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Near Field Communication

Its adoption process and technology acceptance

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ABSTRACT

NFC was often predicted in media as well as academic literature to become a de facto standard, which offers great value. Today there are more smartphones than personal computers and tablets combined, predicting that the mobile payment market to grow radically. NFC is often cited as a suitable technology for mobile payment solutions. This thesis aims to answer the research question why NFC has not become a standard for mobile payments as well as widely used and accepted. To answer this, we propose a research model based on extended TAM. Our findings suggest that there is a general positive attitude towards NFC, but the participants tend to lack awareness of its existence. In order to complement the findings of our research model, we discuss the adoption process and value of standardization. We also conclude that Apple has a considerable share of the smartphone market and that they will play a key role for the future of NFC with whether or not the next generation of their products will support it. Furthermore, it is clear from historical examples that in the end, it will be the users that decide whether or not NFC will be the de facto standard for mobile payments.

Keywords: *Near Field Communication, NFC, Technology Acceptance, TAM, Standard Adoption, Trust*

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A	Attitude
CB-SEM	Covariance Based SEM
IU	Intended Use
NFC	Near Field Communication
NFC	Near Field Communication
PEOU	Perceived Ease of Use
PLS-SEM	Partial Least Square SEM
PU	Perceived Usefulness
SEM	Structural Equation Modeling
T	Trust
TAM	Technology Acceptance Model
VCR	Video Cassette Records
VHS	Video Home System

1 Introduction

In this chapter a background to the technology of NFC is provided. A problem area is identified that culminates into our research question of which this paper is based on.

1.1 Background

Near Field Communications (NFC) is a short-range wireless technology that lets devices communicate when in close proximity. The NFC technology allows for development of devices, including mobile phones to be used like contactless cards. NFC has a shorter transmission range and slower data rates compared to other short-range wireless technologies such as Bluetooth, radio-frequency identification (RFID), and Wi-Fi.

The possibility and potential uses of NFC are vast, Anokwa, Borriello, Pering, and Want (2007) suggest cell phones to be used as tagged car keys, retrieving information about a particular movie directly from a smart movie poster, save the data on the phone and then directly transfer the information to the NFC enabled TV at home. Thus, allow the user to view the trailer for the movie on a bigger screen. Remedios, Sousa, Barata, and Osorio (2006) predicted that the cell-phones will evolve and help us control and monitor surrounding entities by providing services of authentication and control e.g. open garage doors, yard gates, front doors, turning on and off alarm systems using NFC. Dominikus and Aigner (2007) suggested NFC should be used for mobile coupons referred to as mCoupons.

Today many businesses are trying to go green, and a lot of focus is on environmental issues. NFC technologies can through innovative and creative solutions help organizations and individuals minimize their effects on the environment e.g. during events a lot of flyers are handed out featuring commercials, or schedule information, with NFC the user can retrieve the information just by swiping their phone over the tag. Thus, decreasing the need for paper handouts and thereby also the effect on the environment ("Current Trends in Near Field Communication," 2014) ("Frequently Asked Questions," 2014). However, the most predicted use of NFC tends to be related to economic transactions (Haselsteiner & Breitfuß, 2006; Ondrus & Pigneur, 2007; Remedios et al., 2006).

NFC was developed jointly between Philips and Sony in 2002 for contactless communications. A NFC device generates a low frequency radio-wave field within the 13.56-MHz spectrum. Once another NFC enabled device gets close enough to contact the field, magnetic inductive

coupling occurs and energy is transferred from one device to the other. The use of magnetic coupling is a principal difference between NFC and technologies such as Bluetooth and Wi-Fi. There are two different types of NFC devices, active and passive. In order for an NFC device to be considered active it has to have an internal power supply, for instance a mobile phone. In contrast a passive device does not have an internal power supply, e.g. a smart card. Inductive coupling causes a passive device to absorb energy when it gets close enough and can after it has been powered up exchange data with the other device. "The ability to act as both passive and active devices make NFC devices unique among contactless communications technologies" said Tariq Shahab, Philips Semiconductors business development and marketing manager for identification technologies. Magnetic inductive coupling is a simple technique that can easily be implemented in silicon. Therefore, vendors can simply integrate an NFC system's antenna, such as an analog modulator or demodulator (for sending and receiving signals) directly onto a single chip (Ortiz, 2006).

The NFC's operating range is only 10 centimeters because inductive coupling only works over short distances. In practice however, it tends to only work with the devices right next to each other. This is significantly shorter than the operating range of 10 meters for Bluetooth or Wi-fi's 100 meters. NFC can transfer data at a maximum of 424 Kbits per second compared to Bluetooth's 3 Mbits and Wi-Fi's data rate ranging from 54 Mbits to 600 Mbits depending on their standard. Therefore NFC is not suitable for many types of data transfer. However, because NFC requires the devices to be in close proximity with each other intercepting signals is difficult, which gives the technology some inherent security. NFC has other advantages compared to the other wireless communication technologies. It only consumes a mere 15 mA of power (a trivial amount for modern batteries). NFC does not need to be configured where Bluetooth and Wi-Fi both require the user to manually configure settings.

1.2 Problem area

eMarketer is a digital analysis company that collects data from thousands of sources. They predict that 4.55 billion people will use mobile phones worldwide in 2014. The mobile phone penetration will rise from 61.1% to 69.4%. The global smartphone market is smaller, it surpassed 1 billion in 2012 and is expected to total 1.75 billion in 2014. eMarketer expects a continued fast paced trajectory through 2017 ("Smartphone Users Worldwide Will Total 1.75 Billion in 2014," Jan 16, 2014)

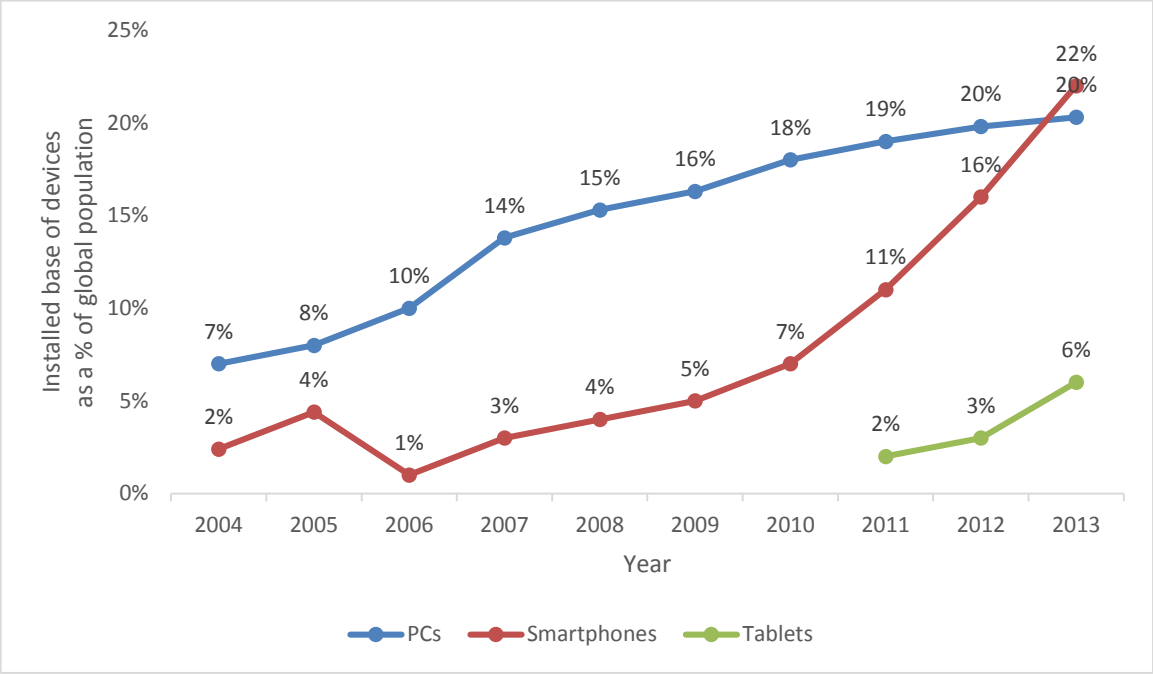

Figure 1.1: PC, smartphone and tablet diffusion according to Heggestuen (2013)

Figure 1.1 shows the percent of the world population owning a smartphone. It is clear that there has been a very dramatically increase between 2010 and 2013. Historically for the first time ever, more people in the world own a smartphone than a personal computer.

In 2012 the value of mobile payments was $4 billion and ABI Research forecasts that it will rise to $191 billion in 2017, breaking the $100 billion mark in 2016. The current prediction is that transportation and ticketing are the first applications to adapt the technology, with 26% of all NFC handsets to house a contactless ticketing application in 2017 ("NFC Mobile Payment Transaction Spend to Hit the $100 billion Mark in 2016," 2014).

NFC is not a new technology, it was developed already in 2002. Between 2006 and 2007 authors within the academic field predicted that NFC would become widely successful and used (Ondrus & Pigneur, 2007; Remedios et al., 2006). During this time NFC was also mentioned a lot in media, such as the technology newspaper Computer Sweden. A quick search on google scholar for papers containing the term Near Field Communication in their title produces 856 results, 606 of which were published since the year 2010. The NFC technology is often discussed around new features, services and innovative ways of use. Such as the exchange of business cards simply by shaking hands and how NFC devices could be inserted into the human body itself. However most IS related research on this topic tends to be related on analyzing the security of this technology and how it could be used for mobile payments (Cavoukian, 2012; Haselsteiner & Breitfuß, 2006; Madlmayr, Langer, Kantner, & Scharinger, 2008; Sharma,

Gusain, & Kumar, 2013; Yaqub–Undergraduate & Shaikh–Undergraduate, 2012; Zimmerman, 1996).

Today there are multiple technologies and services for mobile payment that all compete for market share. It is clear that the future will allow us to pay using a mobile device even though as of now, no specific technology has been successful in becoming a standard. The reason that newer technologies often are standardized and end up being dominated by a few stakeholders are many. Since there is some confusion regarding the term standard, also caused by increasing diversity, the applied terminology has to be defined. Blind (2011) defines a standard as something that represents an agreement in respect of the standardization of products, procedures or practices. Standards are published by formal standards organizations based on a strict consensus process. A standard is typically published together with specifications. Egyedi and Blind (2008) state that there are clear values to having standards. It is possible to refer to them implicitly and explicitly, therefore reducing transaction costs. What is more is that standards create compatibility. They allow products to work together and equipment parts to be replaced based on standard interfaces i.e. such as paper processing equipment such as printers, copiers and fax machines that are all based on the common A-series of paper formats (ISO 216).

It is not for the first time technologies battle for market dominance within the standards wars. A good example of Microsoft Word and Excel which vanquished WordPerfect and Lotus 1, 2 and 3 respectively. Another example is the war between Video-Cassette recorders Duel of the 1980s, in which Matsushita's VHS format triumphed over Sony's Betamax. Today few people remember how Philips's digital compact cassette and Sony's minidisk flopped in the 1990s. In the beginning of the 21th century DVD competed against DivX in the battle to replace VCRs and CDs. Thus, we can see that these kind of standardization wars commonly occur amongst competing technologies.

Commonly the term 'standard' is used in two main senses namely in the sense of committee standards and de facto standards. A committee standard is a very specific type of agreement. It is specified and developed by a committee for a repeated use e.g. ISO. De facto standards on the other hand, are widely adopted standards or specifications that include products, services, practices e.g. the portable document format (PDF) developed by Adobe (Egyedi & Blind, 2008).

There are many organizations that work with standards relating to ICT such as ECMA (former European Computer Manufacturer's Association and since 1994 the European Association for Standardizing Information and Communication Systems), Organization for Standardization (ISO) and OASIS (Organization for the Advancement of Structured Information Standards). These organizations often play a crucial role in the final decision, such as in the standards competition between ODF and OOXML (Blind, 2011).

NFC was approved as an ISO standard on December 8th 2003 and later as an ECMA standard. It is standardized as an open platform technology in ECMA-340 and ISO 18092. These standards specify the modulation schemes, coding, transfer speeds and frame format of the RF interface of NFC devices. The standards also describe the initialization schemes and conditions required for data collision-control during initialization for both passive and active NFC modes as well as the transport protocol, protocol activation and data exchange methods. Additionally, NFC itself incorporates a variety of existing standards including ISO/IEC 14443, type A and B, and FeliCa. GSMA (Global Systems for Mobile Communications Association) a global trade association representing in excess of 200 product and service companies and almost 800 phone operators across 219 countries. Many of its members have led NFC trials around the World and are now preparing services for commercial launch e.g. The Pay-Buy-Mobile initiative ("Near Field Communication," 2014).

On the 17th of November in 2010, after two years of discussions, AT&T, Verizon and T-Mobile launched a joint venture, intending to develop a single platform where they could use technology based on NFC for their customers to make mobile payments. The new venture, today known as ISIS, is designed to allow NFC-enabled cell phone users to be able to use the technology similarly to credit cards. This was a major breakthrough since they combined account for 200 million customers across the United States ("Now You Can Pay With Your Phone," 2014).

NFC in itself is not a new technology whereas the feature of mobile payments is. In Sweden mobile payments has typically meant sending complicated SMS texts including various codes. Today there has been a rise of new competitors and solutions all aiming and hoping on providing the next mobile payment solution, many of which are based on NFC. Sadly, having multiple different and incompatible systems for mobile payment makes for an upcoming standardization war. Many users, distributers, shops and key actors are waiting for one technology to become more dominant than the others.

1.3 Research question

In this paper we aim to answer the following questions.

- Why has the NFC technology unlike predicted failed to:
    - Become a standard for mobile payments?
    - Become widely used and implemented (adapted)?

1.4 Purpose

The purpose of this thesis is to further develop the understanding of the adoption process for NFC. We propose our own research model based on TAM and complement the findings with theory about technology adoption in order to improve discussion quality.

2 Theory

In the following chapter relevant literature and research is presented for our paper. Furthermore our theoretical framework is presented.

2.1 Technology acceptance model

We selected the technology acceptance model (TAM) in the context of this research because we can find out what actually determines the use of NFC. And based on the responses in the questionnaire we can see a general opinion of people towards NFC. Based on the factors that determine the use of NFC we use this in the discussion to make sense of where NFC as a technology is right now in comparison to what happened to other technologies in the past.

2.1.1 Evolution of TAM

The foundation of evaluating the acceptance of the NFC technology used in this paper is the TAM. The TAM was developed to explain and predict the user acceptance of an information system (IS). It was introduced by Davis Jr (1986) as an adaption of the Theory of Reasoned Action (TRA) and is therefore an adaption that implies that behavioral intention to use an IS is mainly influenced by perceived usefulness and perceived ease of use towards the user.

Meanwhile there are three major versions of the TAM. The initial TAM, which was developed to predict and explain technology acceptance. It explains the technology acceptance in a more plain way (Venkatesh & Bala, 2008). TAM2 is an extension towards TAM, which is tailored to explain technology acceptance within an organizational environment (Venkatesh & Davis, 2000). TAM3 combines TAM2 and the model of determinants of perceived ease of use and results in an integrated model of technology acceptance (Venkatesh & Davis, 2000). TAM3 major benefit is to provide guidance for corporate IT implementation as well as getting insights and understanding of user reaction towards new IT within an work environment (Venkatesh & Bala, 2008). The fact that TAM is more general and the fact that the initial TAM was used in several studies to explain technology acceptance of end-user technology was decisive for us to use TAM over TAM2 or TAM3 (Dahlberg, Mallat, & Öörni, 2003; Srivastava, Chandra, & Theng, 2010; Tan, Ooi, Chong, & Hew, 2014).

