e-Ticketing Strategy and Implementation in an Open Access System: The case of Deutsche Bahn

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ABSTRACT

The paper describes the opportunities and challenges of e-ticketing in public transportation. While the concept of e-ticketing is prevalent in the airline industry, it is difficult to implement in an operating environment where the entire business strategy is based on an "open access" system for flexible travelling. We present here the case study of Deutsche Bahn Mobility as the world's largest logistic network, in its successful e-Ticketing implementation strategy. First we describe e-ticketing strategies in transportation and briefly differentiate two closely related industry: airlines and railways. Then we describe the strategy and challenges faced by DB in its e-Ticketing implementation follow by proposals of future market expansions areas based on existing platforms and infrastructure. Finally we conclude by setting out implications of this case study for the broader business and research community as agenda for future research.

1. INTRODUCTION

E-ticketing in tourism as a "paperless" revolution, first hit US based airlines in the 80s. It was used primarily by domestic carriers operating point to point flights (BusinessTraveller, 2004). The first airline to start experimenting with e-ticketing, in 1984, was United Airlines but it took six years before the procedure was actually implemented. But once it got started, the travel industry globally saw the opportunity for a dramatic transformation in ticketing systems. E-ticketing is a method for documenting sale, tracking usage and accounting for a passenger's transportation without requiring the issue of paper "value documents". Passengers are able to book, pay for and print their e-tickets online from any point in the world. The main users of this system are business travellers as this market segment accounts for 70 per cent of all travel (BusinessTraveller, 2004). The business segment, being more "technology savvy", was also better prepared to adopt this new booking method. The two main advantages for travellers are convenience and a more secure way of travelling. Under the traditional system, most travellers have to carry physical tickets at all time of travelling. With e-ticketing, all associated information will be stored digitally in a central database and therefore there are no chances of the traveller losing them or having them stolen. All the passenger needs to do is to carry the ubiquitous "photo identification" (Anonymous, 2006).

When a public transportation company determines a ticket sales distribution system, it is vital foremost to identify the market segment for which it will be adopted (LaPlaca, 1997). Figure 1 illustrates a generic example of two types of mass public transportation systems – that of airlines and railways:

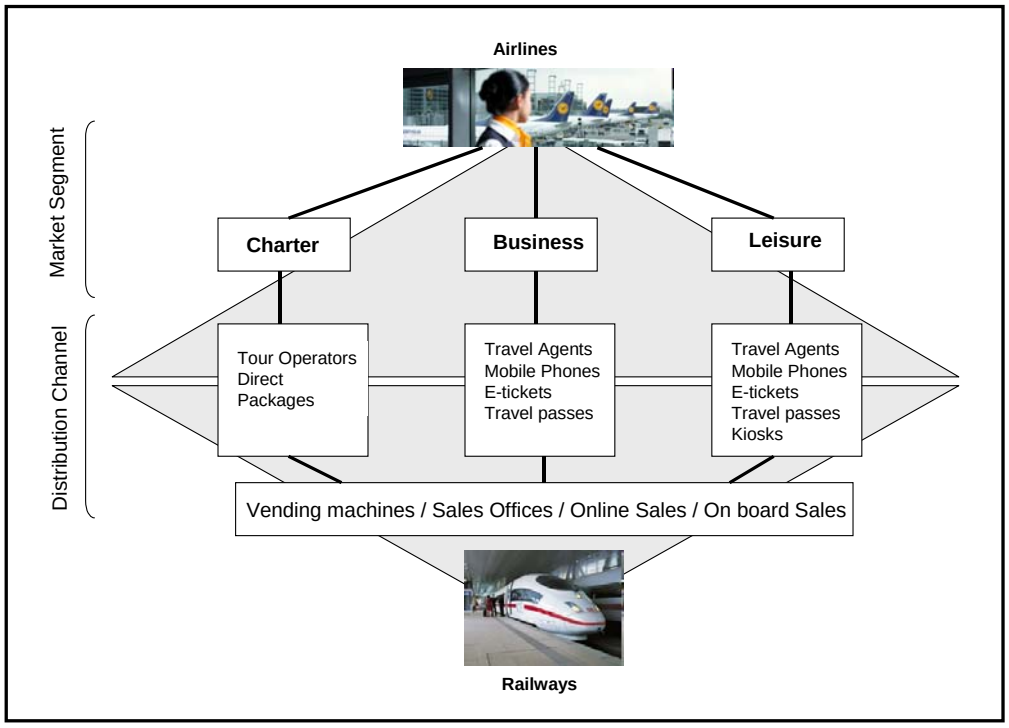

Figure 1: Generic Market Segmentation and Distribution channels
for public transportation

