THE TICKET MACHINE CHALLENGE? SOCIAL INCLUSION BY BARRIER-FREE TICKET VENDING MACHINES

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Abstract

Subjective access barriers to public transport are often the result of insufficient knowledge of how to use the electronic systems (ticket machines) that are becoming increasingly common at railway stations and of the complexity of these systems. The hardware and software used in self-service machines can also raise additional barriers for people with restricted mobility or who have a low affinity for technology. The InnoMat¹ research project seeks to identify how new machines should be designed to best meet the needs of their different user groups. This article presents the insights obtained from a literature review and from observations and interviews at Austrian railway stations. The literature review focuses on the special needs of the visually impaired, wheelchair users and the elderly, uncovering numerous specific hardware requirements that are needed to make such machines more accessible.

Although a large number of passengers had no problems quickly purchasing the ticket they wanted, and the senior citizens interviewed made absolutely no reference to the special needs of older people and the problems with text size and layout/size of keys, etc. discussed in literature, this group was reluctant to use Austrian Rail ticket machines and, at times, had difficulty understanding the menus on the machines currently in use. Despite frequent demands that such machines need to be self-explanatory, this proved to be not the case, and both the interviews and the observations revealed that some passengers needed someone else to teach them how to use the ticket machines.

Keywords

public transport, ticket machines, accessibility, elderly, technically unskilled persons, disabled persons, inclusive design

1 INTRODUCTION

In recent years, many railway stations have reduced the number and opening hours of their ticket counters and replaced them with self-service ticket vending machines. Indeed, ticket machines are now Austrian Rail’s (Österreichische Bundesbahnen, ÖBB) most popular sales channel: over 60% of all tickets sold in 2007 were purchased from a ticket machine². Although ticket machines offer a number of advantages for rail companies and passengers (reduced waiting times, no restrictions on opening hours), they also raise an important question: To what extent does the enforced use of these machines in some locations restrict the mobility of some groups of people?³ For example, only a small number of ticket machines are low enough to be used by wheelchair users. Similarly, a lack of alternative to the touchscreen makes it impossible to be used by the blind and visually impaired. But it is not only people with serious disabilities who are affected by restrictions to mobility on public transport. A study presented by Kasper & Scheiner [16] indicates that health problems, loneliness and difficulties with public transport are the biggest problems facing people over the age of 60. Complicated timetables, ticket machines and a lack of connections were most frequently cited as specific barriers in public transport systems. The older people who took part in the ÉGALITÉ project focus groups expressed a wish for easy-to-use

¹ The InnoMat project is funded by the Austrian Federal Ministry for Transport, Innovation and Technology’s “Ways2go” (Innovation and Technology for Evolving Mobility Needs) research programme. In a project managed by ÖBB Personverkehr AG, the Danube University Krems (Department for Knowledge and Communication Management), Plot EDV-Planungs- und Handels Ges.m.b.H. and AlliedPanels Entwicklungs- und Produktions GmbH are developing the framework for a new generation of rail ticket machines.

² Information provided by ÖBB, 28 November 2008.

³ This problem was also discussed in the project INFLOW [14].
technology, noting that many of the information and communication technologies currently available on the market simply do not suit their needs in terms of either design or ease-of-use. Small keys, long menus and confusing displays all make information and communication tools more difficult to use [8] – a criticism directed not just at consumer electronics products, but in particular at everyday objects like ticket machines.

The question of so-called technological literacy [9], which includes the ability to use not only computers and consumer electronics products but also everyday items like cash and ticket machines, becomes more relevant among older generations. People born before 1939, for example, did not have any opportunity to learn how to use digital technologies at school or in the workplace [22]. In addition to senior citizens, some other groups are also disadvantaged by the “secondary digital divide” [10]: people with lower levels of education and members of ethnic minorities number relatively frequently among those with little experience of technology. Gender, income level and occupation are also seen as predictors of a lower level of technological literacy [5]; [6]. A consequence of this reduced level of familiarity with technology is the active avoidance of such machines, and it is to be suspected that the people concerned will consider the prospect of buying a ticket from a self-service machine to be a barrier to their mobility.