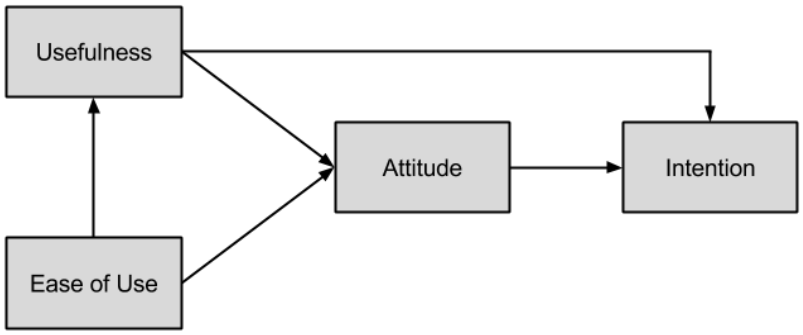

Figure 2.1: TAM adapted from Davis, Bagozzi, and Warshaw (1989)

In the initial TAM, Perceived usefulness (PU) is defined by Davis Jr (1986) as the user's subjective probability that the use of an IS will increase the work performance in an organizational context. Perceived ease of use (PEOU) refers to the degree the user expects the IS to be free of effort (Davis et al., 1989).

The behavioral intention to use (IU) is influenced both by the attitude towards using (A) the IS as well as the PU. At the same time, the attitude is affected by usefulness and ease of use while ease of use has an impact towards usefulness as well (Davis et al., 1989).

The work context the original TAM aimed at is not applicable in this paper, instead this research is about a consumer technology. In previous research TAM was applied to predict technology acceptance of end-user technology (Mathieson, 1991; Vijayasarathy, 2004; Yi & Hwang, 2003).

2.1.2 Complementing TAM with trust

Due to the discussed characteristics of NFC, namely that it is used in mobile devices, it is a technology to transfer data, and its potential for mobile payment, we will not only investigate if ease of use and usefulness but also if trust has an influence towards the intention to use. Therefore instead of using the original TAM, this research is based on a modified version of TAM that includes Trust as another construct used Trust as a construct in an extended TAM within their studies. The investigated technologies in those studies were online shopping, internet banking and mobile payment, which are similar to our case, especially considering that one of the predicted major uses of NFC was mobile payment (Dahlberg et al., 2003; Gefen, Karahanna, & Straub, 2003; Suh & Han, 2003a, 2003b). The specific model followed for this research is the one proposed and used by Gefen et al. (2003) which is the by far most cited article with a similar problem area and the major reason that, we confidently rely on it.

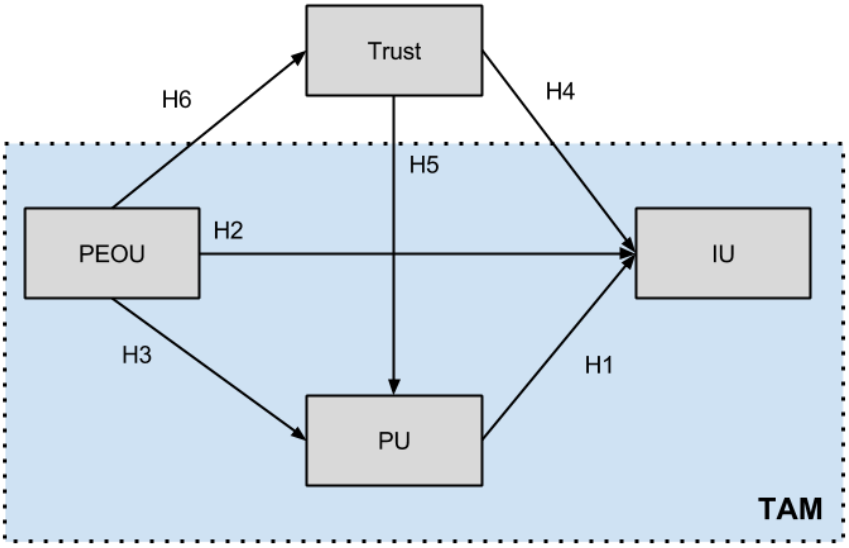

Figure 2.2: Trust extended TAM according to Gefen et al. (2003)

The trust extended TAM was proposed and tested with online shopping and accepted all proposed hypothesis. The model of Gefen et al. (2003) contains the TAM as proposed by Davis Jr (1986) and therefore the original hypothesis H1, H2, and H3. Additionally to that, it extends it by H4, H5, and H6. Therefore the model we try to confirm in the context of NFC contains the following hypothesis:

H1: PU will positively affect IU of NFC.

The relationship in this hypothesis explains that IU is a dependent variable of PU with a positive dependency. This means that knowledge of PU enables to estimate IU as well as when PU increases, the IU increases.

H2: PEOU will positively affect IU of NFC.

H2 states that IU is a dependent variable of PEOU while PEOU has a positive dependency. This means that knowledge of PEOU enables to estimate IU as well as when PEOU increases the IU increases.

H3: PEOU will positively affect PU of NFC.

This hypothesis shows a relationship that PU is a dependent variable of PEOU with a positive dependency. This means that knowledge of PEOU enables to estimate PU as well as when PEOU increases, PU increases.

H4: Trust will positively affect IU of NFC.

This hypothesis shows the relationship between Trust and IU. It states that IU is a dependent variable of Trust and has a positive dependency. This means that knowledge of trust enables to estimate IU as well as when trust increases, IU increases.

H5: Trust will positively affect PU of NFC.

The relationship in this hypothesis explains that PU is dependent variable of trust with a positive dependency. This means that knowledge of trust enables to estimate PU as well as when trust increases, the PU increases.

H6: PEOU will positively affect trust in NFC.

The relationship observed in this hypothesis states that trust is dependent variable of PEOU with a positive dependency. This means that knowledge of PEOU enables to estimate trust as well as when PEOU increases, trust increases.

Additionally to this Gefen et al. (2003) determined calculative-based trust, institution-based structural assurances, institution-based situational normality, and knowledge-based familiarity as constructs that positively affect trust in the context of the study. Due to the different context of our study, we will not include those constructs.

2.2 Literature review trust

The trust construct introduced by Gefen et al. (2003) was in the context of online shopping, however as a result of the fact that NFC technology consists of a set of standards, which is not bound to any vendor but can be utilized by any company, the definition of trust in this context obviously differs. Therefore we reviewed literature and studies and extracted trust constructs to provide a more general definition of trust in this chapter, which is applicable to the context of this study. We use this definition as a foundation for the questions that determine trust in NFC technology within model.

We approached the literature review by gathering relevant articles and pre-selecting them by skimming the texts for relevant trust constructs. After determining the articles, we were going through the selected articles and classified the definitions and uses of trust. This lead to a list of four constructs presented in Table 2.1.

Table 2.1: Trust constructs

Author	Field	Control-lability	Privacy	Relia-bility	Secu-rity
Srivastava et al. (2010)	Mobile payment	X		X	X
Dahlberg et al. (2003)	Mobile payment	X	X	X	X
Vance, Elie-Dit-Cosaque, and Straub (2008)	Online shopping	X	X	X	X
Zaheer, McEvily, and Perrone (1998)	Online shopping		X	X	
Crosby, Evans, and Cowles (1990)	Online shopping	X			
Doney, Cannon, and Mullen (1998)	Online shopping			X	
Ganesan (1994)	Online shopping			X	
Tan et al. (2014)	Mobile payment			X	

In the following chapters, we define the determined trust constructs controllability, privacy, reliability and security according to the found definitions in Table 2.2.

Table 2.2: Trust literature review

Author	Concern/Statement	Construct	Field
Srivastava et al. (2010)	Traceability of the mobile payment	Controllability	Mobile payment
Dahlberg et al. (2003)	Transaction record and documentation (traceability) Vagueness of the transaction (control when paying)	Controllability	Mobile payment
Vance et al. (2008)	General feeling while online shopping Comfort when making purchases on the Internet	Controllability	Online shopping
Crosby et al. (1990)	Party will behave in the interest of the customer	Controllability	Online shopping
Doney et al. (1998)	Importance of perceived credibility and benevo-lence	Reliability	Online shopping
Zaheer et al. (1998)	Actor will fulfill its obligations, is predictable, and is fair and not opportunistic (keeping promises and is trustworthy)	Privacy	Online shopping
Dahlberg et al. (2003)	Willingness to provide personal information	Privacy	Mobile payment
Vance et al. (2008)	Feeling that legal and technological structures pro-tect the user from problems	Privacy	Online shopping
Srivastava et al. (2010)	Importance of reliability and stability of the tech-nology supporting the mobile payment systems	Reliability	Mobile payment
Ganesan (1994)	Willingness to rely on a partner in whom one has confidence based on belief in that party's credibility (integrity and ability) and benevolence.	Reliability	Online shopping
Zaheer et al. (1998)	Actor will fulfills obligations, is predictable, fair and not opportunistic	Reliability	Online shopping

Tan et al. (2014)	Concern that technology failure leads to financial or psychological loss.	Reliability	Mobile payment
Vance et al. (2008)	Vendor is interested in customer well-being, meets obligations, fulfills agreements, serves customers and meets needs	Reliability	Online shopping
Dahlberg et al. (2003)	Errors in payment transactions are a potential risk Mobile device and network are unreliable for payments	Reliability	Mobile payment
Dahlberg et al. (2003)	Concern about unauthorized use	Security	Mobile payment
Srivastava et al. (2010)	Security concerns in the technology supporting mobile payment systems. Afraid of hackers when doing monetary transactions through wireless mediums. Trusted parties and government regulations can assure security.	Security	Mobile payment
Vance et al. (2008)	Safeguards, legal and technological structures, encryption, and other technological advances make the user feel comfortable and protected when using the internet.	Security	Online shopping

2.2.1 Controllability

Controllability is the most general and abstract of the three constructs, describing the feeling of control a customer has when using a certain technology. We define controllability as the extent to which a user feels in control when using a certain technology. In terms of NFC this could for example mean if the actions are traceable when using NFC. We determined controllability due to several findings in similar studies.

Literature states that the usage of mobile payment systems is highly influenced by the possibility to trace payments and processes (Dahlberg et al., 2003; Srivastava et al., 2010). Dahlberg et al. (2003) mention that the amount a user feels in control when using mobile payment systems makes the system trustworthy and therefore increases usage. Vance et al. (2008) determine the extent to which a user feels good and comfortable when purchasing online as a component of trust. While Crosby et al. (1990) state that trust involves, that the technology or vendor behaves in the interest of the customer.

Therefore in this context we define controllability as the amount a user feels in control when using NFC which is a construct that influences trust. Hence we add the following hypothesis to the research model:

H7: Controllability will positively affect trust of NFC

2.2.2 Privacy

Privacy is the construct regarding the extent to which a user feels confident using the technology in terms of privacy reasons. That means if the user would feel comfortable using the service and providing personal information for services utilizing the technology.

Zaheer et al. (1998) state that an actor is trustworthy, when it fulfills its obligations, is predictable and is fair and not opportunistic. We classified this as privacy, because a vendor has to meet its own privacy policies as well as privacy laws and act appropriate when it comes to personal information. The willingness of users to provide the payment service provider with personal information as well as the belief in legal and technological structures to adequately protect the user are part of trust in technology, which influences the usage (Dahlberg et al., 2003; Vance et al., 2008). Those statements indicate that privacy concerns influence the users trust.

Specifically in terms of NFC this means, that a user is confident in trusting the technology as well as a service utilizing the technology with handling personal information. This could for example be credit card information for a mobile payment system utilizing NFC. However to determine privacy in this study, we will measure the privacy concerns a user has when using NFC in general. Therefore we determine privacy as an influence towards trust which results in the following hypothesis:

H8: Privacy will positively affect trust of NFC

2.2.3 Reliability

Reliability describes the extent to which a user thinks the service or technology is reliable. By this we mean if a user could think the technology is reliable enough to use it on a regular basis and be dependent up to certain extent.

Several authors state that an actor has to meet their obligations, fulfill their agreements and be predictable (Doney et al., 1998; Ganesan, 1994; Vance et al., 2008; Zaheer et al., 1998). This is associated with reliability because a user has to be able to rely on the service or technology, otherwise this will reflects in the trust. This and that a service provider has to be good at what it does in general and that the users willingness to rely as well as stability of a technology is very important for users and influences the trust (Ganesan, 1994; Srivastava et al., 2010; Vance et al., 2008). As well as the fear of technology failure that leads to financial or psychological loss is important and significant towards trust and use of a technology (Dahlberg et al., 2003; Tan et al., 2014).

Based on this literature review, we define reliability as the extent to which the user thinks NFC is a reliable technology that could be utilized for regular tasks. Due to this we add the following hypothesis:

H9: Reliability will positively affect trust of NFC

2.2.4 Security

Security describes the extent to which a user thinks the provided service or technology provides good security. This can be crucial for the decision of possible users to use the service or technology for sensible applications like payment. We found indications that emphasize the importance of security in several of the investigated articles.

User concerns regarding the importance of security of wireless technology underlying payment services due to attacks of hackers or unauthorized use or others are influencing trust (Dahlberg et al., 2003; Srivastava et al., 2010). This and the users believe that third party applications, trusted parties, established technologies, encryption and government regulations improve the security trust in a system or technology show the relevance of security (Srivastava et al., 2010; Vance et al., 2008).

Due to the findings in the reviewed literature, we define security as the extent to which a user has concerns towards that NFC is an unsecure technology and could be used for services that transfer sensible data. We therefore determine a positive relationship between security and trust and add the following hypothesis:

H10: Security will positively affect trust of NFC

2.3 Proposed research model

The literature review about trust as well as the trust extended TAM result in the following research model (Figure 2.3). This research model proposes that the following hypotheses are true in the context of NFC, which we will test in the process of this research.

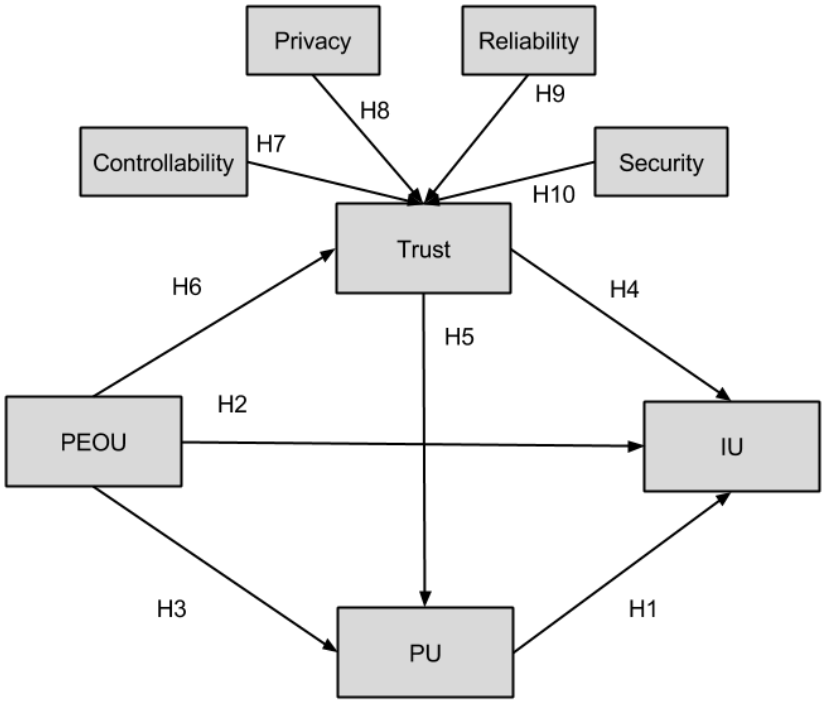

Figure 2.3: Proposed model

2.4 Complementing our research model

To complement the discussion of the results from the research model and to help provide a better answer for our research question we will discuss the standardization process (Chapter 2.4.2), provide a historically similar example, in our case the video format war (Chapter 2.4.3), discuss the values of standardization (Chapter 2.4.4) and finally discuss how platforms differentiate from standards mentioning Apple as an example (Chapter 2.4.5).