The first row denotes the market segment – charter, business and leisure which are differentiated into residents and non-residents travellers (Fisher, Coogan and MarketSense, 2002). The second row of boxes describes the marketing tools to be applied to each segment with the related distribution channels for the issuance of tickets. For instance, for the charter flight travellers, the strategy would be to sell advanced tickets through tour operators directly. For the local market, the strategy calls for the use of locally available national trip-planning system. A good example in Germany, would be the Deutsche Bahn Internet information system for railway travellers primarily, as well as for other connecting public transportations, excluding the airlines although there are special connecting trains in cooperation with Lufthansa Airlines departing from specific stations. For the technology savvy and mainly higher-scale local business markets, the strategy emphasizes the use of e-ticketing (IATA, 2005) and evolving smartcards and mobile phones[1] concepts. For the lower-scale, local short distance travelling, the strategy emphasizes sales at kiosks. For those requiring international travel within Europe, until an international standard is achieved for tickets control for railway, travel agents or sales offices are emphasized. The types of tickets sold can again be differentiated by the time of travelling. The first type would be advanced ticket sales or sales at the time of trip planning which is requires sales via vending machines, at sales offices or self printed tickets – thus e-

[1] See a radical example of Japan's E-Ticket Program, a joint activity of the Narita Airport and a consortium of Japanese companies. The ticketless services use mobile telephones with IC chips to automate departure procedures and biometric technology to allow passengers complete their procedures smoothly and safely. Source: http://www.e-airport.jp/en/f_kousou/index.html

tickets. The second type will be the strategies for sales while *en route*—for example, on board the German ICE trains.

The e-ticketing strategy has been well exploited in the airline segment, however in public transportation as a whole, especially the railway/metro/bus travel segments, implementation techniques have been mixed due to the varying business environment and travel culture. This paper describes the opportunities and challenges of e-ticketing in "open access" public transportation, focusing on the example of the railways.

While the concept of e-ticketing is prevalent in the airline industry, it is difficult to implement in an operating environment where the entire business strategy is based on an "open access" system for flexible travelling. We present here the case study of Deutsche Bahn Mobility (DB) as a pioneering example within this "open access" travelling context. First we briefly differentiate two closely related industry: airlines and railways. Then we describe the strategy and challenges faced by DB in its e-Ticketing implementation follow by proposals of future market expansions areas based on existing platforms and infrastructure. Finally we conclude by setting out implications of this case study for the broader business and research community as agenda for future research.

2. DIFFERENTIATING BUSINESS CASES IN E-TICKETING: AIRLINES VS. RAILWAYS

The main functions of an airline ticket are to confirm to airline staff that the passenger has paid for travel, to document sales and manage inventory. The e-ticket concept, instead, tracks the sale and use of tickets through data which is stored in a central database and updated by the validating airline, enabling the passenger to check-in and board the flight without holding a paper ticket. For the airline, e-tickets offer a number of clear benefits. They reduce document distribution costs, eliminate paper-ticket fraud, enhance passenger check-in options, stop revenue leakage through automation of check-in and ticket change control, eliminate lost / stolen tickets, and eliminate the need for pre-paid tickets (SITA, 2005). The benefits of e-ticketing has moved the International Air Transport Association (IATA) to discontinue the distribution and processing of paper tickets by December 2007 (Bisignani and Peters, 2005).

The main functions of an electronic railway ticket are quite similar to those of an airline ticket. Like an airline's ticket, Deutsch Bahn (DB)'s online ticket's is also prepaid. Each ticket is assigned a unique number – the Passenger Number Record (PNR) and is personalised to each booking.

However, the e-ticketing strategy pursued by IATA differs in many ways to that of DB because of its different business context, travelling needs and consumer profile. Table 1 outlines these differences and explains why it is a challenge for DB's e-ticketing deployment.

