Open Smart Card Infrastructure for Europe

v2

Volume 6:   **Contactless Technology**

Part 4:   **Field Trial Specifications and Guidelines for Contactless Card Systems**

Authors: **eESC TB6 Contactless Smart Cards**

Table of Contents

Executive Summary

The set up of guidelines and specifications of field trials is an important procedure for successful validation of contactless technology. Operators will find many considerable ideas on how a field trial can be done in an efficient way giving a maximum of results. These results are as well referring to customer interfaces as to technical parameter. In this document operators and all other interested parties find a set of issues they will need to consider when they plan a field trial. First a clear definition of objectives is presented and the underlying functional scenario that can be chosen. After this first step the key parameters of the field trial are defined and explained:

Definition of territory dimension

Equipment

Population (Customers, staff)

Communication

Outsourcing

Risk

Costs

This explanation of key parameters will illustrate and help to understand what issues have to be considered for the set up of a field trial. When this process is completed and the field trial is running it is important to make use of the previously defined validation methods and assessment categories for the evaluation of the field trial process. Here various phases and methods of evaluation are explained in order to have a continuous view on the feedback of the testers. A short functional system comparison is very useful in this process as it will allow to have a summary overview on the performance of different systems. This will facilitate the future decision making process in favour of a contactless technology system.

After these merely theoretical aspects, various experiences of different European countries are briefly described to give a real scenario and a feedback for other operators. The cities and regions analysed are Berlin, Paris, Venice, Dresden, Barcelona and the Swiss Easyride project.

Abstract

The advantages of contactless technology in public transport and other sectors will be tangible if the large scale implementation is well prepared. The most efficient instrument for this preparation is a well structured field trial. This will significantly contribute to make all possible advantages of this technology visible. General public, operators, public authorities and all parties concerned will be able to get clear results on the objectives and expectations they have put into this technology.

Many field trials all over the world have proved similar general lines in terms of validation of technical and user related criteria. The clear and concise definition of performance and validation categories will give clear feedback on the potential the contactless technology can offer for each single operator, city or region.

Most field trial range as first approach to modern information technology on contactless smart card bases. Testers will get an impression how card have to be handled and what sort of advantages in terms of usage facility they can contribute. The operators will have a validation of a system configuration and system architecture they would prefer for their future fare management system. The technical criteria will demonstrate the level of confidence that is necessary to have an intelligent system architecture organising all data transfer in a secure and safe way.

Field trials are in principal a type of validation of various options for the operators. They can test whether they should go for an upgraded system or a completely new system. With these testing options the operators will have a complete set of answer that will allow them to take the correct decision for the future contactless system. After the decision for the new or upgraded system the field trial experiences will help to ease the transition process from old to new fare management system. These experiences are especially concentrated in the personalisation, distribution and sales process interfacing as well with customers as with staff. In most cases field trials are a sort of small scale generalisation. The results will help operators to gain faster political decision making processes for such system.

Field trials are the most important step when preparing the introduction of contactless technology in fare management systems. The way the technology is perceived will be decisive for the following process of implementation. Results will ease the procedures and fasten the process of introduction.

Objective of this document

Pilot schemes and field trials are a constituent part of the success of the introduction of contactless technology. Consequently it is of great importance to prepare carefully these working tasks. This document provides a guideline for all companies that wish to make use of contactless technology in future. To make this document understandable a logic structure has been set up consisting of three main issues:

➢ Report on pilot scheme specifications

➢ Evaluation guidelines

➢ Report on current experiences

This report is dedicated to field trials in the domain of public transport with reference to electronic ticketing. This sector will be decisive for the large scale deployment of contactless smart cards as millions of millions of customers of public transport need to be equipped with this support. None the less major parts of this document are also applicable to other domains and business sectors. Basically this document will help newcomers to find a detailed orientation on how to successfully deploy contactless technology. With the series of guidelines for setting up a field trial and evaluating the results, newcomers will be in a position to easily achieve successful deployment scenarios for themselves.

1. Report on pilot scheme specifications

1.1. Objectives:

In first place companies willing to test contactless technology have to carefully analyse their objectives. Only clearly stated objectives will allow a maximum gain of knowledge. In principle there are three main sets of objectives:

- ➢ Customer oriented objectives

- ➢ Operator oriented objectives

- ➢ Technology oriented objectives

This repartition of objectives will allow a clear cut vision of the aims that contactless technology shall fulfil for the companies. The following chapter will briefly describe some of these objectives.

1.1.1. Customer oriented objectives

Ease of access

Thinking of customer orientation means to integrate the advantages of contactless technology into the interface with the customers. Mainly the aspects of rapidity and fluidity are seen at the centre of the advantages of contactless technology. This fluidity and speed are mostly referred to as easing the access for customers. Mainly this aspect is reflecting that the access times to services are mostly to long. Therefore a validation of the customer acceptance of this is crucial to gain input from concerned people.

Improve quality of service

Besides the ease of access contactless technology is improving the quality of service. Most people these days are confronted with lack of quality of service. This new technology will allow a far better provision of service to customers. The contactless cards will enable its users to get more and better advantages when using such cards. Users will receive personalised services which are especially dedicated to them.

Improve the attractiveness of public transport

Ticketing features will change towards new forms of tarification which is unknown for customers. The evolution of tariffs will include new parameters of calculation which are not in use until now.

New services such as emergency call options or personalised travel information will increase the attractiveness of services. These services will be new possibilities which customers did not have until now.

Establishment of a new customer relation of confidence

Contactless technology will enhance new approaches for customer relation management. Loyalty schemes will allow customers to get more advantages from the usage of public transport. In addition this new relation will contribute to more concise services for customers. The operators will have more ease to provide adequate service according to the customer expectations.

1.1.2. Operator oriented objectives

Cost reduction

The major goal of all operators is to reduce costs with the introduction of a new system based on contactless technology. Each operator has to analyse by himself which is the degree of cost that can be reduced. Here it is very important to emphasise the significant potential of reduction of maintenance costs. Especially transport operators having magnetic stripe ticketing systems will benefit from the contactless technology. The contribution of contactless technology will be to abolish the cleaning of mechanical parts and consequently an increased technical reliability. In principle the operators have to state the sector in which they will reduce costs and intensify their focus in this sector for the field trial.

