Entree

Design vision for user-centred electronic payment in public transport in 2019

J.I. van Kuijk, M.C. Niks, G. Niermeijer, J. Joppien

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Entree

Design vision for user-centred electronic
payment in public transport in 2019

project description - use vision - notes

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Content

Introduction

The OV-chipkaart

The Netherlands is the only country in the world with a national system for electronic payment in public transport: the OV-chipkaart. E-ticketing systems can make travelling by public transport easier and more efficient. After it was introduced, however, the usability of the OV-chipkaart proved far from ideal in a number of respects.

Analysis of OV-chipkaart use

TU Delft's OV-chipkaart Graduation Lab has conducted research into the use of the OV-chipkaart and of two similar systems in Hong Kong and London. The research was carried out by means of extended traveller observations, interviews, surveys, literature research and interviews with experts. This provided greater insight into usability problems and their causes, as well as into opportunities for improving the system.

User-centred design

User-centred design (see Figure 1) is an innovational approach that focuses on the user: first, one considers what the user wants and is able to do; then, based on this, one selects appropriate revenue models and technologies. This was the approach taken by the OV-chipkaart Graduation Lab. The result is a design vision on how the OV-chipkaart should work in 2019, such that the Dutch may become so enthusiastic about it that they will boast about 'their' OV-chipkaart abroad.

Partial solutions

The students developed partial solutions to the problem areas identified in the analysis phase. Within the individual design processes, there was also a constant focus on users and use, and on how the design proposals related to these. The three themes on which the individual students worked were:

- Improving card and travel-product acquisition and the handling of problems
- How to make traveller status visible on cards and smartphones
- The payment border: checking-in and checking-out smoothly.

Integral vision for 2019

Based on the knowledge gained in the analysis phase and during the development of the partial solutions, an integral design vision was formulated for user-centred electronic payment in public transport in 2019.
'Integral' means that the following were considered:

- Electronic payment within the entire travel domain, not (only) in relation to individual transport operators
- All use phases, from purchase to replacement
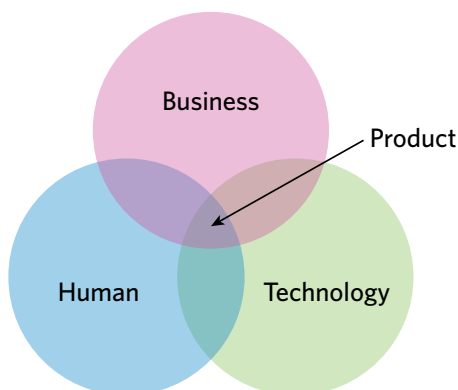- The technologies and commercial conditions needed to transform this vision into reality.

Figure 1: How successful innovations are dependent on achieving a good balance between human aspects, business considerations and technology (visualisation by IDEO).

Project design

Mission

To design an OV-chipkaart that is so user-friendly that the Dutch will boast about it abroad in five years' time.

Project objectives

Primary
To produce a design vision for the ideal OV-chipkaart from a user's perspective, based on an analysis of the strengths and weaknesses of OV-chipkaart use; not only by looking at today's problems, but also by considering the opportunities that will arise tomorrow.

Secondary
To transfer knowledge from TU Delft to partners involved in the field of user-centred product development and the methods used for this.

Project organisation

Implementing organisation
Faculty of Industrial Design Engineering
Delft University of Technology

Coordination
Jasper van Kuijk, assistant professor in user-centred innovation

Implementation
For the most part, the research and designs of the partial solutions were produced by three graduation students:
- Johanna Joppien
- Thijs Niks
- Geert Niermeijer

The integral vision was drafted by Jasper van Kuijk in collaboration with the three final-year students.

Supervision
All three students were supervised by the coordinator and by one of the following content experts:
- Lilian Henze, user research, multi-stakeholder service design
- Erik Roscam-Abbing, strategic co-creation and value-based design
- Bart Gerritsen, interactive technology and system design

Partnerships
The following partners participated in the project. Each of the partners appointed a contact person:
- Dutch Ministry of Infrastructure and the Environment/Permanent Structure (in formation): initially Zuhal Gul, taken over by Femke Buitenhuis and Anneke van Dorp
- IPO: Nienke Broekema, mobility advisor
- SkVV: Eric Köhler, senior policy officer for public transport
- ROVER: Tim Boric, policy officer
- Dutch Railways (NS): Joost Mortier, OV-chipkaart programme director
- RET: Wilko van Oosten, BBE senior advisor

Roles and financing
The initiative for the project was taken by TU Delft. The Ministry of Infrastructure and the Environment provided the financing and the assignment. RET and Dutch Railways (NS) made a financial contribution in order to participate. The other organisations participated 'in kind' only.

Analysis of OV-chipkaart use

At the start of the project, research was conducted into use of the OV-chipkaart and of two similar systems in Hong Kong and London. This was done by means of extended traveller observations, interviews, surveys, literature research and interviews with experts. The results of the analysis were also captured in a short video.

Summary Analysis Report

The analysis consisted of:
- A literature review of the models and theories relating to ease-of-use, (user) acceptance of new technologies and systems, technology-based self-service and innovation in networked organisations.
- Based on the literature and expert interviews, an overview was provided of the history, system design, stakeholder organisation, user operation and market introduction of the OV-chipkaart.
- An overview of existing studies on use of the OV-chipkaart and the strengths and weaknesses that these identify.
- An analysis of use of the OV-chipkaart based on:
  - Observational research in public transport
  - Interviews with travellers
  - The keeping of travel diaries
  - Exploration by the researchers
- An analysis of the use, context, system architecture, key principles and introduction of e-ticketing systems in London and Hong Kong, based on:
  - Expert interviews
  - Observational research in public transport
  - Interviews with travellers
  - Exploration by the researchers
- Based on a comparison of findings in the literature, existing studies and the researchers' own field research in the Netherlands, Hong Kong and the United Kingdom, an overview was given of the strengths and weaknesses of the OV-chipkaart from a user's perspective. These were visualised in a 'customer journey'.
- In conclusion, the report outlines interaction principles for future user-centred e-ticketing solutions, as well as descriptions of the three graduates' individual assignments.

The OV-chipkaart: usability problems

The main usability problems of the OV-chipkaart are as follows:

Mental model
The concept underlying the OV-chipkaart – the 'mental model' that travellers need to learn – is more complex than it was in the past. Check-in and check-out, the credit balance, travel products: all are new concepts, and not everyone understands this.

Exploring new possibilities
for user-centred e-ticketing

Analysis report, March 2013
OV-chipkaart Graduation Lab

J. Joppien, G. Niermeijer, M.C. Niks, J.I. van Kuijk

Faculty of
Industrial Design Engineering

TU Delft

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Card purchase
Some travellers are unsure about where and how they need to purchase an OV-chipkaart — something that can be done in various ways, in a number of places. Once they have applied for a card, travellers have to wait too long to receive their personal card, and in some cases they also have to 'activate' the card or desired travel products.

Choosing a travel product
The different transport operators offer a large number of travel products. Travellers find it difficult to select the right product from these.

Too few benefits
Some travellers believe that the system does not offer enough benefits, in view of the effort needed to learn the system and purchase a card.

Checking in and checking out
When the travel domain is not closed off by gates or there is no-one to remind them, travellers sometimes forget to check in and check out.

Inconsistent touchpoints
Many of the devices, websites and people that OV-chip-

3

kaart users encounter – the touchpoints or 'touchpoints' – behave differently, despite having the same function. Travellers see the OV-chipkaart as a national system and expect the same rules and behaviour to apply everywhere. As well as being inconsistent, the terminology used is often unclear.

Invisible information

The old paper tickets displayed a lot of information: for example, whether your ticket was valid or not, the class in which you were permitted to travel and whether you were travelling with a discount. With the OV-chipkaart, this kind of 'status information' is invisible to the user, and this creates uncertainty among travellers.