2.4.1 Defining standards

In this thesis we talk about the concept of standards in two ways, although similar they differ slightly. The first way is the definition of Blind (2011) that states that a standard is something that represents an agreement in respect of the standardization of products, procedures or practices, commonly referred to as a committee standard. These standards are typically published by formal standards organizations based on a strict consensus process. A standard is typically published together with specifications. In this sense of the definition, NFC is already a standard,

standardized by both ISO and ECMA. Since this is the case, our discussion relating to NFC as a standard will follow the second way. Which means that it is the common and preferred technology or service used by the general population e.g. English is the recommended choice of language when publishing scientific papers, commonly referred to as a de facto standard. The difference is the acceptance. A standard as defined by Blind (2011) can be achieved simply by creating an agreement together with a list of specifications and has nothing to do with how widespread its use is e.g. English, is thus standardized in both ways, since it both is a standard with a list of specifications (alphabet and grammatical rules) and also is the common language amongst scientists. The following chapters will discuss standards in this context.

2.4.2 The adoption process of standards

Standardization first emerged in theoretical literature in 1994 in industrial organization models upon which the theory was based. Essentially, it assumes that standards in competition are not compatible with each other, and therefore a market decision is necessary for any of the two or more standards. This is due to the development of network effects, that increase the significance of other actors which use the technology, especially if there is collaboration and communication involved (Besen & Farrell, 1994). In the beginning earlier models like these assumed that it is not possible to for two competing standards to achieve a stable equilibrium, and by the force of network effects a more dominant standard would emerge. The competition is especially fierce since the company that holds the "winning standard" anticipates a strong and long-term monopoly position. Besen and Farrell (1994) describe it as a "winner takes all" game where the returns can exceed expectations several times over. Another alternative for the competition between two standards ending is a settlement or ensuring compatibility between the standards (David & Greenstein, 1990).

According to Lim (2008) many believe that standards ensure the success of mobile payments. He states that the standardization process is more a negotiations process than a technical discussion, it involves various players with different strategies. According to Shapiro and Varian (1999) standard wars are especially bitter and crucial to business success in markets with strong network effects, such as fax machines or modems (where compatibility is essential). A more modern example could be the World Wide Web consortium (www) or the different standardized communication protocols such as HTTP, XML, SOAP. Furthermore, it is important to note that not all technologies have to compete for standardization.

A critical factor distinguishing the battle is the magnitude of the switching costs, or more generally the adoption costs of each rival technology. Standards have to be classified on how compatible the new technology is with existing technology. If a newly introduced technology is compatible with existing technologies it is defined as an evolutionary strategy. If it is instead incompatible with existing technologies it is defined as an revolutionary strategy (Shapiro & Varian, 1999).

2.4.3 The videotape format war

A technology example often cited is VHS and its success over the competing Betamax technology (Farrell & Saloner, 1985, 1986; Katz & Shapiro, 1986, 1992).

The videotape format war was a period of intense competition between incompatible models. Those were analog video videocassette and video cassette records (VCR) in the late 1970s and 1980s. The first video cassette recorder to become available was the U-matic system, released in September 1971. U-matic was designed for professional television production and thus not affordable nor suitable for home videos or home movies. Philips was the first to release a consumer friendly VCR with their N1500 VHS format in 1972 followed by Sony's Betamax in 1975. Philips then made a quick follow up with the competing Video Home System (VHS) format from JVC. The videotape format war was now becoming more intense and other competitors such as Sanyo's V-Cord and Quasar's "Great Time Machine" disappeared. The war originated to Sony demonstrating a prototype video tape recording system they called "Beta" to the other electronic manufacturers in 1974. Sony's expectation was that they would agree to go for one standard format for the good of all but JVC in particular decided to go with its own format. In the U.S the war sparked a mini-war that was centering on recording times. The original Sony Betamax video recorder for the NTSC television system could only record for 60 minutes. JVC's VHS could manage 120 minutes, later followed by RCA's entrance into the market with a 240 minute recorder. RCA reportedly insisted they needed a minimum four hour recording time because this was the length of an average American football game. The picture quality had differences but they are considered to be minor. There has been a lot of discussion on why VHS ended up victorious, even though Betamax was technically superior. The common belief is that it due to slick marketing, but in reality the answer is more complicated. An obvious benefit for VHS was its significantly lower price, which turned out to be more important than the slightly higher quality of Betamax. Furthermore, an issue that is widely discussed is Betamax and its role with Pornography. Allegedly Sony would not allow for pornographic records. Several sources, including Wikipedia, refer to it as a fact while others call this a myth. However, at some point the choice for rental movies began to favor VHS and arguably once this happened there was no turning back. Betamax supports became a niche market, and their corner of the video renting store became ever smaller ("The Decline of Betamax," 2014; "Format War," 2014; Owen, 2008; "Videotape format war," 2014).

The videotape format war is often used to show that the entire population of all users can decide on a specific standard. In essence this means that the rivaling standard loses its attraction very quickly and thus disappears from the market with the exception if the users are faced with high switching costs (Blind, 2011).

2.4.4 Value of standards

There are clear benefits to standardization. Standards make our life easier, we can refer to them explicitly and implicitly and thus they reduce transaction costs. They create compatibility, allow products as well as services to function together and parts to be replaced. Complementary products can be used together based on standard interfaces (Egyedi & Blind, 2008). Moreover, standards also structure and co-ordinate the way markets develop. Egyedi and Blind (2008) argue that there are many economic benefits to standards, they facilitate trade and allow economies of scale. Standards are also credited for increasing economic efficiency and contribute significantly to economic growth. It makes sense to receive CBS and NBC television on the same TV set, and that GTE subscribers can talk to each other. Today there are fewer types of sparkplugs than there are models of cars. Most governments are clearly in favor of standardization with institutions such as the National Bureau of Standards, the British Standards Institute as well as voluntary industry committees (Farrell & Saloner, 1985).

Standardizations occur because of "network externality" in the sense that one customer's value for a good increases when another customer has a compatible good. There might also be a market mediated effect, that makes goods (parts, servicing, software) cheaper and more readily available the greater the effect of the market (Farrell & Saloner, 1985; Katz & Shapiro, 1986). However, standardization also offers risk. Allegedly the National Bureau of Standards declined to write interface standards for the computer industry because it feared that such standards would retard innovation. An example investigators mention is that the standard QWERTY typewriter keyboard is in fact inferior to alternatives such as the Dvorak, but that the persistence is (supposedly) the overwhelming benefit from compatibility.

Egyedi and Blind (2008) argue that for standards to be of value, they need to be stable. The problem is, that often they are not. Standards are repeatedly revised, extended, replaced, succeeded, withdrawn and reinstated. The change in itself is described as a double-edged sword. On one side there can be great benefits accompanied with change such as innovation in science and technology. Whereas on the other side it can be disruptive for industries that are heavily reliant on that particular standard.

2.4.5 Platforms are not standards

Cusumano (2010) argues that companies within the information technology sector are the most successful when their products achieve industry wide platforms i.e. de facto standards. The term "platform" however, is used in many different contexts and can be hard to understand. The common definition is a foundation, or base of common components around which a company builds a series of products. Platforms, often center around standardization in the way that products or services should be reusable (Cusumano, 2010).

Companies seldom have the capacity or the economy to provide all the useful applications and services on their platform; which in turn makes the platforms some compelling to the users. The network effects of standards discussed in academia also apply to platforms (Besen & Farrell, 1994; Shapiro & Varian, 1999). An example mentioned by Cusumano (2010) is that once a majority of developers are on one platform and create apps for that platform, it will also increase the value to the user and thus attract more users, creating more value to the developers. This loop grows exponentially. Cusumano (2010) states that it is however important to see and understand the difference between committee standards e.g. often rules and specifications and that they cannot be compared to platforms like de facto standards can. He states that understanding how platforms work is often an important part to how the standards war will play out, and which standard will emerge victorious.

A renowned and famous company for their dominant platform is Apple. To provide an example of the exponential growth that occurs we have identified key events in relation to their stock market value. Many of the services later introduced such as iPod Touch and iPhone, together with App Store and iTunes complement each other i.e. by introducing iTunes they increased the value of owning an iPod and so forth. Apple and hence forth, up the current date enjoyed a large market share, although it has decreased slightly from 17.5% to 15.3% (Q1, 2013 to Q1, 2014) it remains significant (Lomas, 2014).

3 Methodology

In the following chapter we describe how we conducted our research including sampling design, validity, research ethics, our approach to data analysis and our questionnaire. This chapter will aid other researchers reproduce our study.

3.1 The subjects

Recker (2013) describes the research method or methodology chapter of a thesis, as the objective section that describes how the research was carried out in such a way that anyone should be able to repeat the work based on how it is described. With this in mind we structured the methodology chapter in such a way, that it describes our thought process and reasoning behind the decisions we faced around our study.

Before we conducted our research we evaluated the common mistakes made in research as presented by Bhattacherjee (2012). Furthermore, TAM is commonly used research model, often cited in literature which provided us with helpful previous examples that we could follow; which is a recommended approach by Recker (2013).

3.1.1 The sampling design

Sampling is described as the statistical process of selecting a subset (commonly referred to as "sample") of a population of interest for purposes of making observations and statistical inferences about the population (Bhattacherjee, 2012). The sampling process consists of multiple steps. First to define a target population (e.g. unit of analysis). Originally, our intention was to study the Swedish population, although since we expanded our survey to the internet our respondents became more international. Second, choose a sampling frame; commonly a contact list from where samples or information can be drawn and finally choose a sample from the sampling frame using a sampling technique. Our sampling frame was first visitors of a shopping mall and later also people on various social media and online communities e.g. Facebook, forums and contact groups. They are divided into two categories probability (random) sampling and non-probability sampling. The shopping mall offered a higher probability sampling, which is preferred for its generalization potential; whereas the same cannot be said for the participants responding via online communities (Bhattacherjee, 2012). Therefore, our study could potentially have certain biases when it comes to generalizability of our results (Chapter 3.5). The aim of our study is to research the general perception about NFC from our sample. For this we used the extended TAM, a framework commonly used in research models for this aim in IS) such as mobile payment systems. The shopping mall is one of the biggest in Scandinavia and contains

a huge number of stores with a wide variety of products. Thus, we reasoned that a shopping mall with this size combined with the broad audience on the internet would allow our sample to be of great diversity.

3.1.2 Providing an incentive

In order to increase our response rate we studied the non-response biases presented by Bhattacherjee (2012). We tried to make our questionnaire respondent-friendly, making sure the questions were understandable before we conducted the study. We made sure that our questionnaire also was short and precise, informing potential participants that we estimated partaking would take between two and three minutes. To increase the response rate we raffled off a gift card for the shopping mall or Amazon at the choice of the participant. The participants that wanted to be part of the lottery were put in an array according to when they filled out the questionnaire and given a unique identifying number. Afterwards a random number generator generated a number within the range of the participants identifying numbers and a random winner emerged. The study was also conducted anonymously, in our effort to maintain confidentiality and privacy. However, since we needed a way to deliver the gift cards participants had the option to enter contact information via our website so that we could contact them in case they won. Their information was stored in our database only accessible by us. After the study was completed, and the winning participant received his price (Amazon gift-card) we deleted all personal information.

3.2 Questionnaire as data collection technique

In order to measure our research model we used a questionnaire for data collection. The literature review describes how each question relates to each construct (see literature review). Furthermore, the full questionnaire is enclosed as Appendix A and Appendix B. The questions to determine PEOU, PU, IU and trust are based on former TAM studies, while the questions regarding controllability, reliability, privacy and security are based on the literature review in the theory chapter (chapter 2.2). The wording of the questions was adjusted to fit our topic but the purpose of the original question remains. The questions regarding controllability, reliability, privacy and security are based on the literature review about trust. Based on this we identified the questions listed in Table 3.1. The response to each item was measured on a 5-point Likert scale. Likert scales are commonly used among other TAM studies (Davis, 1989; Gefen et al., 2003; Srivastava et al., 2010; Tan et al., 2014). The respondents had the options (1) Strongly disagree, (2) Disagree, (3) Neither agree or disagree, (4) Agree, or (5) Strongly Agree to answer every question.

Additionally to those questions we added six control questions:

- How old are you? (Year)
- Gender? (Female/Male)
- Did you know about NFC before this study? (Yes/No)
- Did you ever use NFC before this study? (Yes/No)
- Do you have a smartphone? (Yes/No)
- Does it have NFC? (Yes/No/I don't know)

The control questions were added to provide additional information about user groups on top of their perception about NFC. It allows for a deeper and more meaningful discussion and analysis e.g. we can see if there are differences between certain age groups, male or female respondents or whether or not the respondents had any previous knowledge about NFC.

Table 3.1: TAM Survey questions

Construct	**Question**	**Sources**
PEOU1	NFC is easy to use	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989), Venkatesh and Davis (2000)
PEOU2	It is easy to become skillful at using NFC	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989)
PEOU3	Learning to operate NFC is easy	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989)
PEOU4	My interaction with NFC is clear and understandable	Gefen et al. (2003), Srivastava et al. (2010), Venkatesh and Davis (2000), Davis (1989)
PEOU5	It is easy to interact with NFC	Gefen et al. (2003), Srivastava et al. (2010), Davis (1989)
PEOU6	I find it easy to get NFC to do what I want it to do	Davis (1989), Venkatesh and Davis (2000)
PU1	NFC is useful	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989), Venkatesh and Davis (2000)
PU2	NFC could improve my performance in certain tasks	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989), Venkatesh and Davis (2000)
PU3	NFC could enhance my effectiveness in certain tasks	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989), Venkatesh and Davis (2000)
PU4	NFC could increase my productivity in certain tasks	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989), Venkatesh and Davis (2000)
PU5	NFC could enable me to do certain tasks faster	Gefen et al. (2003), Davis (1989)
PU6	NFC could make certain tasks easier	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Davis (1989)
IU1	Given a chance, I adopt NFC in the future	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Venkatesh and Davis (2000)

IU2	Given a chance, I will use NFC in the future	Gefen et al. (2003), Srivastava et al. (2010), Tan et al. (2014), Venkatesh and Davis (2000)
IU3	I will recommend others to use NFC	Srivastava et al. (2010)
TC	I am in control when using NFC	Srivastava et al. (2010), Vance et al. (2008), Dahlberg et al. (2003), Crosby et al. (1990)
TP	NFC provides privacy	Vance et al. (2008), Dahlberg et al. (2003), Zaheer et al. (1998)
TR	NFC is reliable	Srivastava et al. (2010), Vance et al. (2008), Dahlberg et al. (2003), Zaheer et al. (1998), Doney et al. (1998), Ganesan (1994)
TS	NFC is secure	Srivastava et al. (2010), Vance et al. (2008), Dahlberg et al. (2003)
T	I trust NFC	Srivastava et al. (2010), Vance et al. (2008), Dahlberg et al. (2003), Zaheer et al. (1998), Doney et al. (1998), Ganesan (1994) Crosby et al. (1990), Tan et al. (2014)

3.3 Introducing the participants to NFC

Since NFC is a newer, and little implemented technology it is hard to find participants that are actual users. Therefore, we had to introduce the participants to NFC before they could partake in the study. We did this in two ways, the shopping mall participants were briefly informed about NFC and given the chance to try an implementation of the technology. To give any participant the same information we prepared an A5 NFC fact sheet (Appendix C) that each participant received when filling out the questionnaire. The fact sheet also contained an NFC tag which gave the possibility to try the technology first hand. The online survey contained the same information. Since online participants could not try NFC by themselves, an informational video showing the use of NFC was included.

3.3.1 Field survey

The first part of the study was conducted inside a major Swedish shopping mall. This shopping mall contains a huge amount of stores with a wide variety of products and services and should thereby attract a wide variety of customers and potential participants. We constructed informative signs that told by passers about our study of NFC, that participants could take part and win a price, and that participation takes around three to five minutes. We asked visitors of the shopping mall to participate in our study. If a visitor was interested, they received a laminated copy of the fact sheet (Appendix C) in either English or Swedish, a pen and the questionnaire (Appendix A).