Increase of revenue

Besides reducing costs the major goal of the operators is increase their level of revenues. Here it is necessary for the operators to study carefully which kind of fare models they want to adopt. With new parameters in the algorithm of the fare they will be able to increase the revenue according to new parameters such as time and vehicle kind. Other sources of increase of revenue are generated by the contactless technology and its ability to provide accurate statistical data for income repartition among different operators. The cost intensive customer surveys can be cancelled as the new fare collection system will automatically provide these data.

Gain new customers

Complementary to these objectives the operators want to gain new customers. New technology will increase the public image and new fares will allow to increase the number of persons operators usually address. This means that they will be able to have a significant increase of awareness for their products they offer. This will attract people to use their services and keep them attached to these new services.

Fare evolution

Actually most public transport operators lack of ability in their fare collection systems. This means that the offer to the customer is closely related to such rigid models which allow only little adaptation to individual requests of customers. The new contactless technology will enhance the use of new parameters for the building of a newly designed fare collection management system. Contactless technology will enable the operators to have much more sophisticated fare and to provide individual solutions which correspond to the effective use of public transport.

Fraud reduction

One of the major related issues to the increase of revenue is the enforcement possibility towards persons travelling without valid tickets. This means that with the new technology counterfeiting of tickets will be much more difficult and illegal selling of fraudulent tickets will be significantly reduced. Contactless technology will allow to have a systematic validation of tickets on buses which is actually not supported by the ticket supports. So the contactless smart cards will significantly reduce fraud. On the other side the new technology will allow the customers to be in a position to have an intelligent ticket giving them the possibility by validating to have always the correct and appropriate ticket. Further very important aspect is the reduction of vandalism. Here the switch to contactless technology means the complete suppression of all forms of vandalism related to terminals and readers. The contact guided interface between card and terminal / validator is source of many problems of vandalism. So contactless technology means less problems less deficiency on payment terminals.

Create intermodal transport offer

The creation of an intermodal transport offer is a possibility opened up by contactless technology. With the set up of an accurate data base and the statistical data the precondition is build up to have a share of revenue of common tickets among different operators. As consequence an intermodal transport offer can be set up which will enable customers to get more services with one single ticket medium.

Raise political awareness

The raise of political awareness is a long lasting process which will be having major consequence on the budget of many regions and cities. As public transport is heavily subsidised by the public authorities the costs are always under pressure to be reduced. With such a new fare collection system the subsidy allocation can be made on a real updated statistical bases. The set up of field trials will enhance the knowledge of this contactless

technology also on a political level which is very important for the future financing of investment costs in such new systems.

Company organisation and procedures

The contactless technology will oblige the companies to review completely their organisational structures and their procedures. The effects of such a new fare collection system are widespread in the company organisation. All levels have to be integrated and all staff members instructed. The technical and marketing departments will mostly be involved and the purchase, distribution and sales policy has to been restructured according to the new system.

1.1.3. Technology oriented objectives

Technology validation

The third set of objectives is technological. Here all parameters have to be fixed to know which performance the contactless technology must have for the testing parties. There are various levels such as cards, validators and terminals. Each of them needs a validation of the objectives and an overall functioning within the system architecture. In general the functioning of the technology in the chosen architecture has to be validated.

Performance criteria

The definition of the performance criteria is very important. These criteria have to be set up according to the requirements the operator has fixed. These criteria cover the cards in terms of overall functioning, reliability of the microprocessor, transaction times, physical resistance. Besides the cards the validators and concentrators have to be measured in terms of performance. It is evident that the complete system architecture has to be validated in order to see the general validity of the chosen configuration.

1.1.4. Functional scenario

The definition of the three levels of objectives is fundamental for any field trial but has to be enlarged by a clear vision concerning the functional scenario. This functional scenario has three major levels of reflection:

➢ Technological status

➢ System configuration

➢ Fare definition

All three levels have to be defined in an accurate way before the field trial is specified in its key parameters.

Technological status

It is primarily important to decide on which kind of technological status the final scenarios is planned. Therefore the operators have to decide whether they want either a renewal or upgrading of their existing technology or a completely new technology for their fare management system. This aspect is of great importance for the operators to decide either for upgrading or new implementation. This decision is specific to each operator and at the final stage of a careful study of the potentialities of both technological approaches.

System configuration

The aspect of the system configuration is important for the decision which kind of technology will be validated in transport network. In principle there exist three main possibilities. The first is a check-in-check-out system where the customer presents his card when entering and leaving the system. The second possibility is merely to check-in without any check-out procedure. And the third system configuration is be-in-be-out where the card is detected during the stay in the vehicle. Obviously there are no obligations to have fixed system configuration as described. The operators can mix these configurations for instance testing a configuration of check-in and be-out.

Fare definition

The aspect of fare definition is closely linked to the system architecture, but needs to be detailed explicitly. What are the intentions of the transport operators when thinking of their future fare collection system. Do they want to maintain the fare and just make a change of technological support? Or do these operators want to change the fare structure? These questions have to be carefully studied. The contactless technology allows all possibilities of fare models. There are many options like the electronic calculation of the fare (best-price-model) which will allow customers to have an intelligent fare management system calculating the fare for them. Closely linked to the aspect of fare models is the method of payment. Here the operators have to decide whether they want to introduce an electronic purse or a store value card. Prepaid or post-paid methods have to be considered in this context. Which types of tickets shall be supported with the field trial? This question varies from one field trial to another. Contactless cards can support single tickets, electronic purse or "e-purse", season tickets, and multi-ride ticket booklets. The e-purse functionality is able to cover functional requirements for stored value including zone- and distance-based fares. Even more the cards cover various fare categories (adult, child, elderly/disabled) being able to include flat fares and zone or distance-based fare models. For instance additional subcategories can be introduced such as late night reductions or others.