Solving problems

When a traveller encounters a problem, the system does not give sufficient indications as to what is happening and how to solve the problem. Often, travellers do not know which organisation to turn to for help.

Travellers' characteristics

The user research revealed three characteristics of travellers that appear to influence the quantity and severity of usability problems (see Figure 2):
- Travel frequency: people who travel more frequently have more established routines and a better knowledge of public transport and the OV-chipkaart, and therefore experience fewer problems.
- Number of transport operators: the more operators a traveller encounters during a journey, the higher the chance of usability problems.
- Understanding of technology: as a rule, people who have more experience with digital systems generally encounter fewer problems with the OV-chipkaart.

Background to the problems

Some of the usability problems can be put down to the fact that the OV-chipkaart is more complex than similar systems in Hong Kong and London, for example. The system in the Netherlands:
- Covers a broader geographical area;
- Involves more transport operators and related agencies;
- Has more subscription/season-ticket types, and
- Is a non-closed system, for the most part.
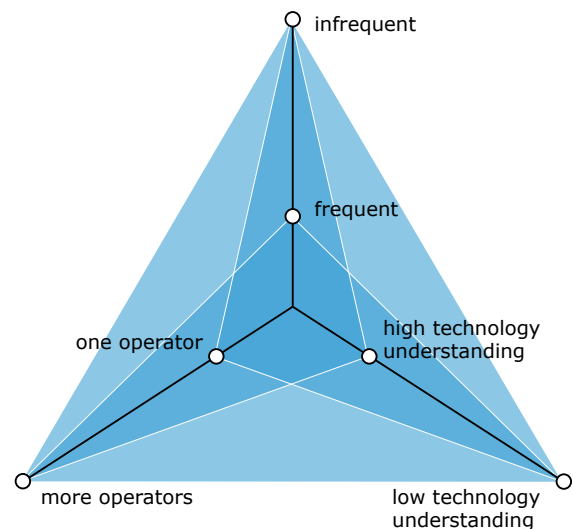
Figure 2: The three user characteristics that seem to have the most influence on the number of problems experienced by travellers.

In addition, when making design choices, more attention was paid to technology and commercial considerations than to usability.

Acceptance of technological innovations

From the literature, we know that users are more ready to accept technological innovations such as the OV-chipkaart if they:
- Offer clear benefits for the user and
- Are simple to understand, purchase and use.

If this is not the case and users are forced, not encouraged, to use a new system, a high degree of resistance may develop.

Partial solutions

The students developed partial solutions to the problem areas identified in the analysis phase. In order to explore their individual problems, they carried out more observations of and interviews with travellers. Together with the results of the analysis phase, this produced user requirements for the partial solutions, which were then used to generate solutions. These were subsequently evaluated (a number of times) with users. In addition, the partial solutions were also evaluated with experts from the parties participating in the project, as well as a number of experts from other transport operators and organisations.

Improving card and travel-product acquisition and the handling of problems

Johanna Joppien

The aim of this partial solution was to improve adoption of the OV-chipkaart, by making it easier for users to:
1) Apply for an OV-chipkaart and activate travel products, and
2) Obtain assistance when problems and questions arise.

In order to obtain a deeper and clearer insight into the usability problems, the following forms of user research were carried out:
- A workshop focusing on users' expectations of the process of purchasing an OV-chipkaart and a comparison of these with the actual procedure
- User research and an interview in which we went through the entire application procedure with participants who did not yet have an OV-chipkaart
- A survey on travellers' reasons for purchasing anonymous or personal cards.

This research produced the following user requirements:
- Users should be better informed about how the OV-chipkaart works, where and how they can apply for a card, and which travel products are available.
- An online advisory module should be introduced to help travellers choose the right travel product.
- Travellers should be able to use cards and travel products immediately after purchase. In order to achieve this, activation (of travel products) and the initial purchasing of credit should be avoided, and people should be given a temporary card immediately after applying for a personal OV-chipkaart.
- In order to make travelling in the train domain easier, a single check-in/check-out process should be introduced.
- Missed check-outs should automatically be resolved by the system.
- The differences between anonymous and registered cards should be clearer.
- The cost of purchasing an anonymous card should be lower.

Based on this research, an application procedure and helpdesk were developed that could respond to travellers' needs. Subsequently, three organisational scenarios for
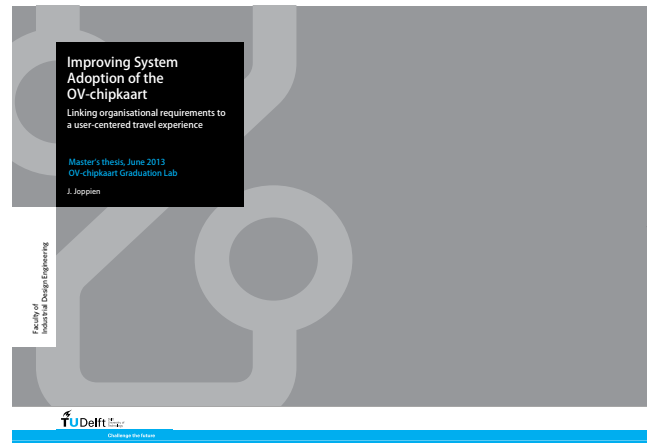
the OV-chipkaart were drawn up:
- The platform: a decentralised approach, in which the OV-chipkaart provides transport operators with a technological platform on which they can implement a version of the OV-chipkaart that is appropriate for them.
- The polder: in this scenario, interaction with the system is made easier and more coherent by introducing a facilitating party that attempts to coordinate with all parties involved with the OV-chipkaart.
- The authority: in this centralised approach, one leading agency ensures that all user aspects of the OV-chipkaart are simple and coherent.

The user preferences and the organisational scenarios, as well as the links between the two, were evaluated with experts from the project partners (as well as a number of other experts). The desired user experiences were endorsed, as a rule, and the 'authority' scenario was described as the most probable scenario for being able to achieve this successfully. It was noted that it would be essential to involve the transport operators, and that elements of the 'polder' scenario should thus be introduced. This final scenario was known as the 'balance of forces'.

Making traveller status visible on cards and smartphones

Thijs Niks

The aim of this sub-project was to make the information that used to be visible on paper tickets (such as validity, class, and travel product), and that became invisible to users with the introduction of the OV-chipkaart, visible again. The aim was to do so for as large a group of travellers as possible, thereby increasing travellers' confidence and comfort levels.

In order to gain a better insight into travellers' information needs, interviews were conducted with participants as they travelled, at home and at a train station. This produced the following user requirements:
- Provide insight into: ticket validity (checked-in or not), the cost of the last trip, subscriptions/discount products, and — ideally — an individual's travel history.
- Increase the level of transparency for those who travel less frequently, because this group has the most difficulty with the current lack of status information.
- Allow travellers to access status information during the entire journey, because a need for status information can arise at any time during a journey.

In addition to the user requirements, the researcher investigated the current state of the necessary technologies: passenger identification, data communication between validators and 'cards' (passenger identification modules), visualisation of information for users, and energy storage. Based on user requirements and the available technology, three solutions were generated and evaluated:
- A 'keyring' that can be used to read the OV-chipkaart;
- A smartcard with an integrated display;
- A smartphone that can be used to read the OV-chipkaart;
- A smartphone that communicates directly with the OV-chipkaart infrastructure.

These solutions were presented to users in the form of draft prototypes. During the evaluation with the users, the smartcard with the integrated display and the smartphone that communicates directly with the OV-chipkaart infrastructure proved the most attractive options.

Most people who have a smartphone would like to use their phone to check in and check out. This is not the case, though, for those people who do not use smartphones, as well as for some smartphone users. The latter have a stronger preference for the display card.

The display card and an app that allows travellers to check in and check out using a mobile phone were therefore developed further and evaluated once more with users. As the app involved the most uncertainties in terms of interaction, this was developed in more detail.

The researcher looked for an app design that could be realised in the short term. The solution is a design that uses a QR code to identify travellers at access gates and poles with a barcode scanner.