	Airlines - IATA	Railways (DB Mobility specifically)
Seat Reservation	• Obligatory • Limited seats	• Recommended but not necessary • Number of passengers on the train is not dependant on the number of seats. In some situations, passengers may also stand.
Checkpoint	• Before boarding • Closed public access	• Not applicable • Open public access
Ticket control	• Centralised computer booking system, • Online control units. • Before boarding and checking in	• Decentralised • Offline control units. These are based on existing IT and onboard infrastructure. • On board trains
Travel flexibility	• Not flexible with fixed travel plan • Fixed passenger list, thus paperless e-Ticket is possible when only the passenger identity is verified at given check points.	• Flexible. Not bound to trains or trips with options to break/ interrupt journeys (depending upon tariff). • No passenger list exists. With no fixed exit points, it is also not certain which conductor will perform the control check.
Online booking and cancellation	• E-Tickets (or otherwise) need to be converted to boarding pass upon checking in. • After confirmed online bookings, online cancellation or changes to travel plans not possible	• E-Tickets are boarding passes, with or without reservations • Online cancellation or modifications to travel plans possible even after confirmed bookings.

3. CASE OF DEUTSCHE BAHN MOBILITY

Deutsche Bahn Mobility (DB) is the provider of mobility, transport and logistics services in Germany, the largest in Europe. The company is also the main railroad operator in Germany and conducts its business through five business divisions: passenger transport, transport and logistics, track infrastructure, services, and passenger stations.

The passenger transport division carries out transport and service activities in passenger transport under DB Personenverkehr (passenger services business unit), with DB Fernverkehr (long-distance transport business unit) and DB Regio (regional transport and urban transport business units) forming wholly-owned subsidiaries.

As part the company's marketing and sales development strategy, DB Personenverkehr has pursued an aggressive web presence strategy, offering pan-European travel information and services. The first e-tickets were offered by DB in 2001 to corporate customers. The offering took the form of a standard tariff with flexible travel plan. A year later this product was offered to the general public.

When it was first launched, the eTicketing sales channel had a total value of €45 million. In 2004, its sales value totalled €263 million. Last year, in 2005, sales of eTickets almost doubled with up to 30,000 online tickets sold per day for long distance travel (a total annual value of €440 million) . This amounts to almost 5% of the entire value of web-generated business in the Germany's tourism industry for the year 2005[2] – €8.99 billion (Rossman and Donner, 2005) - or almost 8% of the total sales value German public transportation (including normal and budget flights, and car rental) which is estimated to be €5.7 billion in 2005 (Rossman and Donner, 2005). DB expects the sales value of the eTicket channel to rise to half a billion Euros by the end of 2006 (Deutsche Bahn Sales and Marketing Report, 2005). These figures emphasise the importance and strength of the internet for DB for ticketing sales and distribution.

The business systems challenge for DB – requiring ease of use for the potential passenger and back office fulfilment - has been significant. The drive for e-ticketing is complicated by the expected operating environment – passengers expect, and it is DB's strategy to fulfil, an "open access" system for flexible travelling. This means no dependence on fixed travel plans. A customer thus has the possibility of travelling at anytime and on any train, depending on the tariff purchased. Even the product – the travel route and rate offered, is customised - the online ticketing website is able, for example, to search and locate the best tariff available for a customisable set of passenger needs.

4. E-TICKETING IN RAILWAYS

Electronic commerce (eCommerce) takes many forms and is often classified dependent upon the degree of digitisation of three dimensions – the product/service sold, the sales process and the delivery agent (Turban, King, Lee, Warkentin and Chung, 2002). In traditional bricks-and-mortar organisations, all these dimensions would be physical while in on-line music stores such as iTunes, all dimensions are digital – iTunes coule be said to be a pure eCommerce organiastion. Most companies, of course, are a mixture of both "clicks-and-mortar" or hybrids like, for example, *Amazon* where the extent of the digital experience depends, inter alia, on whether physical books or e-books (or software) are ordered.

In the case of DB's sales and marketing, the goal is clearly to maximise the digitisation and to move towards a pure eCommerce business model for ticketing (of course, *travel* cannot be provided in a digital manner, so the passenger *experience* cannot be pure eCommerce). One of DB's main objectives is to optimise the cost of distribution of railway tickets. By distribution, we mean all activities related to the sales of travel services in a passenger railwayincluding processes and services for (1) customer information and journey planning, (2) reservation, ticketing, cancellations, and (3) sales planning and control (Accenture, 2003).

When distributed electronically via the Internet, DB's average cost per ticket dropped dramatically by more than 50%, compared to tickets booked through a travel agent. For DB, e-ticketing thus offers a new self-service concept for passenger ticketing in public transportation. From this business model, opportunities are created in simplified access to passenger rail, improved service level in ticketing and optimized sales processes.

