

Improving Accessibility in Train Services: SJ

A Service Design Project Guided by Universal Design

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Abstract

This paper documents a service design project developed as part of the course *Human Centered Technologies for Disabilities* at KTH Royal Institute of Technology in Stockholm, focused on increasing accessibility in Sweden's regional rail services, SJ. Access to public transportation is fundamental to social, professional, and personal participation, yet the service still has barriers for people. The SMFOI report highlights the scale of the problem: only 50% of people with disabilities report feeling included in the digital society (Begripsam, 2023). According to van Dijk's Resources and Appropriation theory, bridging this digital divide requires more than just providing material hardware; it necessitates overcoming sequential barriers in user motivation, skills, and confident usage (Gültekin, 2023). A lack of these personal resources and confidence directly prevents full digital participation. This gap has direct consequences for how transport services are accessed and used, as purchasing tickets to travel is the activity with the largest difference when comparing disabled and non-disabled users.

Grounded in universal design principles, this project frames disability according to the Social Model, conceiving exclusion not as a product of individual limitation but as a design failure. Using participatory qualitative research methods, the project draws on firsthand accounts from people with varying functional needs to map friction points across the travel experience. The findings inform the conceptual proposal of a set of service design interventions targeting key touchpoints in the SJ travel journey, from planning and booking to on-board and post-journey experiences.

1 Introduction

1.1 The service, context, and societal relevance

SJ provides railway service across Sweden, Norway, and the capitals of Scandinavia, with the mission to run passenger traffic on business grounds (SJ, 2026a).

SJ has bookings available for single and round-trip tickets through its website and app. SJ tickets are also available to buy by calling, at vending machines, at some stations, and at selected retailers. A seat is pre-assigned when booking a ticket (SJ, 2026b).

There are many relevant policies, regulations, and standards for the project to ensure that rail services are accessible and usable for everyone (Advokatfirman Delphi, 2026; Regeringskansliet, 2023; Sveriges riksdag, 2018). A summary of the rights of passengers with disabilities when traveling by train is available on Konsumentverket's website, based on national and EU regulations (Konsumentverket, 2026). SJ has non-discriminatory rules for national train travel in accordance with Article 21.1 of EU regulation 2021/782, which can be found on its website (SJ, 2026c).

Known accessibility challenges in this area include ensuring that services are easier to use for everyone. Railway accessibility is important for social inclusion and independence and majorly affects user's life choices (Chen et al., 2022; Henke, 2017), but literature shows that a larger share of people without disabilities use these services than people with disabilities (Begripsam, 2023; Funktionsrätt Stockholms län, 2025).

1.2 Using a service design approach guided by Universal Design principles

Service design is a design methodology that frames services holistically, accounting for the user experience and the relationship between relevant stakeholders across a system (Stickdorn et al., 2018). Universal Design is defined as the design of products and environments that are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (Bęczkowska & Grabarek, 2024; Connell et al., 1997), so that people with diverse abilities can access and use them equitably. The Social Model of disability is an approach that attempts to shift attention away from the functional limitations of individuals and toward the problems caused by disabling environments (Barnes, 2011; Johansson, 2022).

These frameworks are highly relevant and complementary to each other. In the context of this project, where the aim is to identify and address systemic barriers in SJ's rail services, the combination allows for both understanding existing failures and developing grounded directions for redesign. It places the responsibility for accessibility on the system, rather than on the user.

2 User Interviews

To ground the project in lived experiences, semi-structured interviews were conducted with four consultants, each with varying functional needs and experience using public transport in Sweden. The consultants involved were from disability and accessibility organisations whose members bring both professional expertise and direct lived experience of navigating services. They were recruited and assigned through the course setup. Interviews lasted approximately 30 minutes each. Sessions took place in person and remotely, with timing and communication formats adapted to each participant's needs and preferences.