1.2. Key parameters for field trials

After the set up of the functional scenario and the definition of the objectives the field trial has to be specified in terms of territory, equipment and population.

1.2.1. Definition of territory dimension

The dimension of the territory depends on the objectives that have been stated. Obviously the validation of the objectives leads to different territorial sizes. So different objectives are in compliance with different territorial dimensions. The operators have to decide on which types of vehicles (metro, train, bus, tramway, ship,...) they want to make their validation. The size of the lines in terms of passengers and vehicle types is an important criterion for the choice of the test ground.

1.2.2. Equipment/ Roll out phase

The second major parameter are the equipment aspects and the processes within the roll out phase.

Ticket Type

Various sorts of tickets can be tested during the field trial: season tickets, multiple tickets, single tickets. Each ticket type is addressed to a specific customer segment. Therefore it is useful to test all different types tickets and to validate them individually.

Personalisation

Referring to the cards and ticket it may be relevant for the season ticket holders to personalise their cards with a photograph. This issue can be done either by the operator himself or by the a specialised company on behalf of the operator. The objective of the personalisation is to code the described profile onto the card which shall be given to the tester. These data will conceive the heart of the system as they will allow to filter the information send out from the server to the card holder.

Sale

The sale network is of special relevance especially if the testers have to pay for their tickets. Then the configuration of the trial needs to have a sales network that is adapted to the technology tested. The sales network is normally the same compared to the running system, but the equipment has to be upgraded for sale. This refers mainly to ticket vending machines either stationary or mobile.

Distribution

Further important aspect is the distribution of the cards. The field trial must address this issue already in a way that valuable results can be obtained for a later generalisation. The distribution of the cards to the testers shall be conceived as the later delivery to all customers. The field trial has to be managed like a small scale generalisation. First, the profile of each tester has to be collected, then the profile written on the card and then the card must be distributed in order to allow its user to understand the overall architecture, to know how to use it, to be conscious of eventual constraints and to be motivated on the long term. Different distribution channels are possible like:

➢ Station desks

➢ retailer

➢ Mail

➢ Employers

➢ Public agencies and institutions

Reloading

Testers are in position to load their cards with fare value at the entire reloading network. This network includes vending machines capable of adding all types of value to their cards. The testers can add all types of fares to their cards. The network should mainly be located in stations and stops.

Ergonomics of use

For the field trial is it of great importance to make a choice on the type of ticket. The physical support is normally ISO format, but Edmonson format or other packaging may be envisaged. In this context it is of interest to verify if any special card features for mobility reduced people shall be validated.

Ticket validation procedure

Closely linked to parameters of the ticket are the validation procedures. Here the gestures for the testers when using the tickets have to be specified. When passing at the validators there could be a coloured signal or an acoustic signal giving the testers the feedback that the ticket has been correctly validated.

Ticket verification

The transparency of all transactions is at the centre of customer attention. Therefore readers will enable the testers to see the balance on their cards. The debiting amount can be checked and the value on the card.

Ticket control

Besides the control of the customer also the operators need to check the new types of tickets. The enforcement policy will have new hand held devices for the ticket inspectors. It is clear that these devices are very important for the functioning of the field trial.

Back office

The back office system has to guarantee the functioning of all component parts of the system and alert immediately irregular situations. The back office is taking care of all aspects that are closely linked to the clearing system and the related issues.

System Architecture

In the system architecture all interacting components of the system are screened up. In the centre of the interaction chain is the card. The terminals, concentrators and validators have to be connected and the data flow has to be verified. The system architecture must reflect the overall interest of the partners in terms of organisation and set up of secured communication chains. The overall system architecture consists of subsystems such as:

➢ Fare Payment Systems – e.g. consisting of fare gates, fare boxes and gates

➢ Distribution Systems – these include ticket vending machines, ticket offices, third-party retailers or merchants, mailing or on-line purchases.

➢ Central Computer System – the data and message central processing system where the central database is located. The system traces the testers and memorises all card transactions. This sub system will be dealing with aspects of revenue share among operators.

After sales

The after sales support is defined to meet various scopes. First the after sales are intended to collect a maximum of information towards future mass processing of customer requests. Second whenever a tester has a question the front office must be able to manage his situation. Third after sales policy must be integrated into an existing organisation as key factor for managing changing environments.

Fraud prevention

Contactless technology has many advantages in terms of fraud prevention. In the frame of a field trial it is essential cover all areas which might be menaced by fraud. This means that an intervention at the level of validation, personalisation, reloading procedures is important. The field trial is a major opportunity to validate the system security.

Security implementation

Not only aspects of fraud on the cards have to be investigated. The level of validators and terminals is also of crucial and fundamental importance. Considering the reloading network and the data transmission a security check of the system architecture is mandatory.

Data treatment

The aspect of data treatment and processing is of fundamental importance. On the one side the data treatment has to cover all legal aspects of data privacy and on the other side the data flow has to be defined. The processing of all data generated during the field trial has to be well organised. This has to be fixed within the system architecture. The responsible subsystem collects daily relevant data associated with customer trips and settles the funds among operators according to contractual agreements.

1.2.3. User/Population

1.2.3.1. Customers

Panel constitution

The constitution of the panel of testers is crucial to get representative results. Therefore many different customer segments and representative groups in the population have to be included and their reaction and comments have to be collected carefully. In order to determine the profile of each tester mostly two surveys have to be carried out. In this second stage the testers have to confirm their wish to participate. The profiles are saved and the personalisation process will start. Normally each profile should cover a rate of approximately 20% for each testing purpose. In case of any under representation of any profile an alteration can occur. Also the additional testers for reserve could be activated to reduce the danger of disproportion.

Recruitment

The recruitment of the testers can be done in different ways. Either they are contacted on the ground of stations or at home. The contacts can be established on a personal bases or by phone. An additional possibility could be to recruit testers by newspaper advertisement.

