

Bank card as OV-chipcard

A user-centered strategy for successful adoption of the contactless EMV bank card in Dutch public transport

Analysis report, March 2016

Expertise Centre for E-ticketing in Public Transport

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Faculty of
Industrial Design Engineering



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Master Design for Interaction
Faculty of Industrial Design Engineering
Delft University of Technology
This report is part of Expertise Centre E-Ticketing in Public Transport

March 2016 (version 2.0)

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LIST OF ABBREVIATIONS

CBO	Central Back Office
CiCo	Check-in, Check-out
CJM	Customer journey mapping
CL	Contactless
CTA	Chicago Transit Authority
EMV	Europay, Mastercard, Visa
EMV-c	EMV contactless
EMV-pt	EMV contactless within public transport
IBAN	International Bank Account Number
NFC	Near Field Communication
NOVB	National Openbaar Vervoer Beraad
OV	Openbaar Vervoer (Dutch public transportation system)
OVCP	OV-chipcard
PAN	Primary Account Number
PAYG	Pay As You Go
PIN	Personal Identification Number
POS	Point-of-Sale
PTO	Public Transport Operator
RTA	Regional Transportation Authority
SEPA	Single Euro Payments Area
SIM	Subscriber Identification Module
TCO	Total Cost of Ownership
TfL	Transport for London
TLS	Trans Link Systems

EXECUTIVE SUMMARY

To cope with problems concerning the OV-chipcard, the Nationaal Openbaar Vervoer Beraad (NOVB) created a future vision document in which to implement contactless EMV bank cards within public transport (EMV-pt) in order to increase traveller satisfaction. The aim of this analysis is to discover what factors contribute to the successful adoption of EMV contactless (EMV-c) within public transport. Because experience with the OV-chipcard has shown that it is important to deal with a new development through a user-centered and integral approach, the main focus for this research will be the perspective of the user.

In order to see what has been written about the adoption of new technologies, a literature study was performed. This study focused on the topics of technology acceptance, trust and user behaviour. A new model was created by combining the trust adapted Technology Acceptance Model and the Information Success Model in order to make a model that is more suitable for the implementation of EMV-pt. This model shows that there are two moments one can design for the traveller when it comes to the adoption of a new technology. These moments, which influence the expected and the experienced qualities the traveller perceives, can be influenced by various factors connected to the design of the new technology. When these qualities are perceived as satisfying for the user the new technology is more likely to be adopted.

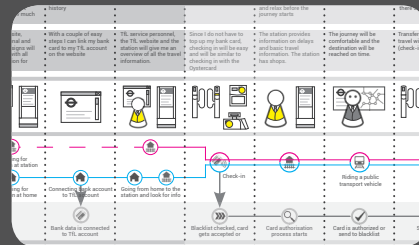
Since the new development combines the worlds of transit and banks, a study was conducted to find out what the limitations and opportunities are of EMV and what requirements this sets for introducing it in public transport. This showed that there are many existing restrictions and barriers one

has to deal with and that the position of EMV-pt in relation to other future developments is crucial for a successful implementation. Next to this investigation of the separate worlds of EMV and public transport, a closer look was taken at the current situation of the EMV-pt development. This showed that the EMV-pt in the Netherlands is going to be the product of a complex cooperation and that unity is needed in design and service to avoid confusion amongst travellers. Even though several issues have already been identified because the EMV-pt model currently considered for the Netherlands is based on the already working London model, there is still a big emphasis on technology and business issues and user issues are relatively unknown or highly connected to the existing OV-chipcard.

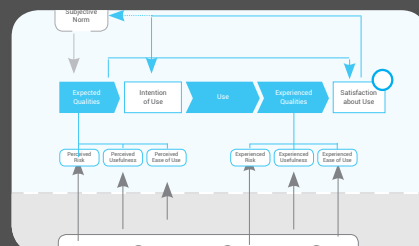
To identify these user issues and to know just how people will react to using their contactless bank card in public transport, a study abroad was conducted to look at contexts that already have EMV-pt implemented. The situation in the Czech Republic was analysed to get a better understanding of what it means to pay with an EMV contactless bank card because the country has a widespread acceptance of EMV-c. Next to that, the cities Chicago and London have been visited in order to analyse the adoption of EMV-pt within their public transport systems. Within these contexts users and employees have been observed and interviewed and the contactless bank card has been used multiple times in order to get first hand experience. The data of the research led to the identification of problem areas and helped in creating insights. The data collected has also been used to map out the customer journey of the transit user in London to identify problems and relevant design opportunities.

The results show that there are still many pitfalls when it comes to implementing EMV-pt and that studying these contexts can really help in avoiding them. The Czech Republic gave an impression on how contactless transactions work in a different context and what it would mean to rely on non textual feedback. In this country the results showed that there is not much consistency, both in readers as well as in bank regulations, and that it is difficult for users to rely on their previous experiences to make contactless transactions. Research in Chicago showed that the complex nature of the working principle of EMV-pt in their system combined with the unreliable service of the payment system and added transfer costs resulted in poor adoption. The results in London pointed out that there is a big group of incidental travellers that use EMV-pt. Research also showed that travellers have to deal with a large information gap at check-in and check-out (CiCo) points causing confusion and doubt and that information concerning EMV-pt can sometimes be hard to find in London. All contexts displayed issues concerning consistency, service personnel knowledge and users experiencing a feeling of loss of control when using the contactless bank card. Next the insights and results discovered during the research were connected to the model created in the literature study to give an overview of the factors that influence the implementation of EMV-pt and to show how the expected and experienced qualities of such a system can be influenced.

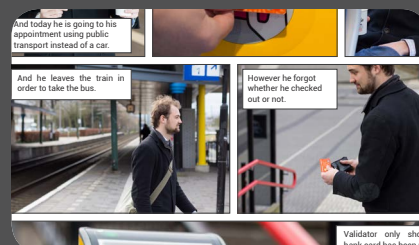
The findings of the analysis led to an overview of threats to successful adoption of EMV-pt and guidelines for the successful implementation of EMV contactless in the Dutch pubic transportation system.



London Customer Journey - Page 58



EMV-pt Acceptance Model - Page 65



Threats for User Experience - Page 68



Guidelines for adoption - Page 76

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Chipkaart niet langer heilig als betaalmiddel

Openbaar vervoer. Dit najaar begint een proef met betalen via smartphone of bankpas. De ov-chipkaart krijgt dus concurrentie.



Nu nog inchecken met je ov-chipkaart, straks met je bankpas of smartphone.

hinnen een paar maanden starten de gemeentelijke ov-bedrijven in Nederland een pilot die het mogelijk maakt om in te checken met bankpas of smartphone. Als die proef succesvol verloopt, kunnen reizigers volgend jaar de ov-chipkaart inzetten voor een alternatief.

Om dit te bereiken, hebben de ov-bedrijven in Nederland handen ineen geslagen in de brancheorganisatie OVNI, onder leiding van RIT-directeur Peter Peters. Vanuit die instantie is de Coöperatie Reizen opgericht. Deze coöperatie zorgt ervoor dat innovaties in het openbaar vervoer worden uitgerold. "We beginnen dit najaar met een proef met zowel bankpas als de smartphone", bevestigt directeur van Connexxion. Hij de coöperatie aan. "Dat we goed testen, want niet veel veilig zijn."

De coöperatie denkt dat de ov-chipkaart langzaam verdwijnt. Reizigers kunnen inchecken met bankpas of smartphone. Maar bij die mogelijkheid blijft het niet. Het pullen van twee betaalmiddelen

de bedrijven", meent hij. Volgens Peters staan er, naast het verbeteren van betalen in het openbaar vervoer, nog wel andere zaken op de agenda. "De mobiliteit in de Randstad wordt steeds intensiever. Ook andere zaken als rijden zonder bezittingen als vliegen op de ov-staag, dat kan ook eld

In ov betalen met je bankpas mogelijk

Aanbevelen Delen 271 Tweet 0 G+ 0 16 REACTIES BEWAAR ARTIKEL



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Vervoerbedrijven willen laten betalen met sma

Gepubliceerd: 18-09- Laatst update: 18-09

Vervoerders willen proberen gaan ho mogelijk wordt om in plaats van met contactloos te betalen met een sma bankpas.

Dat staat in een vrijdag gepubliceerde van het Nationa

Innovatie vier ov-ch

Inchecken. Reizigers kunnen snel verbeteringen en innovaties rond de ov-chipkaart verwachten, nu chipkaartbeheerder TLS een coöperatie van alle vervoerders wordt.

even geduld en dan wordt gebruik van de ov-chipkaart stuk eenvoudiger. Althans, zeggen de verschillende vervoerders die hebben besloten te gaan samenwerken bij het beheeren en innove

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Snel betere ov-chip voor reiziger

Openbaar vervoer. Reizigers kunnen snel verbeteringen en innovaties rond de ov-chipkaart verwachten, nu chipkaartbeheerder TLS een coöperatie van alle vervoerders wordt. PAGINA 3

4 11

1 INTRODUCTION: CONTACTLESS EMV BANK CARD AS OV-CHIPCARD

As part of a collaboration between the TU-Delft Expertise Centre for E-ticketing in Public Transport and Translink, this project focuses on improving the Dutch public transport system by introducing contactless EMV bank cards (EMV-c) as a new method of payment in public transport. The project consists of two phases; an analysis phase and a design phase. The first phase, which is documented in this report, takes a closer look at the world in which this new technology has to fit and the factors that influence it.

This chapter describes the project as a whole and its background as well as the approach for the analysis that has been taken to tackle this assignment.

1.1 Project Overview

This part explains the relevance of the project and the challenge connected to it.

1.1.1 Project Background

Since 2012 it is possible to travel throughout the entire Dutch public transportation system (OV) with only one card known as the OV-chipcard (OVCP). Travellers no longer have to buy separate tickets but instead use an OVCP charged with money to just check in and out during their journey. Although the OVCP has been widely accepted within the Netherlands as method for payment in public transport, it does not lower the barrier of use for everyone. Infrequent or international travellers for example still have trouble purchasing and using the OVCP as can be seen in the research of Joppien, Niermeijer and Niks (2013).

In order to cope with this problem the Nationaal Openbaar Vervoer Beraad (NOVB), a

council created by the government consisting of public transportation companies, local governments and consumer organisations, created a future vision document (NOVB, 2014) in which the NOVB states it wants to enhance the travel experience and increase traveller satisfaction within the Netherlands. To accomplish this the NOVB states in this vision that it wants to change the way travellers can pay for their public transportation by introducing several new payment technologies, which is also accepted and fully supported by Translink and all the PTOs. One of these new technologies the NOVB wants to introduce in 2018 is contactless EMV bank cards (Figure 1). Inspired by London where this system is already up and running and managed by Transport for London (TfL), the NOVB wants to implement a similar system in the Netherlands. Travellers would no longer have to put money on an OVCP but instead

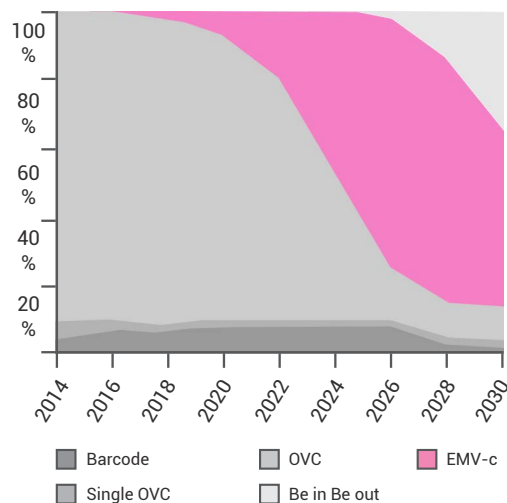


Figure 1. NOVB vision development OV payment methods

can instantly use public transportation using the EMV-c which will remove the travel fee directly from the travellers' bank account.

At the same time Trans Link Systems (TLS) better known as Translink, the company that developed the system behind the OVCP, wants to play a part in the implementation of this new innovation. Translink is responsible for the back office of the OVCP and thus has a central role within the public transportation system of the Netherlands. It wants to keep this position by adding EMV-c as one of the products in their service and thereby also fulfilling a central role in all EMV-c related payments in public transport. Another reason Translink wants to be part of this implementation is because they want to improve their service towards the travellers by adding a more approachable way of paying for public transport. Finally the introduction of EMV-pt also gives Translink the opportunity to set up a smart central back office which can be more suitable for handling transactions of possible future payment developments.

1.1.2 Problem Statement

Experience with the introduction of the original OV-chipcard has shown that it is important to deal with new developments through a user-centered and integral approach. Previously the OV-chipkaart was developed mostly from the technology and business perspective, and the human and societal perspective received less attention (Meijdam commission, 2011). A good product/service is however the result of the integration of the needs of the people, the possibilities of technology, the requirements for business success and the needs of society (as can be seen in the framework of Van Kuijk (2015) in figure 2). Additionally the stakeholders involved in the OV-chipcard (governments, transport operators, system developers and travellers) often have conflicting requirements, which can be hard to align.

For EMV-pt each of the stakeholders looking from their own perspective could pose the same problem and could result in a product service system that does not meet the users needs and would discourage people from using EMV-c in the Dutch public transport.

Apart from looking too much from one's own view there is also a danger in blindly copying the already working system in London. Currently stakeholders seem to view London's integration of the bankcard with the Oystercard as a 'best practice', that shows that EMV-pt works. However, the fact that the context of London is not the same as the one in the Netherlands in terms of size (not nationwide) and complexity (less stakeholders) but still expecting a product of one system to function just as well in the other could prove to be a problem.

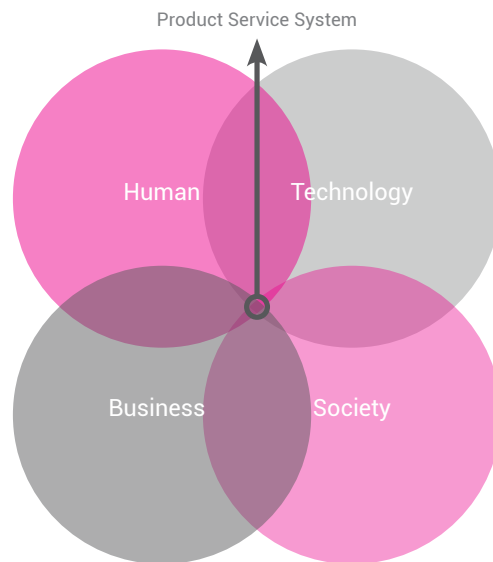


Figure 2. Innovation Model by Van Kuijk (2015)

1.1.3 Relevance

Public transport fulfills an important role in the Netherlands and is a service that should be available to everyone and as such it is also the responsibility of a public university like the TU Delft to use its expertise to improve it. The Dutch Government values the effect public transport has on area accessibility, impact on livability, participation of citizens in society, and the support for economic activity (CPB & KiM, 2009). The introduction of EMV-c in the Dutch public transportation system could be a benefit to both the transporters as well as the travellers. As the NOVB states in their vision, the aim of this new form of payment is to help with the following goals:

- Increase the amount of travelers in public transportation
- More convenience for travelers
- Increase of market growth by strengthening positioning of the transporters
- Decrease of total cost of ownership

A good implementation of EMV-c within public transportation could increase the simplicity of the Dutch public transportation system by giving travellers, both national and international, an extra way of traveling using something they already have; their bankcard.

1.1.4 Project Goal

Since all the parties involved in EMV-pt have one aspect in common in the form of the traveller that will use EMV-pt, it is essential to have the user segment as a central pillar throughout the implementation of EMV-pt. In order to make sure the user is accurately represented within EMV-pt, it is important to design for this innovation keeping the user perspective in mind to avoid the earlier described problem.

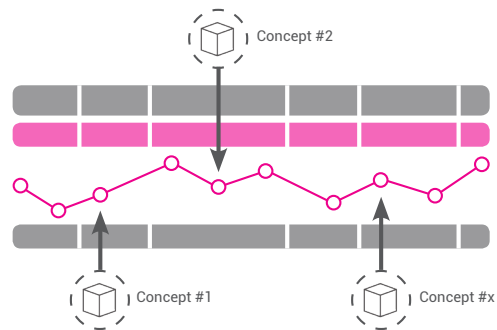


Figure 3. Customer journey with touch point concepts

The goal of this project is to create a customer journey depicting the ideal and optimal journey for EMV-pt in the Netherlands and to design several solutions for potential problem areas as well as creating guidelines in order to successfully implement EMV-pt in the Dutch public transportation system (Figure 3).

The outcomes of this project will contribute to a larger objective which has been separated into two parts. First of all the vision, which represents the ideal future outcome. And second of all the mission, which is the more concrete target leading to the proposed vision.

Vision

Travellers will no longer have to concern themselves with different transporters and their tickets. Using their bank card they can go anywhere they want at any time. Their bank card will no longer be just a tool to access their bank account but will become a key that opens up their world.

Mission

To enhance the user-friendliness and accessibility of the Dutch public transportation system through a user-centered implementation of EMV-contactless as a new method of payment.

1.1.5 Project Context

This report and the corresponding project is part of X-CEPT (eXpertise Centre E-ticketing in Public Transport) of the faculty of Industrial Design Engineering at Delft University of Technology. Previous projects within this lab also focussed on improving the public transportation system of the Netherlands and this project will use the findings of the analysis report of Joppien, Niermeijer and Niks (2013) as a basis for the research on the Dutch public transportation system. The goal of the lab is to improve the user-friendliness of paying for public transportation in the Netherlands and it has the following mission:

To improve the public transportation system within the Netherlands to such a degree that Dutch people will brag about it when they go abroad.

As stated before, this project is a collaboration between the TU-Delft and Translink and is regarded as a graduation internship. The approach to the project however is done purely with the intention to make it as user-friendly as possible without being too much influenced by the company and its goals.

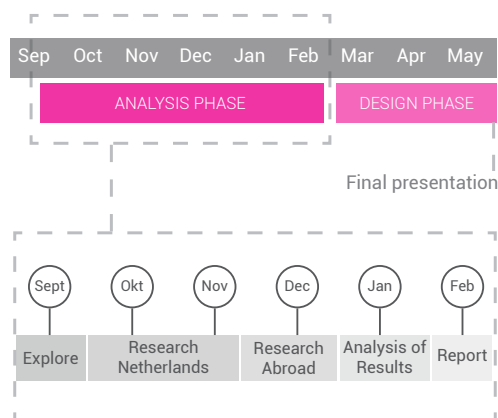


Figure 4. Timeline of project with focus on analysis phase

The project will take place during nine months from September till May and will consist out of two phases out of which the analysis phase will take till halfway February which is then followed by the design phase (Figure 4). Each phase is concluded with a report and a presentation.

1.2 Analysis Approach

This chapter explains the way the research for the analysis phase will be conducted, the general research questions that will lead this analysis and the way these questions will be answered connected to the approach that will be used.

1.2.1 Aim

The aim of this research is to discover what factors contribute to the adoption of EMV-c within public transport in order to get a better idea of what the design parameters are with which the successful adoption of EMV-pt in the Netherlands can be achieved. Next to these factors, the objective is to identify the issues, patterns and opportunities that occur within a system that has EMV-pt implemented. Finally the research aims at discovering what the current situation in the Netherlands is when it comes to EMV-pt and in what context this development eventually would have to fit.

During this analysis the main focus of the research will be the perspective of the user and thus a user-centered approach will be taken. User demands and wishes will serve as starting point and the technological and business feasibility will act as frame in which the eventual design should fit.

The project concerns itself with combining the products and services of both the public transportation companies (also known as transit) as well as the banks, as both have implemented contactless (CL) payment systems, but both systems work

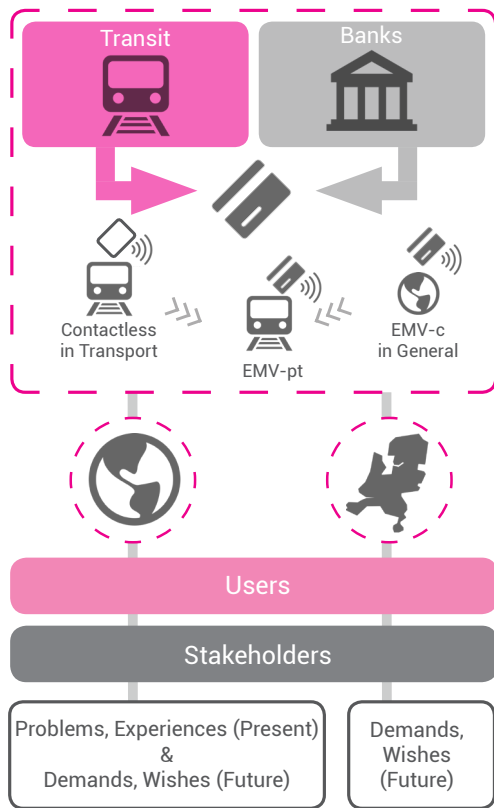


Figure 5. Research context scheme

differently. Therefore it is necessary to look at interactions and user experiences in both service-contexts, in order to see what they do and what they do not have in common. And what it would mean to combine these worlds (Figure 5).

Apart from the user interaction it is also essential to get a clear understanding of the way both worlds work and with what boundaries one has to deal in the form of the technology that can be used and the business model that is part of it. Research should be done to look at both systems and the parties involved to realize what the restrictions, possibilities and opportunities are.

In this analysis a study will be conducted to look both within the Netherlands as well as abroad at the way EMV-c and EMV-pt are used. Although EMV-bank cards as payment method within the Dutch public transportation is new, a small number of other countries are using it or something similar but with a different bank card. This gives the opportunity to look at both the present (current problems and experiences) and the future (demands and wishes) in order to see what will happen when you implement EMV-pt. It is important however to remember that the data acquired abroad is subject to a different context and thus cannot be directly linked to the situation in the Netherlands, but the usage patterns that can be seen in these different contexts can serve to bring new insights into the matter.

By looking at both the way it is used as well as the demands and needs people have when it comes to contactless EMV bank cards, a complete picture can be obtained in order to see what is needed to apply the innovation within the Netherlands.

1.2.2 Main Research Questions

In order to get an answer to the objective stated in the aim, the following main research questions were formulated. These questions serve as guidelines throughout this analysis phase. All of these main questions consist of several sub questions which will form the basis of the research done in chapters 2 to 6 and which will be described at the beginning of each of these chapters.