ÖBB sales statistics clearly confirm the above and indicate that both elderly and disabled people use ticket machines less frequently than other groups: 63 % of senior citizens purchase tickets from a ticket machine, while 31 % opt to go to a ticket counter. ÖBB passengers under the age of 26 use ticket machines almost exclusively (91 %). Holders of regular travelcards (“VorteilsCard”) or family travelcards (“FamilienvorteilsCard”) use ticket machines relatively frequently (69-74 %), followed by purchases at a ticket counter (17-22 %) and via the internet (4-8 %). Disabled passengers make equal use of the internet (29 %) and ticket machine (28 %) sales channels, but also purchase tickets from conductors (24 %) and at ticket counters (17 %)4. Austrian Rail suspects that the inflexible menu structure (a consequence of its different fare options and the basis for its automated ticketing and ticket information) is the main reason why the elderly make less use of its ticket machines5.

2 METHODS

The InnoMat research project seeks to identify how a new generation of ticket machines should be designed to best meet the needs of different user groups. With due consideration given to the target groups, the project team is drawing up a framework for an analysis of user’s requirements for inclusive design. Two approaches seemed appropriate to address this issue: (1) Focus on those groups of users most frequently confronted with problems in using ticket machines, and (2) an analysis of those aspects of ticket machines that most frequently cause problems. Since the main target groups identified by the team (senior citizens, people with limited affinity for technology, disabled people) are the same as those most frequently discussed in related literature, a review of this literature to summarise existing insights in this field was considered appropriate. With regard to the specifics of the machines currently being used at Austrian railway stations, the project team chose to conduct an empirical study with interviews and observations to learn from the actual experiences of users and identify those particular elements that hinder use.

2.1 Literature Review

Existing research on the special needs of people with disabilities revealed a range of specific requirements that need to be met to make ticket machines accessible to the visually impaired or to wheelchair users and that should be considered in the design of a new generation of accessible ticket machines. The literature review also provided preliminary insights into the special needs of the elderly, needs which result primarily from changes in their cognitive abilities.

2.2 Observations

For a period of two hours on a weekday at the railway station in Baden (Austria) and on a Friday and a Saturday at a major station in Vienna (Südbahnhof), a total of 50 people were observed as they used the ticket machines. The observers sought to identify those people who had problems using the machines. Note was taken of how decisively they made their selection, whether they demonstrated any unusual behaviour or showed signs of

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4 Figures based on ÖBB sales data for 2008 (Weeks 8-30); only includes purchases by Travelcard (“VorteilsCard”) holders, a customer group which shows a bias toward ticket machine purchases (information provided by ÖBB, 28 November 2008).

5 Information provided by ÖBB, 28 November 2008.
nervousness, how often they corrected or cancelled their input, and whether they actually managed to successfully purchase a ticket. The subjects were categorised into three age groups: “young” (up to about 30 years of age), “middle-age” (30-60) and “old” (over 60). A sales data log file analysis was additionally carried out to support the observations and interviews.

2.3 Interviews

On two weekdays at the railway station in Baden and on a Friday and a Saturday at the Südbahnhof in Vienna, a total of 65 people (roughly equal numbers of men and women) from all age groups (15 to 89) were asked about their experiences, level of satisfaction and reasons for choosing/avoiding a ticket machine. The subjects were interviewed after purchasing a ticket either at the ticket counter (Group C) or from a machine (Group M). To identify their level of affinity for technology, the interviewees were also asked about their use of mobile phones, computers, cash machines and the internet. In addition, they were asked to make concrete suggestions for improving ticket machines.

3 RESULTS

3.1 Literature Review

Austrian Federal Government figures for 2007 show that 3.9 % of the Austrian population had sight problems (despite the use of visual aids), around 13 % of Austrians suffered from a permanent mobility restriction and 0.6 % of the population were wheelchair-bound [1]. The visually impaired are particularly dependent on public transport, since they cannot use private means of transport on their own [18]. However, 42 % of the visually impaired reported problems using public transport [1]. The number of people affected increases with age. Trends indicate that advances in medicine and demographic developments will lead to a further increase in the number of people with visual impairments and restricted mobility [2]; [7]; [12]. According to Statistics Austria forecasts, the Austrian population is expected to grow strongly in size and could reach 9.52 million by the year 2050. The population will also clearly age. Currently, around 22 % of the population is aged 60 or over, with this figure expected to rise to about 26 % in the medium-term (2020) and exceed 30 % in the long term (after 2030). Given the repeated emphasis placed in mobility and demographic studies on the influence of access to mass and private transport on the quality of life, health and happiness [20], the provision of barrier-free access to public transport becomes highly relevant.