Making the Invisible Visible
Increasing travellers' trust in electronic ticketing for public transport by making ticket information visible during the journey

Master's thesis, September 2013
OV-chipkaart Graduation Lab

M.C. Niks

Faculty of Industrial Design Engineering

TU Delft

Challenge the future

The payment border: a smooth check-in and check-out process

Geert Niermeijer

This sub-project focused on the following interaction problems:
- Travellers do not recognise 'OV-Chipkaart moments' because validators and gates vary in location and appearance.
- OV-chipkaart's touchpoints as a whole do not form a single, coherent service.
- The appearance and behaviour of the touchpoints are often different; screen layout, the terminology used and audio-feedback vary.

The aim of this sub-project was to design a smoother check-in and check-out process in the three travel domains (train, tram/bus and metro), to reduce the cognitive burden presented by checking in and checking out, and thereby to reduce the number of cases of people failing to check in or check out.

An analysis was carried out of the functions, user interface of and interaction with all the equipment with which OV-chipkaart users interact, and the main usability problems for each touchpoint. In addition, during observational studies in the three travel domains, we looked at the structure of the check-in/check-out zone and the behaviour of users within it. Finally, the researcher spent six months filming and analysing his own interactions with access gates and poles.

This analysis was used to create an overview of the phasing of all operations (at the micro-level) that take place during check-in and check-out: the 'check-in and check-out flow'.

This provided the input for a draft proposal for a 'payment border'; a design for a transition zone in which travellers cross a border from public space to (paid) travel space, where they need to identify themselves and pay (check in or check out). The transition comprises three phases:
1. Orientation and recognition
2. Information and support
3. Validation.

The principles of the payment border can be applied to open payment borders (poles), closed payment borders

(gates) and in vehicles. The open payment border posed the greatest design challenge and thus the decision was made to develop a design for this type of border. The concept was evaluated with users by means of a scale model, an interactive physical prototype and screenshots, which were then used to optimise the design.

This resulted in an open payment border that:
- Is easily recognisable at a distance, thanks to the portal, consistent placement within stations and OV-chipkaart branding;
- Facilitates the validation step, thanks to the adjusted measurements and designs of poles and gates;
- Gives clear feedback, thanks to the adjusted screen layout and messages on poles and gates;
- Clearly communicates the rules of the OV-chipkaart system;
- When problems occur, gives users a clear explanation and helps travellers to find a solution.

Related projects

Within three disciplines at Industrial Design Engineering, students carried out research into and produced designs for (parts of) the OV-chipkaart.

Usability and User Experience Assessment (in coopera-tion with Dutch Railways)
Evaluation and re-design of:
- Feedback on and solutions to check-in problems;
- Purchasing and activation of digital services;
- Suitability of existing ticket machines for OV-chip-kaart services.

Inclusive design (in cooperation with the Ministry of Infrastructure and the Environment)
Re-design aspects of the OV-chipkaart for people with disabilities (dementia, low literacy levels, mental disabili-ties and visual impairment).

Interactive audio design
Evaluation and re-design of the sounds produced by poles and gates in different contexts (train, bus, tram and metro).

Integral design vision: Entree 2019

Based on the knowledge gained in the analysis phase and during the development of the partial solutions, an integral design vision was formulated for user-centred electronic payment in public transport in 2019.

Objective

This design vision is by no means a definitive design. It is intended as a starting point for an iterative design process involving all the necessary fields, looking at how people want to pay in public transport and how this could be realised. This vision arose out of extended traveller observations, in consultation with a large number of experts within the organisations involved. In order to avoid usability problems such as those surrounding the introduction of the OV-chipkaart, when improving systems and innovating, we need a good understanding of how people want to use a system – something to which this vision contributes.

Framework conditions

Ambitious yet realistic
The objective was to produce a vision of a user-friendly electronic payments system for public transport, with elements that could be established in the coming five to ten years. Desired use formed the central focus when developing the vision, but commercial and technological framework conditions were also taken into account. The objective was to produce an ambitious yet realistic proposal.

Improving and reforming the existing system
The decision was made to build on the existing OV-chipkaart system and use pattern. The current system suffers from a number of fundamental usability shortcomings that should be eliminated. The focus of the project was thus on the short to medium term. Partly due to the complexity of the system and the lifetime of the touchpoints, system changes are adopted at a relatively low rate. As a result, a radical re-design was considered unfeasible in the short or medium term (five to ten years). One could also question whether it would be desirable, from a user's perspective, to force travellers to learn how to work with a new system within a relatively short period of time. With some modifications, the user-centred process that we followed could also be implemented to produce scenarios for a more radical re-design.

Exclusion of contactless payment
Various parties in the Netherlands and abroad are working on the development of contactless payment using bank cards and mobile telephones. Although this is a development that could be combined with payment in public transport, it is currently unclear as to which technologies

and parties will become dominant or what the standard will be. However, the use principles of the system outlined in the design vision should be applicable if contactless payment is also brought into use in public transport.

Structure of the vision

The vision is set out below. In each section, we first formulate the vision for use, after which we explain the underlying technologies, revenue models, challenges and potential alternatives. The use of Entree has also been visualised in a short film.

The vision consists of the following elements:
- Uniformity: how Entree is a coherent service, due to the introduction of one strong brand, the harmonisation of online and physical service-points and having one publisher of keys.
- Keys: description of the various types of identification and payment (keys) that can be used by travellers.
- Purchase of keys: where and how users/travellers can apply for and receive keys, the choices they have when doing so and how these are set up.
- Purchase of travel products: how travellers are helped to choose the right travel product and how this is linked to a key.
- Touchpoints: how simplicity and consistency are achieved at all of the touchpoints with which travellers interact.
- Check-in and check-out: how it is ensured that travellers are no longer able to forget to check-in or check-out.
- Problems and questions: how to communicate with users when problems arise.
- Communication: where and how the functioning and advantages of Entree are communicated, and about the introduction of the Entree brand.

entree

for payment in public transport

The year is 2019. Many aspects of the original OV-chipkaart have been improved and developed. Under the name 'Entree', people have become fully accustomed to electronic ticketing in public transport.

Uniformity

One brand
Entree has become synonymous with payment in public transport, wherever and whenever, across the whole of the Netherlands. Whatever might be happening behind the scenes and regardless of the parties involved, the user interacts with one helpful, ambitious and recognisable service.

One service-point (online and physical)
Users always know where to turn to for services, because:

- There is one central website for all Entree-related matters, such as applying for a card, selecting and purchasing travel products, questions and complaints, missed check-in/check-out and trip summaries.
- All transport operators' service desks feature an Entree terminal where staff can add travel products, change settings and solve problems.
- Travellers can use all transport operators' service machines to change their Entree settings and purchase services.

One key supplier
All keys (in card or app form) are published by the Entree consortium. Individual transport operators no longer publish cards with specific/different settings, meaning that travellers are no longer confronted with different activation procedures. The cards' appearance has also been harmonised; there is only a limited number of graphic designs, all of which feature the Entree design.

Uniformity

Travellers see the OV-chipkaart as a national system and expect the rules and interactions to be the same everywhere. Although in the original design it was intended that Trans Link Systems (TLS) would play more of a background role and that transport operators would focus on developing touchpoints and maintaining client contact, in practice this did not add to the user-friendliness of the system. Fragmentation and inconsistency at service desks, ticketing machines and in the range of travel products proved to be detrimental to travellers. Entree has therefore been designed as a single integral, coherent, user-centred service for payment in public transport.

One service for travellers and transport operators
Achieving a coherent and consistent service requires cooperation with the parties involved, but also leadership. The parties involved must have a voice within the Entree consortium, but it must also be possible to take decisions that benefit the quality of the service as a whole, even if these have some adverse implications for one or more of the organisations involved. In order to run a user-friendly, successful service that is supported by stakeholders, it is important to take the interests of the organisations involved into account. Above all else, however, the lead organisation should be aiming for a good product, meaning that travellers' interests should be its key priority.