- What factors influence the implementation of EMV contactless in public transport?
- How does EMV-c work in the Netherlands?
- How does the current OV-chipcard system work?
- Who are the stakeholders and what are their interests?

- Which usability problems, patterns and opportunities can be identified for EMV-pt users?

1.2.3 Methods

To get an answer to the research questions various methods were used to gather the necessary information. Interviews with users, stakeholders and experts were conducted, a literature study was performed and field research in the form observations and own experience took place to see how EMV-c works. Since EMV-pt is a relatively new innovation and thus information concerning the consequences of implementing EMV-pt is hardly documented or researched, it is important to perform research in the field to see what effect it has in order to identify which factors contribute to successful implementation.

Most of the research was based on qualitative methods since the focus of this project is centered around the user. Qualitative research better enables the collection of rich data that makes it possible to get a better understanding of the wants and needs of the user and of the actions that they are displaying (Kvale, 1983). As Patton (2002) states; qualitative research seeks to understand a phenomena in context-specific settings and produces findings arrived from real-world settings where the phenomenon of interest unfold naturally. In order to enrich the description of a phenomenon, multiple and diverse observations were used (Malterud, 2001). Through this type of measuring, also known as triangulation, the validity of the research were increased by utilizing the data from various sources like travellers and service personnel.

The precise methods used for these various types of research and the reason why are elaborated on at the beginning of each chapter.

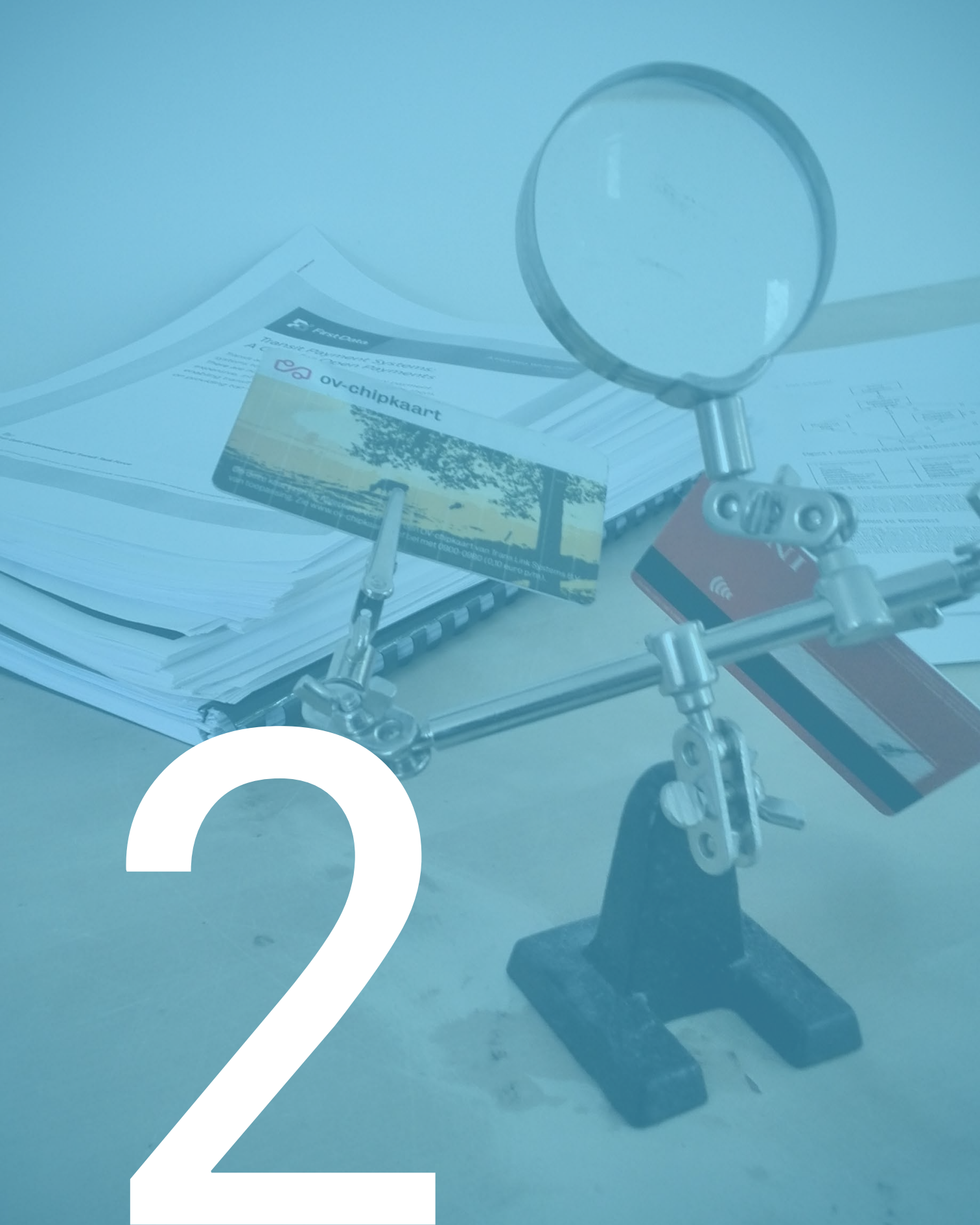
1.2.4 Analysis Report Reading Guide

This analysis report starts with giving an overview of the general project and the way the research relates to this in chapter 1. Chapter 2 to 5 serve as state of the art, exploring the current state of the system in the Netherlands into which the development EMV-pt has to take place and looks at research that has already been done. These chapters are followed by the research abroad that has been performed that has been separated into chapter 6 describing the method used and chapter 7 explaining the results. These results and insights have been separated for each country but the conclusion of chapter 7 contains the general insights and factors of influence for EMV-pt. In chapter 8, several of the issues and insights found both abroad as well as in the Netherlands are translated into threats which could become a risk for the adoption of EMV-pt in the Netherlands. The analysis ends with chapter 9 which contains the conclusion and the discussion concerning the entire research. The last chapter contains the advice of the author for the implementation of EMV-pt and will serve as starting point for the next phase of the project.



HTM EMV contactless pilot

2



2 LITERATURE REVIEW

In order to see what is already known about the implementation of a technology and to avoid reinventing the wheel, a literature study was preformed. Since part of the research aim is to see what factors could influence the implementation of EMV-pt and what usability problems and patterns users experience, a study was conducted to find relevant literature on these topics. For this literature research this resulted in the exploration of themes in the context of technology acceptance and adoption of innovation.

This chapter presents the literature found in this research and can be separated into; diffusion of innovations, acceptance of technology and the mental models of people. The subchapter of the Technology Acceptance Model (TAM) is split into several chapters describing various forms of the TAM and ends with the creation of a model that combines the different versions into one suitable for this project.

2.1 Diffusion of Innovations

To know how, why and at what rate an innovation spreads through a group, Rogers (1962) devised a theory based on the theory of Tarde (1903). Rogers proposes that the spread of an innovation is influenced by four elements: an innovation, that is communicated through certain channels, over time among the members of a social system (Rogers, 2003). Rogers also states that diffusion manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process.

Part of this theory is the description of the life cycle of an innovation which consists out of five different stages with corresponding types of adopters. The diffusion curve of

these adopters follows a normal distribution (Figure 6). Between these adopters (or decision-making units) there are many differences in characteristics such as in social economic status, personality variables and communication behavior.

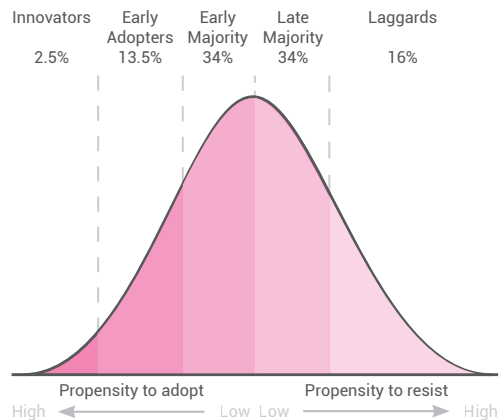


Figure 6. Diffusion of innovations among adopters (Rogers, 1962)

The distinctive characteristics of the five adopter categories mean that these adopter categories can be used for audience segmentation, a strategy in which different communication channels and/or messages are used to reach each sub audience (Rogers, 2003).

The fact whether an individual adopts or rejects an innovation is described by Rogers as being dependent on the way the decision-making unit goes through the innovation-decision process (Figure 7). This process consists out of five stages: knowledge, persuasion, decision, implementation and confirmation. An individual will first gain an understanding of how the innovation works and will then form an attitude towards the innovation based on the five characteristics

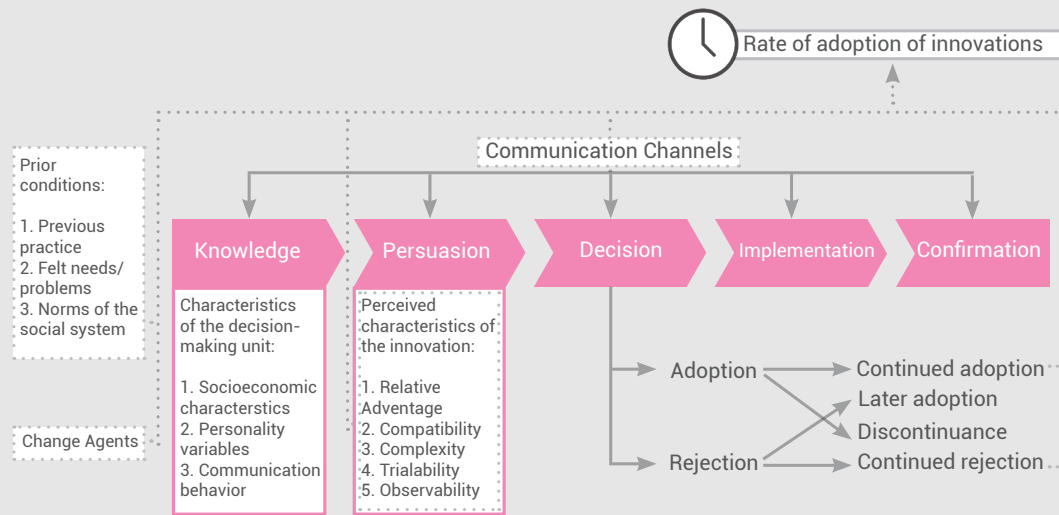


Figure 7. Innovation-decision process and adoption rate (Rogers, 1962)

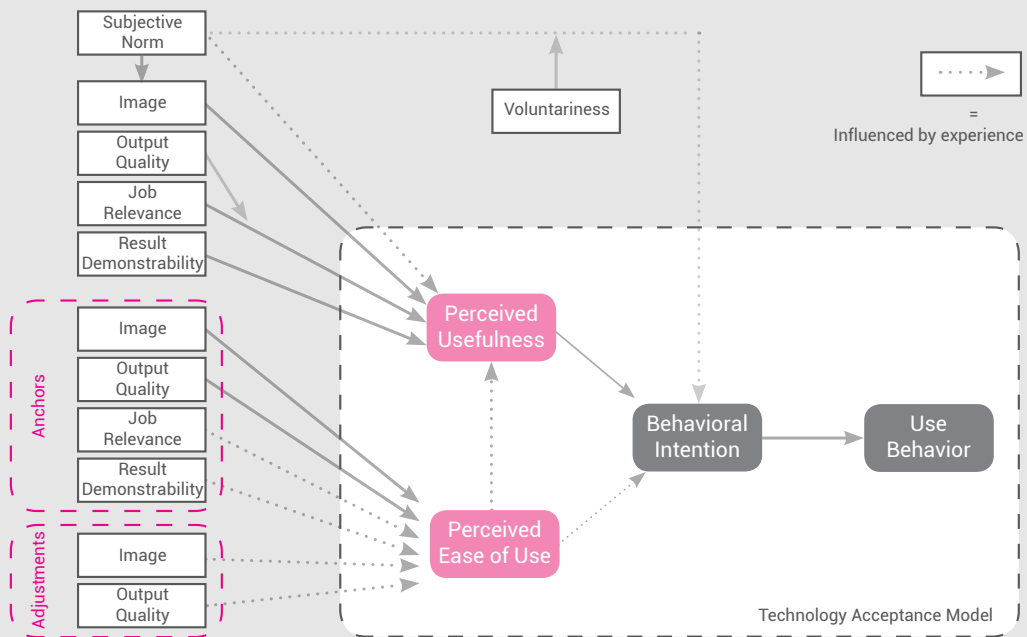


Figure 8. Technology Acceptance Model 3 (Venkatesh & Bala, 2008)

of an innovation. The individual then decides to adopt or reject the innovation and if it is adopted will start using the innovation and will confirm the decision.

The rate with which an innovation is being adopted by the members of a social system is determined according to Rogers by five variables: the five characteristics of an innovation, the type of innovation-decision, the communication channels, the nature of the social system and the effort of the change agents (individuals who attempt to influence clients innovation-decisions) in diffusing the innovation.

2.2 Technology Acceptance Model

To understand what factors influence the adoption of a new technology by users, Davis (1989) constructed a model, based on the Theory of Reasoned Action (Ajzen & Fishbein, 1980), that describes the factors that have impact on the decision making of the user when they are presented with a new technology. Two important factors within the Technology Acceptance Model are the

'perceived usefulness' and the 'perceived ease of use' which influence the behavioral intention. The first factor is described by Davis (1989) as the degree to which a person believes that using a particular system would enhance his or her job performance and the second factor is explained as the degree to which a person believes that using a particular system would be free from effort.

Another version of TAM was made by Venkatesh & Bala (2008). This version, also called TAM3, added the determinants that shape the perceived usefulness and ease of use (Figure 8). Several of these determinants are dependent on the design of the system and therefore this model could help to give an overview of all that is influential when introducing a new technology.

2.2.1 IS Success Model and Technology Acceptance

In order to comprehend what makes an information systems (IS) successful or not, DeLone and Mclean (2003) created a model (Figure 9) describing the relationship between the dimensions of success with which these systems are evaluated. In this model the overall value to the user, called net system benefits, is determined by both the actual system use as well as the satisfaction

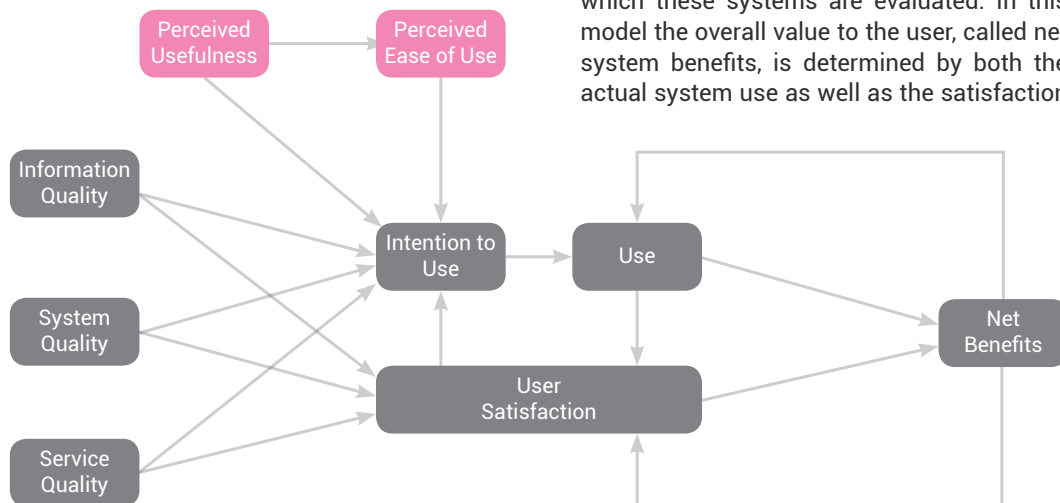


Figure 9. Framework of IS Success Model (grey) in combination with TAM (pink) (Devos, 2011)

connected to this use. When users are both persuaded to use the system and this use is satisfactory it would result in a loop that would make the user keep using the system. These two factors, intention of use and user satisfaction, are in turn influenced by three different factors (information, system and service quality) concerning the quality of the overall information system.

Since the Technology Acceptance Model also deals with the intention to use a information system, Devos (2011) combined both the TAM with the IS success model to create a more complete framework (Figure 9). Within this framework the intention of use is connected to the perceived ease of use and usefulness of the Technology Acceptance Model. This creates a framework that shows that both a certain perceived value is needed as well as an experienced value before an information system can be successful.

2.2.2 Trust and Technology Acceptance

Due to the fact that EMV-pt will make it possible for people to directly remove money from their bank account in order to pay for public transport, an important issue that could play a significant part in this project is the issue of trust.

Although the meaning of trust varies a lot depending on the context in which it is used, most descriptions see trust as an outcome of a process and something that gradually develops and is self-enforcing (Blomqvist, 1997). Salmond (1994) also calls trust a concept with a strong temporal dimension since it is a bridge between past experiences and future anticipations. Trust plays an important part in human interaction seeing as learning and problem solving all require trust. The existence of trust is connected to the moments one feels uncertain or vulnerable or when a choice based on judgment has to be made.

In terms of trust linked to business contexts, Sako (1992) states that trust has three different levels: contractual (honoring agreements), competence and goodwill. This last level he explains as being the partners' willingness to go beyond what is promised and the will to take initiatives. Although even in business context the meaning of trust varies, Blomqvist (1997) states that all business related definitions have the factors competence and goodwill in common and so he defines trust in business context as follows:

"An actor's expectation of the other party's competence and goodwill"

The creation of trust is a hard and a slow process. Once trust is created it is a fragile thing that is easy to break and difficult to mend.

Pavlou (2003) created a TAM version for e-commerce in which he integrated trust and risk to match with the implicit uncertainty of this environment (Figure 10). In this Technology Acceptance Model the intention to use is also affected by the perceived risk factor. This factor together with the already existing perceived usefulness and ease of use form the trust the user has in the system. Seeing as EMV-pt deals with a similar uncertain environment, this model could help with determining the aspects that will play a big part in convincing the users to use EMV-pt.

2.2.3 The Combination of Acceptance Models

In order to see full scope of factors that influence the implementation of a technology based on the literature found, the framework created by Devos was combined with the trust integrated TAM of Pavlou to give a better overview of the factors that play a part in the acceptance of EMV-pt. This resulted in the model that can be seen in figure 11.

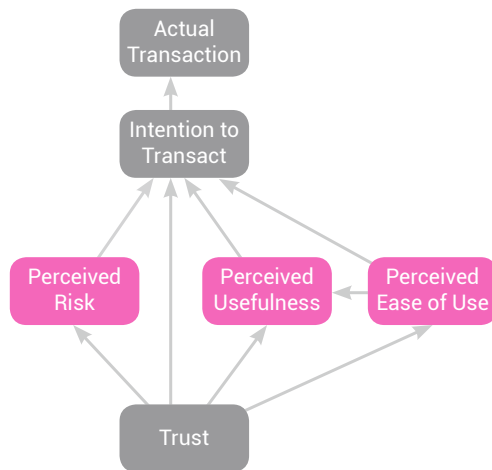


Figure 10. Trust adapted Technology Acceptance Model based on e-commerce (Pavlou, 2003)

Within this model the three qualities described by Devos, from now on called features, influence both the perceived qualities as well as the experienced qualities of the system. When these qualities are sufficient it will lead to use and user satisfaction which will cause people to keep on using the system. The level of use satisfaction determines the opinion formed on the system and will result in an intention to use to system again but will also influence the opinion that will be conveyed to others, the so called subjective norm. Within this model the three qualities are system related and can therefore be changed while the perceived and experienced qualities are the result of this system and are user related.

2.3 Mental Models

In order to get a better grasp on the way users behave when they come into contact with something that is new, it is important to know the mental models connected to these actions. Looking at the way users solve problems as well as what causes human errors can help understand the way users interact with products/services. When looking at human

reliability, Di Pasquale (2013) explains that the failure rate of a system is dependent of all its components of which one is 'man' and that human errors can affect the rates of rejection of a product.

To describe the amount of attention and conscious thought a user gives to an activity, Rasmussen (1983) made a model in which human activity is compared to the amount of conscious control exercised by the individual. His model divides human behavior into three classes; skill-, rule- and knowledge-based (SRK) and compares these with the cognitive level used (Figure 12) where knowledge-based behavior requires the largest amount of conscious thought and skill-based the least. Rasmussen (1994) also states that an individual only operates at one of the three levels and that this decision is based on the degree of experience one has with the particular situation and the nature of the task.