We contacted the store manager of Telia. In agreement with Telia, we had the possibility to allow people to use Telia's NFC enabled phones to try the NFC tag. The participants were told to read the fact sheet and try the technology, using the tag inside the leaflet on the phones and

afterwards fill out the questionnaire. The NFC tag that was included in the leaflet was programmed to contain the URL to a website created for this study, which an NFC enabled phone will open in the default application as soon as the device is in range of the tag. The website contained additional information about the survey and a contact form where participants could enter personal information in order to partake in the competition if they wanted.

In case participants had a question regarding how the chip worked or which phones were eligible we answered and helped them, but we kept all of the answers factual to not influence the result.

3.3.2 Online survey

The second part of the study was conducted online. The online questionnaire was created using a Google form, which provides useful features such as required fields. Proceeding to the questionnaire the participants were asked to read the same facts as stated in the fact sheet and were asked to watch a short video showing an example use of NFC before they would proceed to answer the questions. Using the online questionnaire we reached a big audience in a short time. The questionnaire was spread over various social media such as via Facebook and forums with a minor post stating the purpose of our study and that each respondents could take part in a competition to win a gift card. The respondents were given the possibility to add their email address at the end of the questionnaire. This was necessary for us to be able to contact the winner of the gift card.

3.4 Ethics

Ethics is defined as a branch of philosophy that seeks to address questions about morality, which is about concepts such as good an bad, right and wrong, justice, and virtue (Recker, 2013). Individuals are considered free moral agents, able to make choices to guide their behavior.

Bhattacherjee (2012) states that ethics is of vast importance, because science has often been manipulated in unethical ways by people and organizations to advance their private agenda and engage in activities that are contrary to the norms of scientific conduct. According to Bhattacherjee (2012) ethics involve voluntary participation, harmlessness, anonymity, confidentiality, disclosure analysis and reporting. In accordance with the recommended guidelines our participants were informed that participation was voluntary and that they could at any time stop the survey. They were also treated completely confidential, with the exception for contact information that was collected from participants that wanted to partake in our lottery; this information was terminated after our winner was selected. The participants were also informed about the study's aim and goal before agreeing to participate.

3.5 Biases

A non-probability sampling is considered to be less generalizable than the counterpart probability sampling (random) (Bhattacherjee, 2012). According to Bhattacherjee (2012) our study falls into the category of convenience sampling which is when a sample is drawn from a population that is close at hand, as in our case with field survey at the shopping mall. The reason it is considered to be less generalizable is because we exclude the people visiting other shopping malls, and the sample might represent characteristics of the shopping mall (e.g. expensive luxury stores attracts a richer demographic). However, the selected shopping mall is one of Scandinavia's largest and offers a wide variety of stores and thus we assumed that it also attracts a wide variety of visitors, and potential participants. Nevertheless, the main part of the respondents were through social media and online communities due to this we only reach a certain audience through our social media profiles. The findings of this study cannot be generalized without keeping this in mind.

We are also aware that our approach looks like we are promoting the technology in order to get a certain result. However we took several actions to limit those concerns. To not influence the participants, we did not mention the technology while approaching them but only asked if they were willing to participate in a questionnaire about NFC. All participants were treated equally by handing them the same fact sheet (containing the NFC tag). We did not talk about the purpose of the survey as well as the technology to any of the participants before they finished the questionnaire. Like this we assured that every participant had the same level of knowledge and was not manipulated by us. The provided information on the leaflet contained only facts about the technology and was written neutral to not influence the participant's decisions. The tag in the leaflet acted as a demonstration of the technology so people had a practical experience additional to the abstract description in the handout, the leaflet contained necessary instructions, so participants could try it without asking us for any help.

4 Data analysis

In the following chapter our analytical process is explained. We describe how our data was screened, which analytical software tools and methods were used in order to achieve our results.

4.1 Data collection

The data was collected on separate occasions.

- 2014-04-21: Data was collected in the shopping mall between 12:00 and 19:00.
- 2014-04-22: Online data collection started and was open until the 27th at 23:59.

4.2 Respondents

Table 4.1 shows that in total we collected 140 responses out of which 40 are collected in the field survey while the remaining 100 responses are from the online survey. Out of the total 140 respondents 41 (29.3%) are female and 99 (70.7%) are male. As the table shows, the field survey conducted in Emporia has pretty even respondents of both genders. However, within the online survey the respondents are 76% male and 24% female. The age of the respondents is presented in Figure 4.1. The mean age of our respondents is 30.20 years, with a standard deviation of 12.92 within all participants of which 60.6% have a college degree.

Table 4.1: Respondents

	Question	Answer	Count	Percent
Emporia	Gender	Female	17	42.5%
		Male	23	57.5%
	Education	Less than high school (grundskola)	3	8.1%
		High school (gymnasium)	17	45.9%
		College degree (eftergymnasial)	17	45.9%
Online	Gender	Female	24	24.0%
		Male	76	76.0
	Education	Less than high school (grundskola)	3	3.0%
		High school (gymnasium)	31	31.0%
		College degree (eftergymnasial)	66	66.0%
Combined	Gender	Female	41	29.3%
		Male	99	70.7%
	Education	Less than high school (grundskola)	6	4.4%
		High school (gymnasium)	48	35.0%
		College degree (eftergymnasial)	83	60.6%

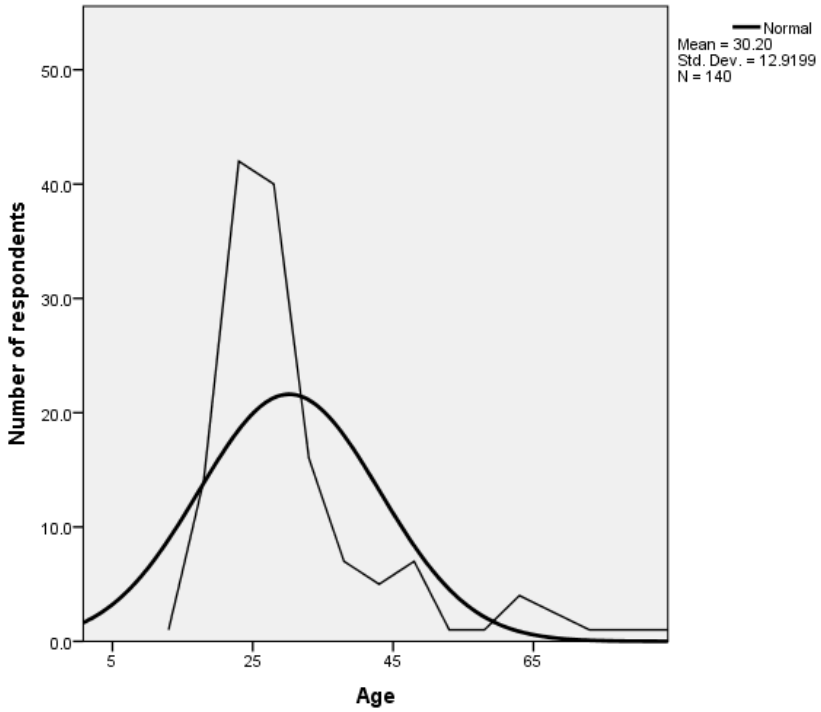

Figure 4.1: Age distribution of respondents

Table 4.2 shows the answers to the control questions that were asked during the questionnaire and their subsequent counts and percentages. The number of smartphone owners (95.7%) is higher than the average in Sweden which was 68% for the age group 18-65 in 2012 (Bager, 2013). Therefore our respondents resemble a highly educated young group of people that are overly technology affine.

Table 4.2: Previous knowledge of respondents

Question	Answer	Count	Percent (subgroup only)
Did you know about NFC before this study?	No	63	45.0%
	Yes	77	55.0%
Did you ever use NFC before this study?	No	39	29.1% (50.6%)
	Yes	38	28.4% (49.4%)
Do you have a smartphone?	No	6	4.3%
	Yes	134	95.7%
Does it have NFC?	No	57	42.5% (43.2%)
	I don’t know	26	19.4% (19.7%)
	Yes	49	36.6% (37.1%)

4.3 Data screening

In order to achieve high quality in our results we have to screen the data before running any statistical tests to prove our model. Therefore we test the collected data for unengaged respondents and missing data.

4.3.1 Visual screening

Previous to any analysis the collected data is visually screened for any abnormality. Doing this we detect one record. This particular record was collected during the online survey, the record states that the respondent was born in 1901 and the questions were systematically answered only using one (1) and five (5) (Table 4.3). Therefore we are confident in deleting this response.

Table 4.3: Answers for response 106

Questions	Mean
PEOU1 to PEOU6	5
PU1 to PU6	1
IU1 to IU3	5
TC, TP, TR, TS, T	1

4.3.2 Unengaged respondents

Then we check the dataset for unengaged respondents. Unengaged respondents are participants that answer the questionnaire with no deviation within the answers. After calculating the standard deviations within the TAM questions of all participants we are confident in removing the following 12 records (Table 4.4) due to none or low variation in their answers (Little & Rubin, 2002).

Table 4.4: Records removed due to unengaged response

Respondent ID	Standard deviation
5	0
7	0.218
11	0
14	0
31	0
34	0
37	0
67	0
117	0
128	0
130	0
140	0

4.3.3 Missing data

Because we collected parts of the data in a field survey, some respondents did not fill out the whole questionnaire but left one or more questions not answered. Fifteen (15) out of the twenty (20) questions regarding the constructs have missing values (Variables chart presented in Figure 4.2). Moreover, the remaining 127 responses contain six records that are missing one or more answers to questions (Cases chart presented in Figure 4.2) that shows that only a small amount of 4.724% of the respondents did not respond to some answers. In total only 28 of all 2512 answers are missing (Values chart presented in Figure 4.2) which equals 1.102%. All this indicates that the data is missing at random rather than that there is a particular question where the participants had trouble answering.

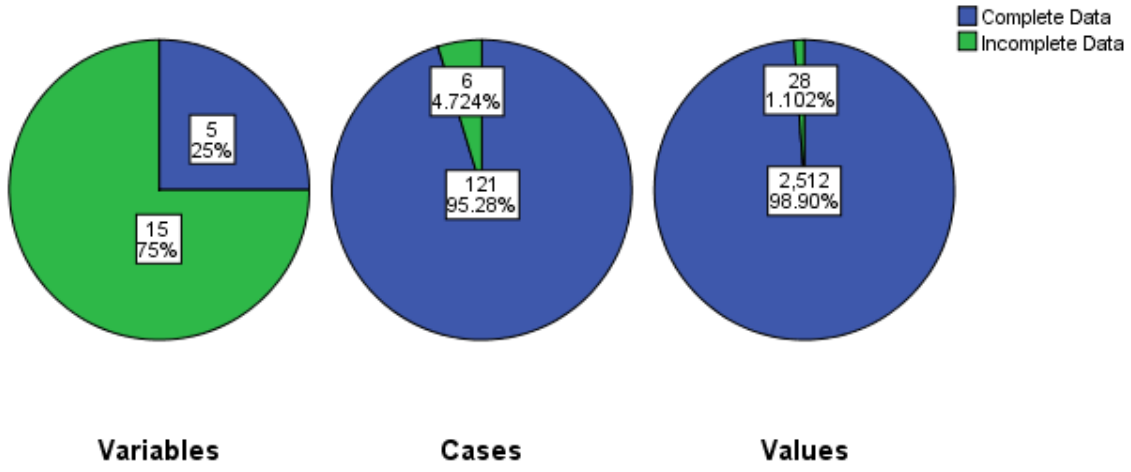

Figure 4.2: SPSS missing value analysis

When values are missing in a dataset it is important to know if the values are missing randomly or if there are certain patterns. Patterns indicate that for example certain questions may not be answered by a certain group of respondents (Little, 1982; Little & Rubin, 2002). To make sure the missing values are distributed randomly the MCAR (missing completely at random) test according to Little and Rubin (2002) is performed upon the dataset. We fail to reject the null-hypothesis, which states that data missing from the dataset is missing completely at random with a significance of 0.627. This result indicates that the missing values are missing completely at random and there is no bias in the data collection (Little & Rubin, 2002).

H_0: The data that is missing from the dataset is missing completely at random.

Due to the relatively small number of total responses, we impute the missing values instead of trimming the dataset as suggested by Little and Rubin (2002). The imputation is done by replacing the missing values with medians of nearby points within SPSS and results in a complete dataset for further data analysis (Little & Rubin, 2002).

4.4 Analytical tools

To conduct quantitative research it is common to use software to analyze the collected data. We decided to use SPSS due to our previous experience with the software and its wide use in social science (Babbie, 2013). To prove the proposed model we used SmartPLS, a software for structural equation modeling (SEM) with the partial least square method. SmartPLS was selected due to the ease of use and the fact that it is available for free.

4.5 Structural equation modeling

In order to prove the proposed model, we will use SEM. SEM in contrast to more simple statistical techniques like correlations, regression, or difference of means tests allows the researcher to model causal networks of effects simultaneously rather than one relation at a time (Chin, 1998a).

Causal deduction enables us to do three primary assumptions (Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007):

- **Covariation:** Predictor and predicted variable vary together
- **Absence of spurious relationships:** This means that potential confounds are accounted for in a model.
- **Temporal precedence:** Predictor occurs prior to the predicted construct

In essence there are two forms of SEM. One is covariance based (CB) and represents constructs through factors, the other one is partial-least-squares (PLS) based and represents constructs through components. PLS-SEM is selected due to its strength in exploratory research compared to CB-SEM as well as the possibility of validating single item constructs, which we have in our research model (Barclay, Higgins, & Thompson, 1995; Chin, 1998a; Fornell & Bookstein, 1982; Fornell, Lorange, & Roos, 1990; Gefen, Straub, & Boudreau, 2000; Hair, Ringle, & Sarstedt, 2011). Furthermore PLS-SEM is good in handling small sample sizes (Marcoulides & Saunders, 2006).

4.5.1 Construct characteristics

To prove the model in any form we first have to define the model. Especially which constructs are reflective and which are formative because they are handled differently in statistical analysis. A construct is formative when adding or removing an indicator changes the conceptual domain of the construct, which is not the case for any of the measured constructs (Bollen and Lennox (1991); Rossiter, 2002).

4.5.2 Construct validity

By ensuring that a construct is valid, it is tested if the construct measures what is intended to measure and can be divided in convergent and discriminant validity (Cronbach & Meehl, 1955). Convergent validity measures if and to which extent items that measure the same construct actually measure the same construct, while discriminant validity measures if items that are supposed to be unrelated are in fact unrelated (Cronbach & Meehl, 1955).

To ensure convergent validity for the construct we check if all items are loading with significant t-values on the intended construct. In our case all items loaded with t-values greater than 1.645, which means that they are significant at the α 0.05 level (Table 4.5). The results indicate strong convergent validity in the defined model (Gefen & Straub, 2005; D. Straub, Boudreau, & Gefen, 2004).

Table 4.5: Item loading and t-values

Item	Loading	t-value
PEOU1 <- PEOU	0.848	4.254
PEOU2 <- PEOU	0.784	3.236
PEOU3 <- PEOU	0.773	1.798
PEOU4 <- PEOU	0.665	1.663
PEOU5 <- PEOU	0.771	3.556
PEOU6 <- PEOU	0.687	3.247
PU1 <- PU	0.808	9.719
PU2 <- PU	0.825	10.137
PU3 <- PU	0.883	11.995
PU4 <- PU	0.786	7.895
PU5 <- PU	0.796	9.412
PU6 <- PU	0.858	10.777
IU1 <- IU	0.929	15.815
IU2 <- IU	0.946	17.367
IU3 <- IU	0.887	15.211

To confirm the discriminant validity of the constructs, the average variance extracted (AVE) test is performed. According to Gefen and Straub (2005), discriminant validity is ensured when the AVE square roots are higher than the correlation between constructs for the same row and column which is the case for all constructs (Table 4.6).