In the current set-up, all transport operators develop their own hardware, back-office and software, despite the fact that this does not really allow them to distinguish themselves from the competition. This also has a negative effect on the coherence and consistency of the system for payment in public transport. It would therefore be interesting to explore whether Entree could become a shared service, both for and made up of all of the transport operators. For every transport operator that has a concession in the Netherlands, the Entree consortium will ensure that the right equipment is purchased, installed and maintained.

One service-point
Developing a single central website requires coordination and leadership. The Entree consortium must be given access to all of the transport operators' travel-product overviews and travel data. All of the transport operators' service vending machines will have to be adapted so that they can facilitate all Entree operations. The software of all of the vending machines will therefore need to be changed, and some machines will also require changes to the hardware and the back-office.

All transport operators' service desks will require an Entree terminal, and their staff will need training in order to operate it. A settlement system will need to be introduced, providing for the reimbursement of transport operators whose service desks and machines handle Entree-related matters or problems that have arisen at a different transport operator.

Keys

In order to use public transport, travellers need a key that allows them to pay and enter the travel domain. Keys have the following functions:

- Storing travel products
- Saving settings
- Authorising payments
- Giving travellers access to the travel domain
- Giving feedback to users

Display card and app
Entree offers two kinds of keys that give users clear feedback on their status, wherever and whenever, meaning that they can feel relaxed and confident when travelling:

- The display card: a smartcard with a large e-paper screen that shows all of a traveller's status information.
- The Entree app: allows travellers to check-in and check-out using a smartphone, view their traveller status and travel history, and purchase new travel products on the spot (class, surcharges).

Single tickets
Travellers can also use single tickets in all modes of transport, meaning that public transport is always accessible to everyone at all times, including occasional travellers; tourists, for example, or car drivers, or travellers whose keys are lost or defective.

Basis of Plus
On both the card and the app, travellers can opt for a basic (Basis) or enhanced (Plus) level of service. Plus covers more advanced travel products, such as season tickets or subscriptions for particular routes, which can be linked to an individual. The key therefore needs to be registered in order to access Plus services.

Complementary: the display card and app
The fact that travellers are unable to view their status information is one of the main problems with the current OV-chipkaart. The user research conducted for this project revealed that some — but not all — smartphone owners would like to be able to check in using their telephone and to be able to view status information on their phone. Not all of the smartphone owners who participated in the research expressed this need, however, and in addition, the current state of the technology would not permit users to check in using their phone in the way they envisage. We therefore suggest that in addition to the longer-term introduction of a system that would allow travellers to check in using smartphones, a smartcard with a display is also introduced.

Visual checks
One interesting side-effect is that because these solutions would make the status information visible again, conductors would be able to make visual checks once more — which are also quicker and more humane.

Development of the display card
A display card with an LCD display, which could be introduced in the short term, could show whether the user had checked in or checked out, the basic fare, the balance on the card and the cost of the last journey. The technology needed to produce a display card with a small LCD display is available. It is estimated that it should be possible to introduce the first display cards in the Dutch system in one to two years. The great advantage of the display card is

that it would not necessitate any changes being made to the existing OV-chipkaart infrastructure, and Entree would not be dependent on other parties for its introduction and development (this would be the case for the smartphone). Depending on the speed of technological developments, it should be possible to introduce a smartcard with a (large) e-paper display in four to five years.

The greatest challenge for the introduction of the display card appears to be the financing model. It is estimated that the extra cost (production, distribution, analysis, etc.) of the display card, compared to that of the current cost, would be around €7.50. When we evaluated the display card concept with consumers, we asked them what they thought the extra cost of a card such as this would be. Although consumers appeared to expect the extra cost to be higher than it actually was, once the extra cost had been revealed, they were unable to say whether they would actually buy the display card for that price.

Assimilating the extra cost into the purchase price could form an additional barrier to acceptance of the system. In addition, there is the question of whether it is right for travellers to have to shoulder the additional cost in order to rectify a design fault in the existing system (the lack of status information). Alternatives would be to assimilate the extra cost of the display card into the transaction costs, or to use the anticipated price fall resulting from the introduction of the app at a later point (the app would not
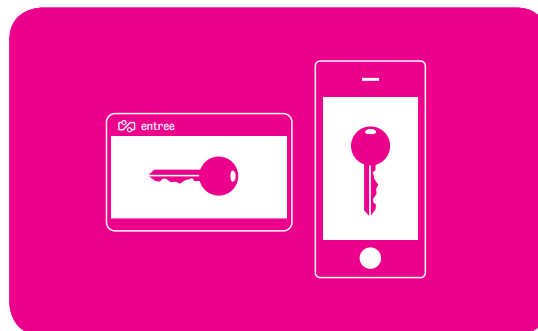
have to be manufactured and distributed physically) to aid the development of the display card. This would require Entree to take an integrated approach to the cost of the keys.

Development of check-in with a smartphone
This is a very common subject, both among those who are working on the development of the system and among users. If people indicate that they want to check in using a mobile phone, though, it is important to find out how they want to do this. In the research that we carried out, people said that they wanted to be able to check in simply by holding their mobile phone to a validator, i.e. like they currently do with the OV-chipkaart. This would not be possible with the OV-chipkaart's current technological platform and the technology commonly used in mobile phones.

At present, the most logical protocol for establishing communication between the OV-chipkaart system and mobile telephones would be near-field communication (NFC). The current generation of validators and NFC chips are unable to communicate with one another, however. Moreover, only ca. 13% of smartphones contain an NFC chip. Whatever solution is chosen for check-in using a smartphone, we should ensure that this solution does not benefit a small group of smartphone users alone. It is not enough for a manufacturer to include a specific chip in a mobile telephone. If travellers who want to check in with a mobile telephone are forced to purchase a telephone from a particular brand or even a particular phone type, this will probably lead to resistance. In all likelihood, the technological solution that is chosen will therefore have to use commonly supported and implemented standards.

There are two key problems with finding a technology that can establish communication between the OV-chipkaart system and mobile telephones. First, TLS has no control over one essential part of the necessary ecosystem, namely smartphones. Second, the development cycle and lifetime of smartphones is much shorter than that of the equipment used in the OV-chipkaart system. The lifetime of a mobile telephone is around two years, whereas that of the OV-chipkaart equipment is around eight years. The manufacturers of mobile telephones can therefore incorporate new technologies much more quickly, as well as phase out old technologies.

Check-in with a mobile telephone would appear to be a highly logical development, though, which some travellers would consider extremely desirable. For interaction to take place as envisaged by users, mobile telephones would have to have an integrated payment circuit that is always on stand-by to register desired payments. In addition, this integrated payment circuit would have to be able to communicate with Entree's equipment.

A pro-active approach will be needed in order to ensure that the necessary infrastructure is in place by 2019.

Potential new technologies and standards for contactless payment should be mapped out and their development followed. It would also be desirable to form a consortium, together with other organisations that have implemented e-ticketing systems (for example, from London, Hong Kong, Denmark, etc.). This consortium could ensure that the new contactless payment standards also provide a satisfactory basis for payment in public transport. Cooperation on this issue could likewise be sought with banks, which are also developing new standards for contactless payment.

In the run-up to 2019, check-in using mobile phones could be introduced in phases. If the new-generation OV-chipkaart were to offer a second 'communication channel' that allowed smartphones to communicate with the telephone, a chip could be provided that could be affixed to the phone (inside a cover or sticker, for example). The chip would communicate with the OV-chipkaart system and the telephone would then read the chip. The size of the user group that could access this solution would depend on the protocol of the new chip and on how many mobile telephones were compatible with it. In addition, as a pilot in environments where barcode scanners are present in addition to RFID readers, we could experiment with checking in with an app that uses QR codes to check in and check out. Both the telephone/card combination and the QR-code app offer stakeholders the possibility of developing the app in exploratory fashion, so that when the desired technology becomes available, the necessary designs and knowledge are there to roll out the app more broadly.