An extension of the SRK model was made by Reason (1990) called Generic Error Modeling

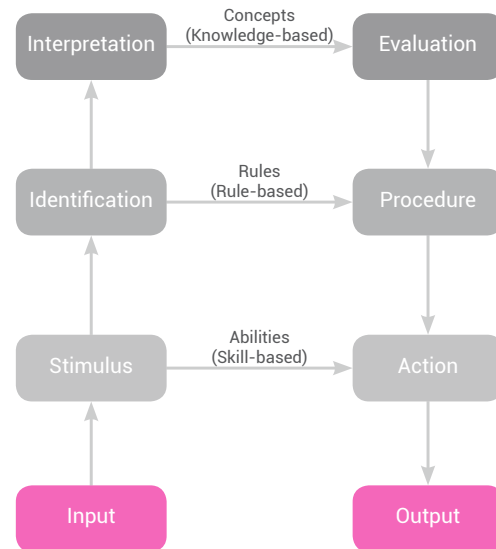
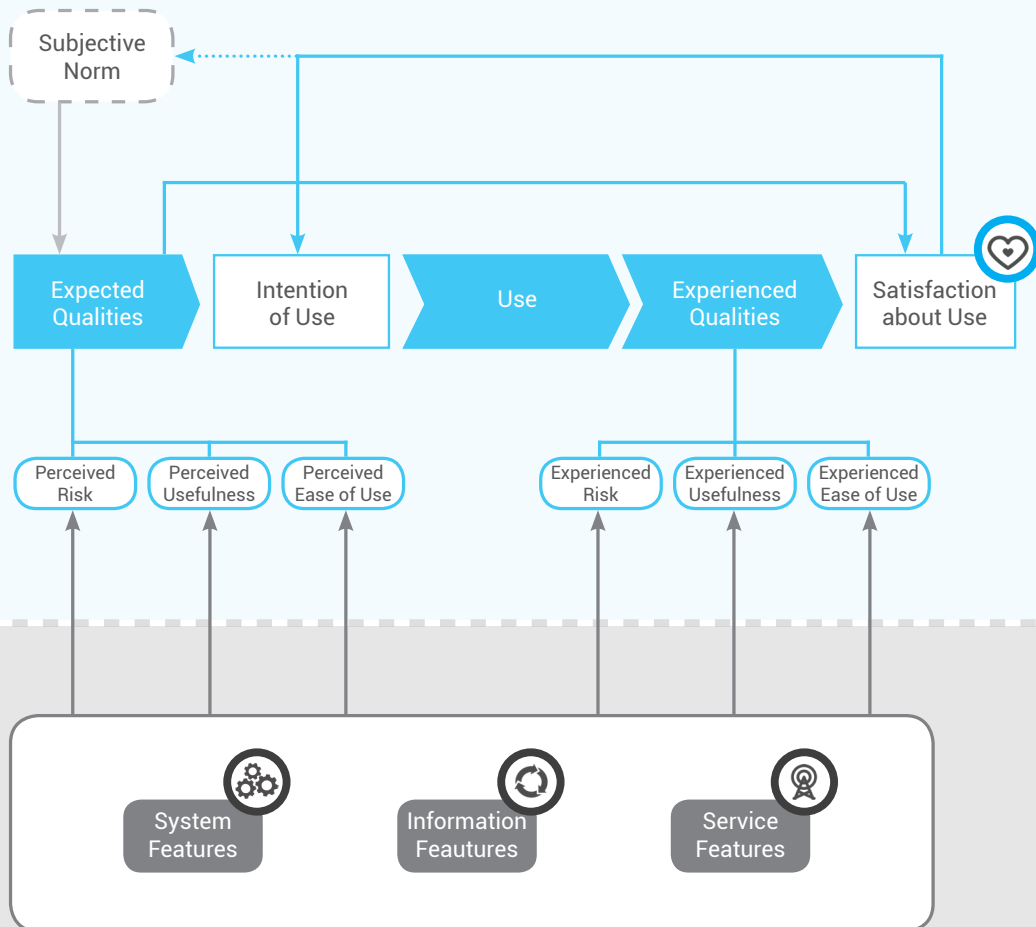


Figure 12. SRK Model (Rasmussen, 1983)

USER



SYSTEM

Figure 11. Combination of Trust integrated TAM with IS Success Model

System (GEMS). This model describes how individuals switch between the three different types of information processing (Figure 13). Reason also compares the two extreme cases: knowledge-based and skill-based, and shows the different characteristics of both (Figure 14).

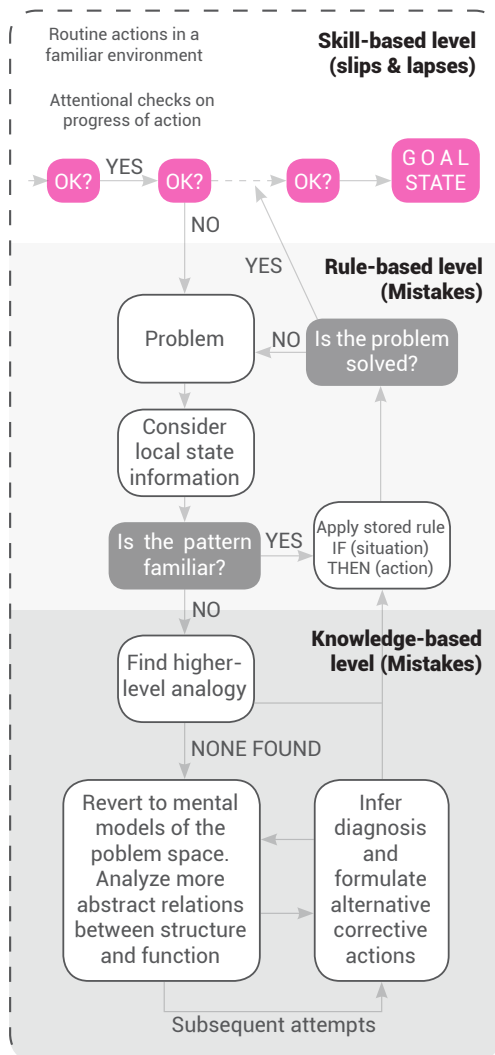


Figure 13. Generic Error Modeling System (GEMS) (Reason, 1990)

Knowledge-based mode	Skill-based mode
Conscious	Automatic
Unskilled	Skilled
Novel environment	Familiar environment
Requires considerable feedback	Requires little feedback
Causes of error: <ul style="list-style-type: none"> • Overload • Lack of knowledge of modes of use • Lack of awareness of consequences • Manual variability 	Causes of error: <ul style="list-style-type: none"> • Strong habit intrusions • Frequently invoked rule used inappropriately • Situational changes that do no trigger the need to change habits

Figure 14. Comparison knowledge-based and skill-based action (Reason, 1990)

2.4 Conclusion

The literature found in this study can help both within the analysis phase as well as the design phase. The diffusion of innovations is an important model to show how people adapt to an innovation and will give a better understanding of how people will react to EMV-pt and what causes this. The Technology Acceptance Model can give a more complete picture of all the factors that influence the acceptance of something new. It will play a crucial part in understanding what can be changed in a system by design in order to facilitate a successful implementation of EMV-pt. Both the diffusion of innovations model as well as the TAM model can also help in comprehending the results found in the primary research.

The literature on mental models provides a better idea of the decision making process of users when they come into contact with a system. Where the previously described models look at the system from a higher perspective, the mental models take a look at what makes a user understand the system. Therefore these models can support the design phase by help creating touch point concepts that match with the behaviour users display.

3



3 ABOUT EMV

Since the project concerns itself with the implementation of EMV technology in public transport, it is important to know how this technology exactly works and what the limitations and opportunities of EMV are. This chapter gives an overview of the working principle of EMV and takes a closer look at future developments within this domain.

Aim

The aim of this part of the research is to analyse the boundaries of EMV-technology and to identify opportunities to support the implementation of EMV-c in public transport.

Research Questions

- How does the EMV bank card standard work?
- How does EMV-contactless work within the Netherlands?
- What are the restrictions of EMV-contactless technology?
- What are the opportunities of EMV-contactless technology?
- What are the current trends within the world of banking/finance?

Methods

In order to get an answer to the research questions, experts were consulted and relevant literature was studied. The knowledge of experts was obtained by conducting semi-structured interviews (Patton, 2002), in which a set of standard questions were asked at the beginning and in which the other questions act as guidelines. The comments giving during the interview were noted.

3.1 The EMV Standard

EMV is a security standard for payment cards and mobile card payments and was written in 1994. The name is an abbreviation for Europay, Mastercard and Visa, the organisations that developed the initial specifications of the standard. EMV covers the processing of credit and debit card payments using payment instruments like cards and mobile phones that are embedded with microprocessor chips. These chips (Figure 15) store and protect the data of the cardholder. The standard was created to ensure interoperability between various chip-based payment cards and terminals (Wallischeck et al., 2015).



Figure 15. EMV chip on bank card

The EMV standard has been implemented to replace the magnetic stripe credit and debit cards in order to combat fraud and protect sensitive payment data. Compared to magnetic stripe transactions, EMV transactions are more safe because the payment transactions are secured in three different ways. During payment the card

needs to be authenticated by the issuer to check whether it is an original bank-issued card in order to protect against counterfeit cards. Next to the validation of the card, the transaction also needs to be authorized which is done through uniquely authorized dynamic cryptograms generated by the chip itself. The last security measurement is the verification of the cardholder, which is done by giving a personal identification number (PIN) or signature, in order to protect against lost or stolen cards.

The transition from magnetic stripe bank cards to cards with chips in the Netherlands started in 2011 and was called 'het nieuwe pinnen'. The switch to EMV in the Netherlands was completed in 2012 when all paying terminals where EMV compatible.

3.2 Contactless EMV bank cards

One of the payment instruments used for EMV transactions is the contactless EMV bank card. These contactless smart cards use near field communication (NFC), a communication technology that enables a radio connection between two electronic devices within close proximity of each other, to make payment transactions. Unlike EMV contact chip cards, which need to be inserted into a slot, EMV-c requires no physical contact between the card and the point-of-sale (POS) terminal and also makes it possible to transfer money up to a certain amount without entering a PIN.

Contactless bank cards can be recognized by the 'contactless functionality' symbol (Figure 16) located on the card. The EMV-c cards are connected to a bank account and the transactions are processed through a financial payment network. Many leading financial payment networks have deployed their own branded contactless bank cards with their own name (Table 1).



Figure 16. Contactless functionality symbol on bank card

Payment Network	Contactless Name
Mastercard	Paypass
Visa	Paywave
American Express	ExpressPay
Discovery	Zip

Table 1. Payment network names for contactless

3.2.1 EMV Contactless Usage

Contactless EMV bank cards can only be used at vendors that display the 'contactless smart card' logo (Figure 17). When using a contactless EMV bank card, the user holds the card in close proximity (less than 10 cm) to a point-of-sale terminal in order to wirelessly communicate the payment account information the moment a card needs to be presented for payment (Figure 18). When the contactless card is within range, the card

reader gives feedback (often in the form of a beep and a blinking light) and starts the authorisation process. The user can now remove the card and must wait for the authorisation process to finish after which the transaction is completed.



Figure 17. Contactless smart card symbol on point-of-sale terminal

Although contactless EMV bank cards mostly do not require the use of a PIN for authorisation, there are certain scenarios where this still needs to be inserted. When a user wishes to make a transaction that exceeds the single or cumulative spending limit, these limits are respectively €25 and €50 for Dutch bank card issuers, the user is obligated to enter the correct personal identification number. If the machine does not offer the possibility to enter a PIN, then the card is blocked and can only be used when a transaction with PIN authorisation has been completed.

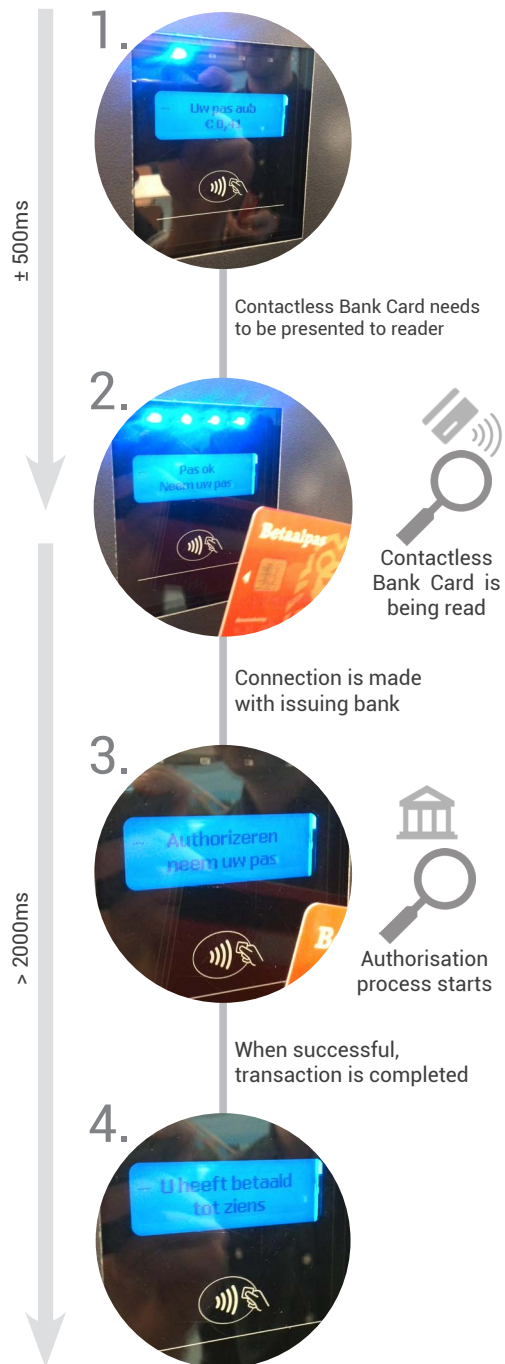


Figure 18. Sequence of use contactless bank card and the time it takes

3.2.2 The Technology behind EMV-c

Most EMV bank cards that are issued by Dutch banks are so called 'dual interface' cards that have both contactless functionalities as well as a chip on the surface like contact EMV bank cards (Figure 19). Located between the layers of plastic of the bank card is an antenna coil and circuitry which connects with the antenna on the back of the chip module through radio communication. The card can communicate contactless with a card reader because the embedded antenna and the integrated circuit is powered inductively by radio frequency energy that is emitted from the reader on a POS terminal (Dorfman, 2007). This enables the bank card to work even without a source of energy within the card itself. The EMV bank cards follow the ISO/IEC 14443 international standard which determines characteristics like its physical size, radio frequency and transmission protocol.

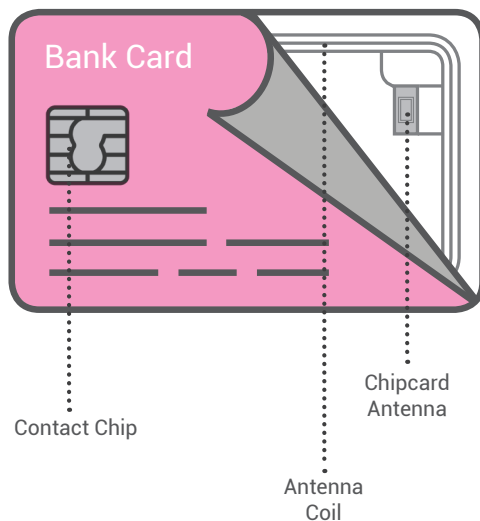


Figure 19. The components inside an EMV bank card

3.3 Payment Process

When paying with an EMV bank card the flow of information is the same as the payment flow model described by Akers (2006) as can be seen in figure 20. The moment a cardholder makes a purchase at the POS terminal of a merchant, the merchant sends the cardholders information to his/her acquiring bank to request authorisation for the transaction. The acquiring bank sends the request to a payment network (e.g. MasterCard) which in turn sends the request to the cardholder's issuing bank. The issuing bank then performs a security check and either accepts or denies the transaction. When it is accepted, the issuing bank will send the value of the transaction to the payment network. The payment network sends the authorisation response back to the acquiring bank which can then pays the merchant the value of the transaction minus the interchange, processing and service costs.

3.4 Future Developments

When it comes to future developments that take place for EMV and the bank sector, the following trends can be seen that could influence EMV-pt and its implementation.

Expansion of EMV

Although the EMV bank card has become a standard within the Netherlands and much of Europe, many countries in the world still need to make the shift and are willing to do so. For big countries like the United States and China this shift from magnetic strip to EMV is taking place and will be completed by the end 2017 (Visa, 2013).

Bigger Focus on Customer Relationship

Customers are taking more control of their financial relationships and by 2030 banks are expected to deepen their personal

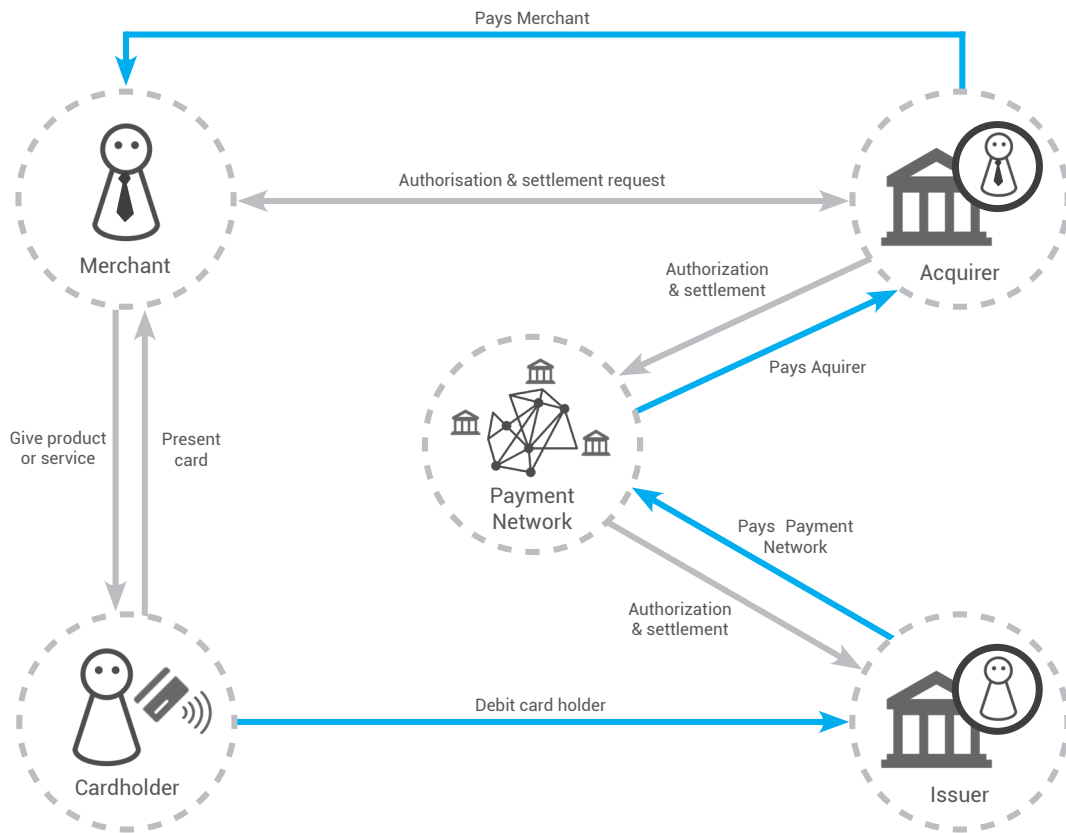


Figure 20. Contactless payment process model

connections with customers through data analysis that would not be possible today. This includes making their services more personal but also increasing the trust the customers have in the banks (EY, 2016).

More use of Digital Payments

The use of devices like mobile phones for digital payments has not yet taken off but the use of mobile payments and wallets is expected to increase in 2016. Many companies are currently developing mobile wallets and it is predicted that most retailers as well as card issuers will announce a mobile wallet by the end of 2016 (Marous, 2015).

3.5 Conclusion

Taking a look at the EMV technology can help to better understand what is possible with this new payment method and to know what its limits are. Although the transition from magnetic strip to EMV helped in making payments more secure, the use of contactless payments, however, can be considered a small step back due to the fact a PIN does not have to be entered for smaller amounts. The combination of making it easier to pay, along with the limit rules connected to it to make it safer, are important aspects of EMV-c that could cause problems for EMV-pt.



4 ABOUT THE CURRENT OV-CHIPCARD SYSTEM

Because EMV-c is going to be part of an existing public transportation system it is essential to know how the current system works in the Netherlands in order to know how a new technology could be implemented. This chapter describes the working principle of the OVCP system and the parties that are involved as well as the future developments that lay in store for this system.

Aim

The aim of the OVCP research is to get a better understanding of the context in which EMV-pt has to fit and to analyse the boundaries and opportunities within the OVCP system.

Research Questions

- What is the background of the Dutch public transportation system and how does its structure work?
- What is the role of public transportation in the Netherlands?
- How does the current OV-chipcard system work?
- What are the restrictions of the OVCP system?
- What are the opportunities of the OVCP system?
- What are the current trends within the world of public transportation?

Methods

In order to get an answer to the research questions, experts were consulted and relevant literature was studied. The knowledge of experts was obtained by conducting semi-structured interviews (Patton, 2002), in which a set of standard questions were asked at the

beginning and in which the other questions act as guideline. The comments given during the interview were noted down. The report of Joppien, Niermeijer and Niks (2013) acted as starting point for the research on the usage of the system.

4.1 OV-chipcard system

Since 2012 the Netherlands uses the OV-chipcard system as electronic payment system for all the Dutch public transportation services like trains, busses, metro and trams. The system was implemented to reduce the amount of fare dodgers, increase safety, control fare payment and to give insight in the behaviour of travellers ("Waarom de OV-chipkaart?", 2016)

4.1.1 Concept

The idea behind the OV-chipcard system is to use one card, the OV-chipcard, to travel throughout the entire Dutch public transportation system instead of buying separate tickets for each transport operator. Travellers load money on this smartcard and by checking in and out during their journey at validation devices they only pay for the kilometers that they have travelled. When a traveller transfers from one operator to another, the user needs to check-out when leaving the vehicle and check-in again when entering the other. By using contactless technology in the form of NFC, travellers only have to keep their OVCP near a payment terminal to check-in.

The OVCP comes in three different versions; the personal, the anonymous and the business OV-chipcard (Figure 21). The personal OVCP is a card that is connected to a user and can

only be used by the user it is connected to. The personal OVCP gives the option to add personal travel products such as seasonal tickets and can be combined with automatic top up in which the card is automatically loaded when depleted, with money from the user's bank account. The anonymous OV-chipcard is similar to the personal OVCP but because it is not connected to a user, it can be used by multiple travellers and can not be loaded with a personal travel product. Both the personal as well as the anonymous OVCP can be purchased for 7,50 euro. The business OV-chipcard is a card facilitated by Translink for the business market and allows business card providers to publish and distribute the card themselves. The business OVCP makes the user pay for his/her travels after the journey has been completed, also called 'Reizen op Rekening', or gives companies the possibility to purchase the travelrights for their employees.



Figure 21. Different OV-chipcard versions

When using an anonymous or personal OV-chipcard, travellers are able to load money on the card and travel products. Before a user can start travelling a deposit needs to be deducted from the card, ranging from 4 euro for the metro to 20 euro for the train, which is partly returned to the traveller when checking out. The actual journey price is determined by the combination of a basis fare plus a fare per kilometer which can vary depending on the travellers transfer time and region in which one travels.

Next to the OVCP travellers can also purchase a paper ticket or an E-ticket in order to use the Dutch public transportation services. The paper ticket, which is a sort of disposable version of the OV-chipcard, is used for single journey or multiple days travels and needs to be validated on a reader before use. The E-ticket is a printed ticket that uses a barcode or QR-code to communicate with a reader and is often used for journeys through multiple countries.