Table 4.6: latent variable correlation with AVE square

	Control-lability	**IU**	**PEOU**	**PU**	**Privacy**	**Reliabil-ity**	**Security**	**Trust**
Controllability	**1***							
IU	0.259	**0.921***						
PEOU	0.323	0.274	**0.757***					
PU	0.199	0.636	0.293	**0.827***				
Privacy	0.509	-0.004	0.298	0.066	**1***			
Reliability	0.538	0.127	0.427	0.133	0.500	**1***		
Security	0.485	0.171	0.270	0.202	0.699	0.605	**1***	
Trust	0.550	0.149	0.245	0.241	0.627	0.531	0.805	**1***

* square root of AVE

4.5.3 Reliability

Reliability refers to the degree to which a scale yields consistent and stable measures over time and applies only to reflective indicators (D. W. Straub, 1989). According to (Chin, 1998b), reliability is ensured when the reliability level is above 0.7, which is the case for all constructs (Table 4.7).

Table 4.7: Composite reliability

Construct	**Reliability level**
Controllability	1.000
IU	0.944
PEOU	0.889
PU	0.928
Privacy	1.000
Reliability	1.000
Security	1.000
Trust	1.000

4.5.4 Common method bias

Common method bias is the appearance of variance due to the measurement method instead of the constructs that the measures are supposed to represent (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Due to the fact that each response was collected at a single occasion using one data collection method, the dataset is tested for common method bias by examining the construct correlations (Pavlou, Liang, & Xue, 2007).

Therefore the Harman's single-factor test is performed. Out of all twenty (20) distinct factors, the largest accounted for only 33.334% of the variance within the model. This indicates that there is no common method bias (Podsakoff & Organ, 1986). The result of Harman's single-factor test is confirmed by examining the latent variable correlations. It is suggested that any value higher than 0.9 strongly indicates common method bias, however the highest value observed in our dataset is 0.805 between trust and security (Table 4.8) (Pavlou et al., 2007). Due to this results we declare the likelihood of common method bias in our dataset as low.

Table 4.8: Latent variable correlations

	Controllability	**IU**	**PEOU**	**PU**	**Privacy**	**Reliability**	**Security**	**Trust**
Controllability	1.000							
IU	0.259	1.000						
PEOU	0.323	0.274	1.000					
PU	0.199	0.636	0.293	1.000				
Privacy	0.509	-0.004	0.298	0.066	1.000			
Reliability	0.538	0.127	0.427	0.133	0.500	1.000		
Security	0.485	0.171	0.270	0.202	0.699	0.605	1.000	
Trust	0.550	0.149	0.245	0.241	0.627	0.531	0.805	1.000

4.5.5 Model fit

After running those pre-tests that approve the collected data as suitable for the measured constructs, the predictive power of the model can be evaluated. By doing this analysis we get results about the extent to which the proposed hypothesis are relevant and significant. According to Chin (1998a) high R^2 and substantial significant structural paths demonstrate meaningful predictive power of a PLS model.

The calculated R^2 values of secondary constructs explain to what extent the variation in the construct is explained by the modeled relationships. For our model we calculate the following R^2 values (Table 4.9):

- **Trust:** 68.3% of the variation in trust can be explained by the constructs PEOU, controllability, privacy, reliability, and security.
- **PU:** 11.6% of the variation in PU can be explained by the constructs PEOU and trust.
- **IU:** 41.4% of the variation in IU can be explained by the constructs PEOU, PU, and trust.

Table 4.9: R^2 of secondary constructs

Construct	**R^2**
Trust	0.683
PU	0.116
IU	0.414

Standardized regression weights are the estimates to how much the standard deviation of the predicted construct changes, when the standard deviation of the influencing construct changes. According to Chin (1998a) standardized regression weights of the paths have to be close to 0.20 (and ideally 0.30 or higher) in order to be substantial and have meaningful predictive power.

Therefore for our observed model the paths controllability to trust, PEOU to PU, PU to IU, security to trust, and trust to PU are substantial (Table 4.10). While the paths PEOU to IU is not substantial but still significant at the 0.30 level (Table 4.10). However Chin, Marcolin, and Newsted (2003) state even small interaction terms that are significant are important to a model.

Table 4.10: Standardized regression weights and t-values

Path	**Standardized regression weight**	**t-value**
Controllability -> Trust	0.201	2.411***
PEOU -> IU	0.100	1.153*
PEOU -> PU	0.249	2.569***
PEOU -> Trust	-0.016	0.218
PU -> IU	0.612	8.297****
Privacy -> Trust	0.064	0.688
Reliability -> Trust	-0.010	0.103
Security -> Trust	0.672	6.938****
Trust -> IU	-0.023	0.288
Trust -> PU	0.180	1.771**

* significant at the 0.300 level
** significant at the 0.100 level
*** significant at the 0.020 level
**** significant at the 0.001 level

Due to this findings we accept hypothesis H1, H2, H3, H5, H7 and H10 and reject hypotheses H4, H6, H8 and H9. Regarding the weak predictive power, regression weight, and significance the acceptance of H2 (PEOU will positively affect IU of NFC) questionable. We can think of two causes:

- NFC by itself does not require any configuration and is therefore by nature easy to use, which would supersede this relationship.
- The data provided to the participants during the data collection was not sufficient enough.

Due the fact that this hypothesis is renowned and proven within TAM we accept it even due to the comparably weak results.

5 Empirical results

In the following chapter the empirical results of our study are summarized and presented.

5.1 Research model results

Figure 5.1 summarizes the findings for all proposed hypothesis (H1-H10) and shows whether or not they are supported. Based on the data analysis our research model is not fully supported (Chapter 4.5) hypotheses H1, H2, H3, H5, H7 and H10 are supported as opposed to hypotheses H4, H6, H8 and H9 which are rejected.

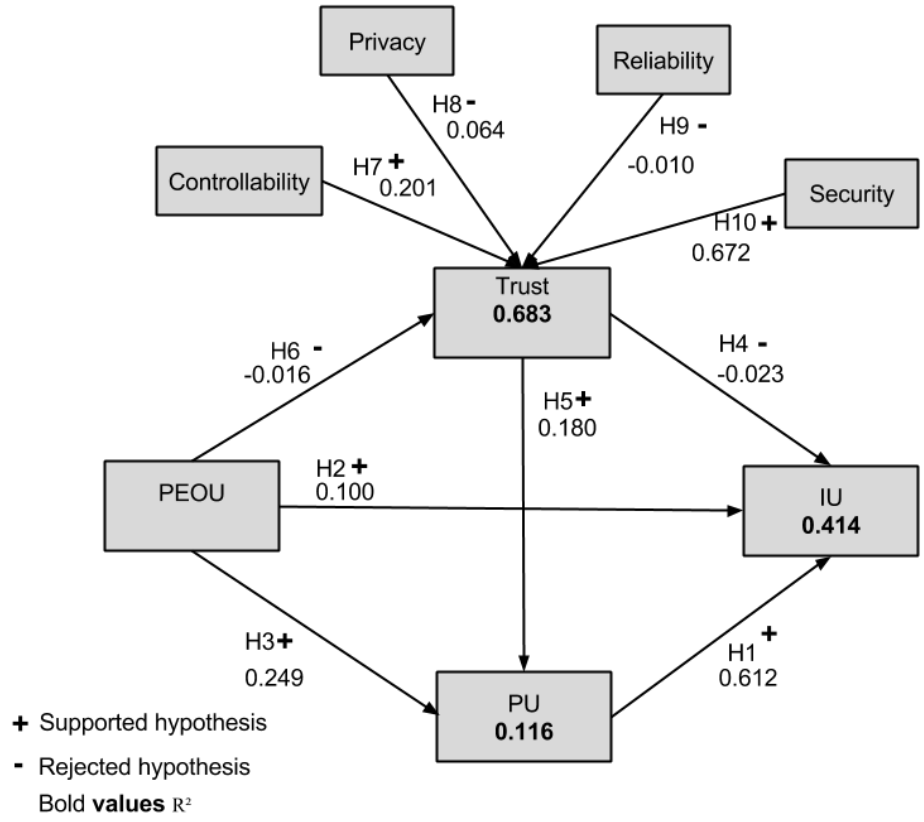

Figure 5.1: Standardized regression weights and R^2 values

5.1.1 Supported hypotheses

There is a positive causal relationship between all hypotheses. However, the only relationships that we could prove to be statistically significant with our collected data and data analysis are H1, H2, H3, H5, H7 and H10. Meaning that all hypotheses relating to the original TAM (H1, H2 and H3) are supported.

H1: PU will positively affect IU of NFC.

The results indicate that there is a statistically significant positive causal relationship between PU and IU. This means that whenever PU changes, it will affect IU in a systematic way. Thus, increased PU leads to increased IU and vice versa.

H2: PEOU will positively affect IU of NFC.

Moreover, the results also indicate that there is a statistically significant positive causal relationship between PEUO and IU. This means that whenever PEUO changes, it will affect IU in a systematic way. Thus, increased PEOU leads to increased IU and vice versa.

H3: PEOU will positively affect PU of NFC.

Furthermore the results also indicate that the same applies to PEOU and PU. This means that whenever PEOU changes, it will affect PU in a systematic way. Therefore, increased PEOU will also lead to increased PU and vice versa.

H5: Trust will positively affect PU of NFC.

The results also indicate that there is a statistically significant positive causal relationship between Trust and PU. This means that whenever Trust changes, it will affect PU in a systematic way. Thus, increased Trust leads to increased PU and vice versa.

H7: Controllability will positively affect trust of NFC

The results also indicate that there is a statistically significant positive causal relationship between Controllability and trust. This means that whenever Controllability changes, it will affect trust in a systematic way. Thus, increased Controllability leads to increased trust and vice versa.

H10: Security will positively affect trust of NFC

Finally, the results indicate that there is a statistically significant positive causal relationship between Security and trust. This means that whenever Security changes, it will affect trust in a systematic way. Thus, increased Security leads to increased trust and vice versa.

5.1.2 Rejected hypotheses

The data analysis could not provide statistical significant evidence to support hypotheses H4, H6, H8 and H9.

H4: Trust will positively affect IU of NFC technology.

The results failed to show a statistically significant positive causal relationship between Trust and IU. Although Trust might increase in relation to IU, there cannot be predictions in between the constructs.

H6: PEOU will positively affect trust in NFC.

Furthermore, the results also failed to show a statistically significant positive causal relationship between PEOU and trust. Although PEOU might increase in relation to trust, there cannot be predictions in between the constructs.

H8: Privacy will positively affect trust of NFC

Similarly, the results show that trust also failed to show a statistically significant positive causal relationship between Privacy and trust. Although trust might increase in relation to privacy, there cannot be predictions in between the constructs.

H9: Reliability will positively affect trust of NFC

Finally, the results show that trust also failed to show a statistically significant positive causal relationship between Reliability and trust. Although trust might increase in relation to Reliability, there cannot be predictions in between the constructs.

5.2 Respondents perception of NFC

To increase the overall understanding of the results, relating to the perception and adoption of the respondents we calculated the means of the constructs. This data shows that the overall opinion of NFC among all constructs is positive (in between 3=”neither agree nor disagree and 4=”agree”). The only exceptions are Security and Trust were the mean is neutral (3=neither agree nor disagree).

Table 5.1: Construct means and standard deviation

Construct	**Mean (Std.)**
Controllability	3.3 (0.9)
Privacy	3.1 (1.0)
Reliability	3.2 (0.9)
Security	3.0 (1.0)
Trust	3.0 (1.0)
PEOU	3.77 (0.65)
PU	3.60 (0.87)
IU	3.77 (1.0)

6 Discussion

This chapter discusses the standardization, acceptance, availability and possible future development of NFC.

6.1 Adoption of NFC

Computer magazines such as Computer Sweden, as well as academic authors such as Ondrus and Pigneur (2007) and Remedios et al. (2006) predicted that NFC would achieve success and become a renowned technology, widely used and implemented. This did not occur as predicted, which sparked our research question. In the following chapter we will discuss the extent to which NFC is accepted and what influences this acceptance, the availability and how we could learn from similar historical examples.

6.2 Acceptance of NFC

TAM explains the user acceptance of NFC by showing the relations between constructs and their effect on each other. The accepted hypotheses prove that there is a cause and effect relationship between the corresponding constructs.

Our results suggest that there are two constructs, PU and PEOU that positively influence the intention to use NFC (H1, H2); which is contrary to trust, where our study was unable to find a statistically significant positive casual relation between trust and the intention to use NFC (H4). From the positive causal relationship identified between PU and IU we can conclude that the more useful something utilizing NFC is, the higher the intention to use is. Therefore, the more value an NFC service or product provides to the user, the more it will get used. This same relation applies for the opposite direction. If a company were to design services or products that does not offer users any additional or new value, the users' intention to use NFC would be low. In this sense, NFC can achieve a breakthrough, but it must be via innovative and useful new services or products. Thus, an NFC service or product has to offer either a novel experience or improve an existing one to attract frequent use. Furthermore, in the same fashion PEOU will also positively affect the intention to use NFC. If users consider NFC services or products to be simple, manageable, and easy to grasp their intention to use NFC will increase. Remarkable and contrary to literature, we were unable to find a significant relation between trust and IU (H4). Thus, we can conclude that when technology offers a value, or a novel experience and is easy to use the intention to use NFC will be high; however trust does not have a direct causal

relationship with IU. An entity designing an NFC service or product should hence always prefer PU and PEOU over trust.

The fact that trust influences PU mitigates the previous statement. Only because trust does not cause IU in a direct causal relationship (H4) does not mean that trust does not influence IU. As H5 states trust causes PU which then causes IU (H1). Therefore trust indirectly influences IU. Furthermore, PEOU influences PU as well (H3). Thus, if NFC is considered easier to use the PU will increase as well. In a similar fixed fashion, if the PEOU for NFC is lower the PU will decrease which indirectly influences IU as well (H1). Therefore both PEOU and trust are an indicator for the usefulness of a product which by itself is an incentive to use the product.

We identified five constructs relating to trust: PEOU, controllability, privacy, reliability and security. Contrary to our findings in the literature, the statistical analysis shows that the perception of trust in the case of NFC is not influenced by PEOU (H6), privacy (H8), and reliability (H9). However controllability (H7) as well as security (H10) are causing trust. Because of the technical specifications of NFC, the technology by itself has a high controllability and security due to the fact that the user has to put the device actively in short range, which decreases the likelihood of unintended use as well as eavesdropping. However providers of NFC services or products can for example increase the controllability by asking the user for permission before an NFC interaction executed and the security by encrypting the data communication. Such actions would therefore increase the trust in NFC and benefit the overall acceptance. However, we could not detect evidence that PEOU, reliability or privacy concerns such as providing personal information hinder the perception of trust of NFC.

In short, our findings imply that future NFC services should be easy to use and increase work performance which will increase the intention to use them. Furthermore, it is important to develop trust, which is increased by controllability and security. Trust will increase the work performance if implemented, but will not increase the intention to use NFC directly but through PU. Privacy and reliability both failed to show any statistically significant positive relationship to trust. Considering those constructs, providers of services or products have several options in increasing the users' interest in NFC.

In addition to the research model, the collected data (Chapter 5.2) shows that the average intended use among the participants is 3.77 (3="neither agree nor disagree", 4="agree") and therefore positive. This makes us conclude that NFC is accepted by its potential users. Furthermore, the proposed model can help to increase its technology acceptance. Important to consider are studies which have shown that users refuse to change the existing system even when there was obvious improvement or they experienced negative feedback. This tells us that even though users normatively know that their judgment should be objective they unconsciously make prejudiced judgments biased towards their committed course of action (Jermias, 2001, 2006). Similar to Cutcher (2009) our opinion is that people are often conservative and resist change They

want to do things in the same fashion they always have. However, we think that this applies to all competing standards and is thus not a problem specifically related to NFC but for people to accept mobile payment solutions in general. Instead a problem with NFC could be with its availability.