Single tickets
Single tickets will probably entail higher transaction costs for transport operators than travel with a key, because a single-use key has to be issued. In this regard, it would be justifiable to set the cost of travelling on a single ticket slightly higher than that of travelling with a key. It would be even more user-friendly, however, if users were encouraged to switch from single-tickets to travelling with a key, on the grounds that the latter brought benefits to the user.

Contactless bank cards
Banks and other parties are currently developing contactless payment methods, which are used in bank cards and mobile telephones. Given that the OV-chipkaart is a system of contactless payment in public transport, it would seem a logical step to make Entree suitable for contactless bank cards, too, as is already the case in London, or even to use this as a new technological platform. This research did not consider these options. Adjustments to a technological platform, however, should never undermine the quality of the interaction. Should this option be explored, it would therefore be important to test whether the intended system could meet the user requirements identified in this research. A technological infrastructure that facilitates user-friendly interaction needs to be able to do more than handle payments alone. It is doubtful, for example, whether contactless bank cards could provide the desired

visual feedback or store travel products.

In the vision outlined for 2019, contactless bank cards could present an interesting option for ad hoc payment (single tickets) and travelling without travel products, assuming that contactless bank cards and Entree's technological platform are harmonised with one another.

Basic or enhanced services: key registration
The Entree system is no longer based on an anonymous card and a personal card. At the user's request, services such as transaction summaries can be linked to the user's current anonymous OV-chipkaart, meaning that the latter is no longer (entirely) anonymous. 'Anonymous' is therefore perhaps the wrong term for this card. In addition, the terms 'anonymous' and 'personal' do not capture the differences in terms of use at the service level. With Entree, instead of an anonymous or personal card, travellers can opt for an enhanced ('Plus') or basic ('Basis') level of service, both on the app and on the card. Plus services are those travel products and forms of payment for which Entree or transport operators/staff need to know the identity of a traveller and where they live. Examples include travel on account and season tickets and subscriptions for particular routes, which are linked to an individual.

The basic card and basic app are options for travellers who prefer not provide any personal data. Single tickets are an option for users who want to guard their privacy more closely, although these are more expensive and it is less efficient to have to purchase a ticket every time.

Purchasing a key

Travel immediately after purchase
Users can use a card immediately after purchase, regardless of whether it was bought from a service desk or a vending machine. The app can be made suitable for travel immediately after download. In addition, all purchased travel products work immediately.

Cost
The user pays a deposit for the card and the app can be downloaded for free. When purchasing a card, the traveller is asked separately how much initial credit they would like to have on the card (in doing so, they are informed about the amount of credit needed to travel using the various modes of transport).

Key migration
If a user gets a new card or if they switch from the card to the app, all travel products, settings, credit and options are transferred automatically and free of charge, once the traveller has given their authorisation.

In order to encourage system adoption, it is important that the traveller is given a working key at the time when he/she is making a journey. The key principle is that we should minimise the amount of time and effort taken to apply for, purchase and activate a key. Having to purchase or replace a card must not form a barrier to travel on public transport. The options for topping up keys (in order to pay) will determine the user-friendliness of electronic payment in public transport. The more ways that people can add credit to a key, the more accessible the system will be.

Initial credit balance and activation of payment method
This relates to how we ensure that the card can be used to pay for a journey. There are three methods of payment:
- Top-up credit balance. This can be done with both the app and the card at vending machines and service desks, using a debit card or credit card (for foreign travellers). There should always be at least one vending machine present where keys can be topped up with cash. Keys can also be topped up using debit cards and cash in shops that have an Entree terminal.
- Automatic top-up. This is available for basic and enhanced (Plus) keys and can be activated at vending machines, service desks, via the Entree website or within the app. At service desks and vending machines, a current account can be linked by means of a debit card and PIN code. On the Entree website and in the app, this could be done via internet banking;
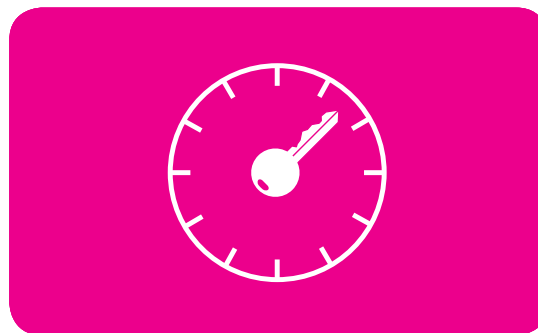
this would probably require agreements with banks.
- Travel on account. For this option, the traveller has to identify themselves, authorise Entree to withdraw amounts from a current account and provide an (email) address for billing.

Visual identification
One important question is whether keys should contain a passport photo, allowing for visual identification (in the case of a discount product). Visual identification introduces two complicating factors. First, the traveller will need to provide a passport photo or be photographed. Second, the passport photo will need to be visible when the key is checked by the conductor, and it will thus need to be on the key or on the checking equipment.

We can distinguish three main scenarios for visual identification:
- A passport photo on the key (on the Plus card and Plus app). A passport photo should be added in situ, so that travellers can take their cards with them straight away. In the case of the OV-chipkaart, the need to have a passport photo proved a barrier to travellers purchasing a personal card, so the photo should ideally be scanned from a person's ID card or taken on the spot. It should also be possible to print the passport photo on the card in situ (personal details can be displayed on the card's e-paper display), which would probably limit the issuing of cards to

15

medium-sized and larger stations and stops.

- The conductor can see the passport photo of the traveller. In this scenario, too, being able to issue a card immediately would mean adding a passport photo in situ. In addition, it would necessitate having checking equipment that had non-stop access to all travellers' passport photos, whether locally or via a network. It is likely that there would be (possibly strong) privacy-related objections to this.
- Keys without photo identification. Although this could give rise to the objection that it would be possible for people to travel using other people's personal travel products, it would make the issuing of tickets very flexible and wide-ranging, as this would be possible at every station or stop that had a vending machine.

Application and delivery

There are three environments in which users can apply for keys:

- At stations and stops (at service desks and vending machines);
- On the Entree website;
- Via a smartphone (app stores).

Once they have applied, travellers must be able to travel using their key as quickly as possible. Travellers who apply for a card at a service desk or vending machine will receive it immediately. The app can be downloaded and activated immediately at any time. People who apply online for a card at home, via the Entree website, receive the card at home in two days' time. This delay is not considered to be problematic, because a traveller in a hurry always has the option of obtaining a card from the service-desk at the station.

Travel products immediately ready for use

In order to ensure that travel products are immediately ready for use, they can:

- Be put on the key at service desks and vending machines;
- At validators, be put on the key by a smart back-office;
- Be downloaded by a smartphone (in the case of the app; this will not work if there is no network).

The cost of keys

The user research found that users considered the initial cost of the OV-chipkaart to be too high. This appeared to be a barrier to purchase and to have a negative effect on perceptions of the OV-chipkaart ('I'm forced to spend €7.50'). Keys are not an end in themselves, but a means of gaining access to public transport. From a traveller's perspective, it seems strange to have to pay for the card itself (and not for the right to travel that it represents). For this reason, it would seem advisable:

- To distinguish between the purchase price of the card and the initial credit balance that is needed, and to communicate this clearly to customers.
- Not to sell cards any more, but to have customers pay a deposit for them.

Purchasing travel products

Streamlining the range of travel products
As a minimum, all transport operators should offer the same modular package of travel products. In addition, they can offer products that they have developed them-selves.

The right price for every trip
The Entree website offers three ways of helping travellers to select from the wide range of travel products:

- **Travel on account:** at the end of the month, the traveller's trips are analysed and the most economical travel products (discounts, subscriptions) are selected with retrospective effect.

- **Subscription advice:** the most economical package of travel products is compiled, based on previously submitted travel needs. This offers even better value than travel on account.
- **DIY:** an overview of all travel products, allowing customers who want complete control to select their own travel products.

In addition, travellers can opt to receive periodic advice on the most economical travel products for them, based on their travel behaviour.