4.1.2 Context

The Dutch public transport system exist out of a network of train, metro, tram, bus and ferry lines and is managed by 19 public transport authorities. These authorities exist out of regional governments, provincial governments and the ministry of Infrastructure and Environment and are responsible for giving concessions to public transport operators (PTO) in order to provide the Netherlands with public transport services. Since the public transport act of 2000 regional public transport authorities are required to tender transport concessions in order to encourage a market mechanism within the transport sector of the Netherlands ("Wet Personenvervoer", 2016) (Figure 22). An exception to this act is the concession for the national railway, which has been given to the NS, and the concession within the three biggest cities of the Netherlands. Public transport within the three biggest cities Amsterdam, Rotterdam and The Hague is still in hands of their respective local operators GVB, RET and HTM.

4.1.3 Using the OV-Chipcard

When using the OV-chipcard travellers have to check-in at a validation device at the beginning of their journey. This can be done at gates and poles within a station or card readers onboard of a vehicle as is the case for busses and trams (Figure 23). During their travel travellers can be asked by conductors

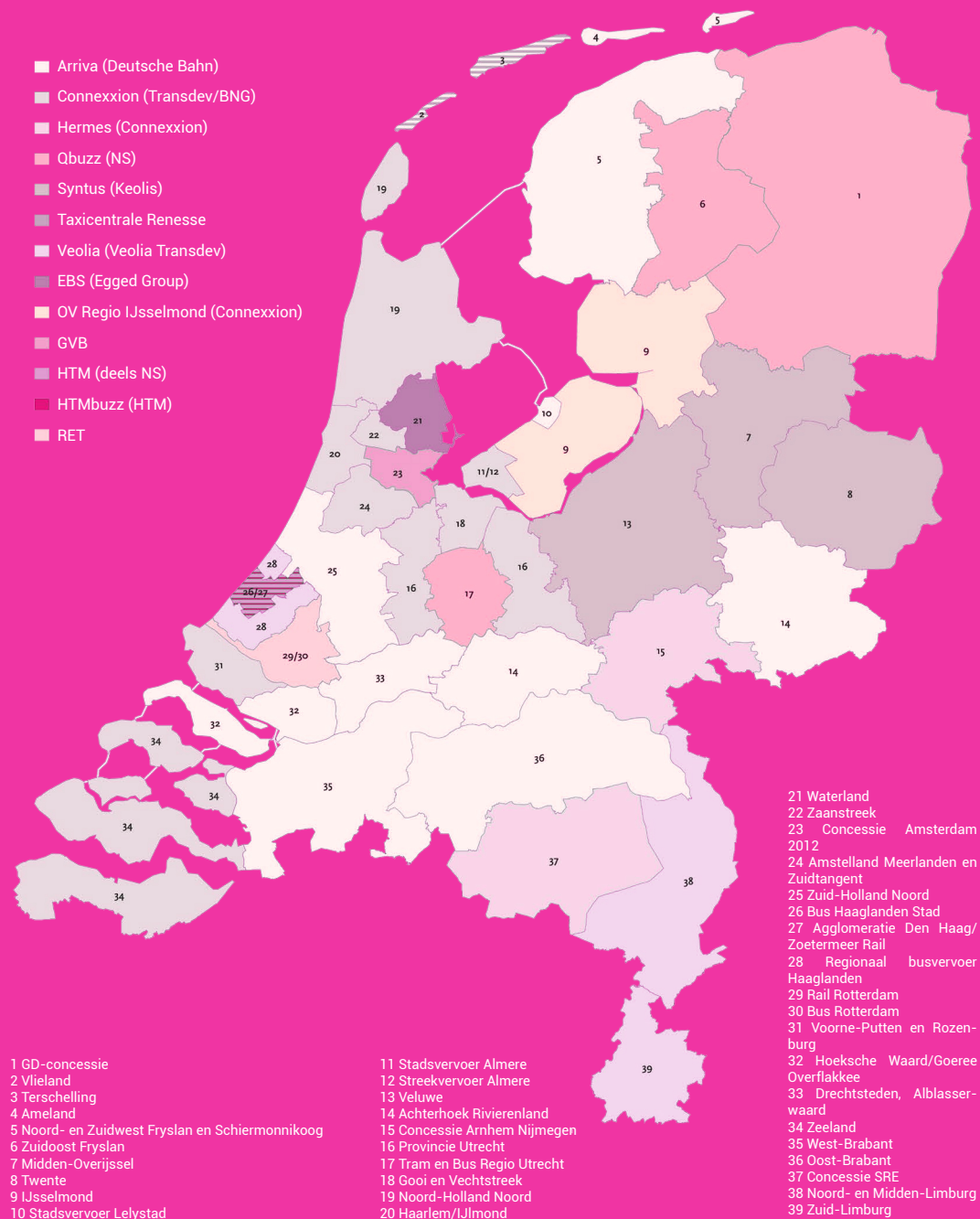


Figure 22. Map of the Netherlands showing public transport operators and their concessions (CROW-KpVV, 2015)

to show their ticket for a validation inspection. When a traveller leaves a vehicle or exits a station, he/she needs to check-out by placing the OVCP on one of the validation devices in order to end their journey to switch from one operator to another.

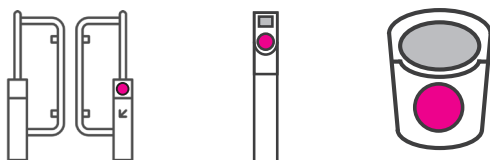


Figure 23. Validation devices in the OVCP system

In a study of the situation in 2012 by Joppien, Niermeijer and Niks (2013), travellers showed to experience many problems when using the OV-chipcard system which they separated into three categories: 'Orientation and guidance', 'check-in situation' and the 'check-out situation'. When orientating and purchasing an OVCP, users tended to have problems finding the correct information and activating and adding value to an OVCP. Users also showed to have difficulties concerning the interface of ticket machines and the feedback they receive. In the check-in phase travellers sometimes had complications with products and value that is stored on the card and experienced a lack of guidance and information from the transport operators in order to help them deal with this situation. During travel they stated that users also dealt with insecurity whether they have checked in or not. While checking out travellers struggled with finding the right operator when transferring as they have to be constantly aware in order not to get charged the maximum fee for making a mistake. Customer service was perceived as unclear and not supportive, which further lowered the trust travellers placed in the OV-chipcard system.

Joppien et al. also stated that they saw that users experienced insecurity, powerlessness and uncertainty and that the inability to solve problems independently led to a reinforced negative image of the PTOs and the OV-chipcard.

4.1.4 The Technology behind the OV-chipcard

The OV-chipcard is a smart card capable of storing information and works with a contactless Infineon SLE-66 NFC chip that is stored within the card. Just like the EMV contactless bank cards the OVCP follows the ISO/IEC 14443 international standard. When using the OVCP in public transport the card communicates with a reader through an inductively powered antenna when the card is in a proximity of at least 10 cm to the device. A safety module within the chip of the OVCP checks whether the reader is certified and when this is the case, the card sends data through radio waves to the reader.

Next to a safety module to verify the reader, the chip of the card has an electronic wallet containing the current balance on the card and an OV-module that is split into several compartments containing travel data. This module contains:

- Card identification data
- The 10 last travel transactions
- The 2 last top up transactions
- Travel products (optional)
- Granted rights, e.g. automatic top up (optional)

4.1.5 Ecosystem

The OV-chipcard system has an open architecture and as such transport operators are free to choose their own equipment as long as it meets the requirements set by Translink (Trans Link Systems, 2014). The system itself exists out of 5 different levels (Figure 24) through which the travel information flows. Level 0: The zero level consists of the various tickets that can be used within the OVCP

system that are issued by Translink and the PTOs. These tickets are used with level 1 devices.

Level 1: Level 1 is a collection of all the devices that sell, top up and validate the tickets. This ranges from gates used at the beginning of a station to validators used by conductors. The devices on this level contain information concerning blocked cards, validation rules and fare prices.

Level 2: On this level, information collected at level 1 is being temporally stored in local PTO information systems located at stations, garages and depots.

Level 3: Information from level 2 is eventually send to the central system of the PTOs which is level 3. This central system stores all transactions made with the OVCP and sends this information to the Central Back Office (CBO) at level 4 in order to verify the financial transactions with Translink.

Level 4: The top level is called the Central Back Office system and is operated by Translink. The CBO is connected with the central systems of the PTOs and relevant financial institutions. Within the CBO all card transactions are stored and validated in order to preform the clearing and the settlement with the PTOs. Next to the role as clearing house, the CBO also keeps a list of blocked card, manages auto-credit top-up and deals with the placement of travel products.

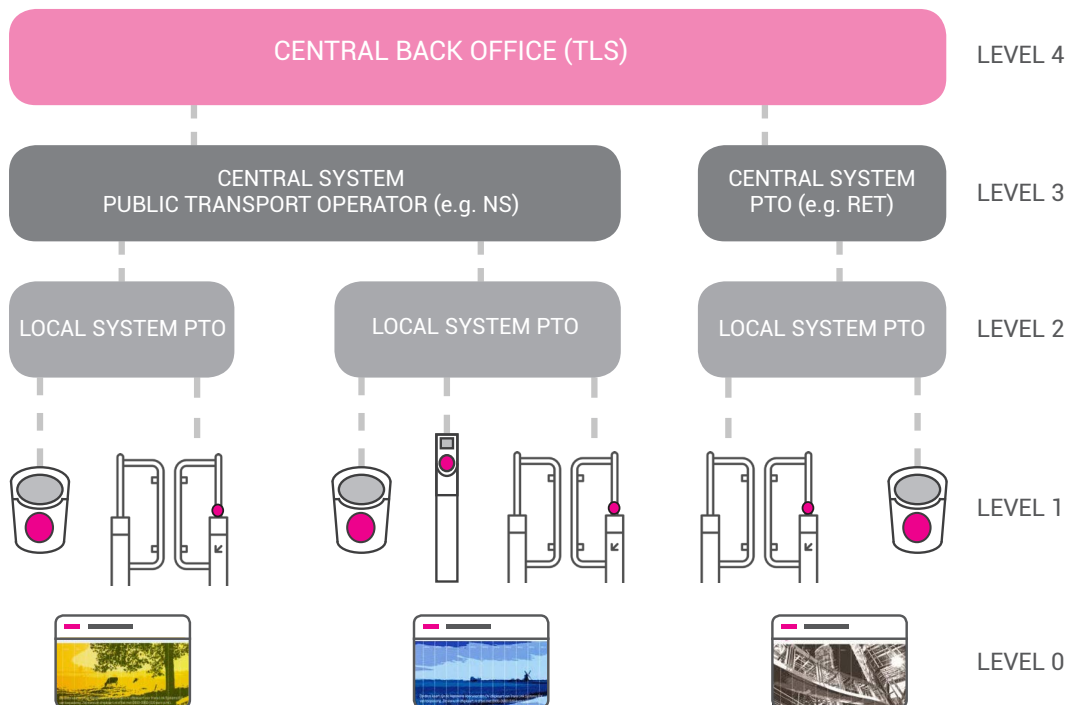


Figure 24. Levels within the OV-chipcard system (Translink, 2014)

4.2 Future Developments

As described earlier, next to the implementation of EMV-pt the NOVB wants to incorporate various other innovations within the Dutch public transport system to improve the travel experience and increase travellers' satisfaction as well as giving travellers more freedom of choice. Looking at these developments is essential in order to see what differentiates these developments from EMV-pt and to know the relative position of EMV contactless bank cards in the innovation timeline of the public transportation system of the Netherlands.

Single Check-in and Check-out

Since travellers are required to check in and out when switching from one PTO to another in the current OVCP system, this development focusses on removing this action. Travellers would no longer have to look which validator belongs to which operator and only have to check in and out once in their journey reducing mistakes and discomfort.

E/M Ticketing

Electronic and mobile ticketing makes it possible to use technology like barcodes or NFC to enter public transport using either a printed ticket or a mobile device. Although similar techniques are already being used by various PTOs, this development also focuses on creating a joint standard for the technology within the Dutch public transportation system.

SmartOV

Smartphones that are equipped with special subscriber identification module (SIM) cards that make it possible to use the phone the way one would use a OVCP to check-in and out in public transport. The SIM cards contains a digital version of the OVCP and through the antenna of the phone make it possible to connect to a validator. Travel history,

CiCo status and travel credit balance can be seen on an application on the phone. This development is currently being piloted and if it proves successful it will be implemented in 2016.

Virtual EMV-pt on Mobile Phone

Next to the implementation of the EMV bank card in public transport, NOVB also want to make it possible to use a mobile EMV wallet as carrier within Dutch public transport. Like the bank card, travellers would pay for a journey directly from their bank account. Using the NFC technology within smartphones, the wallet would connect with a validator and travel information would be displayed on an application on the phone much like with Smart OV. The mobile version of EMV is scheduled to be rolled out after the implementation of contactless EMV bank cards.

Be in Be out

As the name implies, this new developments focusses on the current location of the traveller. When a traveller enters the payment area of the PTOs, a vehicle or station can detect whether the traveller is inside the payment area through the use of presence detection technology. Using this information PTO know how long travellers have used their service in order to automatically calculate fares. This development would make the physical action of checking in and out obsolete for travellers. The development of this new technology will start in 2020.

4.3 Conclusion

Looking at the OVCP system is valuable as it shows what kind of context EMV-pt will be placed in and what kind of issues could arise. The public transportation system is a complex system with many different parties and thus implementing a new carrier can be difficult. The OVCP usage study conducted by Joppien, Niermeijer and Niks also showed

that there are still many issues concerning the OV-chipcard and implementing EMV-pt would mean some of these issues will most likely transfer to the use of the contactless bank card as well. The current system is also very dependent on the fact that the OV-chipcard stores a lot of information, something the bank card might not be able to do, which could

form a problem. Since the implementation of EMV-pt is one of the many developments that is taking place in the Netherlands, it is also important to position EMV-pt in such a way that the developments do not compete which each other and to give the contactless bank card a reason to exist within the Dutch public transportation system.



Rotterdam Centraal Station

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5 COMBINING WORLDS: EMV CONTACTLESS IN DUTCH PUBLIC TRANSPORTATION SYSTEM

Since serious development of the implementation of EMV contactless bank cards in public transport started in 2015, a lot of issues and requirements have been identified in a complex world of stakeholders. This chapter takes a closer look at the current situation of this development and how it came to be, the stakeholders involved and the changes that have to take place in order to facilitate EMV-pt.

Aim

The aim of this part of the research is get a better understanding of the current situation concerning EMV-pt in the Netherlands and the stakeholders involved.

Research Questions

- What is the current conceptual model for EMV-pt in the Netherlands?
- Who are the stakeholders and what are their interests?
- What are the roles of the stakeholders during development, implementation and management?
- Which requirements have already been identified for EMV-pt in the Netherlands?
- Which problems have already been identified for EMV-pt in the Netherlands?

Methods

To get an answer to the research questions that have been formulated, experts on the matter were consulted and relevant literature was studied. The knowledge of experts was obtained by conducting semi-structured

interviews (Patton, 2002), in which a set of standard questions were asked at the beginning and in which the other questions act as guideline. The comments giving during the interview were noted down. Apart from interviews, knowledge was also gained by making notes during meetings in which EMV-pt was discussed amongst stakeholders.

5.1 Concept

As part of the vision stated by the NOVB, the implementation of EMV-pt was one of the spearheads of this document and is scheduled to be introduced in the Netherlands in 2018. This new carrier in public transport would boost travellers' satisfaction, increase the amount of travellers that would use public transport and strengthen the position of the PTOs by increasing the market growth. The implementation of EMV-pt would also go hand in hand with the introduction of a new smart back office supporting the EMV-pt innovation and other payment methods that enable customers to directly use the money on their bank account, also known as open loop payments.

The current model for the implementation of EMV-pt in the Netherlands is partly based on the system in London that is managed by TfL. Travellers would not have to put separate travel credit on a smart card like the OVCP, but can use public transport by directly paying their travel fee from their bank account using their contactless bank card. Unlike the contactless payment process that is apparent in retail, the bank cards of travellers do not get authorized

before they can enter public transport but this is done during their journey in order to keep up with the gate flow speed at stations and vehicles. The current gate flow speed is that one person should be able to enter the system per second while the authorisation of a bank card takes 2 seconds or more. This entering before authorizing means that travellers can enter the system without the necessary balance on their bank account. When this is the case they can be put on a blacklist denying them further access until debts are paid. When the bank card gets authorized a certain amount of money, depending on the deposit set by the PTOs, could be reserved on one's bank account and cannot be used for other transactions. Travel information is collected and the travel fare is calculated throughout the journey. The total amount of travel fare is calculated at the end of the day which can be seen in the bank statements.

The way the transaction information flows and through which parties can be seen in the proposed transaction model for EMV-pt (Figure 25). When a traveller uses the contactless bank card with a validation device, this device connects through the levels described in chapter 4.1.5 to the CBO of Translink. The CBO then starts the authorisation process by sending the necessary information to the acquiring bank of Translink. The acquirer sends an authorisation request to the issuing bank of the traveller who in turn confirms or denies the value of the authorisation to Translink.

5.2 Stakeholders

The implementation of EMV-pt is the collaboration of many parties and thus also involves many stakeholders. Each of these stakeholders have their own reason for cooperating in the implementation of EMV-pt and have their own concerns and goals.

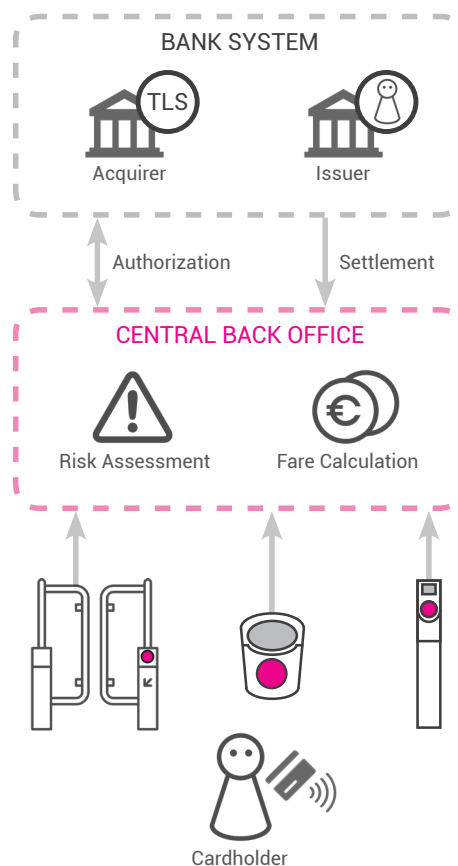


Figure 25. Proposed transaction model EMV-pt
(Bremer & Arzhannikov, 2014)

For the implementation of EMV-pt nine different stakeholder groups can be identified and the relationship between these groups can be seen in figure 26.

Travellers

Since the entire system focusses on giving public transport to people, the travellers can be seen as the most important group. Their interest in this project lies in the fact whether this implementation will better their travel experience or gives them benefits while travelling they previously did not have.

Public Transport Operators

This group provides the travellers with public transportation. For the PTOs the implementation of EMV-pt could mean travellers will experience their services as more convenient and accessible. Important aspects for PTOs for EMV-pt is cooperation with other PTOs when it comes to investments that need to be done for equipment and the delivery of one system that is consistent for the traveller throughout the different operators. Since

the implementation of EMV is part of the vision stated by the NOVB, most PTOs have a positive stance towards the innovation. However not all PTOs see the benefits of the implementation for the services they provide and especially the regional transport operators use the implementation of EMV-pt mostly as stepping stone to be prepared for other open loop payment methods.

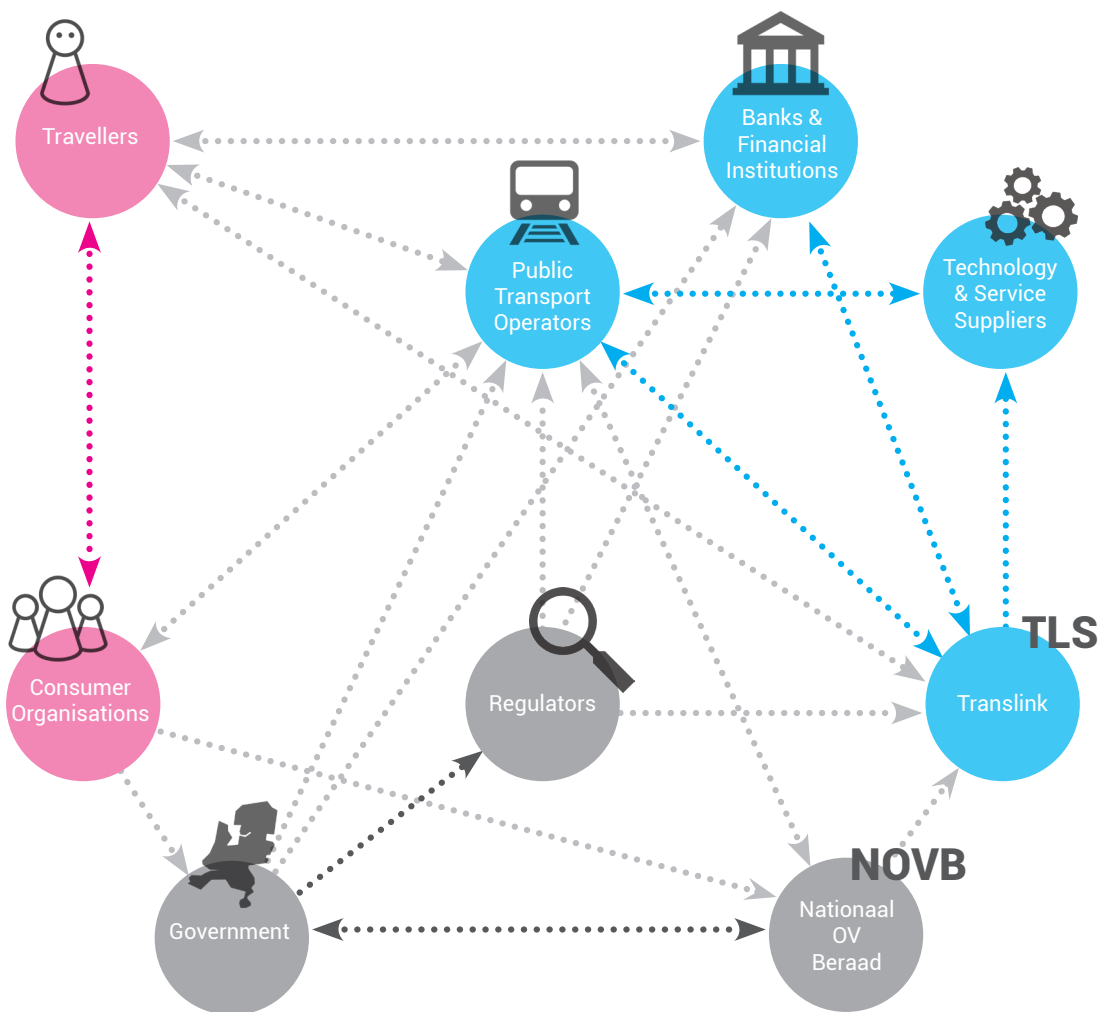


Figure 26. The relationship between the various stakeholders for the implementation of EMV-pt

Banks and Financial Institutions

Since EMV-pt will use the contactless bank card as carrier within public transport, the banks and financial institutions are a new group within the public transport stakeholder's field. For this group the implementation of EMV-pt means that the already existing contactless EMV bank card gains functionalities which improves the service they can provide to their customers. Next to benefits for their customers, profit will increase for banks when more transactions are generated when people start using their bank card in public transport as well. For this group it is important that the different banks and financial institutes make use of the same technology in order to reduce costs. Other concerns this group has are in the form of the way people will use the bank card connected to the user problems that will occur and the consequences this has for the services the banks have to provide.