6.3 Availability of NFC

Although NFC is standardized and the perception is positive, it is hardly used. The results of the survey show that 45% of the respondents did not know about the existence of NFC and only 28.4% did ever use it (Chapter 4.2). Therefore we take a step back and look at NFC and its predicted use. NFC in itself differs from existing technologies such as Bluetooth and Wi-Fi by its short operating range, and from RFID which it was originally developed from by the possibility of having two-way communication. While the advantage over RFID is simply enabling a real communication instead of just one-way, one might argue that it is a worse technology than Bluetooth or Wi-Fi. However because of its auto configuration and security against eavesdropping due to the short operating range, NFC was speculated and expected to be used in mobile payments (Anokwa et al., 2007; Dominikus & Aigner, 2007; Remedios et al., 2006). That there is no adoption within mobile payment so far, can be explained with theory about network effects (Besen & Farrell, 1994; Shapiro & Varian, 1999). Since the user perception is most likely not the cause for the failed adoption, we have a look at other parties partake in a mobile payment process, those are financial services companies, retailers, and handset manufacturers.

6.3.1 Financial services companies

Traditional financial service companies like Visa (payWave) or MasterCard (PayPass) both offer mobile payment services that utilize NFC and therefore climbed on the bandwagon that is mobile payments. There are other companies entering the market and provide independent mobile payment services. Some examples within Sweden are Seqr, Bart, Wywallet and Izettle. They work with QR-code, through the internet or with NFC. (Sellebråten, 2013). By the magnitude of financial service providers that offer NFC enabled payment, we do not see the availability of financial services as limiting towards the adoption of NFC but more as an opportunity for its future success.

6.3.2 Retailers

Retailers are involved in the adoption of mobile payment through NFC as well, because only when a payment option is offered within stores, customers are able to choose it. Willy's as an example within Sweden offers several payment options for their customers supporting all different technologies, including NFC. However, there are little other companies offering such

services. This could become an advantage for such stores that offer this services once users actually have smartphones with NFC and want to use this services. This is discussed and described by Shapiro and Varian (1999) as a first mover advantage which encourages some organizations to invest into a new technology in hopes of obtaining vast benefits. Due to such actions NFC payment systems gain acceptance and market share. We conclude that the adoption of NFC is not hindered by retailers since there are stores already that try to get a first mover advantage by investing into such services and therefore pushing the technology rather than delaying its adoption.

6.3.3 Handset manufacturers

To be able to use a mobile payment service that is utilizing NFC, the user has to have an NFC enabled device. Most high-end modern smartphones are shipped with NFC however Apple as a strong vendor within the smartphone business does not equip its phones with NFC. We observed this specifically when collecting the data in our field survey. Participants often asked us if there iPhone had NFC, which is not the case. This shows in the collected data as well. While 95.7% of the respondents owned a smartphone only 36.6% were sure it had NFC (Chapter 4.2).

As of today Apple has not decided to introduce NFC to any of their products. Officially, they have not motivated this but since the technology has been developed by one of their main competitors it is safe to assume Apple, as mostly done in their past, want to develop a technology of their own. Maggie Reardon from CNET states that although the technology has been around for a while and works fine, its use as a payment technology also requires a broad eco system. She thinks that “there are business issues centering around who controls the customers via the NFC technology that is embedded in the device” (Cooper, 2012).

There has been a skepticism about whether Apple will include NFC ever since they introduced Bluetooth 4.0 in their smartphones. As previously discussed, in order for a technology like this to become widely adopted by the population there needs to be services and instances where they can use it. Jordan McKee, a Yankee Group analyst said that Apple’s decision will prove to be a roadblock to any mobile wallet based on NFC that does not have a QR reader option. He states however, that he believes that it will at least gain some traction in the US. Carolina Milanesi as cited by Hamblen (2013), analyst at Garnet, said Apple will probably add support for NFC at some point because it cannot avoid a universal wireless technology for sharing data with people who use devices that run other operating systems.

Most people agree that Apple has, and continues to play a crucial role with their vast market share and eco-system. They fulfill several of the key assets as described by Shapiro and Varian (1999) such as their control over their huge installed base of customers. Apple has strong manufacturing capabilities since the company controls the entire value chain from design, to production until finally the sale of the product as well as a very good reputation and brand name.

It is safe to assume that if Apple would have supported, and pushed for NFC to be used then it would have already succeeded. Nevertheless, Apple's obvious reluctance to include NFC in their product range does not necessarily result in its demise. However a viable alternative developed by Apple could hinder the success of NFC. Therefore we conclude that Apple has played and continues to play a role for the future of NFC. Maybe not its success but definitely the speed it gets adapted.

6.4 Learning from history

We can often look back into history to learn and make predictions for what will happen in the future. An example often mentioned in literature, for describing competing standards is what is commonly known as the video format war (Farrell & Saloner, 1985, 1986; Katz & Shapiro, 1986, 1992).

What sparked the war was Sony's belief that other electronic manufacturers would embrace their format known as Betamax, for the benefit of all. JVC had other plans in mind. They had decided to go with their own format known as VHS. What would happen is that a competition would occur, where both competing technologies would compete for market share since they could not exist in equilibrium. There has been speculation why VHS ended up victorious of the technically superior Betamax. Commonly believed is that it is due to slick marketing (Owen, 2008). In reality there are several factors, but in essence it was a consumer choice. Consumers preferred it since it was significantly cheaper to purchase this technology and they were willing to sacrifice quality for cost. NFC can be both a cheap and expensive technology depending on whether the device is active or passive; passive devices, commonly known as 'tags' are very cheap to purchase where as active devices, most likely mobile phones (rather in the high end price spectrum) are not. However the smartphone penetration from our study (96.4%) could argue that most people are willing to invest in a smartphone anyways, even if it is not NFC enabled (42.7% did not have NFC). Similar to Bluetooth NFC is also transmitting radio waves, which would imply the phones could support it. Moreover most likely cost is not the reason for smartphone manufacturers not implementing NFC (Chapter 2.4.5). There is an agreement that there are obviously several reasons to why VHS prevailed over Betamax. A reason, considered to be particularly important is that VHS allowed users to record for longer time periods, originally 120 minutes and afterwards extended to 240 minutes with RCA. Sony's Betamax video recorder for the NTSC television system originally only allowed users to record for 60 minutes. There is a clear agreement that there was a demand for longer recording time than one hour, an example often mentioned for the U.S. market is that an average televised baseball match has an average length of four hours. Users buying the VHS could thus record movies and later even longer shows. Sony clearly underestimated the value this would bring to the customer. Another

reason often cited and discussed; but not agreed upon is that Sony would now allow the Betamax technology to record pornographic material. In essence, this tells us that it is sometimes hard for companies to correctly predict how customers and the market value certain features. Once a majority or a larger amount of users have decided to use a certain technology over the other it escalates. It turns into a snowball effect, and very quickly other competition is eradicated (Blind, 2011). However, (Blind, 2011) states that this only applies if the users are not faced with high switching costs. This implies that NFC, or competing technologies might have certain features that could be considered especially valuable to users that we are not aware of. Moreover, the switching costs will affect whether or not NFC will become more widely used. Nevertheless, we can conclude that users have the possibility to determine which of the competing technologies will win, and that once a majority has joined either one the others typically disappear quickly. The perception of NFC amongst our participants tended to be positive. As these findings indicate, it is mainly the availability in one way or another that is a problem towards the adoption of NFC.

7 Conclusion

The main goal of the study was to answer the question why NFC unlike predicted failed to become a standard for mobile systems as well as widely used and implemented. We acknowledge the fact that this question has no single definite answer and limited ourselves to give an account of and discuss the use and perception of NFC based on the extended technology acceptance model. To complement our study we discuss the adoption process of standards and look at historically similar example. The results from our study indicate an overall positive attitude towards NFC, which made us conclude that NFC would in fact not meet resistance if it would be implemented to a higher extent in services or products. A fundamental problem, however, tended to be that people were simply unaware of its existence. Furthermore, we did not identify any properties of NFC that could be considered limiting towards it becoming a common technology utilized by payment solutions. The NFC adoption process is also not hindered by retailers, although there seems to be a general cautiousness, we are seeing first movers implementing services for their customers that use and support NFC. A company that however, will continue to play a major role on the future of NFC and to the answer of our research question is Apple. As long as Apple will continue to maintain a big market share and reject implementing NFC into their products, they will have a strong negative impact through network effects via their platform; which in turn will at least slow down the process of adoption. Looking at historical examples, it is clear that in the end the users determine the outcome of the technology and applying this to our positive feedback from our study we are positive that eventually, in the future, NFC will have its predicted success.

8 Limitations

Our study is limited by data collection method, the proposed research model and the generally broad approach we took to explain how NFC is a standard. The data collection method limits the study because data was both collected in a field survey as well as in an online survey. This is specifically important because we provide the participants with information before they take part in the survey. Participants taking part in the field survey tried NFC with a smart poster whilst online participant watched a short video showing an example of a data transfer between two NFC enabled phones. Combining this with the fact that some people answered questions about something they did not know and never used, solely relying on information we provided is a limiting factor. The online survey was spread by us over the internet through social media, which results in a high number of friends and acquaintances participating. This practice limits the reached participants. Another delimiting factor is the proposed research model that we use for quantitative analysis. Since NFC was not studied in this way before, we proposed a model by reviewing literature. However this model might be incomplete or not most fitting to explain technology acceptance of NFC. Finally due to the broad approach we took to explain NFC, we focus on explaining the acceptance but do not go into details regarding the standard adoption process and decided to rather have a discussion about it, which limits its significance.

Those limitations could be explored in future research. Possible research could reproduce our study with a bigger sample size and study the influence of how respondents get informed. Maybe further constructs can be determined and added to the proposed research model. Research doing extensive literature review and market analysis could further explore the aspect of the standard adoption applied to NFC.

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APPENDIX

A Questionnaire for field survey

NFC – Questionnaire

Taking part in this survey is voluntary, we do not store any personal information of you. There is no right or wrong when answering the questions, we want you to be honest.

General questions

What is your age? _____(Year of Birth)

What is your gender?
O Male
O Female

Did you know about NFC before taking part in this study?
O No
O Yes
↳ Did you ever use it before?
O No
O Yes

Do you have a smartphone?
O No
O Yes
↳ Does it have NFC?
O No
O Yes
O I don't know

What is the highest degree or level of school you have completed? *If currently enrolled, highest degree received.*
O Less than high school (grundskola)
O High school (gymnasium)
O College degree (eftergymnasial)

Perceived Ease Of Use	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
NFC is easy to use	O	O	O	O	O
It is easy to become skillful at using NFC	O	O	O	O	O
Learning to operate NFC is easy	O	O	O	O	O
My interaction with NFC is clear and understandable	O	O	O	O	O
It is easy to interact with NFC	O	O	O	O	O
I find it easy to get NFC to do what I want it to do	O	O	O	O	O

Don't forget to complete the backside! :)

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
Perceived Usefulness					
NFC is useful	o	o	o	o	o
NFC could improve my performance in certain tasks	o	o	o	o	o
NFC could enhance my effectiveness in certain tasks	o	o	o	o	o
NFC could increase my productivity in certain tasks	o	o	o	o	o
NFC could enable me to do certain tasks faster	o	o	o	o	o
NFC could make certain tasks easier	o	o	o	o	o
Intended Use					
Given a chance, I would adopt NFC in the future	o	o	o	o	o
Given a chance, I would use NFC in the future	o	o	o	o	o
I would recommend others to use NFC	o	o	o	o	o
Trust					
I am in control when using NFC	o	o	o	o	o
NFC provides privacy	o	o	o	o	o
NFC is reliable	o	o	o	o	o
NFC is secure	o	o	o	o	o
I trust NFC	o	o	o	o	o

Please return the filled questionnaire and the NFC-Fact Sheet

Thank you!

B Questionnaire for online survey

LUNDS UNIVERSITET

About our study

Hello there,

we are Thomas Steck and Philipp Lange two students that are currently studying Information Systems at Lund University (Sweden). For our master thesis we investigate why NFC (Near Field Communication) did not become a success so far. The following consumer survey is part of our research.

For you to be able to answer our questionnaire we prepared a short description and a demonstration video of NFC on the next page, please read carefully.

Furthermore we want you to know, that taking part in this survey is voluntary, and we don't collect or store personal information of you. There is no right or wrong when answering the questions, we want you to be honest!

Thank you for participating

Philipp & Thomas
gif13pla (at) student.lu.se
gin10tst (at) student.lu.se

Continue »

6% completed

What is NFC? - Read carefully!

NFC is a standard for transmitting data over short distances using radio waves. It is an advancement of RFID (Radio Frequency Identification). The aim is to create a simple, safe and intuitive channel of communication between various electronic devices, mainly mobile phones. Most new mobile phones have NFC. However, not the iPhone.

Technical details:
- Short range of 10cm (between devices)
- 424Kbit/s data transfer rate
- Requires no configuration
- Consumes very little power (1 mA)

There are two different types of NFC devices - passive and active ones. For a device to be active, it is necessary to have an own power source. A passive device can be a very simple chip that contains any kind of data. The active unit transfers energy to the passive device using radio waves and enables the exchange of data.

There are of course other existing techniques that use radio waves to exchange data. Bluetooth has a range of 10 meters and Wi-Fi 100 meters. The data transfer rate is even faster with both Bluetooth that has a max speed of 3 Mbit/s and Wi-Fi which is from around 54 to 600 Mbit/s Both Bluetooth and Wi-Fi requires the user to manually configure devices before connection. For the NFC it is enough to put a device in range.

Example NFC-symbols:

Example use of NFC between two active devices:

« Back | Continue »

13% completed

Where is your current residence? *

« Back Continue »

20% completed

What year were you born? *

(YYYY)

« Back Continue »

26% completed

What is your gender? *

- Female
- Male

« Back Continue »

33% completed

Did you know about NFC before taking part in this study? *

- No
- Yes

« Back Continue »

40% completed

Did you ever use it before? *

- No
- Yes

« Back Continue »

46% completed

Do you have a smartphone? *

- No
- Yes

« Back Continue »

53% completed

Does it have NFC? *

- No
- Yes
- I don't know

« Back Continue »

60% completed

What is the highest degree or level of school you have completed? *
If currently enrolled, highest degree received.