Selection criteria

There are many criteria for the recruitment of testers. Some are mentioned hereunder:

Frequent travellers (at least two journeys per day)

Complex journeys

Journeys through crucial and focal points of the network (connections, retailers)

Sensitive to good offers

Curious and open minded

Ready to take part in this field trial for several months

Male, female

Variety of age

Information and education of users

Mostly there are special meetings where the testers are rapidly briefed on the field trial and the usage instructions. The meetings should include the following main issues:

➢ general presentation of the field trial

➢ distribution of the cards and the guidelines for usage

➢ detailed presentation of the usage modalities

➢ question and answer session

For those who cannot participate to these meetings a personal hand out is possible. This will allow all testers to have the same degree of knowledge of the processes and general information.

Define contract and rules for users

The definition of the rules for the testers and the related definition of the contracts between operator and testers are a key issue. Hereon the legal basis for the relation operator/tester is build. Component parts of this contract are declarations on data privacy, on obligations, on rights and on the time scale. This means for instance modalities of payment (gratuity or payment for the trips) have to be fixed and how many questionnaires the tester has to respond to.

Relation management

All testers have to be informed where they can put questions. Therefore the number of a hot-line should be mentioned and all three weeks a phone call to the testers is submitted in order to receive additional feedback and in case to motivate again the testers. As follow up the testers are interviewed at three different times of the field trial: at the starting phase (learning), at the intermediary phase (accustomed) and at the end. As second option is a special courtesy desk that may be installed for questions, problems and any form of feedback.

1.2.3.2. Staff

Not only testers are involved in terms of general public, but testers can also be employees of companies validating the contactless technology. For those the same procedures do apply as for general public. But a field trial means many implications for the staff of companies. Almost each single department is involved due to the transversal character of such field trials. In addition to this various employee groups have to make alterations to their daily work processes and manners.

Sales clerk

The sales staff has to learn new processes of sale. This means that the selling equipment has to be fitted to the new requirements of the contactless technology and the clerk have to know all the new procedures. They will have to learn the functionalities of equipment and to know how to treat problems. They have to know new process on ticketing machines in order to assist the testers in case of questions. In addition to this they need a general knowledge on what the overall field trial is about. This is important in order to orient interested customers on the issue of the field trial.

Ticket inspectors

The ticket inspectors need also general knowledge on the field trial. Special knowledge is due for the handling of the hand held control devices for the tickets.

Bus drivers

The bus drivers are concerned by the field trial as they have a sort of enlarged work responsibility. A bus driver is in principle also sales agent or at least responsible for verifying tickets. With the contactless technology the driver must learn the new procedures when testers will enter and validate their tickets. Here the bus driver will have an active role in assisting testers.

Maintenance employees

Not only the professions at the interface with the testers are affected by such a field trial. Technicians and especially maintenance employees will have to learn the new requirements for their job due to the introduction of contactless technology equipment.

Training measures

For all the aspects of training special measures are necessary. These are plenary meetings in departments for general orientation and individual working groups related to the specific professions. Here the employees will learn all relevant procedures they have to know and all behavioural aspects they need for their future daily job when assisting the testers. The training programme proceeds through several phases. The relevance of the training is appreciated in three ways:

➢ In-training evaluation of the trainees,

➢ A post-training assessment using self-administered questionnaires and qualitative interviews,

➢ An assessment of product support operations.

This training is evaluated in order to see the state of advancement of the staff. At the end of the sessions, an assessment is made analysing the competence acquired by the trainees and their satisfaction about the training.

Leaflet campaign

In order to foster acceptance of the new technology, a rather substantial professional communication organisation relative to the scale of the field trial needs to be set up. A leaflet campaign will allow all employees in the company to learn about the field trial and have transparency on the issues that are related hereto. In this leaflet the contactless technology, its stakes and the field trial sites should be presented. This will allow to

reduce eventual resistance among employees and let them learn jointly about all new issues dealing with contactless technology.

F.A.Q.

A section merely dedicated to frequently asked questions is very useful. This will allow testers and employees to have a general orientation on what might be of interest for them. With the help of such answers, questions on the hot-line or at courtesy desks will be significantly reduced.

Schooling

The information of the staff is crucial and has to be enlarged by schooling sessions. These sessions will learn them how to use this technology and what processes in their daily work are changing. It is crucial to give staff practical information on handling and management of customer situations. These changes they have to learn and therefore the training session are of fundamental importance. The learning process will be accompanied by training material which will be available in these schooling sessions.

Information campaign

The information campaign is intended to provide continuous information on the state of the art of the field trial by monitoring this process. This allows an open dissemination of the results of the ongoing field trial.

1.2.4. Communication

Press campaign

When a field trial is starting it is very important to have a large presentation of this in the media. This campaign has to be carefully prepared as it will be the very first public appearance of the contactless technology in general public. The advantages for the customers have to be clearly stated and the possibilities this technology offers to them. A press campaign shall include:

➢ print media (newspaper, journal,...)

➢ TV broadcasting

➢ Radio

➢ Internet

Mostly these media are covered when the company make a press conference dedicated to the field trial. In addition specific guided tours on the territory of field trial and information days are useful tools for dissemination. Discussion groups and seminars as well as information booths where contactless technology is presented, widen the dissemination tools.

Public awareness

Press campaigns rise public awareness. As for most of the people such a field trial is the first contact point with general public the messages have to clearly stated. With a positive feedback from the general public the acceleration effect on the generalisation will be perceivable. When people think this will give them advantages they will lobby for this technology and politics will be more tending to finance the implementation of such systems.

Declaration on data privacy

Most fears in public dealing with contactless technology are related to questions on data privacy. Here it is very important to have a clear and understandable declaration on this. In most cases the experts on data privacy are integrated into such field trials. It is clear that the traceability of customers has to be addressed in the appropriate way.

Transparency of field trial

All aspects related to the fields trial have to be explained to the public. This means a significant degree of transparency for the general public and the testers. On the one side the general public needs to know that the are no risks concerning health or data privacy. On the other side employees need a transparency on the fact that this new contactless technology will not range as a job reduction instrument for the general management.

Information Management System

It is of big advantage if the communication policy is done with an information management system. This means that all processes are following certain rules which have be established. Regular reports and press conference are examples therefore.