[2] Source: http://www.web-tourismus.de/studien-webtourismus2005.asp

In the railways industry, there exist three general strategies for e-Ticketing:

- with check-in and check-out points – with or without smartcard, as is implemented in the Great Britain[3] (e.g. the London Tube) and in France (e.g. the Paris Métro[4]) for local trains (Moreau, 2003). This system is suitable for closed access to stations, and short distance travel. It is prepaid, with control check points at each stations – either done manually or electronically.
- with either (1) check-in and check-out points and/or (2) real time tracking of travel route. This method bills the customer after he/she has completed a journey. The first alternative has fixed control points where the second alternative is currently in its infancy stage and not so popular due to its many critiques. One example is that the usage of mobile phones to active the start and the end of travelling route for control. With the possibility of real time tracking, it opens up a new can of worm –that of privacy and data protection issues. In addition, questions still arise on how to verify the "e-ticket" on board and how to bill accurately when the determination of the exact location is not possible. Tracking via mobile phone, even in emergencies is not exact (ITU, 2004). The E112 initiative in Europe has not set any specific performance standards, and it's equal initiative in the US, the E911 only sets the standard to pinpoint at least 67 percent of callers to within 50 to 100 metres.
- Smartcard-based systems with Radio Frequency Identity (RFID) - Near Field Communication (NFC). This method too is reasonably new. The control unit and other infrastructure are very expensive to install. For an example closer to home, is a project related to the usage of smartcards-based e-ticketing. The Rhein-Main Verkehrsverbund (RMV), the public transport authority for Frankfurt's greater area, ran a joint project early 2005 to trial an NFC ticketing solution that uses mobile phones to access an existing contactless smart card ticketing infrastructure (Anonymous, 2004) (Anonymous, 2003). The concept of mobile e-ticketing and closely related to it, of mobile electronic payment has been around since 2001 but has not taken off successfully (Dasai, 2002, Ondrus and Pigneur, 2005). Now taken up in the form of NFC, the results have so far been sceptical. Apart from heavy investment required, there is also a huge barrier for mass market adoption. The users are required to have compatible mobile phones and they would not be able to physically see the "product", a feature deemed important during eCommerce transaction for the sense of security that the purchase works and that he/she has all travelling details in hand.

These e-ticketing strategies all require a high investment in hardware infrastructure and are most suitable for short travel distance. Therefore, unlike pure digitised tickets mentioned above, DB has opted for a paper-based e-ticket self-generated by users. Research (Deutsche Bahn Sales and Marketing Report, 2005) has shown that DB customers prefer to be able to see and physically feel the product he/she has paid for. When travelling long distance on a high priced ticket (an average of €75), it seems the average passenger feels more secure having a piece of paper with all travelling and reservation details and printed on it.

There are two different kinds of operating environments in the European rail network which have influenced online ticketing strategy:

- Fixed train booking: For example part of the railway transportation systems in France[5] and Belgium (TGV and Thalys trains). These have check-in and check-out points and are issued only in conjunction with a specific seat reservation. The similarity with the eAirlineTicket concept is clear.
- Open travel access booking: with flexible travelling plans. For example the railway transportation system in Germany. All customers within a tariff, have the flexibility of travelling at any time, with or without reservation, for long or short distance travelling, with or without a pre-purchased ticket. On one hand this strategy offers convenience and flexibility to travellers, on the other hand it involves massive resources in planning, management and control of the entire system.

[3] British Railways (National Railways) website: http://www.nationalrail.co.uk/
[4] For more information on Paris Métro, see for example:
http://www.discoverfrance.net/France/Paris/Paris_metro.shtml
[5] French Railways (TGV) website: http://www.tgv.com/

The approach that DB has adopted, while (as its sale of eTickets has shown) resonating with the travelling public, has required many new problems to solved for it to work seamlessly.

5. SOLUTION OF DEUTSCHE BAHN

The DB's e-ticketing strategy is based on the "self-service self-print ticket concept". Also called "open access tickets" (Loh, Kramer and Kruelle, 2005, Kruelle, 2003) the online tickets are valid up to 30 days for a return trip and at the moment only available for travel distance of a minimum 50km. No reservation is required although, for passenger comfort, reservations are recommended at certain peak travel times and on certain main ICE (speed train) routes – and reservations may also be made online in conjunction with, or entirely independently of, ticket purchase. Irrespective of how the seat reservation is made, the ticket and the reservation are not tightly coupled – the passenger may still choose to take a different train.