- Less than high school (grundskola)
- High school (gymnasium)
- College degree (eftergymnasial)

« Back | Continue »

66% completed

Perceived ease of use

1=Strongly disagree
2=Disagree
3=Neither agree or disagree
4=Agree
5=Strongly agree

NFC is easy to use *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

It is easy to become skillful at using NFC *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Learning to operate NFC is easy *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

Interacting with NFC is clear and understandable *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

It is easy to interact with NFC *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

I find it easy to get NFC to do what I want it to do *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

« Back | Continue »

73% completed

Perceived Usefulness

1=Strongly disagree
2=Disagree
3=Neither agree or disagree
4=Agree
5=Strongly agree

NFC is useful *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC could improve my performance in certain tasks *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC could enhance my effectiveness in certain tasks *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC could increase my productivity in certain tasks *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC could enable me to do certain tasks faster *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

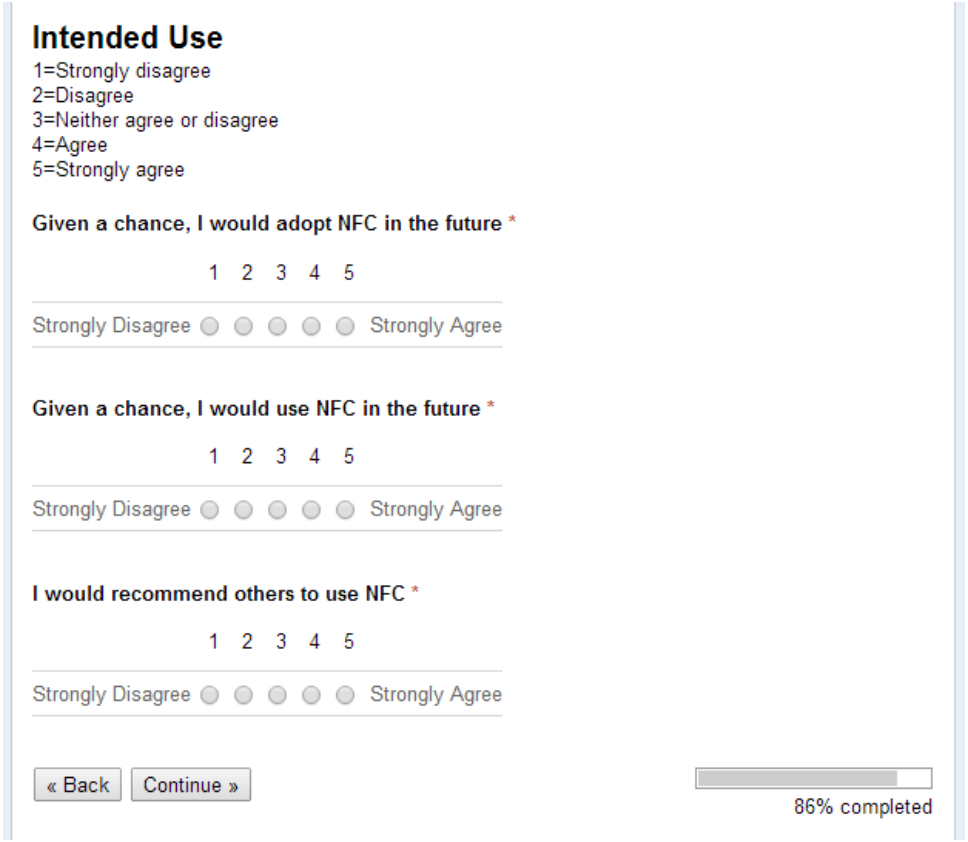
NFC could make certain tasks easier *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

« Back Continue »

80% completed



Intended Use

1=Strongly disagree
2=Disagree
3=Neither agree or disagree
4=Agree
5=Strongly agree

Given a chance, I would adopt NFC in the future *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

Given a chance, I would use NFC in the future *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

I would recommend others to use NFC *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

« Back | Continue »

86% completed

Trust

1=Strongly disagree
2=Disagree
3=Neither agree or disagree
4=Agree
5=Strongly agree

I am in control when using NFC *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC provides privacy *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC is reliable *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

NFC is secure *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

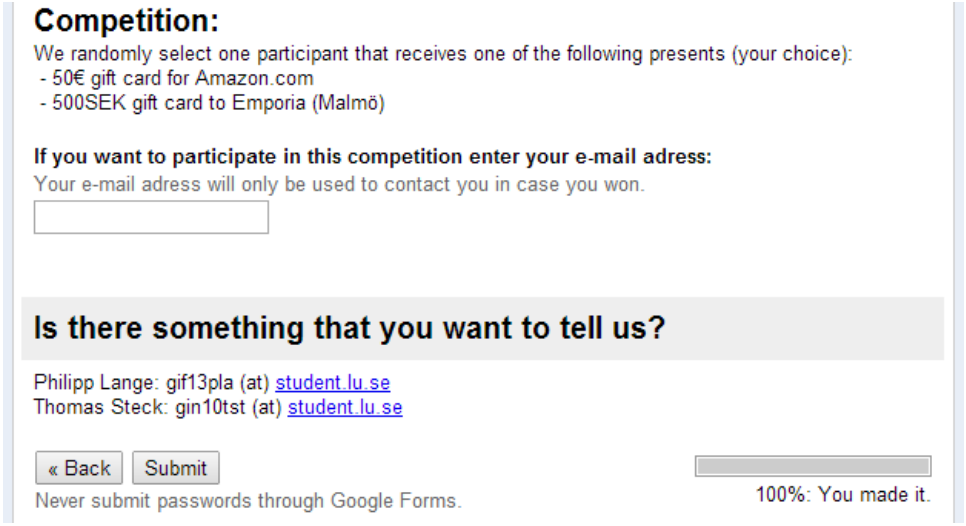
I trust NFC *

1 2 3 4 5

Strongly Disagree ○ ○ ○ ○ ○ Strongly Agree

« Back | Continue »

93% completed



Competition:

We randomly select one participant that receives one of the following presents (your choice):
- 50€ gift card for Amazon.com
- 500SEK gift card to Emporia (Malmö)

If you want to participate in this competition enter your e-mail adress:

Your e-mail adress will only be used to contact you in case you won.

Is there something that you want to tell us?

Philipp Lange: gif13pla (at) student.lu.se
Thomas Steck: gin10tst (at) student.lu.se

« Back Submit

Never submit passwords through Google Forms.

100%: You made it.

C NFC fact sheet

NFC - Fact Sheet
Near Field Communications

Example NFC-Symbols

NFC is a standard for transmitting data over short distances using radio waves. It is an advancement of RFID (Radio Frequency Identification). The aim is to create a simple, safe and intuitive channel of communication between various electronic devices, mainly mobile phones. Most new mobile phones have NFC. However, not the iPhone.

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Technical details for NFC

- Short range of 10 cm (between devices)
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- Consumes very little power (15 mA)

There are of course other existing techniques that use radio waves to exchange data. Bluetooth has a range of 10 meters and Wi-Fi 100 meters. The data transfer rate is even faster with both Bluetooth that has a max speed of 3 Mbit/s and Wi-Fi which is from around 54 to 600 Mbit/s Both Bluetooth and Wi-Fi requires the user to manually configure devices before connection. For the NFC it is enough to put a device in range.

LUNDS UNIVERSITET
Ekonomihögskolan

About Us

We are two students from Lund University who investigate how accepted NFC technology is in order to answer our research question (why NFC did not have a breakthrough yet).

Try NFC and have a chance to win nice prices (three easy steps)

touch with phone here

1. Touch the red circle in the lower left corner with your NFC-phone
2. The phone activates the chip and receives instructions to visit a website in the browser
3. Fill out the contact information on the website and the questionnaire. Now you have a chance to win great prices.

PROBLEM? turn over!


Problem
it is not working?
RELAX! :)
Follow these steps:
1. Is NFC activated?
2. Is the Phones sensor touching the red circle? (where the Tag is placed)
3. Did you try another phone?
These Telia phones have been tested and work best:
Galaxy Express 2, Nexus 5, HTC One m8,
Sony Xperia E1, Sony Xperia V, Sony Xperia ZR
Sony Xperia Z1 och Sony Xperia Z1 compact
Still experiencing problems?
Just ask us! :(

NFC - Faktablad
Near Field Communications

Exempel på NFC - Symboler

NFC är en standard för att överföra data över korta sträckor via radiovågor. Det är en vidareutveckling av RFID (Radio Frequency Identification). Syftet är att man vill skapa en enkel, säker och intiutiv kommunikationskanal mellan olika elektroniska enheter, främst mobiltelefoner. De flesta dyrare nya mobiltelefonerna har NFC. Dock ej iPhone

Det finns två olika sorters NFC enheter - *Passiva* och *Activa*. För att en enhet ska klassas som aktiv så krävs det att har en egen strömkälla. En passiv enhet kan då vara ett väldigt enkelt chip som innehåller någon form av data, den aktiva enheten för över energi till den passiva enheten via radiovågorna och möjligör ett utbyte av data.

Egenskaper för NFC

- Kort räckvidd 10 cm (mellan enheterna)
- 424 Kbit/s data överföringshastidhet
- Kräver ingen manuell konfiguration
- Förbrukar väldigt lite ström (15 mA)

Det finns givetvis andra existerande tekniker som använder radiovågor för utbyte av data. Bluetooth har en räckvidd på 10 meter och Wi-Fi 100 meter. Dataöverföringshastigheten är även snabbare både med Bluetooth som har en max hastighet på 3 Mbit/s och Wi-Fi som har från hela 54 till 600 Mbit/s. Både Bluetooth och Wi-Fi kräver att användaren manuellt konfigurerar enheterna innan anslutningen. För NFC räcker det att dem är inom räckvidd.

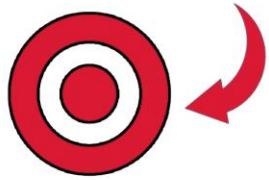
LUNDS UNIVERSITET
Ekonomihögskolan

Om Oss

Vi är två studenter från Lunds Universitet som tänkte undersöka hur pass accepterad NFC teknologin är i syfte att svara på vår forskningsfråga varför inte tekniken slagit igenom ännu.

Prova gärna NFC och ha chansen att vinna fina priser (3 enkla steg)

Håll telefonen här

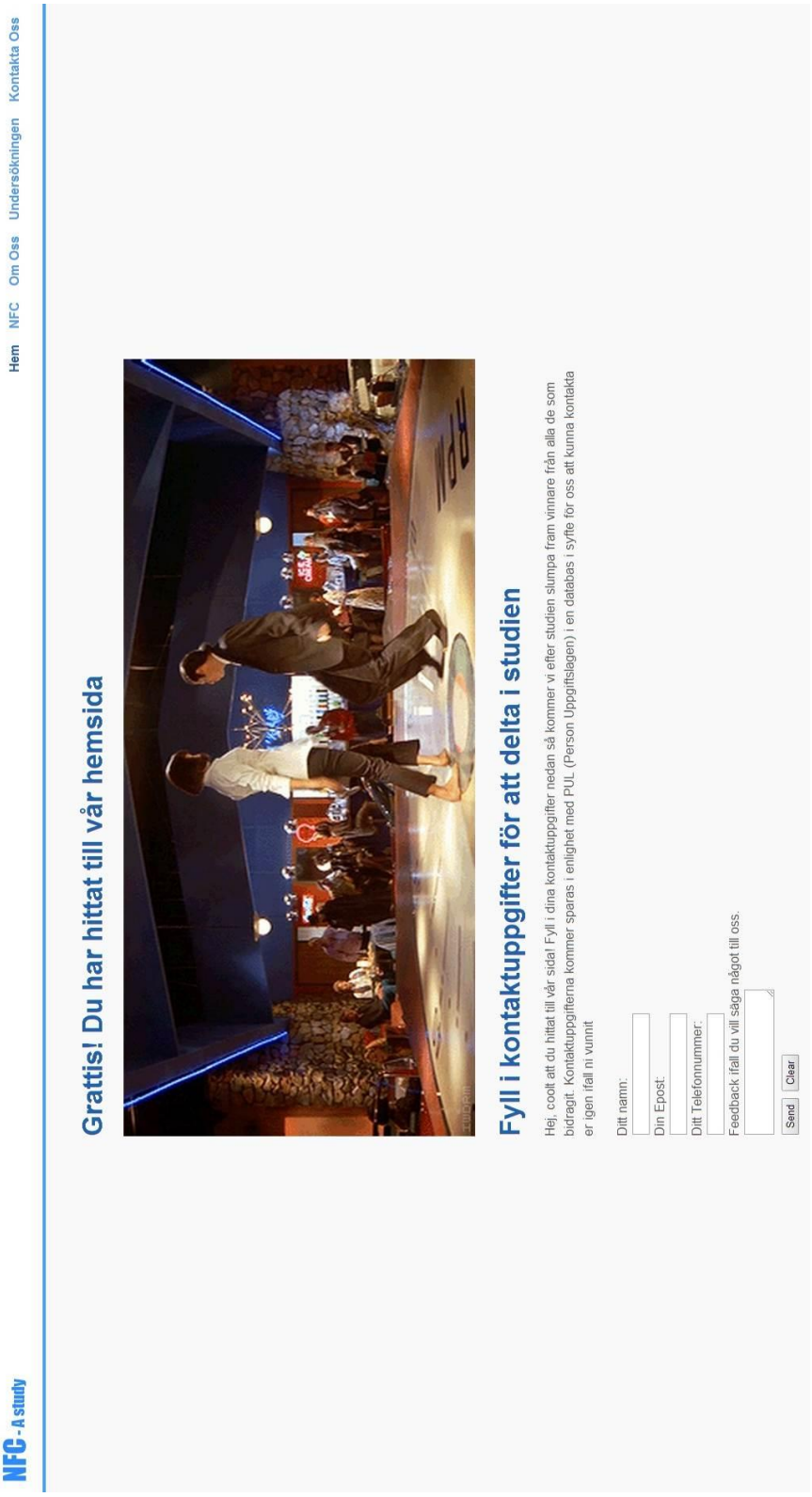


1. Håll din NFC telefon mot den röda cirkeln nere i vänster hörn.
2. Mobilen aktiverar chippet och får instruktioner att besöka en hemsida i webbläsaren.
3. Fyll i kontaktuppgifter på hemsidan och frågeformuläret så är du med i tävlingen och har chans att vinna fina priser.

PROBLEM? Se baksidan


Problem,
Fungerar det inte?
LUGN! :)
Kolla följande
1. Är mobilens NFC aktiverad?
2. Håller du mobilens NFC sensor
mot den röda cirkeln? (där chippet sitter)
3. Provat en annan telefon?
Av Telias telefoner fungerade
Galaxy Express 2, Nexus 5, HTC One m8,
Sony Xperia E1, Sony Xperia V, Sony Xperia ZR
Sony Xperia Z1 och Sony Xperia Z1 compact bäst!
Fortfarande problem? :(
Tveka inte att kontaka oss.

D Website


NFC - A study
Hem
NFC
Om Oss
Undersökningen
Kontakta Oss
Grattis! Du har hittat till vår hemsida
Fyll i kontaktuppgifter för att delta i studien
Hej, coolt att du hittat till vår sida! Fyll i dina kontaktuppgifter nedan så kommer vi efter studien slumpa fram vinnare från alla de som bidragit. Kontaktuppgifterna kommer sparas i enlighet med PUL (Person Uppgiftslagen) i en databas i syfte för oss att kunna kontakta er igen ifall ni vunnit
Ditt namn:
Din Epost:
Ditt Telefonnummer:
Feedback ifall du vill säga något till oss.
Send
Clear

E Collected Data

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
1	1	1991	F	1		2	3	3	4	4	3	3	5	5	4	4	5	4	4	4	4	5	4	3	4	4	4	3
2	1	1990	M	2	2	2	2	3	5	4	4	5	5	2	5	2	2	2	4	4	5	5	4	3	3	4	3	4
3	1	1990	M	1		2	3	2	4	4	3	4	4	3	4	4	2	2	2	4	4	4	3	3	3	3	3	3
4	1	1982	M	2	2	2	2		3	3	3	3	4	5	4	4	4		3	5	5	5	5	4	3	3	3	3
5	1	1983	M	1		2			4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
6	1	1997	F	1		2	1	2	4	3	4	2	3	4	5	3	4	4	4	2	4	4	3	3	4	2	4	4
7	1	1988	F	1		2	1	3	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	1	1996	M	2	2	2	1	2	5	3	5	3	4	4	3	5	4	2	5	5	3	5	5	5	3	5	3	4
9	1	1979	F	1		2	1	2	4	3	4	4	4	3	4	3	4	4	4	4	4	4	4	4	3	3	3	3
10	1	1978	M	1		2	1	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	3	3	3	3	3
11	1	1976	M	2	1	2	3	3	4	4	4	4	4	4														
12	1	1981	F	2	2	2	2	3	5	5	5	5	5	5	4	3	3	3	3	5	5	5	5	5	5	5	4	5
13	1	1949	F	1		2	3	3	4	4	4	4	4	3	4	4	4	3	4	4	4	4	4	3	3	3	3	3
14	1	1981	F	2	2	2	1	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
15	1	1941	M	1		2	1	2	5	5	5	5	5	3	5	3	3	3	5	5	5	5	5	5	5	5	5	5
16	1	1992	M	1		2	2		5	4	4	5	4	4	5	4	4	3	3	3	5	5	4	3	3	3	2	2
17	1	1993	M	1		2	1	2	4	3	4	4	4	4	4	4	5	4	5	4	3	4	4	3	3	3	3	4
18	1	1997	M	1		2	1	2	5	4	3	3	4	4	4	5	4	2	4	3	4	4	3					
19	1	1997	M	1		2	1	1	5						5	5	5	5	4	5	5	5	4					