1.2.5. Outsourcing

When setting up a field trial, companies have various options how to set up the working plan and how to distribute the working tasks. Mainly there are two options. Companies have to decide which working tasks they want to cover by themselves and which shall be covered by external partners. Main areas for intervention for outside companies are:

- ➢ Recruitment

- ➢ Equipment

- ➢ Day by day management

- ➢ Evaluation

In these sector specialised companies are able to provide services to the companies responsible for the field trial. Mainly there is a follow-up of the evaluation of the field trial which is done by institutes dealing with large scale opinion polls. This can be of great advantage but always the external accomplishment of tasks has to be seen cautiously. All tasks addressed by external companies are not contributing directly to company learning which is important to set up a knowledge base for the operators themselves.

1.2.6. Risk

Budget

Among the various scenarios of risks the budget related questions are always on top. The financing of the field trial has to be secured by political and company commitment. This will allow to have a solid financial position for the overall duration of the field trial. It is important to have also a thought on aspects on extension of the field trial when some unexpected delays shall occur. These have to be financed also and the financing mechanisms have to fixed.

Time scale

Time scale is crucial for all field trials. The planning has to be perfectly done as delays in the running trial are always perceived negatively by the external world. Therefore it is advisable to set up a time scale that can also include eventual delays due to unexpected alterations to the working plan.

Staff

Staff is normally not a risk potential if the communication campaign is well organised and staff members are clear on what are the aims of such a technology switch. Full transparency will make staff supporting the new contactless technology and avoid forms of resistance.

Security issues

The security aspects are at the centre of attention when thinking of technical risks. The field trial has to address all related issues of security.

Treatment of anomalies

Within the field trial it is obvious that anomalies will occur. Learning out of these anomalies will help to fine tune the technology for the future large scale implementation. To get a maximum feedback from these anomalies it is useful to standardise the treatment of such cases. In most cases special leaflets are printed where the testers and staff do note what sort of problems they had during certain procedures. The collection of all anomalies will contribute to find eventual system inherent problems that have to be solved on a general bases.

1.2.7. Cost

When starting the process of organising a field trial, the question of costs has to be analysed. Operators willing to test contactless technology have to set up a dedicated budget for the field trial including all major relevant cost factors.

Equipment

In terms of equipment the figures have to be fixed. The equipment includes:

➤ Cards

➤ Terminals

➤ Readers

➤ Validators

➤ Concentrators

Training

The training of testers is a major task with budget relevance. This includes normally various training sessions and the distribution of leaflets and information brochures.

Communication

The communication and all related press campaigns with the print material and dissemination of newsletters is continuous amount of money which has to be allocated in the budget.

Overhead

An overhead has to be always added to the budget.

Running costs and consumables

As long as the field trial will last there is an amount that has to be allocated for running costs of the overall system architecture and for consumables such as cards.

Cost sectors

Further cost sectors are:

➢ Personalisation

➢ Central system

➢ Control system

➢ Consultation

➢ Validation

➢ Sales network

The cost sectors of a system with contactless technology will be the scope of a second document. This document will include the aspect of a business case for contactless technology.

2. Evaluation guidelines

When setting up a field trial the validation criteria have to be set up in order to have clear results on tested objectives. Validation is the process of testing how an application performs with respect to the assessment objectives. Assessment is the full working process of determining the performance and/or impacts of a candidate system in comparison to alternative systems and/or base case, including experimental process such as field trials.

Validation objectives

The validation objectives are closely linked to the three categories of objectives that have been stated so far: Customer related, operator oriented and technology oriented objectives. Each single category of objectives has to be specified according to the requests.

Indicators

The definition of the objectives includes the splitting of these issues into single indicators that will be build up.

Reference system

The reference system is relevant for the definition of the indicators. By having the figures of the reference system it is possible to see which level the indicators have to reach.

Methods of measurement of simulation

The methods of measurement have to be defined beforehand according to all the relevant participating operators. Having a common agreed definition on this there will be a common base line valid for interested parties.

Measurement conditions or conditions to be simulated

The same common agreed definition applies to the measurement conditions and the conditions for simulation.

Statistical considerations – Sampling/ Number of measurements

The size of the measurements has to be agreed on jointly. This can be a unique sample or a continuously increasing amount.

Statistical considerations – Confidence level associated with measurement

A confidence level needs to be defined. This will allow to have a valid and true basis in the measurement procedures.

Statistical considerations – Overall definition of success

For the evaluation it is necessary to define what is considered as a successful field trial. This means to establish figures that need to be attended by the performance of the contactless technology. These figures can be qualitative and quantitative.

Measurement plan

A concise plan of measurement will allow to schedule all the relevant testing within the defined period of the field trial.

Integrity of measurement or simulation

The measurement plan is characterised by integrity and the failure rate of this plan has to be defined in advance. This will avoid to review the overall measurement plan in case of single negative elements.

2.1. Set up of guidelines/definitions compliant with objectives

General rules for validation and assessment

Assessment objectives reflect judgements made about what expected impacts can be validated. This means that determination of assessment objectives is an iterative process which reflects what companies would like to be assessed in principle and is constrained by what assessment objectives, particularly those related to impacts, can be validated in practice. Therefore it is of central interest to define the basic criteria for assessment. It is necessary to mention the different categories of assessment that will be used. An assessment category is a collection of assessment methods which deal with same or similar assessment objectives. Within these assessment categories it will be relevant to define the criteria for evaluation and the user groups involved in the validation process.

Definition of assessment categories

The definition of assessment categories is a process that has to be realised at the beginning of every field trial. A three level procedure has been set up. The first level is the assessment category. The second level is the generic parameter context and the third level is the specification of this parameter. This specification mostly consists in detailing the generic level of the basic parameter. With these parameters a transparency and coherence in the answers has been achieved aiming to show comparable and compatible results. As a model of reference seven categories of assessment are mentioned hereunder which could be of general interest:

➢ Technical

Main aspects of this technical assessment category are the performance and the reliability of the system.

➢ User acceptance

In terms of user acceptance possible categories are user friendliness and satisfaction, the service level as well as the operator acceptance.