Online tickets on standard tariff – normal priced tickets, are not bound to specific trains, and are fully refundable if not used[6]. Online cancellation is possible. Unlike most travel ticket which relate to only one traveller, online tickets can relate up to 5 travellers. The four other passenger is known as co-travellers (Mitfahrer). Only the details of the main traveller, to which the ticket is booked under, is stated on the ticket for control purposes. The tickets can also be re-printed as often as is required. In summary, the major features are:

- No restrictions in validity period and tariff provisions
- Online cancellation available up to first day of validity
- Online overview of all bookings done from the last 6 months and the download of online tickets before first day of validity
- The most popular online tickets include:
    - standard ticket one way/return
    - corporate tickets (up to an additional 10% discount)
    - BahnCard tickets (25/50 % discount)
    - Co-passenger fare (50% additional discount)
    - special low-cost fares ("Sparpreise" and "Aktionspreise")

The features of these "open access tickets" are important aspects of DB ticketing strategy that has to be kept when online ticketing sales channel is used. One single ticket purchase can involve many non-standard inputs, thus is highly customised. Except for this new marketing channel, everything should remain the same, and this is the main challenge for DB. In the next section, we describe DB's online ticketing solution and opportunities for future growth and expansion.

5.1 DB Online Ticket Solution

The DB online ticket is an integrated travel document. It is a train ticket, with seat reservations details (when applicable), product information (thus the tariff type), timetable information, and payment information on one single piece of paper (which is an important aspect for tax declaration when it is used for business travelling). The online booking system is easy to use through a standard web browser. Customers can make all bookings and payments online - payments can be made either by credit card or direct debit from the customer's bank account – and then print their eTicket printed out on standard paper, on their own (or any) printer.

Once booked and paid for, the ticket is immediately available over the Internet in as the form of an Acrobat pdf document. For control and verification purposes, the ticket is only valid (can only be used) in conjunction with a customer's personal identification card, such as his/her credit card, or a DB BahnCard[7], etc.

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[6] When the customer cancels the trip after the intended day of use, a cancellation fee of 15€ would apply.
[7] This is equivalent to that of a loyalty card with specific benefits, mainly travel rebates.

In terms of control, DB uses existing IT and onboard infrastructure without the need of significant hardware or personnel investment. Ticket inspection, which is carried out by more than 15,000 of DB's on-board personnel, is both easy and secure. The control checking is based on the certificate and personal identification card.

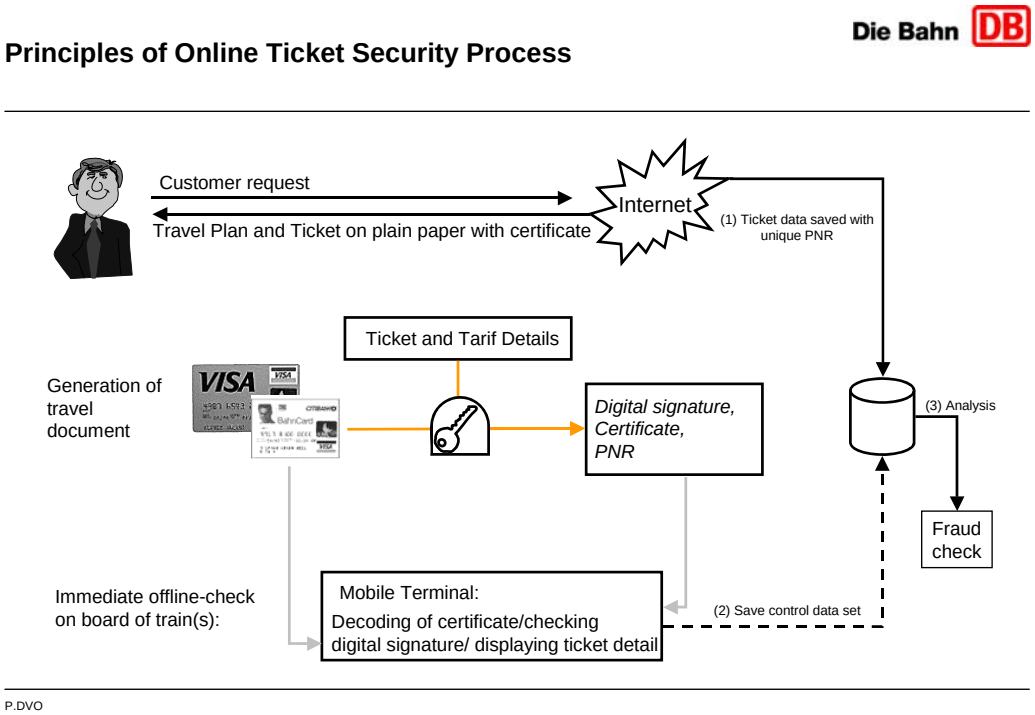

Figure 2: The Process of Sales, Self-printing, Control and Clearance

Figure 2 illustrates the process of sales, self-printing of online ticket, control and clearance. It can be briefly described as follow:

- The customer must log into the booking system. If he/she doesn't have an existing account, s/he will be required to register with the system. When this is done, s/he will always be identified through a Customer Database for future transactions.
- The customer could access the booking system via the WWW from any location in the world. Online booking are done real time as would the payment system.
- Upon the completion of transaction, an online ticket with a PNR (Passenger Name Record), travel information, certificate, ID card, and name of the customer will be generated as one single complete document. The PNR, also used by airlines, is a unique reference number referring to that specific ticket – which within itself may consist of multiple transactions.
- The online ticket can now be downloaded as a pdf document by the customer and be printed on any regular paper and printer with unrestricted number of reprinting. This feature is useful in case of misplacing or loss of ticket.
- The customer can now begin his/her journey with the online ticket and an identification card for on board verification and control purposes.

- One of the most important aspect, apart from customer usability of the online booking system is the control and security aspect. This system is based on electronic certificate used together with a unique ID, such as an ID card or a credit card ID) for ensuring security and for protection against fraud.
- On board the train(s), the conductor(s) check(s) the ticket using his/her mobile terminal (MT) for validity and authentication of the online ticket. The control parameter set would be saved on the MT.
- Later, the data from the MTs would be downloaded to back office system. This is done on a regular basis, and thus is an offline system. All control parameter sets are automatically matched to sales transactions.
- In cases of fraud, either additional charges, disqualification from the Online Ticket System or other legislative measures would apply.

Figure 3 summarises the control processes with the usage of MTs and Figure 4 shows an example of DB's online ticket.

The main obstacle to the pan-European extension of this system is the need for investment in hardware – the mobile terminals to ensure secure and proper ticket control and authenticity. Currently eTicketing is not available internationally (i.e. within the EU) nor regionally.

6. EXPANSION INTO NEW MARKETS

In order for DB's online ticketing strategy to take off internationally, it is necessary for an international Online Ticket Standard (UIC 918.3) to exist. The main drivers pushing for this standard are the German, Swiss and the Belgium railways. The highlights are the interoperability of ticketing control and security. Finalised last year in November, this international standard will be aiming for 2D Barcode containing all necessary travel information. It will include a basic/standard train ticket and additional data of an electronic ticket. Other processes to be complied would be that of digital signature checking and the exchange of control data.