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
20	1	1996	F	1		2	1	2	5	4	4	4	4	4	5	5	4	4	4	5	5	5	5	5	5	5	5	5
21	1	2001	F	1		2	1	1	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	4	3	2	2	3
22	1	1951	F	1		2		2	5	5	4	4	4	4	5	4	4	5	5	5	5	5	5	4	4	4	5	5
23	1	1949	M	2	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	2	2	3	2	2
24	1	1973	M	1		2	1	3	5	3	5	4	4	4	3	4	5	5	5	5	5	5	5	5	4	4	4	3
25	1	1993	F	1		2	2	2	3	3	3	3	4	3	4	3	3	3	3	3	4	4	3	3	3	3	3	3
26	1	1993	M	1		2	1	2	4	4	4	3	5	4	5	4	4	5	4	5	2	3	4	3	4	5	5	5
27	1	1993	M	2	2	2	2	2	4	3	4	4	2	2	1	4	3	3	4	2	2	2	2	3	5	4	3	4
28	1	1966	F	1		2	1	3	5	5	5	3	3	3	5						5	4	4					
29	1	1985	M	2	1	2	2	3	5	3	4	3	4	3	5	5	5	5	5	5	5	4	3	4	2	3	3	3
30	1	1987	F	1		2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	5	5	5	3	3	3	3	3
31	1	1993	F	1		2	1	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
32	1	1996	M	1		2	1	2	5	5	4	4	4	4	5	5	5	4	5	4	4	4	4	4	4	4	4	4
33	1	1979	F	1		2	1	3	4	4	4	4	4	4	4	4	4	4	4	4	5	5	1	3	3	3	3	4
34	1	1976	M	1		2	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
35	1	1984	F	1		2	1	3	3		2	2	3	2	4	4	4	4	4	4	4	4	4	3	3	3	3	3
36	1	1978	M	2	2	2	1	3	5	4	4	4	5	4	4	3	5	5	5	4	5	5	4	4	3	3	3	3
37	1	1965	M	1		2	1	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
38	1	1973	M	1		2	3	3	5	4	4	3	4	3	5	5	5	5	5	5	5	5	5	3	3	3	3	3
39	1	1995	M	1		2	1	2	5	5		4	3	4	5	5	5	5	5	5	5	5	5	4	4	4	4	3
40	1	1964	F	2	1	2	1	3	4	3	4	4	4	3	4	3	3	3	4	4	4	4	3	3	3	3	3	2

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
41	2	1998	M	1		2	1	1	4	4	5	4	4	3	5	4	4	5	5	4	5	4	4	4	2	4	3	3
42	2	1998	M	1		2	3	1	5	4	5	5	5	5	5	4	4	4	5	5	5	5	5	4	3	4	4	4
43	2	1990	M	1		2	1	3	5	5	5	4	4	4	2	3	3	3	4	2	1	1	1	3	4	4	4	4
44	2	1985	M	2	2	2	1	3	4	3	4	3	4	3	4	4	5	4	5	5	5	5	5	3	2	3	2	3
45	2	1993	M	2	1	2	2	2	4	5	5	1	5	3	5	4	5	4	4	5	5	5	5	5	5	5	5	5
46	2	1988	M	2	2	2	1	2	4	4	4	4	4	4	2	3	3	2	4	4	2	4	3	4	4	3	4	4
47	2	1991	M	2	2	2	2	3	4	5	5	4	4	4	2	2	2	2	4	2	4	4	4	5	5	5	5	5
48	2	1992	M	2	2	2	1	2	5	4	4	4	4	3	4	3	3	3	4	5	4	4	4	3	3	2	3	3
49	2	1986	F	2	1	2	1	3	4	2	3	4	4	2	3	4	3	2	5	5	4	4	3	3	1	3	2	2
50	2	1991	F	1		2	3	2	4	3	4	4	4	3	2	4	2	2	4	4	3	4	3	3	2	4	2	1
51	2	1993	F	2	2	2	2	2	4	5	5	4	4	3	3	2	3	2	4	2	3	3	3	4	3	4	3	3
52	2	1995	F	1		2	1	2	3	4	4	4	4	4	1	1	2	1	2	2	1	1	1	3	4	4	4	4
53	2	1987	F	2	1	2	3	3	3	4	4	3	4	4	2	2	2	1	3	3	3	3	2	4	4	3	3	3
54	2	1986	M	2	2	2	2	3	4	4	4	3	4	4	4	2	2	2	2	3	4	4	4	3	2	2	1	2
55	2	1990	F	2	1	2	1	3	4	5	5	5	5	4	3	3	3	3	4	4	3	3	3	4	3	4	4	4
56	2	1985	M	2	1	2	2	3	3	2	4	3	3	2	1	2	3	5	1	2	3	3	3	3	3	3	3	3
57	2	1989	M	2	1	2	1	3	4	5	5	4	3	3	3	2	2	2	4	4	2	2	3	4	5	4	3	4
58	2	1988	M	2	2	2	1	3	4	4	4	5	4	4	4	5	4	3	5	4	4	4	5	4	2	4	3	3
59	2	1992	M	2	1	2	2	3	4	4	4	4	2	4	2	2	2	2	2	2	4	2	2	4	4	4	4	4
60	2	1992	F	1		2	1	3	5	5	5	4	4	3	2	1	1	2	3	1	2	2	1	4	5	5	5	3
61	2	1990	M	2	2	2	2	3	4	4	4	4	4	4	5	3	3	3	3	3	5	5	5	5	3	3	3	2

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
62	2	1985	M	2	1	2	1	3	3	1	4	4	4	3	4	4	4	4	4	4	1	1	1	3	3	3	3	3
63	2	1992	F	1		2	1	3	3	5	5	5	4	3	3	5	3	3	4	4	4	4	4	4	4	4	3	4	3
64	2	1991	F	2	1	2	2	3	5	5	5	5	5	3	3	3	2	2	4	3	2	2	2	3	3	3	3	3
65	2	1990	M	2	2	2	2	3	5	5	5	5	5	5	3	2	2	2	3	3	3	3	3	4	3	3	3	3
66	2	1990	M	2	2	2	2	2	4	3	3	3	4	4	5	4	4	4	4	4	4	5	5	4	4	3	3	4
67	2	1982	M	2	1	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
68	2	1994	F	2	1	2	3	3	3	3	3	4	4	4	5	5	5	4	4	4	4	4	5	4	3	3	4	4
69	2	1985	M	2	2	2	2	3	4	4	4	3	3	3	3	3	3	3	3	3	2	2	2	3	3	4	3	3
70	2	1982	M	2	2	2	2	3	3	4	3	2	2	3	5	5	5	5	5	5	4	4	3	3	3	2	2	2
71	2	1985	M	2	1	2	1	3	3	3	3	3	3	3	2	1	1	1	1	1	3	4	3	1	1	1	1	1
72	2	1990	M	2	1	2	1	3	5	5	4	5	4	4	4	3	3	3	4	4	4	4	4	3	3	4	3	2
73	2	1992	F	1		2	3	2	3	4	4	4	4	3	3	4	4	4	4	4	4	4	3	3	2	3	3	3
74	2	1988	F	1		2	3	2	2	2	3	2	3	1	3	4	4	4	4	3	3	3	3	2	3	2	3	2
75	2	1986	M	2	2	2	1	3	4	4	4	4	4	3	4	3	3	3	3	3	3	3	3	2	2	2	2	2
76	2	1987	M	1		2	3	3	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	3	4	3	4	3
77	2	1987	M	2	1	2	2	3	5	4	4	5	4	3	5	5	3	2	4	5	5	5	5	4	3	3	3	3
78	2	1990	M	2	2	2	1	3	5	5	4	3	4	4	4	5	4	5	4	3	3	4	3	3	3	2	2	2
79	2	1988	M	2	2	2	2	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	3	5	2	2
80	2	1986	M	2	1	2	2	3	4	4	3	2	3	4	5	5	5	5	5	5	5	5	5	4	2	4	4	4
81	2	1987	M	1		2	2	3	3	3	5	4	3	4	3	4	4	2	3	3	4	3	4	4	3	2	3	3
82	2	1988	F	2	1	2	2	3	4	5	3	4	4	3	4	3	4	3	3	4	5	4	4	3	3	3	3	3

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
83	2	1986	M	2	1	2	2	3	4	3	3	4	4	4	5	5	4	5	5	5	5	5	3	3	3	3	3	4
84	2	1991	M	2	2	2	2	2	5	5	5	3	4	5	3	2	2	2	2	2	4	4	3	4	4	4	4	4
85	2	1987	M	2	1	2	1	3	3	3	3	4	4	3	4	4	4	3	3	3	3	4	3	3	1	2	1	1
86	2	1991	M	1		2	1	3	4	4	4	3	3	5	4	4	3	3	4	4	4	4	4	3	3	3	3	4
87	2	1989	M	2	2	2	2	3	5	5	5	4	5	3	4	3	3	3	3	3	3	4	3	3	2	3	2	2
88	2	1988	M	1		1		3	4	5	4	4	4	4	3	3	3	3	5	4	5	5	5	3	3	4	3	3
89	2	1982	M	2	2	2	2	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	2	2	3	3	2
90	2	1988	M	1		2	2	3	3	3	3	3	3	3	4	3	4	4	4	4	4	4	4	3	3	3	3	3
91	2	1970	M	2	1	2	1	2	4	4	4	4	4	3	5	5	5	5	4	5	5	5	5	4	3	3	3	3
92	2	1992	F	1		1		2	3	4	5	5	4	3	5	5	5	5	5	5	4	5	3	3	4	4	5	4
93	2	1952	M	1		2	1	2	4	3	4	4	4	4	3	3	3	3	3	3	5	5	5	3	3	3	3	3
94	2	1990	M	1		1		2	4	5	5	5	5	4	3	1	5	3	5	3	2	2	3	4	5	4	4	3
95	2	1974	M	2	2	2	2	2	5	5	5	5	4	2	5	4	4	4	4	4	3	3	3	4	3	3	2	3
96	2	1992	F	1		2	1	2	4	5	4	4	4	3	5	2	3	2	4	4	5	5	4	3	2	3	3	3
97	2	1989	M	1		2	1	2	4	3	4	3	3	2	4	4	4	4	3	4	4	4	1	3	5	3	2	2
98	2	1990	M	2	1	2	2	3	5	5	4	3	4	3	4	3	3	4	4	3	4	2	3	1	2	1	1	1
99	2	1964	M	1		2	2	2	4	4	4	4	4	4	4	3	3	3	3	3	5	5	5	3	2	4	2	2
100	2	1985	F	1		2	3	3	4	4	4	4	4	4	5	3	3	3	4	4	4	4	4	3	4	4	5	4
101	2	1988	M	2	1	2	2	3	2	2	3	2	2	2	2	2	3	3	3	3	4	2	3	2	3	2	2	2
102	2	1994	M	1		2	3	2	4	3	4	4	3	3	4	3	3	4	3	2	4	4	3	3	2	2	2	3
103	2	1984	F	1		2	1	3	3	4	3	4	4	4	3	3	4	4	4	4	3	4	3	3	4	3	4	3

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
104	2	1982	M	2	1	2	1	2	5	5	5	4	3	4	5	5	5	5	5	5	4	5	5	2	4	4	4	4
105	2	1976	M	1		2	1	2	3	3	3	3	3	2	2	2	2	2	2	2	3	3	1	1	1	3	3	2
106	2	1901	F	2	2	1		3	5	5	5	5	5	5	1	1	1	1	1	1	5	5	5	1	1	1	1	1
107	2	1983	M	2	1	2	2	3	4	4	4	2	4	3	1	3	2	2	3	2	2	2	3	3	2	4	2	3
108	2	1989	F	2	1	2	1	2	5	5	5	5	5	4	4	5	4	2	4	4	5	5	3	2	3	2	2	1
109	2	1964	M	1		2	3	3	3	3	3	3	3	3	4	4	4	3	4	4	4	4	3	3	3	3	3	3
110	2	1996	M	2	1	2	2	2	2	2	3	3	3	3	2	2	2	1	2	2	4	4	3	3	3	3	3	2
111	2	1985	M	2	1	2	1	3	4	3	4	5	3	4	3	4	4	3	5	5	5	5	5	3	4	3	4	4
112	2	1983	M	2	2	2	2	3	5	3	5	4	4	4	4	3	3	3	5	4	4	4	4	1	3	4	3	2
113	2	1987	M	2	1	2	2	3	3	3	2	3	3	3	4	5	5	3	5	5	5	5	3	3	2	3	3	4
114	2	1986	F	2	1	2	3	3	3	3	3	3	3	4	4	4	4	3	4	4	4	4	3	3	3	3	3	3
115	2	1982	M	1		2	3	2	3	2	3	2	2	3	4	3	2	2	3	2	4	4	4	3	2	2	2	2
116	2	1978	M	1		1		2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	3	2	2	2	2	2
117	2	1986	M	2	2	1		3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
118	2	1954	M	2	1	2	3	3	3	3	3	3	3	3	2	3	2	2	3	3	2	3	2	2	2	2	2	2
119	2	1994	M	1		2	3	1	5	4	3	3	3	3	4	4	4	4	4	4	4	4	4	3	3	4	3	3
120	2	1984	M	2	2	2	1	3	5	5	5	5	5	5	4	4	3	3	3	3	4	4	4	5	5	4	2	2
121	2	1988	M	2	1	2	2	3	3	2	2	4	3	2	2	2	2	2	4	4	4	4	3	4	2	3	3	3
122	2	1961	M	2	1	2	1	3	5	4	4	4	3	3	5	4	4	3	4	4	4	4	3	4	3	4	3	3
123	2	1970	M	1		2	3	3	4	5	5	5	5	5	3	2	2	1	3	3	2	2	3	1	1	3	1	1
124	2	1979	M	2	2	2	2	3	3	3	3	2	4	2	3	4	4	4	4	5	4	4	4	3	3	2	2	2

No	Survey*	Year of Birth	Gender	GQ1**	GQ2**	GQ3**	GQ4**	GQ5**	PEOU1***	PEOU2***	PEOU3***	PEOU4***	PEOU5***	PEOU6***	PU1***	PU2***	PU3***	PU4***	PU5***	PU6***	IU1***	IU2***	IU3***	TC***	TP***	TR***	TS***	T***
125	2	1987	F	2	2	2	2	3	5	5	5	4	4	4	5	5	5	4	5	5	5	5	5	4	3	3	3	4
126	2	1985	M	2	1	2	2	3	3	3	3	3	3	3	4	4	4	4	3	4	4	4	3	3	2	3	3	3
127	2	1990	M	2	2	2	2	2	4	4	4	4	4	4	4	2	2	3	3	3	4	4	4	4	4	3	4	4
128	2	1985	M	1		2	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
129	2	1985	M	1		2	1	3	3	3	3	3	3	3	1	3	3	3	3	3	1	1	1	3	3	3	1	3
130	2	1966	F	1		2	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
131	2	1981	M	2	1	2	3	3	4	4	4	4	4	4	3	3	3	3	3	4	2	2	2	4	4	4	4	4
132	2	1992	M	2	2	2	2	3	4	3	3	3	3	3	4	5	4	4	4	4	4	4	4	3	2	2	2	2
133	2	1982	M	2	2	2	2	3	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	3	3	3	3	3
134	2	1990	M	2	1	2	3	3	3	3	4	3	4	3	3	3	4	3	4	4	4	3	3	4	2	3	2	3
135	2	1991	M	1		2	3	2	4	5	3	5	3	4	5	5	4	4	4	5	5	5	5	3	5	4	5	5
136	2	1991	F	2	1	2	3	2	3	3	4	4	3	2	3	4	4	3	5	3	4	4	3	3	1	4	2	2
137	2	1990	M	2	2	2	2	2	4	3	4	4	4	3	5	3	4	3	3	5	4	4	4	2	2	3	1	1
138	2	1973	M	2	2	2	2	3	4	5	5	3	4	4	5	3	4	4	4	4	3	3	3	2	3	1	3	4
139	2	1987	M	2	2	2	2	2	5	3	5	4	5	4	5	3	5	4	5	4	5	5	5	5	4	4	5	5
140	2	1968	F	1		2	1	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

* 1=Emporia, 2= Online

** 1=No, 2=Yes, 3=I don’t know

*** 1=Strongly disagree, 2=Disagree, 3=Neither agree or disagree, 4=Agree, 5=Strongly agree