➢ Impact on users

There are always impacts on users either directly or indirectly. User can be immediately concerned by an issue or merely by its effects.

➢ Operator benefits

Important categories of assessment in terms of operator benefits are the effects on the operating costs, the overall system efficiency, the image and related to the staff the working conditions.

➢ Socio-economic

The socio-economic category of assessment looks at efficiency and distribution aspects.

➢ Legal and institutional

Here the conformity with legislation and the political acceptance have to be pondered.

> ➢ Synergies & Exploitation

An outlook referring to the future aspects of the validated contactless technology includes positioning, the possible synergies and the exploitation potential.

Analysis of target groups of users (testers)

In most field trials the impacts on the users are at the centre of interest. To achieve useful results it is important to define the user groups and to measure the various levels of impact. In principle the testers can be grouped as:

> ➢ Customers

> ➢ Operators

> ➢ Public Authorities

Customers are all segments of users of public transport whereas operators are not merely public or private transport operators but also service providers and bank corporations. The third category are public authorities on an urban and regional level.

These target groups of users are analysed at the level of the impacts the field trial has on them. Different parameters are set up like:

> ➢ System acceptance

> ➢ System operationality

> ➢ System adaptability

> ➢ Economical aspects

> ➢ System security

The clear analysis of these impacts on the target groups of users have to be done on a continuous basis to see possible alterations in the behaviour of testers.

2.2. Different phases of evaluation

The duration of a field trial is relevant for the setting of an agenda for the evaluation phases. Logically there should be quarterly reports on the ongoing results the field trial is giving. At fixed dates such as after one month, after three months and after six months an in depth evaluation is advisable. This will allow to see all eventual changes on the impact level on target user groups. With these reports eventual shifts and changes can be done to the system configuration.

2.3. Means of evaluation

There are different means which are advisable for evaluation. These range from phone enquiries and specific meetings between testers and field trial management to questionnaires that are either distributed at information booths or sent to the homes of the testers.

2.4. Impact analysis/ Reaching the objectives

2.4.1. Economic impact

Any impact analysis that will be done after the field trial cannot only address the impacts on testers. The complete scenario of objectives has to be evaluated by an economic impact analysis. Have the fixed objectives been achieved? This is fundamental for three sectors:

➢ Maintenance

Here all equipment costs have to be included of validators, readers, terminals, vending machines, etc.... The costs are intended as well for new equipment as for upgrading on existing equipment.

➢ Running costs of the field trial

All running costs of a field trial have to analysed carefully. The cautious calculation of a budget for running costs will contribute to get some feedback on the cost development of a generalisation of contactless technology. External assistance costs like consultancy have to be added.

➢ Human Resources

All field trials must give an impression in financial figures of the impact on human resources. The staff will have new tasks and some actual work process will disappear. A field trial is the excellent opportunity to validate this.

The results of these financial impacts are very significant for the future process of generalisation of a system of contactless technology. Keeping the budget will make the political decision making process more favourable and smooth allowing faster and better implementation processes.

2.4.2. Social impact

The financial dimension of field trials is an important testing ground which needs to be enlarged by a social impact analysis. The term social means in this context how people behave with the new contactless technology and how this does fit into their cognitive behaviour and learning. The impact analysis itself focuses on three aspects:

➢ System perception

The perception of the new system is very important as customers have to learn new gestures and behaviours. Feedback from the testers will enable to achieve a solid bases on the perception of the new contactless technology.

➢ Knowledge level

The level of knowledge is dependent on the system configuration that has been chosen. The testers will give their feedback on how they got accustomed to the new rules and procedures and how their knowledge level increased correspondingly.

➢ First experiences

For many testers the field trial will be the first approach to contactless technology. Their feedback will be crucial for the preparation of the future steps in the frame of a generalisation. This will allow to have the correct approach to new users based on the impact analysis of the previous field trial.

2.5. Functional system comparison

The functional system comparison is a fundamental instrument to conclude successfully a field trial. This comparison should be structured according to the range of defined objectives of the field trial. A clear definition of the system which is actually operational on site has to be compared to an upgraded system or to a completely new system. Operators and authorities have to decide when taking the contactless technology into account which is the reference system and starting point. From this starting point a definition of parameters has to be done according to which the new or upgraded system will be compared. These parameters can be chosen according to the validation plan but can also be a mixture of key factors that allow rapidly to compare the system options for the future. Here it is important to mention that the operators mostly analyse two options. One option is to upgrade the existing fare collection system with contactless technology and the other option is to install

completely a new system based on contactless technology. This allows to show an outline of the migration path the operators intend to choose. The table shows parameters of a fare collection system and the interested parties (customer, operator, public authority):

System is	Interested party	Old system	Upgraded system	New system
Reliable	Customer			
More transparent	Customer			
Easing the use of public transport	Customer			
Useable for multiservice	Customer			
Less costly	Operator			
Efficient against fraud	Operator			
Providing better knowledge of traffic flow	Operator			
Allowing a ticketing evolution	Operator			
Extendable to the region/country	Operator/ public authority			
International standard compliant	Operator/ public authority			
Allowing easy transition phase	Operator			

This table gives a very quick summary overview of key parameters that will contribute to a clear and logic decision making process for choosing contactless technology. The logic extension of this table is a short economic impact analysis and a budget plan which will be at the heart of the business case that will be calculated for the generalisation on each site.

3. Report on current experiences

The last chapter is dedicated to current experiences referring to field trials. A European choice of cities and regions will allow an overview on what sort of field trial configurations have been chosen and which results were achieved in terms of generalisation of contactless technology based system.

3.1. Berlin

Objectives

In 1996 the city council of Berlin voted for a technological evaluation of an electronic ticketing system. The Berlin transport operator BVG (Berliner Verkehrsbetriebe) was charged with the task to analyse a system including the fare system of Berlin city and its surroundings. Principal aim of the field trial was to test a check-in-check-out system and flexible fare models based on distance and time related parameters. Also electronic payment was tested in this context. The technological partners of the field trial were: ERG Group as technical supplier and back office system expert, debis Systemhaus AG as supplier of information system software and hardware and ICA Chipkartensysteme GmbH as supplier of the card reloading terminals. The field trial was accompanied by a professional public relation company called Agentur Flaskamp GmbH from Berlin.