Translink

Translink currently handles the OV-chipcard system and all its transactions and is owned by the 'Coöperatie Openbaar Vervoer', a cooperation of all the PTOs within the Netherlands. As party responsible for the transaction processing of the OVCP, Translink wants to fulfill a central role within the Netherlands as well when it comes to EMV-c related transactions in public transport. For Translink the addition of EMV-pt can help with their goal of giving travellers better service by making public transport more accessible as well as showing travellers and transport operators Translink's willingness to meet their demands. The introduction of EMV-pt can also help them set up a new back office system that is more suitable for future open loop payment methods. For Translink the concerns are focussed on the user experience part of EMV-pt as well as the interoperability between the operators and the banks.

Technology and Service Suppliers

Contracted by the PTOs and Translink, the importance of EMV-pt for this group is to keep playing a role in supplying and operating the Dutch public transportation system equipment. EMV-pt gives them the opportunity to anticipate on future technologies and payment methods. Next to maintaining partnerships, the public transportation system in the Netherlands also serves as international showcase so the suppliers are more willing to take innovation risks.

Consumer Organisations

Representing the travellers, these organisations give governments and public transport operators information about the problems travellers experience. Since the implementation of EMV-pt can give travellers a new method to pay for travel this group has a relatively positive outlook on the development. Their only concern is that EMV-pt only focusses on the majority of people and that the parties involved will forget minorities that also might want to use this innovation.

Government, NOVB and Regulators

Since public transport is essentially being installed by national and regional governments in order to supply the general public with transportation, this group can be seen as the client of the public transportation system. Because the implementation of EMV-pt is part of the vision of the NOVB, a council created by the government, this group fully supports the introduction of this new carrier in public transport. The NOVB sees EMV-pt as a way to enhance the travel convenience for users and sees it as an innovation that helps with their goal of supplying travellers with more payment options for public transport. Aspects that are important to the government are the interoperability of a new payment methods, the openness towards the travellers

and the accessibility of public transport. The regulators are instructed by the government to oversee whether the PTOs, TLS and the banks stay within the law.

5.3 Business Model

For the implementation of EMV-pt a business model has been made connected to the payment flow model described in chapter 3. Within this model (Figure 27) the traveller acts as the consumer making use of the services of the merchant, which role is fulfilled by the PTOs and Translink. Translink acts as central merchant who is in charge of fare calculation,

bad debt recovery, the apportionment to the PTOs and risk assessment. Translink is supported in this role by the central payment processor which is in charge of the connection with the banks. As with the payment flow model of Akers (2006), the central payment processor sends settlement and authorisation requests to the acquirer of Translink which in turn send the requests to the issuing bank of the traveller. If the authorisation is successful, the travellers is not put on the blacklist and can continue travelling. If the settlement is successful as well the travel fee is removed from the bank account of the traveller and redirected to Translink.

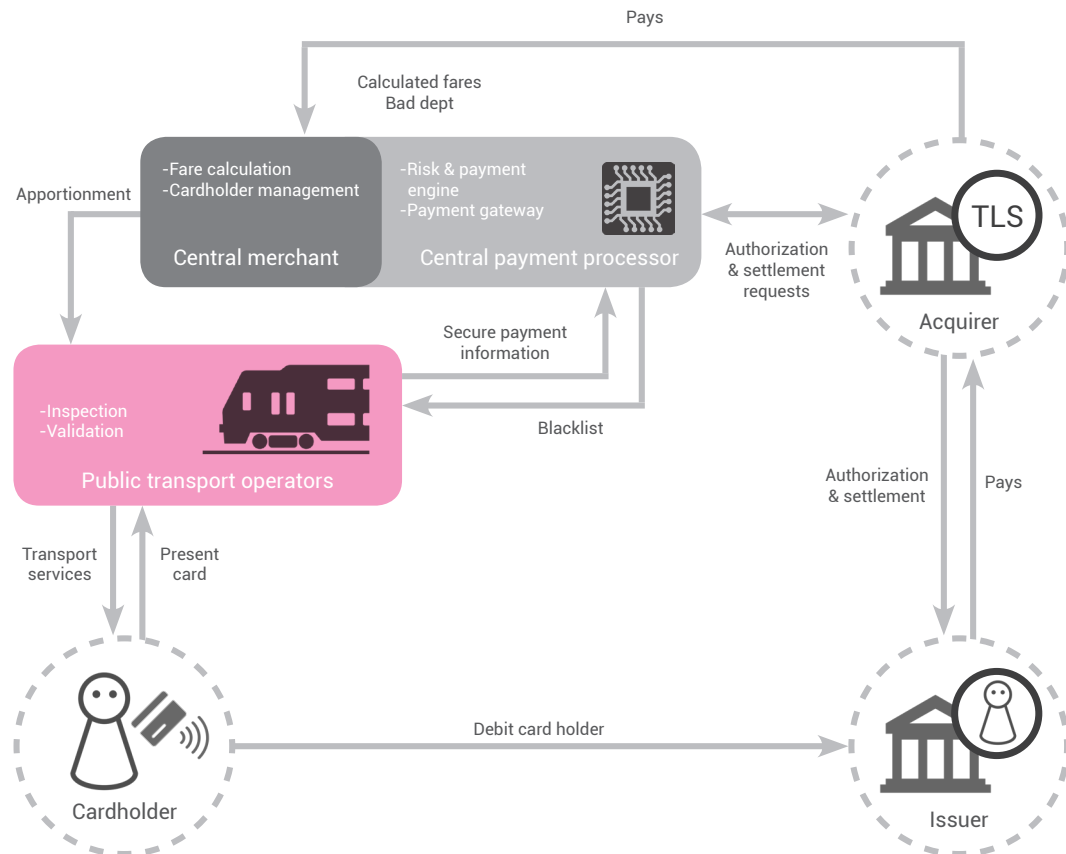


Figure 27. Proposed business model

5.4 Required Developments

In order to introduce EMV-pt within the Netherlands, several required developments have already been formulated by the parties involved to make the implementation possible. These developments would manifest in the creation of a EMV-c central back office, the formation of an independent operational organisation supporting EMV-pt, the upgrade of validators and the connection of various interfaces amongst banks, PTOs and travellers (Albricht et al., 2015). The required developments and their position in time are displayed in figure 28.

EMV-c Central Back Office

Because the bank cards can not be supplied with the same travel information as the OVCP due to the lack of available memory space on the card, an EMV-c smart central back office needs to be created. This would mean that the current back office needs to be transformed in order to facilitate the new EMV-c bank cards as payment option in public transport. For the transformation of the CBO several principles were framed focusing on an open architectural system that can be expended

easily and is capable of handling more future payment tokens apart from EMV-c. The new CBO is scheduled to be operational in 2016 and capable of handling pilots and the gradual implementation of a few PTOs.

EMV-pt Operational Organisation

Next to a system supporting EMV-pt, the plan is to also create an operational organisation which will help with the introduction of EMV-pt in the Netherlands. This organisation will have to be operational in 2016 when the first EMV-c users will be expected in public transport.

EMV-Contactless Equipment Upgrade

In order for EMV-pt to work, public transport operators need to switch to equipment that can handle the EMV-c as payment method in public transport. This will mean that the validators of PTOs need a hardware and/or software upgrade in order to deal with the contactless bank cards.

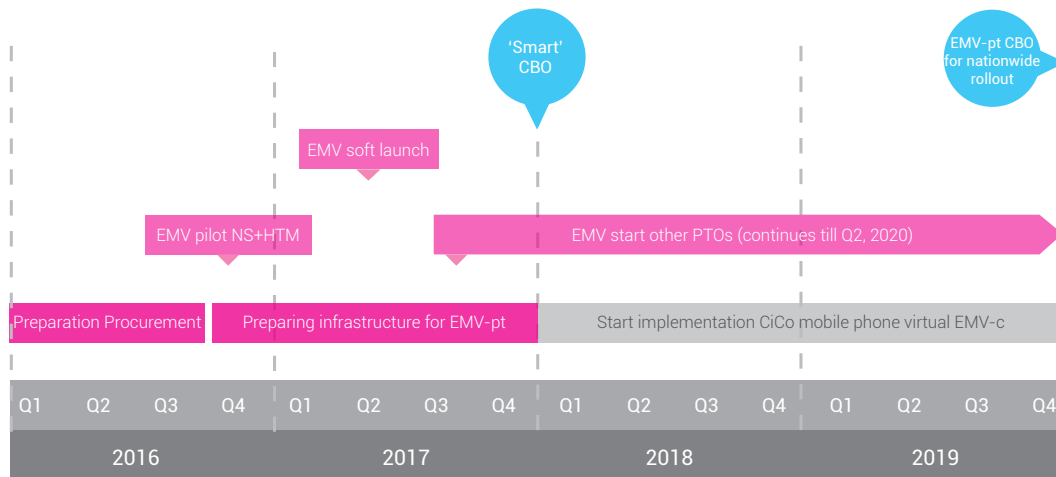


Figure 28. EMV-pt developments timeline

Interface Connection with Transport Operators, Banks and Travellers.

Since EMV-pt deals with a complex web of various parties in different sectors, the interfaces of each party need to be connected. For transit these interfaces can be separated in operation support, interfaces concerning with the proper functioning of the system for the PTOs, and business support which deals with the transactions and the way they are distributed. For transit it is also important to form rules concerning risk management, deny list management and the way missing check-ins or outs are being dealt with. For the banks the interfaces that can be identified are concerned with the connection between issuer and acquirer and the connection between a traveller's primary account number (PAN), which is the identification number of their bank card, and their international bank account number (IBAN), the number displayed on the bank card. And last for travellers these interfaces are the information services and the services connected to the bank card as transportation payment method.

5.5 Current Issues

Looking at the EMV-pt implementation in London, there are several issues that have been identified by the parties involved that could play a role in the implementation of EMV-pt in the Netherlands as well for certain implementation scenarios. These issues can be divided into two categories: issues focused on the public transport payment process and issues concerning the service connected to EMV-pt.

5.5.1 Payment Issues

When a traveller would use the bank card one scenario is that a certain amount of money would be debited to serve as deposit like is the case with the OVCP. This deposit would be returned minus the travel costs at the end of the journey. For the traveller however this

way of paying could pose a problem because it could make the transit bank statements confusing. Another bank related issue could appear when a traveller uses the bank card while travelling to buy something at a shop. Payment transaction need to be presented to the bank in the order that they were made to approved and this could be difficult to do when a traveller forgets to check-out.

The use of EMV-c is connected to some safety rules in order to compensate for the lack of using a PIN while paying and makes sure the user is bound by certain limits. These limits, the maximum amount of 25 euros and the cumulative limit of 50 euros, can only be lifted when using a PIN. When exceeding these limits while travelling, users could be put on the blacklist and denied access or could be unable to pay for certain journeys that go beyond the 25 euros spending limit.

In the current model as well as in London, when checking in with one of the EMV-c limits reached or insufficient funds on a bank account, the user is allowed to make the journey but is put on the blacklist. TfL solves this problem by sending a Card Not Present transaction to get the money the user of the system owes them. When this transaction is paid by the traveller he/she is taken off the blacklist. This type of transaction however is not supported yet by the Dutch banks and would thus mean the traveller has no way of getting off the blacklist.

5.5.2 Service Issues

If a traveller has a problem or question concerning EMV-pt and wants to communicate with a PTO or Translink, the traveller only has the IBAN, which is displayed on the bank card, as a means of identification. When a bank card is used with a validation device only the identification number of the card, the PAN, is visible for TLS. The PAN however is not known to the traveller, since it is stored inside the card, and in the current

system there is often no correlation between PAN and IBAN numbers for Dutch bank cards. This would mean that the traveller has to communicate with the bank as well in order to solve travel related issues.

Another service issue is the fact that travellers have the right to ask for a reimbursement when they do not agree with the money that has been removed from their bank account according to the rules of Mastercard and Visa. This could create the situation where a bank would have to act as a facilitator in a dispute between a traveller and a PTO. The bank is however always in favour of the traveller due to the rules connected to contactless payments and will thus always give money back to the traveller even though the bank can not recover these costs directly from a PTO.

The last service issue that can be identified is the fact that when EMV-pt will be implemented it will experience stages in which travellers cannot use their bank card as carrier in every part of the Netherlands. Most PTOs do not have EMV ready readers yet and would normally update their equipment at the beginning of a new concession. The expiration date of the concessions however differs greatly (CROW-KpVV, 2015) and if only this moment is used for updating equipment, nationwide implementation can only be achieved in 2028 and only half of the country would be ready for EMV in 2020 (Figure 29). Unless all PTOs agree to change their equipment at a certain moment, travellers will have to deal with a reduced travel range for a long time when using their bank card as carrier within public transport.

5.6 Conclusion

Looking at the current model for EMV-pt in the Netherlands is important to get a better understanding of the developments that already took place and to see how much freedom there is when designing for this innovation. Due to the addition of the banks in the already complicated stakeholders field of public transport, the entire system becomes even more complex and many steps need to be taken when someone makes use of EMV-c in public transport. Not only is the current situation a tough cooperation between the parties involved, but the way one pays for public transport through EMV-c cloud also be very puzzling for the user due to the combination of both bank as well as transit rules. Although a lot of issues have already been identified by the parties involved, many of these issues are technology or business focused and many potential user problems for EMV-pt are yet to be determined as well as the required developments that would solve them. Therefore the next chapter describes the research that was conducted in order to determine these potential user problems for EMV-pt.

● = New EMV ready areas

● = Previous EMV ready areas

*Concession Vechtdallijn is now also expired

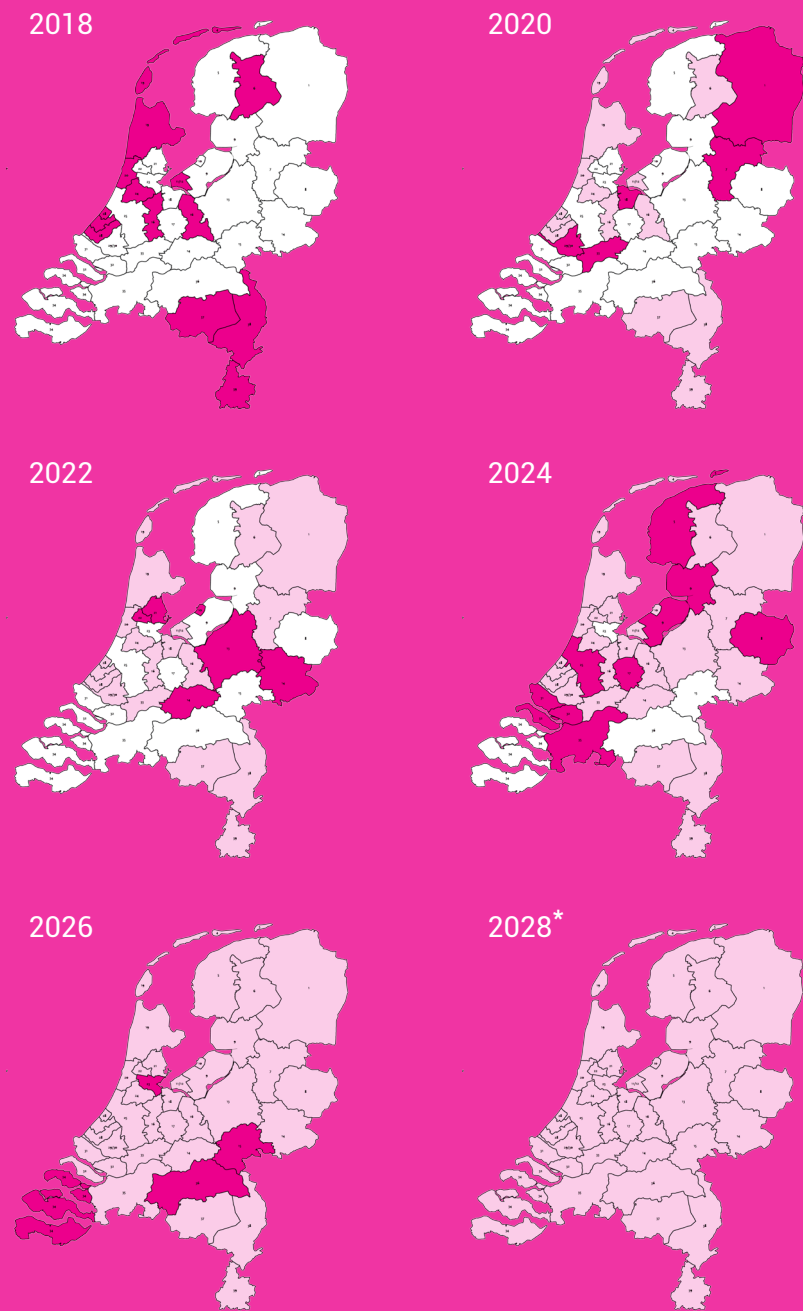


Figure 29. Concession areas with EMV ready equipment from 2018 to 2028 when equipment is not prematurely updated



6 METHOD: ANALYSING EMV CONTACTLESS ABROAD

In order to know how people react to using their contactless bank card in public transport and in general and to see what kind of problems appear in a context that has EMV-pt implemented, a study abroad was conducted to get a glimpse into the future of this innovation. This chapter describes the goal, research questions and methods that are connected to this research abroad.

6.1 Aim

Because multiple countries in the world are either busy implementing EMV-pt or have already succeeded in doing so, a lot of knowledge concerning EMV-pt can be gathered by analysing these foreign situations. Researching these cases gives the opportunity to avoid certain pitfalls and also to see how the implementation differs and what the consequences are of these different approaches. Each country has a different culture and system which makes it impossible to blindly copy a certain system and implement it in the Netherlands. However by identifying the differences as well as the similarities and analysing them, the factors influencing the implementation of EMV-pt can be discovered.

For this research a closer look has been taken at three different cases (Figure 30, next page). First of all the way the situation in the Czech Republic was analysed to get a better understanding of what it means to pay with EMV contactless. Because the country has a fast and widespread acceptance of EMV-c (New Europe Investor, 2015), it makes it an interesting place to look at EMV-c in a context that is different to see what it means to look at an unfamiliar system. The second context

was Chicago and since it is one of the few cities that implemented EMV-pt, it gave the possibility to research the effect the system has on the users and the problems that have arisen. This metropolis of the United States is also an interesting location because it gives insights in a situation outside of Europe. The final EMV-pt system that was investigated is the one in London. The public transport system of London has many similarities with the system in the Netherlands. Because EMV-pt within this city serves as an example and guideline for parties involved in the Dutch implementation of EMV-pt, it is important to see what it means to implement such a system in order to predict the effects it will have on the system in the Netherlands. The complete research proposal can be found in Appendix A.

6.2 Research Questions

For this research abroad the following research questions were formulated to get an answer to the goals stated in the aim. Since the research takes a look at both EMV-pt as well as EMV-c in general, the formed questions are aimed at both of these ways of using contactless bank cards.

- How does EMV-pt/EMV-c work in the Czech Republic, Chicago and London?
- How do users experience the use of contactless bank cards as carrier within public transport and in general?
- How do users interact with contactless bank cards as carrier within public transport and in general?
- What usability problems can be identified for EMV-pt/EMV-c users?

- What usage patterns can be identified for EMV-pt/EMV-c users?
- What opportunities can be identified for EMV-pt/EMV-c users?

6.3 Methods

To get an answer to the research questions for the study abroad, various methods were used to extract the information needed. Users and employees have been observed and interviewed and the contactless bank card has been used multiple times in order to get first hand experience with contactless bank cards in different contexts.

Interviews

In order to find out what people think about EMV-pt and what their concerns are, interviews were held with both users as well as employees of PTOs. These interviews were semi-structured (Patton, 2002) like the interviews conducted in the previous studies and were recorded when possible. The recording of the participants was always done with their permission, which was asked before the interview started. The interviews were conducted at public transport areas like stations and platforms. This was done to make sure the experience of using public transport was still a fresh memory within the participants and to make sure it was easier for the participants the picture the environment of use.

Observations

To see the natural behaviour of people while they are using EMV-pt, observation were performed at various stations and stores. Data during the observations was collected by filming and by taking notes. During the observations extreme care was exercised to not film personal information of people while they are using their bank card.

First hand Experience

During the research abroad, the contactless bank card was used both in public transport as well as for other payments in order to gain a better understanding of the problems that users encounter and the environment that EMV-c is used in. In order to accurately document this experience, the use of EMV contactless was filmed. The filming for this research was done by strapping a video camera to the chest to make sure the researcher was not hindered by equipment during use.