Ad hoc activation of travel options
Frequently used ad hoc travel options (for example, 1st/2nd class, dog surcharge, IC+) can be purchased by holding the card against a special activation pole.

Travel products portfolio

Due to the large number of transport regions and transport operators, at present it is very difficult for users of the OV-chipkaart to get a clear idea of the existing travel product options and corresponding prices. It would therefore seem advisable to have a national standard range, which is standardised in terms of the travel products' names and features. Within the current decentralised concessions system, however, we see few possibilities for clarifying the range of products. We also think that it would not be desirable to standardise the range of travel products completely, because this would prevent transport operators from responding to specific needs in a particular region or developing new, innovative travel products. Moreover, although payment using Entree in public transport will be harmonised as far as possible, we think that transport operators should be allowed a certain degree of freedom when developing travel products.

Travel product selection

If the range of travel products is not streamlined, it will be necessary to help travellers gain a better insight into the options and prices. In addition to Travel on Account, which offers a high degree of convenience for a reasonable price, at the Entree website it should also be possible to get advice on which travel products would be the best options (in terms of journey time, transfers and price) based on previously submitted travel needs. Importantly, this advice module should provide neutral and reliable travel advice. Research should be conducted into which organisation would be best suited to this. Obvious possibilities would

be for Entree to develop this functionality itself, or, in view of its current activities, 9292 might be able to offer this functionality within the Entree website.

Periodic travel product advice

As a traveller's travel details are known to Entree, it should be possible to obtain advice on the basis of actual travel behaviour. Although travellers would probably value this option, it is also highly likely that some travellers would object to this for privacy reasons. It could be investigated whether travellers would consider travel product advice based on an analysis of travel behaviour to be a desirable option, and if so, how it should be communicated. In order to implement this option in a way that would be useful for travellers, the latter would probably need to be able to take out travel products for shorter periods.

Activation of ad hoc travel options

The service vending machines will need to be able to carry out many operations, and they will therefore have quite an extensive menu structure. This means that on occasions, interaction with a service vending machine will take some time. It could be investigated whether frequently used and simple travel options could be put on a key using special activation poles. Travellers could convert a key from travelling first-class to travelling second-class, for example, by holding it against a special validator.
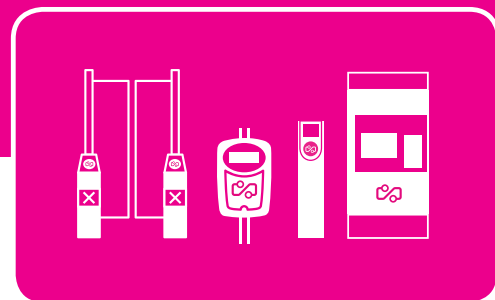
Touchpoints

Consistent and user-centred
All of the equipment that travellers use – the touchpoints – is consistent in terms of its physical appearance, screen layout and feedback. Travellers are able to understand the terminology used, visualisations and audio-signals.

Personal characteristics
The behaviour of the touchpoints can be adjusted to a user's personal characteristics. For example, a user can select communication in English or Dutch, or indicate that he/she has an impairment, such as:

- **A visual impairment**
- **Hearing loss**
- **A mental disability**
- **A low level of literacy.**

All interactions with the user are adjusted in line with the selected personal characteristics.

Consistency

Every new touchpoint that behaves in a different way requires the traveller to make a new investment in learning how the equipment works. In addition, it is hard for travellers to develop routines if touchpoints do not behave consistently. It is easier to verify whether you have checked out, for example, if the audio feedback, screen layout and screen design are always the same. If all Entree touchpoints have the same design, travellers will feel more confident that they can operate the system correctly following their normal routines. In this vision, we assume that the Entree consortium would cover the development, purchasing, installation and maintenance of all touchpoints.

In order to ensure that the appearance and behaviour of the touchpoints are consistent, it will be necessary to look at how touchpoints should be developed and purchased. It would be possible to harmonise the appearance and behaviour of all touchpoints of one type (for example, validators) by choosing a single supplier. If the appearance and behaviour of all touchpoints have to be harmonised, however, there will need to be standards and specifications; design guidelines for touchpoints. Another powerful tool would be to have all touchpoints developed by the same organisation.

For competition reasons, it would also be possible to choose a number of suppliers, including for each type of touchpoint, and to try to harmonise the touchpoints using standards and specifications. It can be difficult to capture user experiences in specifications in advance, however, especially in the case of an ecosystem that contains many touchpoints.

User-centred

In addition to consistency, user-centredness is a major issue. Even if a term or operation has been implemented extremely consistently across a whole system, it can still be incomprehensible to users. It is therefore important to design all terms, visualisations, sounds, screen layouts, etc. in a user-centred way, and to evaluate them with users before implementing them.

Language

The Netherlands receives many tourists and foreign business travellers. Although we did not consider this target group specifically in this project, it became clear that it would be extremely desirable for foreign visitors to have, at the very least, the option of communicating with the system in English. In Hong Kong, where English is the second official language, this is already the case, suggesting that the technological platform in the Netherlands (which is based on that in Hong Kong) should be able to offer this functionality.

Disability

The key principle underlying the system design should be that the system should allow as large a group of people as possible to pay in public transport in a pleasant or, at the very least, adequate way. Ideally, people with disabilities – such as a low level of literacy or hearing loss – should be able to travel without additional aids. In some cases, however, it may be desirable for the system to interact differently with people who have certain disabilities. For this to be possible, the disability could be recorded on the card.

Check-in and check-out

The payment border
Every transition from public space to paid space, the so-called 'payment border', is designed such that it is almost impossible to forget to check in or check out. What is more, if things do go wrong, the solution is clear and simple.

All metro stations and train stations have a 'closed payment border': at larger stations in the form of gates, at smaller stations in the form of a turnstile. This means that travellers can no longer forget to check in and check out. The gates allow for a smooth 'flow' and do not give travellers the sense that they are being herded through a 'cage'.

In the train domain, travellers only need to check in and check out at their first and last stations, not when transferring.

Automatic check-out in vehicles
Vergeten uit te checken bij het verlaten van een voertuig (bus, tram) wordt voorkomen doordat alle in het voertuig ingecheckte OV-sleutels bij het verlaten van het voertuig worden uitgecheckt.

Flat fare option
A 'pay once' payment option has been added, whereby travellers on flat fare journeys (ferry, night bus) no longer need to check in and check out. Entree can also be used to pay in taxis.

The user research clearly revealed that the possibility of forgetting to check-out can affect how travellers experience a journey. Every time a traveller forgets to check out with the OV-chipkaart, the image of the OV-chipkaart is damaged.

Closed payment border
The key principle of Entree is that it is not possible for travellers to forget to check in or check out. This is why all stations (train and metro) have a closed payment border: at larger stations in the form of gates, and at smaller ones in the form of a turnstile. As all stations have a closed payment border, travellers are no longer able to forget to check in or check out. This may also make interactions with passengers easier for conductors.

The risk of having open payment borders (poles) alongside closed payment borders (gates) is that users have to keep two possibilities in mind: one is automatically reminded that one has to check out, or one has to remember to check out. It is very possible that having only open payment borders would lead to fewer forgotten check-outs than having a mixture of open and closed borders.
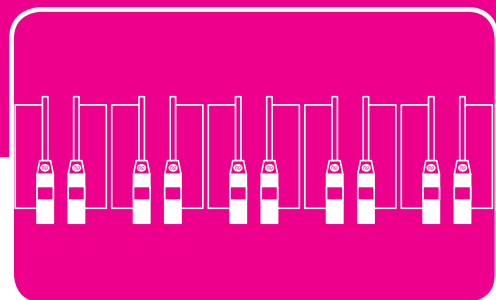
One of the problems identified with the current open payment borders is that the placement of the poles varies. This makes travellers feel uncertain and confused, meaning that they forget to check out. In the case of closed payment borders, the placement of the payment border is less critical. It is important, though, that the gates of the closed payment border allow for a smooth flow and that travellers do not have the sense that they have to go through a barrier.