Testers

The testers have been recruited via print media request for volunteers to participate to this field trial. The testers' sample has been defined according to socio demographic criteria. The testers had a bonus of 25% discount on their usual season ticket. In total more than 25.000 testers were recruited.

Staff

Staff of all involved sectors sales, distribution and maintenance was trained in order to have deep knowledge on the process and much information for customer and tester requests. Special attention was paid to clerk as they are direct interface with customers. Here special training and schooling sessions were necessary.

Territory

The territory of the field trial included the bus lines 100 and 384, the tramway line 2, the metro lines U2 and U4 and the suburban train services between the station of Berlin Zoologischer Garten and Alexanderplatz. All lines are within the central city fare zone AB. In addition to this public transport network also some interservice network points have been added. A distribution and back office centre were also set up.

Equipment

The testers validated all component parts of an electronic ticketing system based on contactless technology. Check-in and check-out terminals, reloading and sales terminals and information terminals. The latter two ones were also used in a mobile/portable version. All components were usable with the contactless cards. Two types of cards were used. One merely contactless card and one dual interface card with contact guided and contactless interfaces. Readers were also distributed to the testers in order to give them transparency on the amounts on the cards. Ticket inspectors had specific hand held devices for control purposes. In total 33 metro – stations, 7 suburban train stations were equipped with 104 check-in terminals, 94 check-out terminals, 25 card reloading terminals and 45 information terminals. 34 busses have been equipped with 84 check-in-check-out terminals and 19 tramways have been equipped with 57 check-in-check-out terminals. This infrastructure has been widened by external terminals in four shops.

System configuration

The system configuration tested was check-in-check-out philosophy in an open access system. The fare was calculated electronically after successful check out at the terminal. The amount was debited from the card. Reloading was possible at the dedicated terminals. The card information showed was on debited amounts and card validity. This information was available on terminals.

System architecture

The concept of an overall central system with three subsystems was validated such as:

➢ Subsystem: fare collection – turnstiles, fare boxes and toll gates

➢ Distribution Systems – including ticket vending machines, ticket offices, retailers, direct mailing or internet purchases.

➢ Central System – data central processing system. The system collects all card transactions.

Time schedule

In August 1999 the field trial started with an information campaign. From October on the field trial started on the metro lines U2 and U4 and was extended in November to the bus lines and from December on to the suburban trains. In January the Dual Interface cards and readers were introduced and by end of April 2000 the field trial was terminated. After this the equipment was removed.

Assessment categories

In the Berlin field trial the user acceptance, the mechanical resistance, the technical performance and the technical reliability were validated. These validations took place on all component parts of the system. The second major stake was the validation of a new sale system and their ability to be integrated into running operational procedures. The terminal infrastructure was validated in terms of usability of information.

Further validation and assessment was dedicated to the user acceptance. This included as well involved staff as normal customers. Special attention was paid to the reaction on the systematic validation due to the check-in-check-out system.

Validation

All equipment components showed excellent functioning and technical problems occurred only rarely. In case of technical problems all data could be saved and securely processed. Sometimes user behaviour caused technical problems as cards were not handled in the appropriate manner. User acceptance registered 90% of positive feedback with reference to the new system. Almost the same percentage of testers was accustomed to the rules of the new system. The location of the validators was also perceived as good. The handling of the card was considered as good by 96% of the testers. Some reservations were just made whether the positive perception would have been also if the access to the platforms would have been closed by turnstiles or gates. The performance of the fare calculation was also positively validated. All models tested within the frame of a fare integration city and region proved satisfying results. Added services were put in place as Park and Ride options in the city centre and proved to be performing well. The results of the distribution network and its channel were also satisfying. Customer service was perceived as very good due to a call centre which was set up especially for the field trial. 75% of testers having called perceived the service as good. The interservices were also validated positively.

Results

72% of the testers accepted the new ticketing system and 90% perceived the handling of check-in-check-out requirements as easy at the beginning. At the end of the field trial acceptance rose up to 88% and 47% voted in favour of such a system implementation for the near future. The overall positive acceptance of the contactless technology as new fare collection system proved that efforts were taken to introduce such a system for the future in the capital region of Berlin/Brandenburg. Secondly the field trial results urged Berlin to lobby in favour of standardisation at the VDV (German transport operator association) of electronic ticketing. For future implementation all participating operators BVG, S-Bahn Berlin and the fare agglomeration Berlin-Brandenburg (VBB) set up additional organisational efforts to prepare the coming phase for a generalisation of this contactless technology.

3.2. Paris

Objectives

The STP (Syndicat des Transport Parisiens) now STIF (Syndicat des Transports d'Ile-de-France) is the authority responsible for public transport in Ile-de-France. STIF is managing the introduction of a new teleticketing system with four operators (ADATRIF, APTR, RATP and SNCF). Before the decision in favour of contactless technology as fare management system support several field trials were conducted.

The main general objectives of the new ticketing system were:

Ease of access to public transport means

Marketing tool for public transport operators

Introduce new services (especially in cities)

Improvement of the quality of services

Reduction of fraudulent behaviour

Paris focused on three aspects during the different field trials:

1 - overall system validation

2 - focus on single tickets for infrequent user,

3- and emergency call function to enhance safety in Public Transport, and the improvement of passenger information.

In total the introduction of the new contactless ticketing system included different field trials, a market test and specific studies.

System configuration

In order to test different solutions a programme of various field trials in different sites in Ile-de-France was set up. Five sites were chosen for this field trial:

different functional scenarios: pre-debit and post-debit (i.e. check-in only and check in-check-out)

different modalities of selection and validation

two types of devices: card + folder with screen and ISO card without screen

There was a systemic validation (check-in) at the entrance for all testers in all vehicles (one single gesture).