6.4 Data Analysis

The data of the research abroad was interpreted and made accessible in the form of statement cards (Sanders & Stappers, 2012). While reviewing the data, all particularities were noted down on cards and categorized according to the source material out of which they originated. The making of the cards was



Figure 30. Countries visited in research abroad

done to make the data more tangible and the cards also helped to make the interpretation and pattern finding steps explicit. By turning the data in cards, designers can be invited to interactively structure and analyze the data (Sleeswijk Visser et al., 2007). It can help with comparing various forms of data as well as create an overview.



Figure 31. Statement cards examples of blue (observation), pink (first hand experience) and grey (interview) cards

The cards (Figure 31) contain a picture showing a particularity or the interviewed person, a code representing the source material and a text describing the particularity. The various colours and icons were used to connect the card to the method out of which the particularity emerged. The complete set of statement cards can be seen in Appendix B and an overview can be found in Appendix C.

In total 213 different statement cards have been made. These cards have been clustered twice into problem areas based on two aspects; what is happening and why is something happening. The clusters of these two groups have helped in creating the insights and can be found in Appendix D.

Data from the research in London has also been used to create a customer journey map (CJM) depicting the current use of EMV-c in public transport in London. By determining the phases travellers go through, the moments travellers come into contact with the product/service (known as touch points) and the experiences they have at these moments, an overview of their journey was created. The making of a CJM can be a useful method in order to look at what research needs to be done, to map insights and to identify relevant design opportunities (Roscam Abbing, 2010). Since the current working model for EMV-pt in the Netherlands is based on the London model, mapping out the customer journey could help in improving the customer experience for EMV-pt in the Netherlands.

The customer journey can be helpful for the implementation of EMV-pt in the Netherlands since it will have a lot in common with the model of London. It will be useful throughout the project in order to look at what research needs to be done, to map insights and to identify relevant design opportunities (Roscam Abbing, 2010).



WHAT



LANGUAGE

FEEDBACK

LINK OF
FEEDBACK

INCONSISTENCIES

EFFICIENCY
OF CONTACTLESS

CONTACTLESS
USAGE AS A
BACKUP SECURE
OPTION

EXPLANATORY
SIGNAGE ABOUT
CONTACTLESS

ASSUMPTION

ASSUMPTIONS
ABOUT USING
CONTACTLESS

GRAPHICAL
INFORMATION

UNCLEAR LOGO
(10) (10) (10)

UNCLEAR GRAPHICAL
COMMUNICATION

7

7 RESULTS

The results of the research abroad have been divided for each country and described in separate chapters. Each country chapter explains the context in which EMV-c/EMV-pt has been implemented and reveals the insights that have been discovered. In the conclusion the general insights, insights that have been found throughout the different contexts, are described and the factors are displayed that influence the implementation of EMV-pt.

Because both Chicago as well as London already have an EMV-pt system installed, research in both these cities yielded more results. Since London had been visited twice and the adoption rate of EMV-pt is higher than in Chicago, in London the research of this EMV-pt system yielded the most results. In the case of London were the public transportation system is slightly similar to the one in the Netherlands, it was also very useful to use the results of the research to create a customer journey

7.1 Czech Republic

In this subchapter the results for the research in the Czech Republic can be found. Since EMV-pt has not yet been implemented in this country, the results are purely concentrated on the use of EMV-c.

7.1.1 Context of Use

As leading country in the use of contactless payments in Europe, the Czech Republic sees a widespread use of contactless in shops, restaurants and vending machines. Because the use of EMV-c is adopted so well in this country, payment networks are partnering up with transport operators in order to implement EMV-pt as well.

Although the use of contactless bank cards in this country is relatively the same as in the Netherlands, a big difference is the way the cumulative contactless limit is implemented. Contactless bank cards issued in the Czech Republic have a single spending limit of 500 CZK, which is around €20, but the cumulative limit is missing. Instead of a cumulative limit the contactless bank cards need to use a PIN for every three consecutive transactions.

7.1.2 EMV-Contactless Usage

When paying with a contactless bank card at shops and vending machines in the Czech Republic, the first thing that can be seen is that the language displayed at payment terminals is in Czech. This makes it hard to follow the advice given by the machines when one does not know the language and makes one reliant on other visual feedback that the machines gives (Figure 32).



Figure 32. POS terminal in Czech language

The feedback on the devices however often differs making it hard to understand what is happening and if the transaction is going well or not. Many steps are still being explained through words (Figure 33) and this can be very confusing when an error happens for people that do not speak the Czech language (Figure 34). Apart from the feedback given by the devices, the steps that need to be taken are also very different from machine to machine making it sometimes impossible to rely on previous experiences with contactless payments to perform a transaction.



Figure 33. Steps for EMV-c displayed in Czech



Figure 34. Error message on reader displayed in Czech

Shopkeepers also have the tendency to grab your bank card when making a contactless transactions. Many users have stated that this made them feel like they are not in control and also makes them distrust the person taking the card. Next to the situation where the bank card had to be given away, distrust was also expressed by people when using vending machines because it could easily be falsified.

"I think it is always a bit shady when a restaurant asks you to give them your contactless bank card so they can do the payment for you. I don't trust it, who knows what they do with it."

-Female EMV-c user (IT01)-

People also had concerns about whether or not their contactless bank card will be accepted. Users stated that the fact if their bank card will be accepted or not is not really clear and they had the feeling this happened at random. The also indicated that acceptance between doing a contact transaction versus a contactless transaction differs and that this is not clearly communicated.

"I sometimes worry if my card will be accepted or not. Because I am from Romania, sometimes my card is not accepted." -Male Traveller (IT04)-

7.1.3 Insights

While interviewing and observing people and using the contactless bank card within Prague and Brno, various insights could be discovered for the use of EMV-c.

Language barrier

Language still plays an important role when using EMV-c and dealing with a payment terminal can be very confusing when the information displayed cannot be comprehended. Although many devices try to

guide the user using other sorts of feedback, the fact remains that most devices rely heavily on text to explain use.

Every machine is different

Although POS terminals are all tied to the same rules when it comes to contactless transactions, the variety that can be found in these machines is huge. The location for card placement, the amount of feedback, the steps that need to be taken before use and the time needed differs greatly amongst different machines. This makes the user unable to rely on previous experiences when using the contactless bank card for transactions and causes them to keep investing time to understand the machine.

Bank cards are not alike

Every bank card issued in a different country uses different rules for contactless transactions. Although most countries agreed upon a certain transaction limit that can be spent per contactless payment, this limit still varies and changes a lot making it almost impossible to know how a certain contactless bank card works without trying it. Next to the variation in spending limits between countries, banks are also allowed to change the rules concerning the cumulative limit, creating even more uncertainty about EMV-c use.

7.2 Chicago

The results for the research on EMV-pt in Chicago can be found in this subchapter. The context of use for EMV-pt is described, as well as the actual usage that could be identified combined with the insights that could be formed out of the results.

7.2.1 Context of Use

Public transport in the area around Chicago is managed by three transit agencies: Chicago

Transport Authority (CTA), Pace and Metra. These agencies are governed by the Regional Transportation Authority (RTA) of Illinois and are responsible for the train, bus and metro services within the metropolis.

The biggest part of the public transport services within Chicago are managed by CTA and uses an electronic fare payment system called Ventra. To make use of public transport one can use a disposable paper ticket, a contactless bank card or a Ventra card (Figure 35). The disposable tickets are used for single journeys and one day passes while the Ventra card is a smart card that can be topped up and loaded with various travel products and when activated can be used as prepaid debit card as well. To get in a station or bus, travellers have to tap their cards once at the beginning of their travel and pay a flat fare for each journey.



Figure 35. E-tickets within Ventra system

The disposable tickets and Ventra cards can be purchased at various retailers and vending machines or can be purchased from Ventra itself through phone or online. The Ventra card requires a deposit of 5 US dollars which is refunded as transit value upon registration online. When registered online, the user can see his/her journey overview and can also top up online.

Ventra received critical responses from its users and media due to the lack of

communication from CTA regarding the implementation of the system (Sudo, 2013). This lack of communication combined with a multitude of errors in both the service as well as the system during its launch, caused Ventra to be not so popular amongst its users (Hilkevitch, 2013).

Together with the rest of the Ventra payment system, the use of the contactless bank card as payment method for the CTA services was part of Ventra's introduction in 2013.

7.2.2 Usage of EMV-Contactless in Public Transport

The contactless bank card was designed for the Ventra system to be used to both Pay As You Go (PAYG), paying travel fares directly from a bank account, and to be used in combination with a Ventra Transit Account for loading fare values or passes on the bank card at Ventra vending machines. The entire public transportation system uses flat fares for their services, so users only have to check-in.

Interviews with various travellers in Chicago showed that the contactless bank card is used by very few travellers and that most people are not willing to use it because they perceive it as more expensive. Apart from the fact that people do not see benefits in using this method of payment, a large group of interviewed people also stated that they never heard of the possibility to use one's own contactless bank card in public transport.

"I have always lived in this city. And did you notice that you can use the bank card immediately (in public transport)? No, really? Would you use it? Oh yes I would, I did not know that! I don't ride it a lot so maybe that's why I don't know. But yeah, I would definitely use it!"

-Male traveller (IC03)-

Pre-Travel Experience

When a traveller starts a journey, the first step that has to be taken is to look whether the transit service is compatible with the contactless bank card. Since the Ventra card is in itself also a contactless bank card, all the information signs focus on using a bank card which makes it easy to see where one can pay with a contactless card or not. Because compatibility with EMV-c was also introduced along with the Ventra system, all information signs show the contactless bank card as a payment option and it is displayed on the same level as the other payment options (Figure 36).



Figure 36. Payment options displayed in same style

The gates and bus readers themselves however do not show what cards are compatible and only show that it is possible to pay with a contactless card (which all the cards are) (Figure 37). Service personnel is often nearby gates to help with either purchasing a card or entering the system. Although personnel has a lot of knowledge concerning the use of a contactless bank card, the complexity of the card makes it hard to convey this knowledge to the traveller.



Figure 37. Contactless card validator logo

Travel Experience

To pay for the service, users can either PAYG or connect the card to a Ventra account in order to use transit value to enter the system. Travellers simply have to tap in once to enter a bus or pass through a gate. If the contactless bank card is part of a Ventra account and loaded with transit value, the reader will first attempt to remove the loaded transit money before switching to PAYG. When transferring, bank cards that are not connected to a Ventra account do not pay a reduced transfer fare of 25 dollar cents, but are forced to pay the full fare of 5 dollars again because the machines cannot see whether the bank cards has travelled before. A lot of people stated that this is the main reason they do not like to use the contactless bank card. Information about the difference in transfer costs is often showed in small letters on posters or is not mentioned at all (Figure 38). When leaving a station or bus, the user only has to pass a turnstile or exit the vehicle.

Post-Travel Experience

If a bank card is connected to a Ventra account, travel information will be displayed when visiting the website. When using an unconnected bank card the transaction can be seen on the bank statements. These transactions are however stacked together

and the date of on statement does not necessarily correspond with the date the journey has been taken. When experiencing problems people tend to call Ventra for help, however many users state that the service provided by Ventra is not ideal and that Ventra often fails to solve the problem.



Figure 38. 'No transfers' is displayed in small text and difficult to see on poster

7.2.3 Insights

The research in Chicago has led to various insights concerning the use of EMV-pt and the following insights have been discovered:

Contactless bank card working principle is complex

Even though the public transportation system in Chicago is relatively easy to comprehend, the way the contactless bank card works in the Ventra system is very complex. Because the bank card can be used in two different ways utilising both PAYG as well as transit value, the payment method needs a lot explanation before it can be used. Although service personnel at stations often had the required knowledge to give this information, even they stated that it is wise to look up information online to fully grasp the concept.

"I am really sure tourists are not going to register their bank card before coming to town. More than likely, they are stuck with Ventra tickets before they can figure out the bizarre open fare system."

-Chicago transit user (IC04)-

Lack of quality in service

In the case of Chicago, just having service is not enough for people to feel comfortable with using EMV-pt. Many users have stated that Ventra's service quality was poor and that personnel was not able or willing to help them with their problem. Knowledge is apparently missing for service personnel that is not stationed in the field and this results in people getting the feeling that the system is not a full grown product.

"My second trip using Ventra and I was double charged. I called and got a message telling me that I should expect a hold time of 17 minutes.

Who are these clowns and what led them to think this was ready to release?" -Online respondent-

Little information contactless bank cards

Because the contactless bank card was part of a larger system, the use of this payment method is hardly promoted and explained throughout Chicago making the payment method unknown to a lot of people. Many poster and information signs for public transport focus on the Ventra system itself and either show very general information or provide travellers with a big list of all available options (Figure 39).



Figure 39. Poster displaying a lot of information about the system making it difficult to see information concerning contactless bank cards

cta O'Hare Station
Blue Line
trains to City

What should you buy?

Tickets are a good option for a trip downtown or a full day of riding.

Ventra Cards let you load money or passes, can be shared and give you more options.

Fares & tickets

What should you buy?

Tickets are a good option for a trip downtown or a full day of riding.

Ventra Cards let you load money or passes, can be shared and give you more options.

Chicago

Chicago

Chicago

7.3 London

In this chapter the results of the research in London are described and separated into several subchapters. Because the Dutch PTOs, banks and TLS use the EMV-pt situation in London as a guideline for the implementation of EMV-pt in the Netherlands, a customer journey was made to map out the entire EMV-pt experience and is added as extra subchapter within this chapter.

7.3.1 Context of Use

Within London most public transportation services are managed by the local government body Transport for London (TfL). This organisation, which also handles the cities transport strategy, is responsible for the services of several companies that operate in London. TfL manages transportation services like the underground network, trams, busses and the overground trains.

The public transportation system in London makes use of paper tickets and the Oystercard, a contactless smartcard, which is comparable with the OV-chipcard in the Netherlands (Figure 40). These cards can be topped up at stations, online or directly from one's bank account. The city is divided into nine fare zones and the fares for travelling with the Oystercard are determined by the zones the traveller covers in the journey. To make use of the system the traveller has to check-in and out in a manner that is similar to the Dutch public transportation system. The fares when using the Oystercard are less than the paper tickets and are also capped which causes the Oyster fares never to exceed the price of a daily travel card.

In order to get an Oystercard one can purchase the card at various stores and vending machines throughout London or by getting into contact with TfL. The card requires a 5 pound deposit which is refunded along with the remaining value that is present on the

card when returning it to TfL. The card itself is initially not registered to a traveller but can be connected to the user when signing it up online in order to benefit from a better journey overview and theft protection.



Figure 40. E-tickets used by Transport for London

The Oystercard has been very successful for TfL, as it caused the use of the underground and the bus to rise, and is relatively popular amongst its users (Henry, 2013).

In 2007 the first contactless bank cards were introduced in the United Kingdom and by the end of 2011 most major issuers migrated to include EMV-c in their programmes. As part of the future ticketing project, TfL started working on an open loop payment system within London which would include the contactless bank card as payment method (TfL, 2014). Reasons for implementation were the ease of use the card would bring visitors to the city and the reduction of costs for TfL due to the increase in direct payments by the travellers. With the help of the financial industry, who were keen on promoting the use of EMV-c, contactless bank cards were first accepted on the busses in 2012 and for the rest of London's transportation services in 2014.

Although the initial plan was to phase out the Oyster card entirely with the launch of EMV-pt due to its expenses, TfL changed their

strategy and made contactless bank cards an addition to the system (Hoscik, 2013).

7.3.2 Usage of EMV-Contactless in Public Transport

The use of contactless bank card within the public transportation system of London was designed to be similar to the use of the Oystercard. When using the metro or train, the user has to check-in at the beginning of the journey and check-out at the end when using the bank card. For the use of the bus or tram the user has the only check-in since these transportation modes have a flat fee tariff scheme. Unlike the Oystercard that uses daily capping, the bank card is capable of giving the user weekly capping.

Pre-Travel Experience

Since the bank card is already at hand when starting to travel, the first thing that has to be done in order to start the journey is to check whether it is possible to use the bank card in public transport. The TfL's website provides clear information about the working principle of EMV-pt and gives the option to connect the EMV-c to an account on the website in order to have a better journey overview. When entering a station, posters and standalone signs often indicate that contactless bank cards are an option (Figure 41).

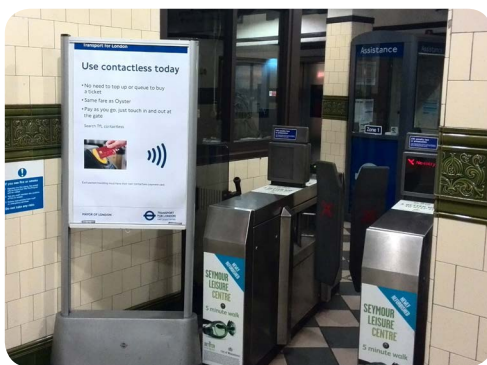


Figure 41. Signs promoting contactless at entrance

Although the information signs show whether or not the cards are compatible, they do not give information about how the system works. Service personal is always available near gates but they do not always have the knowledge when it comes to information about contactless bank cards.

"A lot of people have been using it but some work and some don't work. Best thing to do. Go to one of the shops, buy like a ten pence sweet or something and just tap it on. See if it works. If it doesn't, it doesn't."

-Employee Transport for London (IL12)-

When knowing if a contactless card is a valid option, the next step is to look if the destination can be reached with the contactless bank card and thus how big its travel range is. People indicate that this can be though since the travel range of the bank card is the same as the range of the Oystercard. However the travel range information is only displayed mentioning the Oystercard which makes it hard for people to make a link with the bank card (Figure 42). For people that are experienced with the Oystercard however this proves to be less of a problem.



Figure 42. Difficult to see travel range at map

Since money is being taken out directly from one's bank account the EMV-c does not need to be topped up and users can go directly to a gate or reader to check-in. This causes the traveller to avoid the queuing lines in front of the vending machines and spend less time in the area around the payment machines unless if auto top-up is activated. This is seen by users as one of the biggest benefits of using the bank card instead of the Oystercard. TfL promotes the use of contactless bank cards at these queuing lines by placing promotional signs at the lines (Figure 43).



Figure 43. Signs promoting contactless at queuing lines

"But at the same time, it depends how much of a rush you are in. Because it (contactless bank card) can be extremely helpful compared to the Oyster card"
-London transit user (IL01)-

Travel Experience

In order to make use of the public transportation services, the next step for the user is to check in with the bank card to start the journey. For users that are not experienced with using the Oyster system at all, the places one has to check-in can also be hard to find. Machines do not always clearly indicate whether they are contactless bank

card compatible or not. A lot of information is also displayed either small on the gate itself (Figure 44) or in the case of the bus displayed on a moving part which makes it hard to detect (Figure 45).



Figure 44. Small information concerning contactless compatibility displayed underneath reader



Figure 45. Contactless compatibility signs are put on bus doors

When checking in the bank card can be either declined or accepted. TfL service staff indicated that most of the time when the bank card is declined it has to do with the fact that the card is on the blacklist due to insufficient funds. When a traveller makes a journey with not enough money on his/her bank account the system lets the traveller make use of the

system once, since it cannot see this lack of money immediately, but after this card is added to the blacklist which denies it from further use. The rules for checking in and how this is connected to the working principle of using a contactless bank card in general are experienced as very confusing and people often make assumptions about how this would work. The fact that the machines do not indicate what is wrong with the card further stimulates this confusion. Another reason cards get declined is when a user accidentally puts two contactless cards (either an Oyster card and a bank card, or multiple bank cards) on the reader at the same time. This phenomena, which is called card clash, results in the reader giving an error and the gates closing their barriers. TfL warns about this problem using posters that are spread throughout the station (Figure 46).

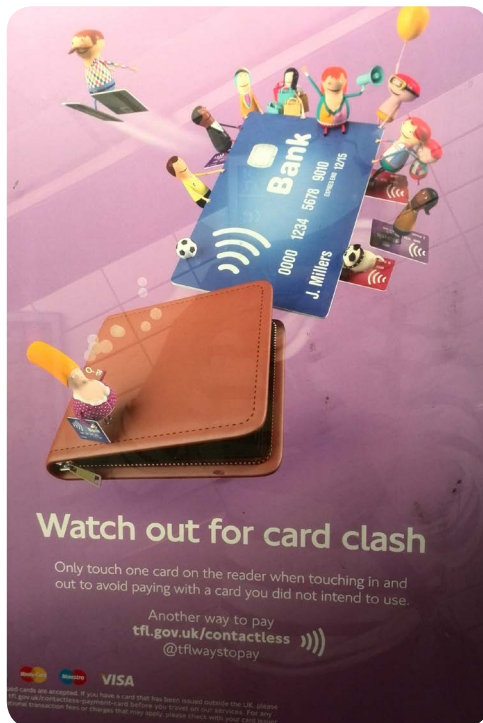


Figure 46. Poster warning for card clash

If there is a problem the service personnel will often quickly help since they are positioned close to the gate and will try to explain the nature of the situation and make sure the user can pass through the gates.

If a person is correctly checked in, the gates will open and the interaction is similar to the Oystercard. When checking in at the reader poles, which do not feature gates, that are used for the train, the machines are not able to give feedback on the CiCo state of the card (Figure 47). Checking in and out can be done numerous times while the machine only gives feedback in the form of the word: ENTER. This causes users to doubt whether they are checked in or not and solving this problem is impossible near these poles.



Figure 47. Reader pole that cannot give CiCo status

When a traveller leaves a vehicle and checks out at a station, the user is presented with limited feedback. When the bank card is presented to a reader, gates can only display the fact that someone is checking out and are unable to display the journey costs. Some interviewees stated this can be very confusing since the Oystercard does give that feedback and it helps them to see whether their journey went right or wrong. If a user checks out at a pole it is only able to tell whether or not

the user correctly held the card against the reader. Just like with the Oystercard, some people forget to check out when the system is not entirely closed and uses reader poles.

