020), and consists of several smart cities throughout the country (e.g., Bergen, Kristiansand, Oslo, Stavanger). Although that is the case, our study has found that several residents of Norway are still unfamiliar with the smart city concept and what are regarded as smart services or solutions. The importance of understanding citizens' perspectives is highlighted in our study, which shows that even in a leading smart city, citizens' knowledge of what the smart city concept is, still seems to be lacking. The findings showed that citizens deem the government and municipality as highly trusted actors. Especially when it comes to collection and storage of personal information. Past studies have suggested enlightening the citizens through better or more advertisements of smart cities and its benefits (Khan et al., 2020; Peng et al., 2017). From our findings, we would suggest that the government and/or municipalities take on the role in educating their citizens to increase awareness of smart cities and its benefits. Our interviews have shown that the subjects perceive the government/municipality to be more trustworthy. We believe that putting more focus on the citizens will be beneficial for both the citizens and actors to achieve

the utmost benefits of smart initiatives. Moreover, we hope that our study will provide insight on why citizens' perspectives are important, and that this information could suggest more of a citizen-focused approach for the development of smart cities rather than the technology-focused ones.

7.2 Limitation and Future Research

This study has some limitations as with any research. Firstly, a major limitation is the sample size, as it is rather small the findings are not generalizable. Secondly, as this study was not performed with one specific municipality in focus, because of the choice of using convenience sampling technique. The data from this survey cannot be pointed to one specific location or municipality. In addition, the age group is quite restricted as most of the sample size consist of individuals from the age group of 18-33. A bigger diversity of respondents could have affected the data of this study by giving a more general view, instead of a dominant view from the perspectives of young adults. Even though the sample size for this study is limited and smaller than preferred, the research has still produced relevant findings according to the goal of this study. A final remark is on the creation of the survey. The design of the survey was created with the room and intention for removal of items that were not needed or usable. For the better or worse, this approach led to the survey becoming rather lengthy. The possibilities to remove items after the survey gave us greater flexibility, but consequently many respondents might have been lost due to the large number of questions and length of the survey as well as resulting in several partially completed surveys responses.

The purpose of this research was to look at how citizens' awareness and perception of smart cities affect their adoption of smart services using a quantitative method. Interviews was also used to complement the survey findings, to get a more in depth understanding. This thesis provides insight on two factors with direct effect and one with indirect effect on citizens' intention to use smart services. Further research on how citizens' perception of smart city affects intention for use of smart services are needed, and more data are needed on our findings regarding the factors which through this research has shown to affect intention. We suggest further research to focus on citizens' concerns that are impairing them from using smart services or solutions, and how trusted actors might play a role in educating the citizens to increase awareness of smart solutions available. Using a more in-depth qualitative approach to get precise data, could also result in interesting findings that a quantitative approach could not capture. Research can also be done with the intent of comparing municipality with municipality, to look for differences and similarities. Expanding the focus to different countries could result in very different citizens' perspectives, as culture and governance of the country could be highly influential on its citizens' (e.g., Síthigh & Siems, 2019). Lastly, the present study can be extended by employing Fuzzy-Set Qualitative Comparative Analysis (fsQCA) (Ragin, 2009), which allows to get deeper insight into the data as it enables us to identify the necessary and sufficient conditions for an outcome to occur (Pappas & Woodside, 2021; Woodside, 2017). Further, fsQCA

allows us to go back to the cases to get a richer understanding of the data (Pappas, 2018; Pappas & Woodside, 2021), thus future studies may compare and complement results from SEM analysis with fsQCA.

To sum it up we will list what we believe further research can focus on to add to the research of smart city services adoption from a citizens' perspective.

- Focus on what citizens' concerns are impairing them from using smart services/solutions.
- Focus on how actors trusted by the citizens could raise citizens' awareness of the smart city concept and its services.
- Conduct research using qualitative methods to gain a more in-depth look at what citizens perceive to be of concerns regarding smart services/solutions.
- Conduct research on different municipalities to compare data looking at similarities and differences.
- Expand the focus to include other countries, to understand how cultural and governmental differences affect citizens' perspectives of smart services/solutions.
- Extending present study by employing fsQCA to get deeper insight into the data.

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Appendix

Appendix A

Scale items with min/max values (likert scale 1-7 where 1 is lowest score and 7 highest), Mean, Standard Deviation (SD), and Loadings.