Kirchmaier [17] stresses the heterogeneity of senior citizens and dismisses the notion of the “elderly” as a sociological category. Among this group, increasing differentiation can be seen in different areas of life, since their age range spans several decades and includes several generations with different backgrounds and experiences. Consequently, different social practices, values, consumer behaviour and, of course, levels of technological literacy must also be assumed. Aside from this, general changes in visual and acoustic perception, motor skills and some aspects of memory and cognition are also observed as a consequence of getting older [3]; [12]. These changes can be used to determine the basic design requirements for ticket machines suitable for use by senior citizens.

The blind and the visually impaired primarily only use local public transport on their own for routine journeys; they rarely travel alone to “new destinations” [11]. It should come as no surprise to note that they find it difficult to use conventional ticket machines such as those in use at Austrian railway stations: ICT systems usually emphasise the visual information channel, and good interface design is basically matched to the mental models of “normally” sighted people. Interface hardware addressing the need for multimodal input is currently not common in Europe, where systems are generally touchscreen-based [21]. But it should be mentioned that individual solutions (like optimally designed ticket machines) will not really help this target group if the whole system is not changed – finding a ticket machine is one thing, but to complete their journey successfully, they also have to be able to negotiate their way around the station, find the right train, etc. (see [4]; [19]; [21]).

The information deduced from our literature review was used to create a catalogue of user requirements. Table 1 shows a selection of the most important changes to conventional interface design which have to be made for a barrier-free access by elderly and impaired persons.
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<th>Target group</th>
<th>User requirements</th>
<th>Cause</th>
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<tr>
<td>Senior citizens</td>
<td>Screens must be light, high-contrast and provide an option to increase the size of any text, different colour coding should be used, and blue-green colours should be avoided. The location of ticket machines should be carefully chosen to circumvent a risk of reflective glare and avoid rapid fluctuations in brightness. Clear, well arranged structure without unnecessary graphics or animations; minimal, discrete indications of changes should be replaced by clear visual signs; symbols should be clear and simple, and windows should not overlap. If voice output is used, preference should be given to lower frequencies. Mechanically sounding “synthesised voices” should be avoided, and since the elderly also tend to have problems understanding them, voice output does not appear to be a suitable primary information channel for this target group. Users should be given the possibility to operate ticket machines at their own pace. Long breaks between commands without the purchase process being automatically cancelled should be possible. Provision of confirmatory feedback from the machine as well as easy-to-use “Back” function. Large input fields with plenty of space between these fields. Alternatively, they could be provided with buttons outside the screen. Machines which provide touch-sensitive, on-screen feedback might be unsuitable.</td>
<td>Deficits in focussing, visual acuity, contrast and colour perception (in the blue-green spectrum). Reduced ability to adapt to light conditions and increased sensitivity to glare. Slower processing of visual stimuli, a reduced ability to recognise embedded figures and an increased tendency to be distracted. Higher probability not to detect signals of 2500 Hz and above. Background noise, incomplete messages or stress, which is compounded by a partial reduction in selective concentration ability. Reduced speed and accuracy of motor skills. Strong tendency to try to avoid mistakes. Restricted gross and fine motor skills due to some illnesses related to higher age. Reduced sensitivity to touch and vibration.</td>
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<td>Blind users</td>
<td>Inclusion of multimodal functions, such as: voice output for texts and instructions that automatically adapts to the background noise; use of Braille or other tactile lettering elements (e.g. on buttons outside the screens, Braille panels). Issuing of tickets in Braille or other tactile forms of lettering, or some form of tagged ticket (similar to an online ticket) which can be put into a machine and the destination is read out. Machines should be designed with solid fronts. Use of audio signals and guiderails to communicate the machine’s location or machines that “speak” to people when they approach (“Welcome to the ticket machine”, see [4]; [15]). Travelcards which store details of user’s most frequent ticket purchases would also be beneficial.</td>
<td>The visually impaired and the blind compensate for their limitations in the visual channel by using other information – primarily touch and audio inputs. Need to provide positive feedback on the successful purchase of a ticket [11]. Possibility of identification with a cane (ÖNORM B 1600). Orientation and identification of the machines. Members of this target group often make the same journey [11].</td>
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<td>Wheelchair users</td>
<td>An adequate height of screens and other interface devices must be considered [8]. Users have to be able to position themselves easily in front of such machines. Customers should be able to stipulate trains with wheelchair access [2].</td>
<td>Conventional displays are adapted to a standing adult’s average size and cannot be reached by a person sitting in a wheelchair. Need for information on barrier-free trains.</td>
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Table 1: Catalogue of requirements
3.2 Observations