Post-Travel Experience

After a journey travellers can get detailed information about their travel history when they linked the bank card to a TfL account. The website quickly and clearly shows the journeys that have been taken and also make it easy to get an overview. Next to the website various applications, although not developed by TfL, also make it possible to get more information about one's journey. When the bank card is not connected to the TfL account, the user receives bank statements at the end of the day showing the journeys that have been made (Figure 48). In the case of some foreign cards, the bank statement are stacked together making it impossible to see what journeys have been taken (Figure 49). If the bank statement that is shown is incorrect, people tend to call TfL in order to get the problem fixed, linking statement problems to the transporters and card problem to the bank.

"I am travelling all day so I use it (Oystercard) a lot. I get a bill from TfL every month and I claim back all that. Whereas I use contactless, I have to use my bank statements. You would have to identify which bit is transport."

-London transit user (IL41)-

Select a date range	
November 2015	
24 Nov SELF-SERVE TICKET	-£13.00
23 Nov TESCO STORES 6165	-£3.14
23 Nov RODBORO	-£2.30
23 Nov T K MAXX	-£39.99
23 Nov BRITANNIA	-£5.95
23 Nov A M RITCHIE	-£10.00
23 Nov FROM A/C 85219959	£220.00
20 Nov ITUNES.COM/BILL	-£17.99
20 Nov TO A/C 85219940	-£8.25
19 Nov RODBORO	-£4.49
16 Nov TICKETOFFICESALE	-£13.25
16 Nov 3029 MICROSOFT	-£1.00

Figure 48. Travel overview for UK issued bank cards

Terug Transactiedetails	
Van rekening	Rabo DirectRekening
Bedrag	AF € -10,88
Naar rekening	TfL Travel Charge TFL.gov.uk/C
Omschrijving	Betaalautomaat 10:10 pasnr. 009 GBP 7,90 EUR = 0,726102 GBP
Via	Betaling Contactloos
Verwerkings- datum	28-09-2015
Rentedatum	26-09-2015

Figure 49. Travel overview for foreign bank cards



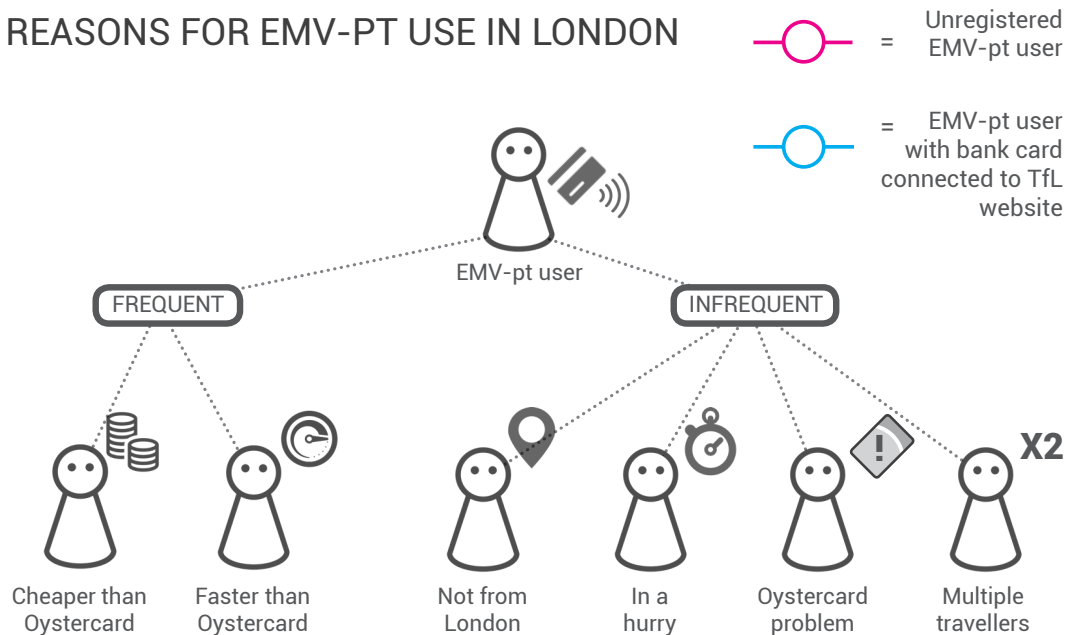
Paddington Station

7.3.3 Customer Journey

In order to map out the entire journey a user makes when using the contactless bank card in the public transportation system of London, a customer journey map was created to both visualize the experience and to get a better grip on the status of the current service. Within this journey two different users are mapped out, travellers that connect their bank card to the TfL website (visible in blue) and travellers who do not (visible in pink). The journey is divided into ten phases with corresponding steps. For each of these

steps the goal of the user is shown as well as the expectations he/she has when using the system in combination with the current experience. This is done in order to identify the differences in these areas and to see where expectations are not met and how this affects the quality of the system. As Polaine et al. (2013) state: when people get what they expect, they feel the quality is right. Next to the experiences the user has, the journey also shows the touch points with which the user interacts and the steps that are being taken by the back office.

REASONS FOR EMV-PT USE IN LONDON



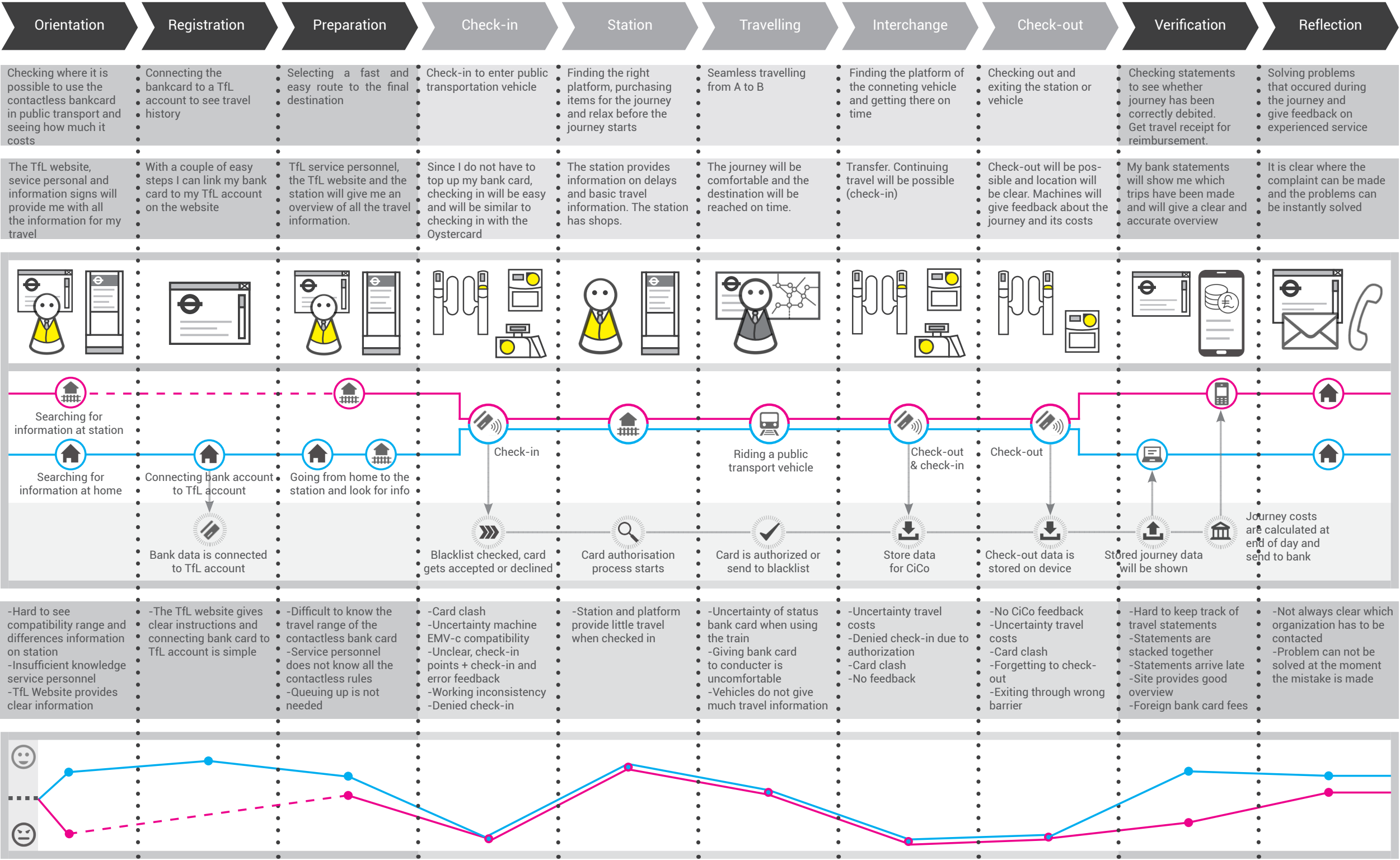
REASONS FOR AVOIDING EMV-PT



PRE-TRAVEL EXPERIENCE

TRAVEL EXPERIENCE

POST-TRAVEL EXPERIENCE



7.3.4 Insights

By researching the public transportation system of London various issues and patterns emerged and combined with the analysis of the customer journey have led to the following insights:

Information gap at check-in and check-out point

Although connecting a bank card to the TfL website can tackle a few of the problems the EMV-c users experience during their entire journey, the points where the travellers need to check-in and to check-out remain troublesome. The lack of information and feedback given by the validation devices creates confusion and doubt among travellers and is a moment when it becomes very apparent that the bank card does not offer the same amount of information as the Oystercard does when used in public transport. For check-in this information gap is most visible because the moment a user cannot check-in because of the limitations connected to contactless bank cards. During check-out the biggest information gap is in the lack of travel information and costs displayed by the machines. When using the validation poles this gap in information is even worse and the system cannot even indicate whether the user has checked in or out, which is part of the fundamental rules for using the public transport system in London.

Large emphasis on equality between Oystercard and EMV-contactless

Both the observations as well as the interviews indicated that equality between the Oystercard and EMV-contactless is an important aspect to the travellers. Travellers value the Oystercard and often want the bank card to be able to do the same or more before they are willing to use it. TfL also puts the emphasis on this equality a lot by showing posters stating that EMV-c is just as

expensive as the Oystercard and can have the same functionalities (Figure 50).



Figure 50. Advertisement focussing on equality in price between the Oystercard and contactless

Rules for using EMV-pt are hard to find

When travelling, a user looks for information concerning the method of payment he/she is travelling with (e.g. Oystercard). The bank card uses more or less the same rules as the Oystercard and as such the users are expected to look for information concerning the Oystercard when travelling with the contactless bank card. However TfL makes the situation more confusing because they occasionally do show information concerning the contactless bank card, making it difficult for travellers to know when the information applies to them (Figure 51).



Figure 51. Differences in information sign of reader

Implementation through promotion

TfL heavily promotes the use of contactless bank cards in London and makes it more alluring for travellers to make the switch. When TfL introduced contactless bank cards as method of payment for public transport, many channels have been used to reach the travellers and to convince them of EMV-pt's value. The contactless bank card for example offers benefits the Oystercard does not, like the weekly capping. Next to added value TfL also promoted EMV-pt even further using special promotion days that would give travellers the chance to try out this new carrier in public transport for free.

Lots of incidental contactless bank card users

During the interviews there were many different people stating that they used the contactless bank card as incidental payment method for public transport. Ranging from people that use it as back up plan for when troubles arise with the Oystercard to people that simply find it easier to use the bank card because they are not from around London. Although a lot of people also use EMV-pt frequently, the group that does not is a lot bigger then it looks because of its diversity in reasons of use.

7.4 Conclusion

The insights gained in the research can greatly help with the introduction of EMV-pt in Netherlands as it can aid in the avoidance of pitfalls. Apart from helping to identify problems it can also assist with finding opportunities that can increase the chances of a successful adoption of EMV-pt. Out of insights gained in the different contexts, various general insights could be formed that were apparent in more than one of the countries visited and which are described in this chapter. Next to general insights the results of the research were also linked to the acceptance model created in the literature

study to get a complete picture of the factors influencing the implementation of EMV-pt.

7.4.1 General Insights

When looking at the different countries and the patterns and issues they show, general insights could be formed which affect the implementation of EMV-c/pt regardless of the three different contexts in which it is implemented. The following key insights have been identified:

Control is Needed

Since EMV-c allows people to spend money more easily, a lot of users express concerns when it comes to the control they lose when making contactless bank card transactions. Concerns are both shown in loss of control when it comes to how quickly one could spend money but also in the fact that money could be depleted from ones bank account without knowing the exact amount.

"Yeah exactly and anything could come out of it and when it's your bank account you just think: I don't want to lose that much control."

-London transit user (IL57)-

"I would rather have my money in a separate place, a little island, instead of it being directly reduced from my bank account." **-Male traveller (IT03)-**

Costs Play an Important Role

As could be seen in both Chicago and London, costs play a serious role in the successful implementation of EMV-pt in ones system. Users in both places expressed that costs is a vital element for them when selecting an e-ticket. Although more factors are responsible for the poor acceptance of EMV-pt in Chicago, costs played a big part in the critical responses the system received. Many users indicated this was the main

reason they refused to use the bank card in public transport within Chicago. London on the other hand has a system where the PAYG prices are the same as when using an Oystercard and always reminds the user of the equality between the Oystercard and the bank card. When using a bank card the user even benefits from a weekly capping instead of a daily capping and is also free from making a 5 pound deposit as is the case with the Oystercard.

Equality in Level

For EMV-pt an essential part is the way the bank card is positioned next to other methods of payment in public transport. A large focus on equality in display could for example be seen in Chicago and the posters in which they show the various e-tickets (Figure 52). In London this equality was harder to find because the entire Oystercard system was already there before they implemented the bank card.

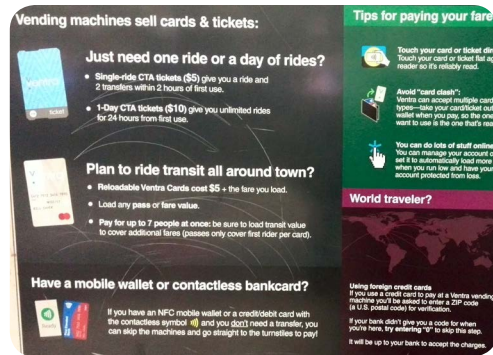


Figure 52. Overview of E-tickets in Chicago

Consistency is Lacking

Throughout the three contexts both in using EMV-c as well as in EMV-pt, many consistency issues could be seen that influenced the use of paying with a contactless bank card and using it in public transport. These issues can be separated into three consistency problem

areas: Information, feedback and design. For the information area, problems could for example be identified in the form of the term 'contactless' which is used in London to identify EMV-pt while it is also used as term for the Oystercard. Next to inconsistency in terms there are also inconsistencies to be seen in information placement where for example important information about the transfer costs in Chicago could not be found in certain areas of the Ventra website describing the use of EMV-c.

Other inconsistencies could be found in the feedback one receives. This was especially apparent in London where the validation devices often gave different sounds and screen information when checking in and out even though a user was performing the same task.

A lack of consistency is also visible in the designs used by both TfL and CTA. Posters can be seen that use the same icon for different meanings (Figure 53) or that use a misleading design to indicate a problem for the user which can be seen in the card clash posters (Figure 46).

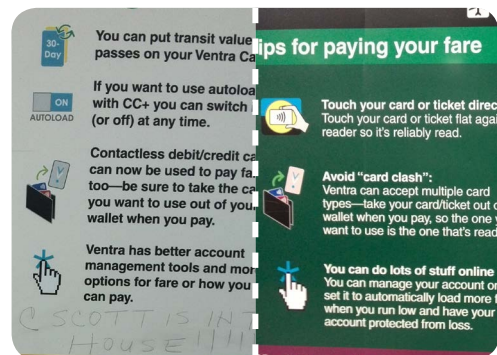


Figure 53. Same icon is used for different meanings

↑ Platforms 1 to 3

1507 Tavergha Hill - On time
1540 West Croydon
via Selhurst 1 On time
1545 Earlsfast
via Greenwich Pier B&T
Page 1 of 2 1521:45

1600 Hordsham - On time
via Gatwick Airport
Page 2 of 2 1521:45

WARNING
Have you read the rules?
Don't drink and drive
Don't drink and ride
Don't drink and swim
Don't drink and work
Don't drink and travel
Don't drink and be alone
Don't drink and be stupid
Don't drink and be reckless
Don't drink and be irresponsible
Don't drink and be a danger to others
Don't drink and be a nuisance to others
Don't drink and be a pain to others
Don't drink and be a headache to others
Don't drink and be a mess to others
Don't drink and be a waste of money
Don't drink and be a waste of time
Don't drink and be a waste of life
Don't drink and be a waste of everything

WARNING
Have you read the rules?
Don't drink and drive
Don't drink and ride
Don't drink and swim
Don't drink and work
Don't drink and travel
Don't drink and be alone
Don't drink and be stupid
Don't drink and be reckless
Don't drink and be irresponsible
Don't drink and be a danger to others
Don't drink and be a nuisance to others
Don't drink and be a pain to others
Don't drink and be a headache to others
Don't drink and be a mess to others
Don't drink and be a waste of money
Don't drink and be a waste of time
Don't drink and be a waste of life
Don't drink and be a waste of everything

WARNING
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Don't drink and swim
Don't drink and work
Don't drink and travel
Don't drink and be alone
Don't drink and be stupid
Don't drink and be reckless
Don't drink and be irresponsible
Don't drink and be a danger to others
Don't drink and be a nuisance to others
Don't drink and be a pain to others
Don't drink and be a headache to others
Don't drink and be a mess to others
Don't drink and be a waste of money
Don't drink and be a waste of time
Don't drink and be a waste of life
Don't drink and be a waste of everything



London Bridge Station

"I use an Oystercard, so contactless.
Well...not 'a' contactless
(referring to EMV-c)"

-Male traveller (IL38)-

EMV-pt is Complex Service

Although implemented in a different way, EMV-pt is experienced by many users both in London as well as Chicago as a difficult service. The combination of the rules of both the bank world (e.g. spending limits) as well as the world of transit (e.g. CiCo) makes it easy to lose overview and to understand how the system works. When combined with even extra features, as was the case in Chicago, the user is confronted with a very complex service.

Many Expectations and Assumptions

Because EMV-pt is a combination of the worlds of transit and banks, users are packed with expectations before they use EMV-pt. These expectations come both in the form of the perceived usefulness but also in the way how the contactless bank card should work.

"Bank card is less useful, you can
not put a product on it" -Chicago transit
user-

Service personnel lack knowledge

Both in Chicago and London service personnel lack the required knowledge to help travellers use EMV-pt. Mistakes are often made in explaining the use of EMV-pt which can cause a lot of confusion amongst users. Even store personnel in the Czech Republic sometimes have problems with the working principle of their contactless POS terminals and vending machines which shows that users often do not stand a chance to correctly use the devices.

7.4.2 Factors Influencing the Adoption of EMV-pt

Using the insights and other results that have been discovered during the research, factors could be indicated which influence the adoption of EMV-pt. These factors, put together with the adjusted Information Systems Success Model created in chapter 2, lead to the EMV-pt acceptance model shown in Figure 54. Within this model the system features define the characteristics of the system in terms of costs, speed and range. The information features determine the way information is communicated and the service features focusses on the way the entire service is presented to the user.

In order to make travellers adopt EMV-pt it is important to make sure there is both an incentive to use it as well as an experience connected to it that is perceived as satisfying. Within this model these two aspects, called the expected qualities and the experienced qualities, can be influenced by design decision made within the various features of the system.

When looking at several issues found aboard and the way they are connected to the model, one can see how they affect the system in a different way. The issue with the higher costs for transfers in Chicago for example influences the perceived usefulness of the system making users unwilling to try EMV-pt and can be changed by making adjustments in the system features. The validator pole with limited feedback found in London however influences the experienced ease of use as it is unable to give users the feedback they need to correctly check in and out and could be changed by making adjustments in the information features of the system.

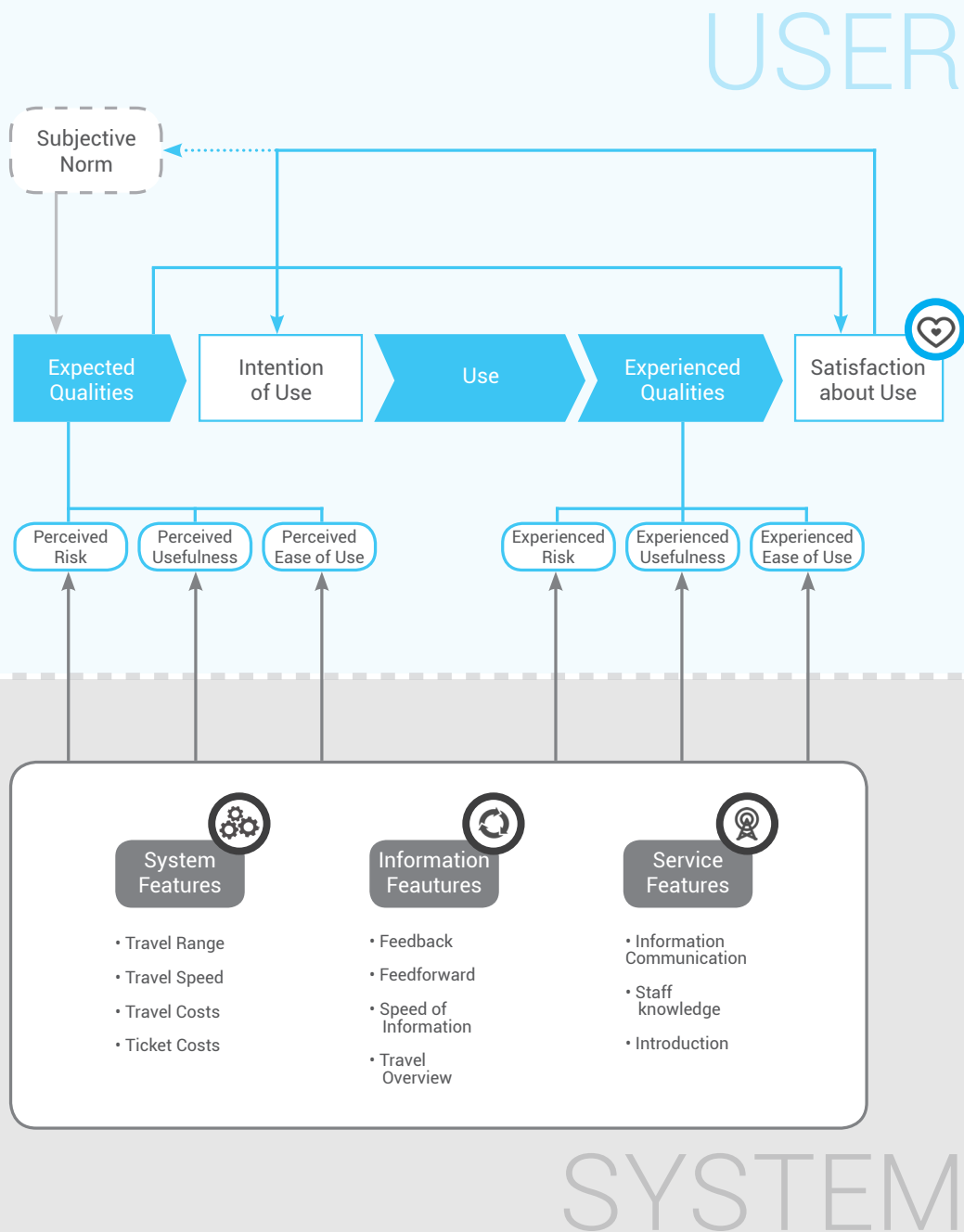


Figure 54. EMV-pt acceptance model with factors found in research



8

8 POTENTIAL THREATS FOR EMV-PT USER EXPERIENCE

When looking at all the issues and insights that could be seen both abroad as well as in the Netherlands, several threats can be discovered that could pose a problem for the adoption of EMV-pt. Even though not all issues experienced abroad have to necessarily be a risk for EMV-pt in the Netherlands, the following threats will become reality without proper intervention.