Only Entree
The fact that they have to ensure that they are using the validator for the right transport operator creates an additional burden for travellers. From a user's perspective, rail passengers should only have to check in at a stop or station, and not subsequently with a specific transport company as well. This is also possible from a technological perspective. If single check-in/check-out were to be introduced, all of the payment borders could feature the Entree branding, which would increase the uniformity of the system.

In the case of vehicles, it is clear that the traveller has to check into a particular vehicle; for trains and the metro system, single check-in/check-out would be introduced. This means that travellers in the train domain would no longer have to check in and check out when transferring from one operating company to another. This is an additional operation that travellers have to make at present, due to competition on the railways in combination with the introduction of the OV-chipkaart. Users have little sympathy for this additional burden, and it is also unnecessary from a technological perspective. Checking in and checking out at the borders of the train domain alone would simplify route changes and concessions, because this would not entail having to move any equipment.

Vehicles
In most vehicles, passengers check in with the driver or conductor. What is more, people check into a vehicle at the same time as they step into the vehicle. These appear to be two reasons why people rarely forget to check into a vehicle. Having a closed payment border for vehicles

would be less efficient (it would reduce the rate of exiting the vehicle) and possibly unsafe. It should also be the case here, though, that it is not possible for travellers to forget to check out. It would not be possible to introduce a flat-fee system such as that in London and Hong Kong, because there is greater variation in the distances travelled by bus (city and regional buses) and tram in the Netherlands. We therefore need to search for a technological solution that would make it possible, in future, for checked-in Entree keys to be checked out automatically when leaving a vehicle.

Transition: open payment border
Until the train domain is fully equipped with access gates, an open payment border concept will be used. This will encourage travellers to check in and check out in a consistent way.

Problems and questions

Human assistance
Travellers can always approach service staff with questions and problems, in situ or at a distance via a communications pole.

Explanation of problem and solutions
When problems occur, the equipment clearly states:
- **What the problem is, and**
- **How it can be solved.**

In addition, a description of the problem is stored on the key, so that service staff or service machines can immediately see what the problem is and provide an appropriate solution.

Failure indication
In the event of an equipment failure, travellers can put a failure indication on their card, so that they do not

encounter any problems during ticket checks in the train and check-out at their final destination.

Proactively approaching travellers
If Entree identifies a problem – for example, a missed check-out – the system initially tries to solve the problem automatically. If this does not work, the traveller receives a short message explaining the problem and what he/she can do about it. If delays occur, travellers who use the app receive a request to confirm their location, after which they automatically receive a refund.

Replacement of card
If a card is faulty, travellers can immediately get a replacement card at a service desk, or within two days by post.

When problems do occur, Entree helps travellers in a friendly and helpful manner. Users should be given insight into problems and how they can solve them. Entree is helpful, humane and flexible.

Human assistance
In both Hong Kong and London, service staff are almost always available to help in the event of a problem. These staff are also authorised to solve problems. During the user research in the Netherlands, the participants complained about the lack of human assistance and that personnel did not have a sufficient understanding of how the OV-chipkaart works. In the Netherlands, the staff at closed payment borders are often security staff, not service staff.

Failure indication
With a failure indication on their key, the traveller can continue their journey with peace of mind, because they know that they will shortly be able to check out again (particularly important when closed payment borders are used) and that the failure indication report will be visible on their card. Checks do not give rise to discussions about not having checked in, and conductors do not have to contact the station or stop in question to verify the failure indication, as they can read the card. This will require having a redundant system that can be activated on faulty validators, putting out a message that can be stored on cards.

Proactively approaching travellers
Travellers are often unaware when problems occur with

their OV-chipkaart. A travel product that has not been activated, a check-out that was missed – the current system does not remind users of such things, but Entree does. Entree clearly explains what the problem is and offers potential solutions. Users can be contacted by Entree by email, text message or the Entree app. Problems can also be reported on the display card. The fact that travellers who use the app automatically receive a refund in the case of delays is one of the benefits that is intended to encourage people to register for Entree or switch from the card to the app (which results in fewer costs for Entree).

Automatic
The fact that the system automatically solves problems is preferable to having users solve problems themselves, because this is less taxing for the user. We need to take a critical look at which problems could be solved automatically. It is questionable whether a system that automatically fills in missed check-ins/check-outs, as happens in London, would be possible in the Netherlands. After all, in London there is just one mode of transport with check-in and check-out – the metro – that involves a large number of standard travel patterns (commuter travel). Travellers should never have to pay for the system's failure to solve problems automatically (for example, if a traveller is charged for a longer journey than they actually took), because this undermines confidence in the system. In any case, it is advisable to keep users informed about the system's operations.

Communication

Operation and benefits
In order to make participation in electronic payment in public transport easier and more attractive, there is clearer communication about how Entree works and its benefits, including:

- **At payment borders**
- **On the internet**
- **On the card and in the app.**

A new brand
Once a substantial number of improvements have been implemented and travellers are starting to feel positive about paying in public transport, the new brand, Entree, is introduced. And with this, the new positioning: Entree, for payment in public transport.

Operation and benefits
For the most part, how the OV-chipkaart works and the benefits it brings are communicated via the website and in adverts. In the physical world – at stations, for example – there is hardly any information about how the OV-chipkaart works and why it is a great way to pay in public transport. The cards themselves and the app also provide space for a brief explanation. It is important to consider which mental model could best be used to explain to people how the OV-chipkaart works, and how this could best be communicated (in text and visualisations).

When considering the mental model of the current OV-chipkaart, one critical issue is the basic fare; people have difficulty understanding why this is necessary and how it works. If there were to be a larger range of basic fares in future, this could create even more confusion. We need to consider whether there is a potential alternative to the basic fare and, if this is not the case, how the

concept of the basic fare and the applicable fares could be communicated as effectively as possible.

'Entree' instead of 'OV-chipkaart'
In this vision, we have used the name 'Entree' mainly to indicate that this is a service that takes a very different line of approach. In addition, in contrast to the Oyster Card in London and the Octopus Card in Hong Kong, 'OV-chipkaart' is a relatively technical name. The fact that the card contains a chip means little to the user in practice. Moreover, in the future, there will be other keys in addition to cards. Our recommendation would not be to change the name to Entree necessarily, but to look critically at the presentation of the service. We would consider it wise to wait to change the brand identity fully until people have experienced the improvements for themselves.

entree
voor betalen in 't OV

The Horizon: 2019

The user-centred re-design of Entree has resulted in large-scale acceptance of the system. People are drawn to the benefits and the ease of use. This boosts the use of public transport and there is a fall in the number of usability problems and complaints resulting from them.

Both the transport operators and public authorities are having to spend less energy and time on drawn-out discussions about system improvements and image issues.

Finally, the Netherlands has earned it place on the map as a trendsetter in the area of electronic payment in public transport, and this expertise is now being developed into an export product; not least by the users of the Dutch system, who boast about 'their' Entree abroad.