Construct and scale items	Min/Max	Mean	SD	Loading
Familiarity of smart services (FamSS)				
1. To what extent are you familiar with Smart transportation services such as: smart parking, mobile connected vehicles, smart buses, smart traffic lights, etc.	1/7	4.27	1.85	0.78
2. To what extent are you familiar with Smart healthcare services: smart home caring systems, remote monitoring systems for disabled, chronically ill, or elderly patients, etc.**	1/7	3.65	1.98	0.75
3. To what extent are you familiar with Smart energy services: smart meters for electricity, gas and water, home energy monitoring systems, smart grid services, decentralized energy ecosystems, etc.	1/7	3.82	2.00	0.83
4. To what extent are you familiar with Smart public security services: smart surveillance using high-resolution and sensor-activated video cameras and video analytic tools, etc.**	1/7	3.28	1.83	0.84
5. To what extent are you familiar with Smart building management services: smart home/building systems using wireless sensors to connect and control in-house heating, air-conditioning, lighting, security systems, and other appliances, etc.	1/7	3.92	1.79	0.78
6. To what extent are you familiar with Smart waste management services: smart bins deployed in households, commercial buildings and public areas, etc.*	1/7	3.07	1.90	0.69
Use of smart services (Use)				
1. To what extent do you use E-hailing services such as: car, taxi, uber or other forms of transportation to pick up via digital devices?	1/7	3.74	2.11	0.74
2. To what extent do you use Online government services such as: city portal, tax returns, construction permits, reporting relocation, etc?	1/7	4.79	1.87	0.73
3. To what extent do you use Digital care search and scheduling services for digitally booking of health services?	1/7	4.29	1.87	0.74

4. To what extent do you use Bike sharing services for renting city bikes or scooters?*	1/7	2.47	2.05	0.66
5. To what extent do you use Civic-engagement tools which are digital platforms used for: crowdsourcing, voting, report of noncritical problems, and making service requests?*	1/7	2.38	1.56	0.51
6. To what extent do you use Apartment-sharing platforms such as Airbnb or similar?*	1/7	2.62	1.84	0.67
7. To what extent do you use Smart parking applications such as: EasyPark, Apoca Flow or others?*	1/7	4.69	2.22	0.55
Citizen concerns (CitCo)				
1. To what degree are you concerned with personal information being leaked	1/7	3.74	1.60	0.84
2. To what degree are you concerned with personal information being misused	1/7	4.12	1.54	0.87
3. To what degree are you concerned with personal information being stored on the web	1/7	4.16	1.68	0.86
4. To what degree are you concerned with a company being able to track your position through mobile devices	1/7	4.13	1.72	0.77
Intention to use e-services (Int)				
1. To what degree would you use the electronic-services provided by organizations?	2/7	5.11	1.21	0.84
2. To what degree would you interact with a service electronically?	2/7	5.10	1.30	0.84
3. To what degree would you hesitate with providing information to an electronic-service?*	1/7	3.92	1.40	-0.22
4. Have you found yourself using a phone call for booking a doctor's appointment instead of digitally?*	1/7	4.08	2.00	0.49
5. Have you found yourself delivering the selvangivelse(skattemelding) physically instead of digitally?*	1/7	1.56	1.23	0.13

6. Have you found yourself using a bus card instead of the phone when paying for tickets?*	1/7	2.84	1.85	0.56
7. Have you found yourself using banking services physically instead of digitally? *	1/7	2.39	1.59	0.37
8. Have you found yourself using a parking meter instead of digitally paying for your parking through an app?*	1/7	3.04	1.78	0.46
Trust in Technology (TrustT)				
1. To what degree do you trust the security of the smart city services?	1/7	4.19	1.28	0.92
2. To what degree do you trust the devices that collect and process the data while you are using smart city services?	1/7	3.93	1.35	0.95
3. To what degree do you count on smart city services to protect your information?	1/7	3.90	1.46	0.87
Note: * = Items have been removed due to insufficient loadings (<0.700) ** = Items have been removed to keep amount down to 3-4 items				

Appendix B

Interview guide
-Age -Education -Occupation 1.Are you familiar with the concept of smart city? If Yes, can you explain with your own words what it is? If No, what do you think it may be? (Explain what a smart city is) 2. Are there any specific smart applications/solutions you are (choosing) not to use? (hvis folk ikke bruker det, finne ut hvorfor) What it would take for them to use it concerns related to it 3. Do you have any negative experiences with smart services/solutions? What and why? 4. Do you have any concerns regarding usage of smart solutions or technologies? Why 5. Do you feel like smart services/solutions gives you more benefits compared to the information you have to give them 6. Can you tell me a scenario where you would stop trusting smart technologies? Would that be a reason that will stop you from using it? 7. If a smart service you are using gets a security breach, would you lose trust and stop using it or switch to a different one? 8. Has the usage of smart solutions affected your daily life? if so explain how/why? 9. Do you complete certain tasks in other ways than what you used to do because of technologies? - examples? 10. To what degree would you say that smart solutions or services increase your ease of life, do you think this affects your quality of life as well? any examples?
Additional questions How often do you use smart city services? who would you trust more between the servcies from the municiplaity or a privat company? Are there any specific smart applications/solutions you are (choosing) not to use? -What it would take for them to use it

Do you have any negative experiences with smart services/solutions? -What and why?
Note: **Questions adapted from each interview round** = inclusion of new questions to get a different view on the in order to supplement the survey findings **Additional questions** = Question that were given to all subjects from previouse interview rounds.