The 50 people observed were split fairly evenly across both genders (45 % men, 55 % women). One third of these people were classed as “uncertain”, since, in contrast to other passengers, they did not make a clear and direct selection or had obvious problems using the machines. Almost 70 % of this group had to cancel the purchase process and start again at least once, while nearly two thirds ultimately gave up and left the machine without purchasing a ticket. The number of young people (i.e. estimated to be under the age of 30) in the group of “uncertain” users was very low (only four out of a total of 17). We also observed some distinctive patterns of behaviour among members of this group. They repeatedly watched other customers using the machines and frequently received assistance from their companions or other customers, e.g. those using the next machine. Also typical of this group were the length of time spent looking at the machines from a distance and a hesitant approach; some members of this group cancelled the purchase process and went away from the machine, only to return a short time later and try again. We also observed that they spent a particularly long time studying both the launch screen (Figure 1) and the options screen (Figure 2).

Figure 1: The launch screen on an ÖBB ticket machine (photographed by the authors)

Figure 2: The options screen on an ÖBB ticket machine (photographed by the authors)
Our analysis of the sales data log files (internal logs of an ÖBB ticket machine at Vienna Südbahnhof for the time between 06:24 and 10:56 a.m. on 14 October 2008) indicated this could be a fairly common pattern of behaviour. Of the 144 purchase processes started during this period, 61 were cancelled before completion: 54% at the launch screen, 20% at the options screen and 10% on request for payment.

3.3 Interviews

Only one of the 65 interviewees – a tourist – was not familiar with the ticket machines. Over half the people interviewed (59%) indicated that they used the ticket machines regularly. Only 14% of the interviewees never used the ticket machines.

Overall, the level of satisfaction of the people interviewed was surprisingly high: 72% considered the machines to be “very good” or “good”. Only 4% of the interviewees were very unsatisfied. Nonetheless, 64% of the interviewees from all age groups reported difficulties in using the Austrian Rail ticket machines. But different age groups clearly had different problems with the machines. While older passengers with little technical experience reported problems in actually operating the machines, such problems were rare among younger interviewees: the group of passengers under the age of 19 reported no problems of this kind at all. The most common problems were difficulties in understanding the machines, the complexity of the machines, pressing the wrong keys or buying the wrong ticket (M15: “One of my friends even once bought a ticket for a dog instead of a normal ticket!”). The complex fare system reflected in the menus clearly often caused confusion. The interviewees mentioned a lack of clarity regarding the input of city limits by passengers, the zone distribution, the purchase of monthly tickets and the purchase of tickets for multiple passengers. Not all customers automatically understood the dual system of distance-based ÖBB fares and zone-based local transport association fares. They also had problems identifying the links between the two systems and the special fares on offer (C4: “It took me a while at first to realise that I had to tell the machine that I had a travelcard – and that in this case you can’t tell it how many zones you need, you have to tell it where you actually want to go.”)

Other issues mentioned by the interviewees included technical problems, long waiting times because there were not enough machines available (C10: “Everyone arrives just before the train is due...there is only one machine up here and it is often busy. I don’t go down there. I would put two up here [on the platform].”) as well as payment problems, e.g. malfunctioning machines not accepting a cash card or credit card, rejecting coins and banknotes or not giving out the right change.