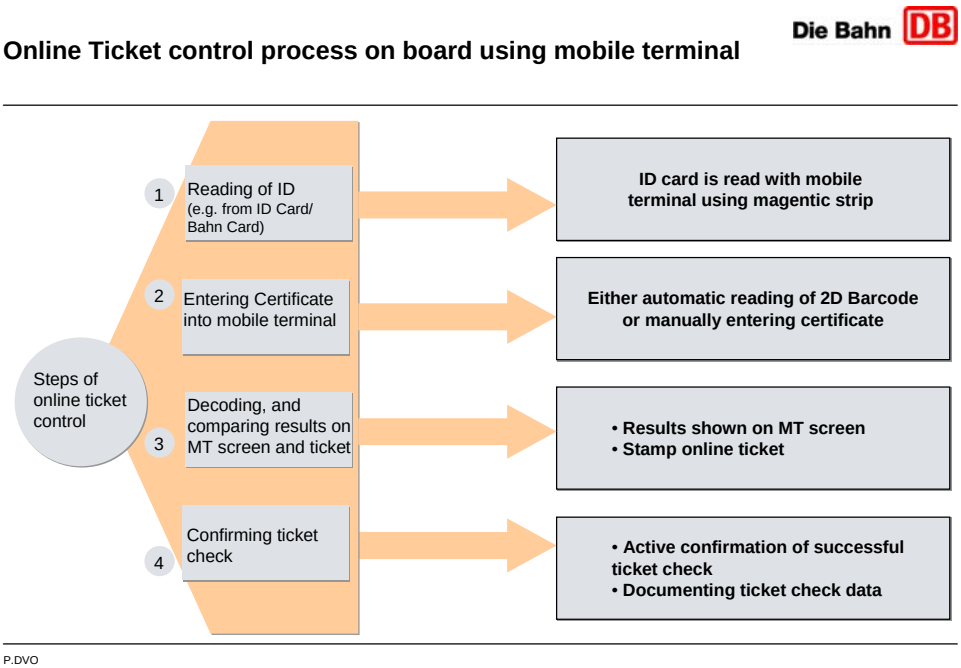

Figure 3: The control process with the usage of mobile terminals

DB's online ticketing solution is currently not available for regional (short distance) travel due to low unit price level and a lack of ticketing control. As the cost of ticket itself is low, it therefore may justify a less secure validation system unlike that of long distance travel. Instead of using specific hardware for authentication, a manual visual check should be made possible. One possible solution is watermarking regional online tickets. In order to discourage fraud (for example free-riders), details of the watermark would be changed on a regular basis. The other solution, would be not to consider online ticketing as the "blanket" solution for regional market, but rather to consider other possible methods, including pre-paid smartcard-like solutions, as already been in place in many regional travels, or possibly even mobile ticketing (Poropudas, 2003).

Most mobile ticketing solutions have their origin in mobile payment. Although mobile payment system has not been successful, it has been found suitable for proximity and micro-payments. They have been adopted by primarily quick service oriented industries (Moore, 2003, Ondrus and Pigneur, 2005) such as public transportation, toll booths, gas stations, fast-food restaurants, retail vending machines and ski resort ticketing. Unfortunately due to the immaturity of the market and the lack of standard it's overall commercial success is still doubtful. Also is the lack of a proper business model and the lack of proper security features. Should DB chooses this method as one of the solutions, one important aspect remains that it should also be made suitable for large payments as well, thus building customer acceptability and trust is essential. Also there should be no new processes for online booking via mobile phones then those already existed with the normal booking via Internet from fixed net. Instead, it should only be an extension to the existing processes.

Mobile ticketing is therefore potentially feasible and could be based on the 2D Barcode technique discussed above. Potential target customers for this method could be the business and corporate market segment. The entire travel information, booking, reservation and ticketing process would have to be supported on mobile phones with WAP 1.1 or WAP 2.0 standard and MMS capabilities. Payments could be made using credit cards or bank debit.