Site 1: Pre-debit and selection on the buses

Site 2 and 5: Post debit including systematic validation at the entrance and at the exit for all transport modes

Site 3 and 4: pre-debit – selection and validation at the entrance in all transport modes including bus

Therefore each single site had to:

assure good functioning of the material

assure the understanding of the system

assure the acceptability of the procedures

locate the changes coming across by the new system

analyse problems

assure the understanding of different situations (foreseeable and not foreseeable)

compare the different application modalities of the new ticketing system

Territory

For the first field trial (site 1) totally 43 metro stations and two bus lines (line 46 /RATP and line K /STRAV) have been equipped. Two stations were installed for the recharging of the cards (République and Créteil Préfecture).

Time scale

The field trial (site 1) covered the period of six months starting mid of February 1997 and lasting to September, including a set up phase of one month.

Recruitment

The participants of the field trial (site 1) were recruited at the RATP stations République and Créteil Préfecture and onboard the buses of the lines 46 and K. In principle the choice of the participants favoured season ticket holders and not infrequent travellers. It took three months from the recruitment to the delivery of the device to all testers. The number of testers on site 1 was of 1000 persons. 900 of them tested the so-called "Pass Francile" folder + screen and 100 tested the ISO without screen.

Staff

The evaluation of staff behaviour within this field trial (site 1) consisted in a description of the interface between each single working group within the RATP - staff and the generic system. Further more the interface between user – system and the staff perception of the interface between user – system. Therefore staff had to be well instructed on the requirements.

Rules

All participants of this field trial (site 1) received a use instruction for their device and the applications. The field trial took into account the actual fare system. All participants had to pay for their journeys. Especially "Carte Orange" (weekly, monthly, yearly) and ticket carnet were integrated.

Assessment categories

The evaluation of users behaviour in this first field trial (site 1) included:

Definition of the exact methodology of evaluation

Recruitment of the experimentators

Evaluation and Analysis of results

Final report on the evaluation of user behaviour and on the general methodology on the sites.

The basic guidelines for the evaluation foresaw the following components:

user behaviour: What do they buy?

How do they use the system?

How do they understand the use?

What do they think of the device?

How do they like the device?

shopping behaviour

use

information (How do they consider the information on the screen?)

Control of the device

Ergonomy

New applications

Results

The results achieved by the field trial (site 1) were extremely satisfying. In general 80% of the user appreciated the card. They considered the card easy to use with the ability of rapid transaction. The card

was easy to recharge, solid but small and reliable. Even more the testers considered the card an instrument of familiar use (like keys or wallets). The folder was considered useful with a good ergonomy and attractively designed. The information on the screen was good but only few participants (40%) consulted it. In general the screen gave testers the impression to have an individual control of the system. The validation gave most of the testers the possibility to verify on the screen the amount of money they had just spent.

The recharging of the Pass showed that testers started to recharge a bigger amount of money on their device, when they could start trusting their card more and more. This was caused by an increase of confidence after having used the card for a time period without any problem (people got accustomed to the new system).

Most of the testers used their Pass in the metro and half of them on the bus lines. More than 80% of the testers agreed to following sentences: The new system support has more advantages than disadvantages, has a notion of freedom, is a system for the future, gives public transport a modern shape and it fastens transaction times. Nevertheless some users (30%) feared an increase of anonymity of the public transport services or technical problems with the card.

Passenger information:

French railway was in charge of studying a fixed equipment providing ticketing information with the ISO smartcard without display, given the specificity of some open networks with variable fares existing in Paris. In this type of network, tickets are validated at entry point only, to make payments for trip.

Development of a single ticket:

The objective was to test contactless technology in all categories of customers, in particular to the occasional users. The single ticket was validated in the field trial.

Emergency Call:

The emergency call is issued by the badge by emission of its serial number; this call is received by a receiver in an area of about 100 m, and automatically re-emitted by this receiver to the central security unit.

The new system of contactless ticketing applications in Ile-de-France had to be validated in general with special attention to the reactions of users, of staff and of the partners. The evaluation of this field trial includes as well users (recruitment, analysis of results) as staff (evaluation).

The basic objective of the field trial was to evaluate the preconditions of the acceptability of the future ticketing system in the Ile-de-France from the point of view of users, operators, society, beginning from the

different possible applications. The analysis was done by comparison of the user reactions in the various sites.

3.3. Venice

Objectives

As a medium size city visited by a very high number of tourists, Venice focused its field trial on the management of the passenger flows within a marketing approach in conjunction with all the main public and private partners operating in the city. A particular focus was put on infrequent users (in particular tourists representing ca. 14 000 000 persons p.a.). The field trial in Venice was basically intended to show the impact of contactless technology on the flow management and the possibilities to offer additional services to the basic transport related application.

The contactless technology is considered as a powerful management tool for the coherent control of visitor flows in Venice aiming the optimisation of the service and the increase of customer satisfaction. With the new technology it will be possible to introduce customer oriented packages aiming in a final view to realise a city pass. The basic objective was to see the functioning of the system in a touristic city environment. The basic technological aim was to test the functioning of specific hardware components in an aggressive saline open-air-environment.

Time scale

The field trial was scheduled for a period of two months (February/March 1998).

Recruitment

The participants of the field trial were recruited within the staff of the transport operator ACTV and the city council of Venice. The number of participants was totally: 150 (100 ACTV and 50 citizens of Venice). To all participants a questionnaire was distributed.

Territory

Totally ten boat stops (Paglia, San Marco, Accademia, San Tomà, Sant'Angelo, Rialto, San Marcuola, Ferrovia, Piazzale Roma and on the island Lido) were equipped with validators and concentrators. These sites were chosen because they represent the main stops of Canal Grande with an elevated passenger flow.

The participants were satisfied by the functioning of the system. From a technical point of view the transactions were functioning excellently. The cards were accepted positively by the testers. The specific results for the Venice site showed a necessity to personalise the hardware components in order to avoid any problems due to vandalism. The second specific result was to modify in future the actual ticketing system procedure that is so far only consisting of a check-in system with optic staff control. The results of this field trial were provided through questionnaires and personal interviews of the participants.

3.4. Dresden

3.5. Barcelona

3.6. Switzerland