The interviews followed a semi-structured approach, covering various topics and progressively zooming in on details. They began with a cognitive walkthrough covering the full travel journey to understand where barriers arise and which parts of the service are already accessible. Further questions addressed problems documented in the literature, such as overwhelming website navigation (Begripsam, 2023). Additional questions concerned the consultant's daily life, their assistive tools, and whether they preferred in-person touchpoints or online interfaces. Lastly, the interviews investigated how accessibility is achieved by other services. Consultants were asked to identify an app, a feature, or a service that they thought provided a positive example and were then invited to compare it directly with their experience of SJ. The preparation for these sessions drew on frameworks addressing stigma, norms, and inclusive research practice (Begripsam, 2023; Johansson et al., 2023), as well as practical considerations around duration, flexibility, and participant comfort.

2.1 User insights

We first synthesized participants' experiences into a user journey map (Gibbons, 2018) (see Figure 1). We then identified and consolidated key insights across different stages of the journey through affinity mapping of the interview data (Pernice & Krause, 2018) (see Figure 2).

2.1.1 Insight 1: The user wants to feel in control and to avoid mistakes when taking crucial steps

One consultant reported feeling anxious during online ticketing, as financial transactions combined with overwhelming information made them fear making mistakes. This anxiety represents a critical barrier in 'motivational access' and 'skills access'. Research highlights that a lack of self-confidence, including safety concerns, and the perceived complexity of digital technology can easily deter users from engaging with these services (Gültekin, 2023; Sundling et al., 2024). This fear ultimately prevents many users from purchasing tickets autonomously, forcing them to ask for help to a relative or a loved one, as emerged during the interviews and as is documented in literature (Funktionsrätt Stockholms län, 2025).

When key information is not shown on a single page, scrolling back and forth makes it harder to remember. The importance of consistency in online services was also highlighted, as consistent interaction flows and information help create predictability and give users a greater sense of control.

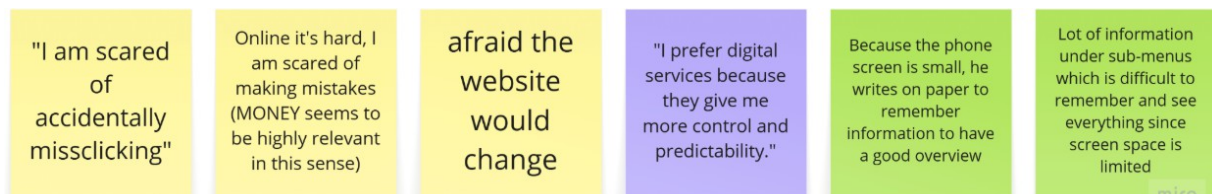
Figure 1: User journey map

	Phase 1: Before travelling	Phase 2: On the station	Phase 3: On the train	Phase 4: After traveling
Touchpoint	Website or app	Train station	Train platform	Train station
Actors	User, customer service, developers, digital platform	User, assistants, station staff	User, assistants, train staff	User, assistants, station staff
Activities	- Search for a trip that matches the desired day and time for a good price. - Choosing payment method. - Buying the ticket through the website or app. - If needed, calling customer service to have them help with booking the ticket.	- Arriving at the station and finding information regarding the booked train and where to go. - Meet up with the assistant. If the user has booked it. - Navigating the train station to find the right platform, with the help of the assistant, and asking staff for help if needed	- Entering the train. - Bringing on luggage, if any, and finding your seat / a free seat, if not pre-booked. - If assistance is booked, getting help to enter the train, finding a seat and carrying bags.	- Leaving the train at the correct stop and taking off luggage. - Getting assistance from the new train station to get off if needed. - Navigating the station

Figure 2: User journey breakdown



Figure 3: Transcripts from insight 1



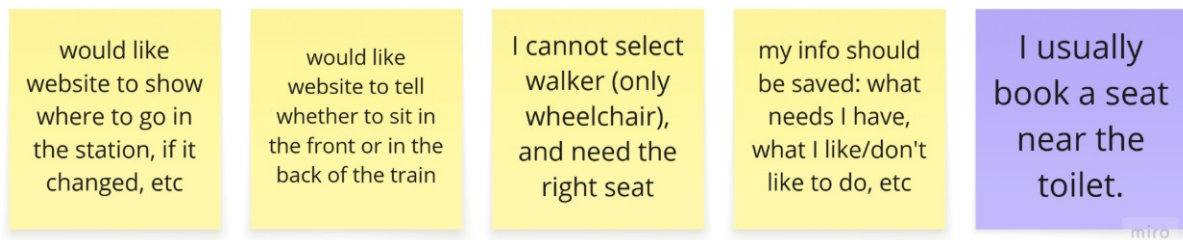
2.1.2 Insight 2: The booking system provides too little information and too few accessible options, forcing users to manage on their own

While the ticketing process provides basic travel information, consultants would also like to know more detailed information, such as how to reach the station or whether a seat is located at the front or rear of the train. Accessible services such as requesting walkers or reserving specific seats should be available online, helping users feel more confident and in control during their journey, as opposed to having to call for assistance and explaining their needs over and over again.