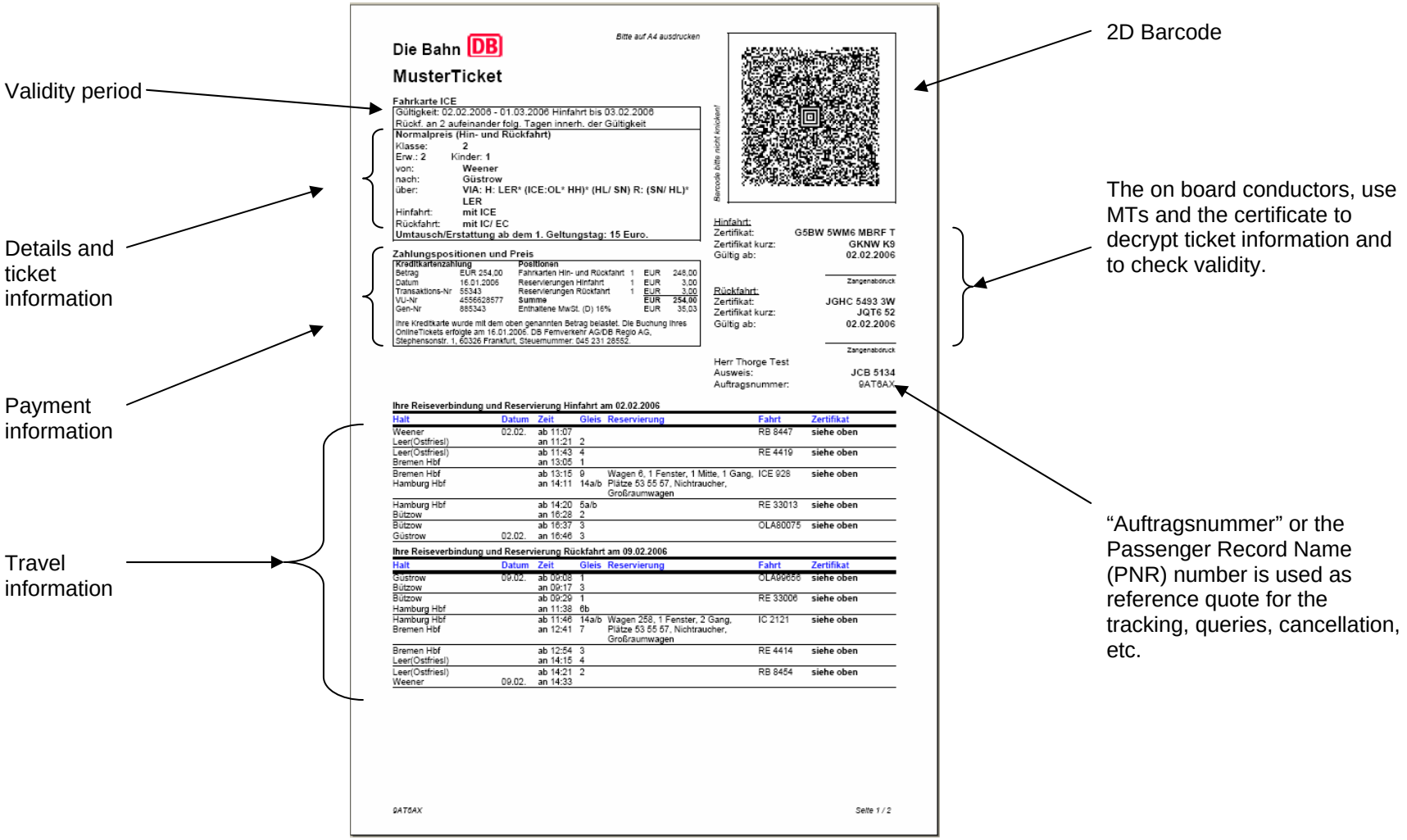

Figure 4: Example of a self-print online ticket

7. CONCLUSION

In this paper, we have presented a practical case of e-ticketing for the railway sector in the form of DB's online ticket. The implementation of DB's online ticketing strategy has been both exciting and challenging. When it was launched in 2001 online tickets were only offered to corporate customers. This pilot launching platform enabled DB to refine the product – in terms, both of features and useability – until it was finally offered to the general public. There was high acceptance and usage rates amongst corporate customers and it was a big hit with the general public. The DB strategy was successful primarily because:

- the DB website had long been an important source of rail information receiving up to 2.7 million "hits" for travel queries alone every day! It was not enough, therefore, to focus on an eTicketing strategy in isolation but rather to strategise in the context of eTicketing's relationship to the entire DB information system and online identity. The online booking system and online ticketing works seamlessly with all other components of the system – which is part of what makes the DB homepage one of the most popular websites in Europe.
- there was an easy adoption path for eTicketing – web-based purchase was familiar to many passengers, no special technology was required. Any computer literate person with an internet connection would be able to book and purchase a ticket online, from anyplace. S/he need not be bothered with the traditional fulfilment method of queuing in lines at the ticketing counter to book, to query or to pick up his/her travel ticket.
- The travelling relationship between the customer and DB remained essentially unaltered – in essence, the travellers' relationship with the product (train travel) remained entirely unchanged. There was simply a more convenient *alternative* way to buy tickets.

Choosing the right e-ticketing strategy was not straight forward. Many e-ticketing "solutions" exist in the market, but none were suitable for the consumer profile of DB. Unlike rail travellers in other countries, who mainly travel short distances to work on trams or city shuttles, many DB customers in Germany travel more than 50km each way to work each day. This necessitated a novel business model for DB in Germany. The next challenge will be to bring the current implementation to the regional, short distance travelling level, and internationally.

The lesson learnt from this case study is clear. While eTicketing is a sales and distribution channel both of the present and of the future, the eTicketing strategy with which we are most familiar – that of the airlines – represents only one form of that channel. The case of DB described in this paper provided an example of an alternative e-ticketing strategy suitable for another segment of the of the travel sector.

This suggests a possible area for future research in e-ticketing. Currently implementation of e-ticketing is being concentrated in "closed access" system, either with known point to point destination (as in airlines) or short travelling distance (as in trams or city shuttles). It would be interesting (1) to explore other similar "open access" travelling and investigate other factors for process optimisation, and (2) to study within this context, the "life" of the ticket (Klein, 2003), the end-to-end e-ticketing process, and how technology (Nauheim, 2000), business process, industry's (and the general public's) acceptance of such innovation.

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