Zero CiCo feedback at validator poles

Since the validator poles used in the Dutch public transport system are very similar to the stand alone validators in London, the Netherlands could also deal with an information gap when checking in and out. Users would have to remember their CiCo status because a validator pole would only be able to tell the traveller whether or not the bank card has been successfully scanned. Both visual feedback as well as audio feedback will be absent if the current poles in the Netherlands are not modified to deal with the new public transport carriers that do not store transit information.

Hard to know where to find help

Even though research in London showed that travellers are more likely to contact the transport authorities when dealing with a contactless bank card related problem, the situation in the Netherlands is slightly different. Due to the complex nature of the relationship between the various Dutch PTOs and service providers, travellers are often not aware of the roles each party plays. Where PTOs in London are all connected to TfL, the Dutch PTOs stick to their separate identities which could make it harder for travellers to know where to find help when dealing with a bank card that is going to be part of the entire

transit system.

Limited travel range when using contactless bank card

In order to implement EMV-pt nationwide, all PTOs have to change their equipment to be compatible with the EMV-c technology. Because the Netherlands deals with many concessions and these concession do not end at the same time, the implementation of EMV-pt nationwide could take several years. Where the EMV-pt travel range limit in London is reached when travelling to the outskirts of the London area, in the Netherlands the areas where one can travel could be more diverse and spread out across the country based on the expiration dates of the concessions. This could results in confusion for travellers when it is not exactly clear where they can or can not travel with their bank card.

Error when reaching contactless limit

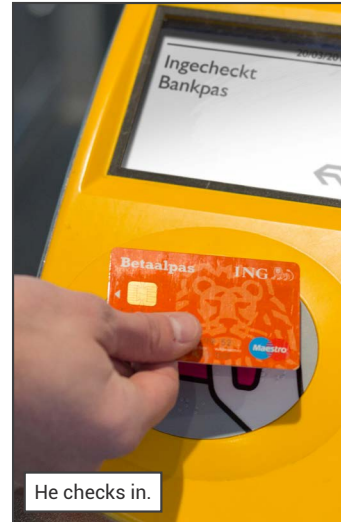
Because contactless bank cards have spending limits in order to improve their safety aspects, travellers could only make use of EMV-pt when staying within these payment boundaries. If validator equipment stays relatively the same as it is right now, users will be confronted with errors when checking in if they reached their contactless limit. The machines however would not be capable to exactly explain the reason why the traveller can not enter the system and would thus create a situation where the traveller is left in the dark.

If these threats are not dealt with and ignored, the outcome could have a negative impact on the user experience of travellers when they are using EMV-pt, which in turn is likely to negatively influence customer adoption

of the service (as can be seen in the EMV-pt acceptance model). To illustrate this impact, the illustration on the next page shows what effect the negligence of these issues could have on the user experience of travellers. For this illustration an imagined journey has been created for incidental travellers in the form of a lease car driver and a tourist.

THE LEASE CAR DRIVER

This is Frank. He lives and works in the Netherlands. He normally gets to work by driving his lease car but today he decided to take public transport using the bank card.



He checks in.



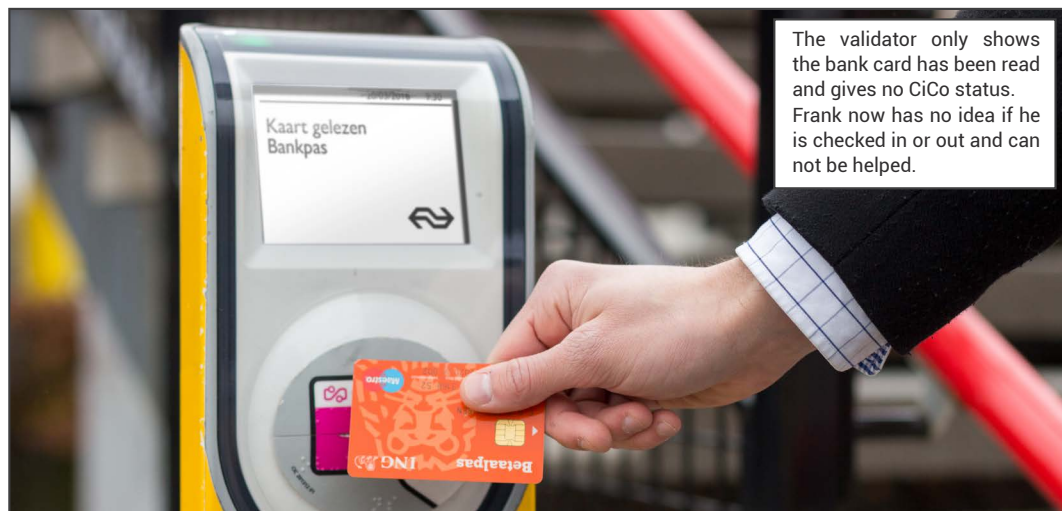
And takes the train.



And he leaves the train in order to take the bus.



However he forgot whether he checked out or not.



The validator only shows the bank card has been read and gives no CiCo status. Frank now has no idea if he is checked in or out and can not be helped.



In order to reach the exact location of his appointment the bus needs to be taken.



The bus service however does not support contactless bank cards.



Frank is now stranded and will miss his appointment.

In the situation described here the traveller was unable to receive the same service as one would get from the OV-chipcard. Both in terms of information feedback and usability the bank card does not match with the travellers expectations. This resulted in a situation where the traveller could no longer reach his destination using just the bank card and which will most likely result in the traveller avoiding the bank card for further use. If these issues are connected to the EMV-pt acceptance model on page 64, the lack of feedback would influence the experienced ease of use and the limited travel range the experienced usefulness.

THE TOURIST

This is Jennifer. She is a tourist and she is staying in the Netherlands for a week. Because she already has a contactless bank card at hand she decides to use that as carrier

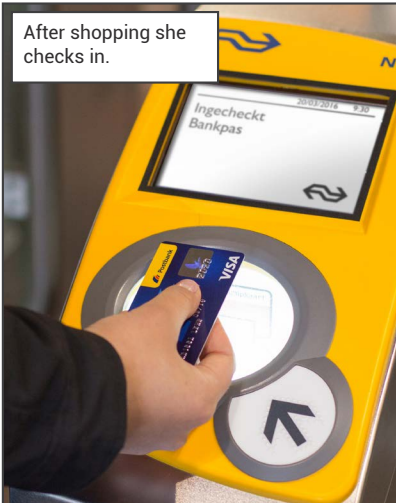


Before she takes the train to Delft she first wants to buy some stuff.

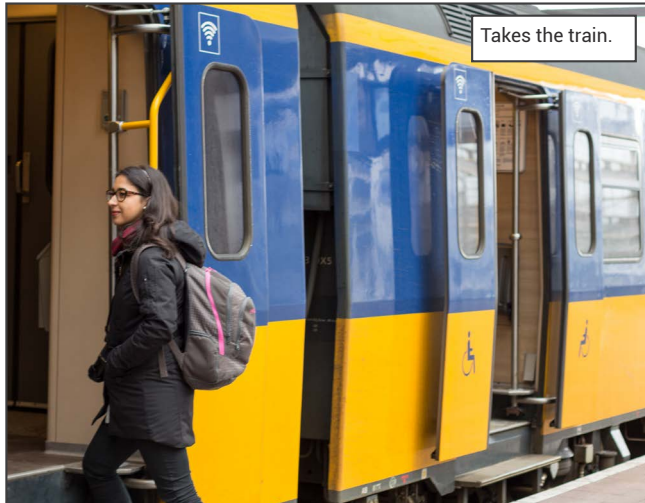


And she reached the €50 contactless limit.

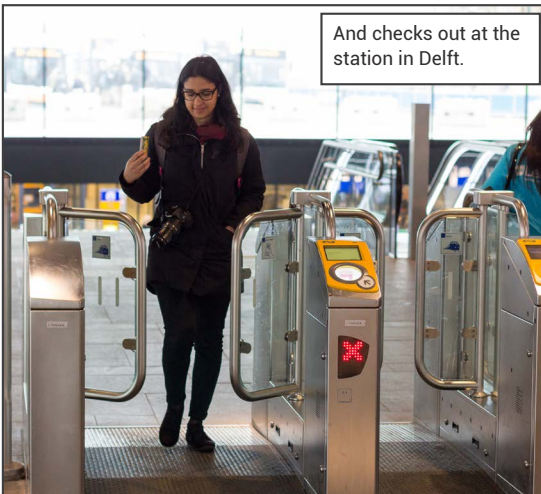
After shopping she checks in.

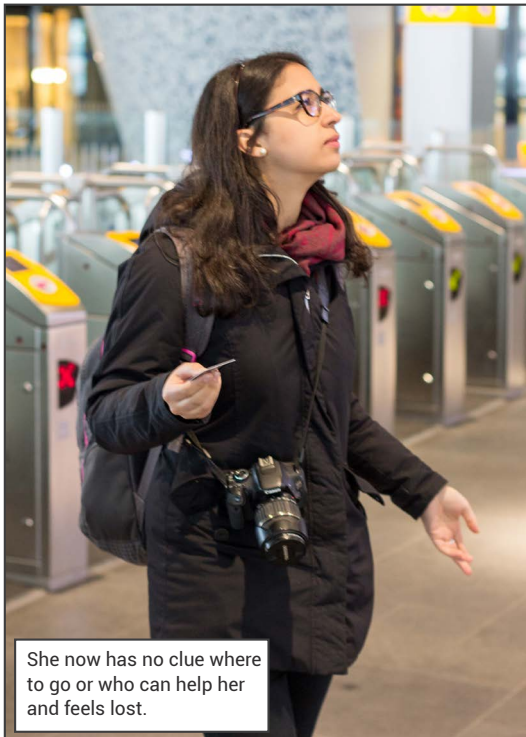
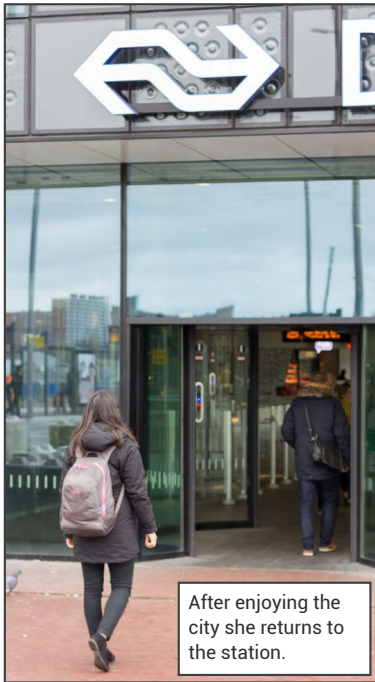


Takes the train.



And checks out at the station in Delft.





The traveller is unable to read nor comprehend the error she has made and there is no way for her to solve the problem at hand. Without proper understanding of the working principle of EMV-pt and the Dutch system it is impossible to know how to solve the problem or where to find help. Instead of using the bank card the traveller is more likely to play it safe next time she is using public transport in the Netherlands by purchasing a ticket. Connecting the issue of reaching one's contactless limit to the EMV-pt acceptance model, it would have an effect on the experienced risk of the system the user will have.



9 CONCLUSION & DISCUSSION

As last chapter of the research, this part takes a closer look at the results that have been acquired and the meaning that can be attached to these findings. This chapter is separated in the overall conclusion of this analysis and the discussion about the research done.

9.1 Conclusion

The implementation of EMV contactless in public transport (EMV-pt) has not been performed in many places before and as such little is still known about the effects of this technology on travellers. Although several countries have already adopted this new carrier within their transit system, not much is written about usability and the effects that influence the successful implementation of EMV-pt.

Studying literature helped to get a better grasp on the factors that can influence the implementation of EMV-pt. The EMV-pt Acceptance Model, generated based on the Technology Acceptance Model and the Information Success Model provides a good overview of factors influencing customer adoption of a new technology. The EMV-pt Acceptance Model shows that there are two moments one can design for the traveller which influences the expected and the experienced qualities. When these qualities are perceived as satisfying for the user it will lead to the acceptance of a new technology.

Because EMV-pt combines the worlds of both the banks as well as transit, there are many existing restrictions and barriers one has to deal with. Although the product of both worlds look very similar, the two sectors connected to them are very different and much has to be done in order to combine these worlds in a natural way. Looking at the

opportunities within this technology as well as keeping a clear overview of the position of this technology in relation to other future developments that will take place is going to be important for its implementation.

When looking at the current developments in the Netherlands and the parties involved, it becomes clear that the implementation of EMV-pt is going to result in a complex cooperation. In order to make EMV-pt a truly nationwide and seamless service, unity is needed in design and service to avoid confusion amongst travellers. The model for EMV-pt that is currently considered for the Netherlands is based on the system in London and as such several issues have already been identified. However there is still a big emphasis on technology and business issues and the user issues are relatively unknown or highly connected to the existing OV-chipcard.

The research abroad in the Czech Republic, Chicago and London shows that there are still many pitfalls when it comes to implementing EMV-pt and that studying these contexts can really help in avoiding them. The Czech Republic gave a good impression on how contactless transactions work in a different context and what it would mean to completely rely on non textual feedback. Results in this country showed that there is little consistency, both in readers as well as in bank regulations, and that it is hard for users to rely on their previous experiences to make contactless transactions.

Research in Chicago pointed out some essential factors that can make the implementation of EMV contactless bank cards in public transport work or not. The complex nature of the working principle of EMV-pt in Chicago combined with the unreliable service and the added costs

travellers have to pay for transfers while using a contactless bank card, resulted in a poor adoption of the technology.

In London EMV-pt has been adopted rather well as an add-on to the system and the contactless bank card is used by both frequent travellers and incidental travellers. Frequent travellers often stated that costs and speed of entering the system influenced their choice to switch to a contactless bank card as carrier in public transport. A big group of EMV-pt users also consists of infrequent travellers using the bank card for various reasons ranging from Oystercard failure backup plan to one time ticket for tourists. Although many fears and doubts were mentioned by interviewees, many people also state that it is a matter of time before they would switch to EMV-pt, a behaviour that matches with the diffusion of innovation model described in the literature study. By making a customer journey map of the EMV-pt service in London, a better overview of expectations, experiences, mismatches and errors travellers experience could be created. Analysis of the EMV-pt service in London made clear that travellers have a large information gap at CiCo points which causes confusion and doubt. The sometimes total lack of one's CiCo status makes it hard for users to use the contactless bank card without making errors. The EMV-pt model of London also relies heavily on previous experience with the Oystercard and rules concerning the use of the contactless bank card are often connected to the existing smartcard making it difficult to find.

Although the implementation of EMV-pt is more successful in London than in Chicago, both contexts still experience many similar problems. Issues concerning consistency could be identified throughout the systems in the areas of information, feedback and design. Service personnel in both contexts lacked the proper knowledge and communication skills and many users exclaimed that control

during their travel was missing when using the contactless bank card.

Using the model created in the literature research an EMV-pt implementation model could be created which shows the factors that influence its acceptance. These factors can help with the design of the Dutch EMV-pt system, making clear how the expected and experienced qualities can be influenced.

9.2 Discussion

For this research a qualitative approach has been taken. This type of research is vulnerable to interview bias, leading questions and skewed interpretation meaning. However the rich information that can be gained with this kind of research and the understanding it provides in the people and the actions they display, made the researcher choose this way of approaching the analysis.

The results gained in this research were gathered by taking interviews, making observations and by personally experiencing the use of contactless bank cards in general and in public transport. Although time for the analysis was limited, the results found were repeatedly observed and further research would probably offer few more insights.

Because the system in London has been visited twice, due to the fact that the current model for EMV-pt in the Netherlands is based on the London model, more results could be gained in this context and a better understanding of the system could be reached.

Even though part of the results were based on personal experiences, insights formed with the results of this data is always backed with data from other sources like interviews and observations.

The contexts in the countries visited abroad and the way EMV-pt is implemented differ in terms of complexity and size with the proposed EMV-t model for the Netherlands, making it impossible to directly link the results. Both London and Chicago deal with a smaller area of EMV-pt use and have a less complicated stakeholder relationship field with which to deal. Apart from these factors the time in which EMV-pt was implemented also greatly

differs, where Chicago implemented it along with the rest of the transportation payment system and London during the introduction of contactless bank cards in general. Next to the way the system has been introduced, the culture of all countries also differs from the culture in the Netherlands and assuming users will adopt EMV-pt in the same manner as they did in Chicago and London is not possible



10 GUIDELINES FOR THE SUCCESSFUL ADOPTION OF EMV-PT IN THE NETHERLANDS

This chapter proposes several guidelines which will help with the successful implementation of EMV-contactless in the public transportation system of the Netherlands based on the research that has been done. These guidelines will form the start of the second phase of this project and will be used to design solutions for the implementation of EMV-pt. The guidelines might however change during the design phase since new information will become available. Using all the findings in this analysis phase, the following guidelines have been formed:

Keep it Simple

Since EMV-pt is a rather complex service regardless of how you implement it, much must be done to keep EMV-pt comprehensible for users in order for them to use it. The focus for EMV-pt should be on the fact that it can be an easy way in the OV system that combines the bank card with public transport. Users will already have enough trouble understanding the difficult mixture of OV and bank rules and adding many features and products to the bank card does not make the use of the bank card more clear. This does not mean the bank card should be excluded from such features (e.g. connecting it to a website, adding seasonal tickets), but the primary focus should be on just entering the Dutch public transport system.

Provide Bank Card CiCo Status Information

Even if it is hard to supply travellers with the same travel information as the OVCP, there is one piece of information that is essential

when using the public transportation system of the Netherlands: A traveller's check-in/check-out status. Since checking in and out is used throughout the Netherlands, a traveller must somehow know if the validation went well and if he/she has the right to be in the paid area of the PTOs.

Ensure Service Personnel is Knowledgeable about EMV-pt

Even if the use of the bank card will be a lot like using an OVCP, the system behind the card and the reasons why errors occur can be fundamentally different. Service personnel needs to be equipped with knowledge to handle problems concerning the bank card and must know more than just the fact that the card is a new method of payment for public transport in order to reassure travellers.

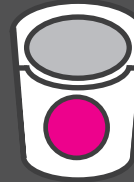
Focus on Incidental Travellers (initially)

The bank card is one of the many new payment methods that will be introduced the coming years, but one thing that makes the bank card quite different from the other future developments is the fact that it is highly accessible for a large group of people. Not only is the contactless bank card something that most people already possess, but it can also be a way to distance oneself from a transit system one rarely uses and does not want to be deeply connected to. The fact that the contactless bank card can provide people with an easy and most basic way in public transport could make it very suitable for tourists and other incidental travellers (as could also be seen in London). This would mean however that the way EMV-pt is

introduced and implemented has to initially be focused on this group in order to get this group to use it and for the system to correctly work.

Make Clear to Travellers Where to find Help

When an operational organisation will be formed to help the users with problems concerning EMV-pt, it is important to position this organisation in such a way that it is logical for users and easy to find. The public transportation system in the Netherlands exists out of many different parties and even though they all share TLS as back office organisation, this connection is not always clear for users.



Stick to One Clear Information Format

As could be seen in Chicago, London and the Czech Republic, information about contactless bank cards is visible in many different names, styles and logos. This makes it hard for users to recognize when information about EMV-pt is displayed and could cause confusion. In order for travellers to get a clear idea how EMV-pt works it is essential to communicate information about this new method of payment in one clear format throughout the different PTOs and banks.



Give Travellers the Control they Need

Travelling while spending money directly from your bank account is an action that can feel unsafe and as such users want to have control over the transactions that they make. Next to spending control, users also express concerns during the interviews in the lack of travel overview that they receive compared to existing travel products. Even though contactless transactions sacrifice some control in favour of speed, added control is needed in order for users to feel comfortable using this technology in public transport.



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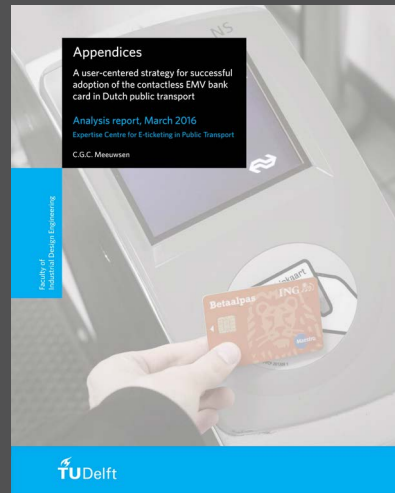
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APPENDICES

The appendices are located in a separate report:



A digital version of the appendices can be obtained at the project website or at the following link:

<http://tinyurl.com/MeeuwsenAppendices>

COLOPHON

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Project

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