A user-centred organisation

In order to be able to achieve actual user-centred electronic payment in public transport by 2019, not only do we need to formulate a good vision, which will form the basis for a good design, but we also need to consider the organisation that Entree is going to develop, improve and operate. The extent of a service or product's user-friendliness can be traced back to the characteristics of the product development process and the organisation that carried out this process. An organisation's capacity to innovate in a user-centred way is influenced by a number of variables (Van Kuijk, 2010).
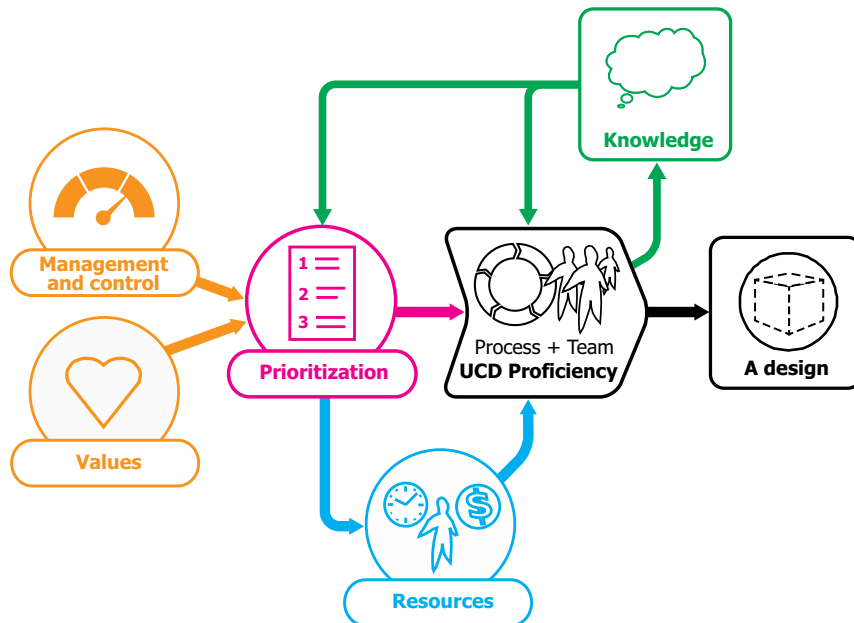

Figure 3: The most important variables that influence an organisation's capacity to deliver user-centred products and services: priority (pink), capacity to design in a user-centred way (black), knowledge about users and usability problems (green) and resources (light blue).

Prioritising ease of use

Within the organisation and the development teams, priority is given to ease of use. This is influenced by knowledge of usability problems in current or upcoming products, the culture within the organisation, and how employees and teams within the organisation are managed and evaluated. It is expressed in design appraisals and the allocation of resources.

In order to improve the use of the OV-chipkaart in future and to ensure that usability problems do not always arise when new functions are introduced – problems which will again require responses (costing a lot of time, effort and money) – ease of use must be made a key priority.

Knowledge about users and use

In order to be able to create a user-centred design, we need knowledge about the user group — their wishes, ideas, desires, measurements and capacities — and about the usability problems in the current generation of products and services.

During the design process, the use aspects of the new design should be evaluated at an early stage, where possible with actual users.

Capacity to design in a user-centred way

This turns on whether an organisation has the processes and people in-house to design in a user-centred way.

The Entree consortium should have the capacity to produce a user-centred design for the entire system. Internal interaction designers and user experience specialists could contribute to this. The consortium might choose to work with external parties, which would be led by internal interaction and user experience specialists. In addition to the ability to design in a user-centred way, however, knowledge of the field, system design and key principles for interaction are also factors that have an impact on the realisation of user-centred product-service combinations. When working with external parties, it takes greater effort to build and maintain a high level of knowledge about the field and the system.

User-centred design is not only about the actual creation of a design, but also about setting the right user requirements and the implementation of the design. It is important to take an integral look at the use of the system, not only at certain touchpoints or parts of these.

Usability aspects must form a key focus of attention in the Entree consortium's innovation and development process, and this process must provide the space to carry out user research in the field and evaluate new designs with users.

Resources

Even if we know precisely what users want and there is a team on hand to design in a user-friendly way, in the absence of (financial) resources nothing can be designed or implemented. In addition, a digital product-service system such as the OV-chipkaart not only requires a good initial design, but also continuous maintenance and improvement.

At present, as far as we have been able to establish, there is no standard budget within the OV-chipkaart organisation (TLS and the transport operators together) for making the improvements and innovations that are needed to increase the quality of the user experience. We therefore advise the organisation to consider building in a revenue flow that could be used for improving user experience. This budget could be used to finance the development (including user research) and implementation of new solutions. The organisation could consider whether to use the sum that has been amassed as a consequence of missed check-outs for the improvement of user experience, not least because these check-outs were missed as a result of a deficient system design. This sum will decrease over time, as system improvements are implemented. For this reason, there is also a need to search for a structural solution, such as setting aside a percentage of the transaction costs for user quality issues.

Conclusion

Put usability first

During the development of the OV-chipkaart, a great deal of attention was paid to technological possibilities and limitations and to commercial considerations, and less to usability. As people tend not to embrace change, the new situation must offer benefits in order to gain acceptance. This was not the case with the OV-chipkaart.

In our opinion, public transport should be as public as possible, meaning that it should be accessible to everyone, regardless of their cognitive skills, budget, technological knowledge or the time they have at their disposal. Barriers to access to public transport should be kept as small as possible.

It is not the aim of travellers to pay for public transport – they want to travel in public transport. Payment is a supporting operation that should take as little time and effort as possible.

The user-friendliness of the OV-chipkaart is a critical factor for the commercial aspect of public transport and has a societal impact. It should therefore be a key priority in future developments. In the future, when further developing electronic payment in public transport, the vision outlined in this document could help to put usability first, or at least to include it in the considerations.

The vision as a starting point

This vision is a starting point, not a final destination. It should form a starting point for the development of a user-centred system for payment in public transport in the Netherlands. It contains uncertainties, questions and alternatives. Above all, this project offers ample points of departure for the further development of what is potentially an extremely valuable system.

The objective of this project was to outline a proposal for a system design for an OV-chipkaart that was so user-friendly that Dutch people would boast about it abroad in five years' time. We think that if all of the elements in the vision were to become reality, there is a high chance that this would happen.

Benefits of a more user-friendly system

By taking the initiative for the OV-chipkaart, the organisations involved also took responsibility for delivering a system offering a certain level of quality in relation to use. Aside from this, however, a more user-friendly system of payment in public transport potentially brings a number of benefits:

- Increasing numbers of users. In view of the characteristics of the current group of OV-chipkaart non-users, who will need to 'enter the system' in the coming period, user-friendliness and use benefits must prioritised.
- Increased use-frequency per user.
- Organisations spend less time, energy and money on:
  - Explanation and training
  - Marketing
  - Solving problems and answering questions
  - Social, political and organisational discontent
- The expertise of organisations involved in this area (knowledge-building and knowledge-export).

However, the advantages of a more user-friendly OV-chipkaart frequently benefit parts of organisations other than those that make the investments. For this reason, too, it is important to take an integral approach, in this case when calculating the costs and benefits.

Uniformity and consistency vs. openness and innovation

In the case of a *national* system of electronic payment in public transport, uniformity, consistency and simplicity are extremely important for ease of use. Sometimes, however, this can conflict with the introduction of innovations that often break with the existing system. For example, we must continue to provide space for transport operators to introduce their own travel propositions, and innovative ideas should also be given a chance within Entree. In the long term, innovation is essential for quality of use. In short, it may be necessary to guard against Entree becoming a monolithic, static organisation that blocks all external innovation, and perhaps even internal innovation as well. We should always consider whether something offers a user benefit, possibly in the longer term.

Limitations of this research

All user research for this project was carried out in the context of a design/innovation process, with the intention of providing input for this process. In the analysis phase, we searched for problems, as this is where gains are to be made. The evaluation of suggestions for improvement was formative in intent: we wanted to find out why people had a preference for a certain benefit and which aspects of a design could be improved. We were not looking for a summary score stating how good a proposal was.

In some cases, for practical reasons, the usability research in this project was carried out with a limited number of participants, or with participants who were not representative of the whole group of users. Despite this, these parts of the research fulfilled their purpose: that of identifying problems and delivering input for proposals for improvement.

Should it be decided to further develop this vision, or aspects of it, then we recommend that the proposed solutions should be evaluated with a broader group of participants, which would also allow for a wider range of participant characteristics.

In addition, in this project we focused on travel scenarios that related to as large a group of users as possible. We wanted to look at whether it was possible to improve the system for the 'average traveller', as this concerns massive numbers of people. We did not consider, or spent less time considering, the following groups of users, to which extra attention should be paid:
- Tourists
- People with disabilities
- Students
- Groups (families, classes, days out)
- Travellers arriving from outside the Netherlands or who are going abroad2628