Passengers considered speed of purchase to be an advantage of the ticket machines (36%). Other reasons for using them included lower prices (16%), but also the fact that ticket counters were either not available or were closed (15%). The most common reasons given for going to a ticket counter instead of a machine were to get information or travel details (19%) or to purchase long distance tickets (11%), which passengers obviously did not like to buy from machines. Some people also mentioned their fear of inadvertently buying the wrong ticket or paying more out of ignorance (C28: “If you ask me, the counter’s better, because someone there tells you what’s what. If you buy a ticket from a machine, you might pay twice as much as you had to!”). This is complemented by a conviction that they would not be able to buy a ticket from a machine without help (C21: “Nobody showed me what to do, and I don’t know what I am doing. If I knew how it worked, I would try it myself.”) Even those people who used the ticket machines regularly said that they had only learned to use them with the help of other passengers (M19: “I sometimes help people who don’t use the trains so often. I also found the machines difficult to use at first.”)

4 DISCUSSION AND OUTLOOK

Austrian Rail is aware that the interface on its current ticket machines does not best address the needs of all target groups. In the course of the InnoMat project, numerous suggestions and technical concepts for an interface design that suits the needs of the visually impaired have been taken from the relevant literature. The same applies for wheelchair users and other people with restricted mobility, who currently only have access to suitable ticket machines at a few locations. However, it remains to be clarified whether the members of these target groups actually consider the realisation of all these concepts necessary, or whether they place greater priority on other, in particular online, sales channels.

Overall, the ticket machine users we interviewed expressed a relatively high level of satisfaction, with the vast majority assessing them to be “very good”, “good” or at least “satisfactory”. Our observations also revealed that a large number of users had no problems in purchasing the ticket they wanted in a very short period of time. The sales statistics analysed also indicate that younger passengers in particular far prefer this sales channel.
However, our observations and interviews revealed a number of serious barriers to the use of the ticket machines, above all among older and middle-aged passengers. A considerable number of users were clearly already daunted by the multiple options offered on the launch screen. The switch between approaching the ticket machines and subsequently avoiding them observed for some users could be interpreted as an expression of an inner conflict of appetence and aversion, i.e. a tendency to seek out a specific situation, combined with the simultaneous wish to avoid it because it might have negative consequences [13]. When developing the new layout, it will be important to ensure that people who are nervous of the ticket machines are given the feeling that they can master the task easily and without the help of others. As initial steps, the choice of options could be better structured and a clearer visual demarcation introduced between higher level menu elements.

A further barrier was encountered on the screen offering a so-called suggested route that can be partly modified by the user. An increased number of users cancelled the process on this screen, indicating that they either felt overwhelmed by the information they were asked to provide or did not succeed in changing the information in the way they wanted. This process is linked to the fare structure (which many passengers found unclear): the relevant fare has to be entered before some products can be selected. It would be worth considering whether some of these factors could be calculated automatically in the background without the need for user input.

Some of the specific needs of the elderly discussed in the literature review (problems with text size, layout and size of keys, etc.) were not mentioned at all by the senior citizens we interviewed, indicating that – as far as the use of ticket machines is concerned – these issues are a low priority or have already been adequately resolved for this target group.

In subsequent phases of the project, we intend to use our results to develop design specifications for a prototype of a new generation of ticket machines. This will be done in participation with representatives of the specific target groups. In a next step, we will carry out focus-group interviews with target user groups, software and hardware developers and representatives of Austrian Rail. In further development phases of the new generation of ticket machines, an iterative usability engineering approach is planned: To support the user-driven design methods, hard- and software mockup testing, laboratory tests with scenario machines and (partial) working systems will be conducted with multiple users to ensure a barrier free and easy to use prototype. This prototype will be evaluated in laboratory experiments and field observations.

The design of the prototype will incorporate the required changes to ticket machines identified in the literature review, our interviews and the above mentioned methods that are necessary to make them suitable for use by disabled users. It will also take into consideration the concrete wishes of today’s users, such as an expanded choice of languages and the provision of space to store luggage.

5 REFERENCES