Appendix C

Vil du delta i forskningsprosjektet: Kjennskap og adopsjon av smart city

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke *hvordan påvirker innbyggernes kjennskap og bekymringer for smarte byer deres tillit og bruk av smarte løsninger?* I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Dette er et informasjonsskriv til studiens informanter. Formålet med samtykkeerklæringen er å informere deltakerne om oppgavens hensikt, bruk av informasjon, samt deres rettigheter. “Kjennskap og adopsjon av smarte byer: en undersøkelse på innbyggere”

Personvern og sikkerhet er et tema under stor diskusjon nå som teknologier har evnen til å samle og overvåke informasjon om brukerne. Denne konflikten skaper usikkerhet og svak tillit til teknologier av denne typen, og synspunktet på teknologiske løsninger implementert i byer blir oppfattet forskjellig fra individ til individ. I vår studie skal vi studere hvordan innbyggerne i Kristiansand oppfatter bruken av smarte løsninger i henhold til begrepet smart city, og deres oppfatning på sikkerhet/personvern.

Vi ønsker å samle informasjon om deres erfaringer/tanker knyttet til Smart City begrepet samt hvordan de føler slike tiltak kan påvirke dem. Informasjonen samlet inn skal bidra til å kunne danne et bilde av hvordan befolkningen i Kristiansand kommune oppfatter bruken av teknologi i byen deres og dens påvirkning på enkeltindivider.

Hvem er ansvarlig for forskningsprosjektet?

Universitetet i Agder er ansvarlig for dette prosjektet.

Hvorfor får du spørsmål om å delta?

Etter som denne undersøkelsen er basert på Smart-By utviklingen i Kristiansand, er det nødvendig for å se på dette temaet gjennom innbyggerne i Kristiansand for å dannet et korrekt bilde om hva en innbygger synes om slike teknologiske utviklinger. Fremgangsmåten vi har valgt å benytte er en blanding mellom Tilfeldig- og Praktisk-Utvalg. Dette går ut på at utvalget er trukket tilfeldig samtidig som den er trukket basert basert på praktikalitet.

Hva innebærer det for deg å delta?

Hvis du velger å delta i prosjektet, så innebærer det at du fyller ut et elektronisk spørreskjema. Det vil ta deg ca. 15 minutter. Spørreskjemaet inneholder spørsmål om din kjennskap til smart city begrepet, samt spørsmål som angår personvern og sikkerhet. Dine svar fra spørreskjemaet blir registrert anonymt og elektronisk. Det er også mulig å delta i et personlig intervju. Vi vil da gjennomføre intervjuer med

varighet på inntil 30- 60 minutter. Spørsmålene vil omhandle tanker og perspektiver innen smart city, personvern og sikkerhet . Dataen vil lagres som lydopptak på enheter godkjent av UiA, dersom informanten tillater det, og notater kan bli tatt underveis.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Alle personopplysninger vil bli behandlet konfidensielt. Lydopptak eller notater som tas i intervju vil bli transkribert og lagret kryptert på UiA's server, hvor kun prosjektgruppens studenter og veileder har tilgang. Informasjonen vil bli anonymisert med en koblingsnøkkel som knytter deg til dine opplysninger. Listen med koblingsnøkler som knytter deg til dine data vil lagres separat. Informantens navn vil ikke bli publisert i forbindelse med oppgaven vår.

- Det er kun prosjektgruppe og veileder som vil ha tilgang til dine opplysninger
- Dataene vil bli lagret i en konfidensiell/låst server på instituttet hvor kun prosjektgruppe og veileder har tilgang
- Spørreundersøkelses verktøyet som blir brukt for utforming og distribuering er SurveyExact
- Eventuell lydopptak vil bli tatt opp gjennom en diktafon fra Universitet i Agder

Ingen deltaker vil kunne bli gjenkjent gjennom publikasjonen av oppgaven

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?

Når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er slutten av Juni 2021. Ved prosjektets slutt vil datamaterialet og alle personopplysninger bli slettet. Disse vil ikke bli oppbevart eller brukt videre etter prosjektets slutt.

Dine rettigheter

Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke personopplysninger som er registrert om deg, og å få utlevert en kopi av opplysningene,
- å få rettet personopplysninger om deg,
- å få slettet personopplysninger om deg, og
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.
På oppdrag fra Universitet i Agder har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Hvor kan jeg finne ut mer?

Hvis du har spørsmål til studien, eller ønsker å benytte deg av dine rettigheter, ta kontakt med: Ali Al-Musawi på epost: asalmu16@uia.no eller Erik Yang på epost: eriky15@uia.no. Faglig veileder under prosjektet er førsteamanuensis ved Universitetet i Agder Ilias Papas og professor Devendra Bahadur Thapa. Vårt personvernombud er Ina Danielsen, e-post: ina.danielsen@uia.no
tlf: 38 14 21 40.

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Ali Al-Musawi

Erik Yang

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet *[sett inn tittel]*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

¨**å delta i** Intervju ☐

¨**å delta i** spørreundersøkelse ☐

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

Jeg har mottatt og lest informasjon om studien, og samtykker til å delta i intervju.

Signatur Dato, sted