This localized finding aligns with broader public transport research, which highlights that for mobility-impaired passengers, having prior knowledge of whether multipurpose areas or specific seats are available

is a critical factor in ensuring an accessible and confident journey (Faulhaber et al., 2022).

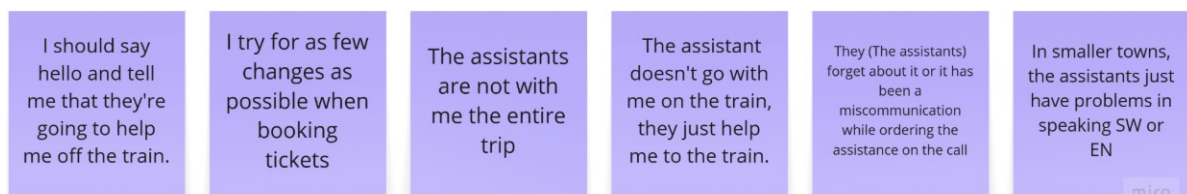
Figure 4: Transcripts from insight 2



2.1.3 Insight 3: Inconsistent and poorly trained assistance reduces user confidence and control

One consultant noted that users must locate the human assistant themselves. A similar issue occurs during transfers, as assistants typically do not continue to the next station, requiring users to find another assistant upon arrival. Some assistants are not adequately trained to support people with disabilities, with incidents such as knocking over their canes, misunderstanding their needs, being unable to communicate in English or Swedish, or even missing the appointment with the user in need. These inconsistencies reduce the reliability of the service. The same issues were documented in a previous study about SL, Stockholm's local public transport service, closely connected with SJ (Stjernborg, 2019). Beyond Sweden, qualitative research on disabled people's experiences of rail travel in general and in the UK identified inconsistent passenger assistance as a systemic issue that undermines both independence and confidence among disabled passengers (International Transport Forum, 2009; Office of Rail and Road, 2025; Outhwaite et al., 2025).

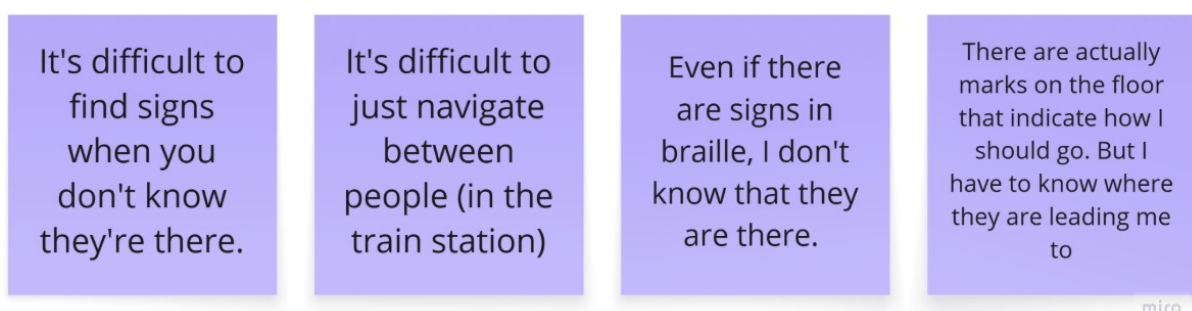
Figure 5: Transcripts from insight 3



2.1.4 Insight 4: Insufficient guidance for users to navigate through the station, and no clue about what is around them

While tactile signs are installed in most stations to indicate how users should walk, they provide little help for navigation. These markings do not indicate where they lead, which makes them unreliable. Moreover, users often have no way of knowing what is around them. Even when Braille signs are present, they may still not know where they are. Research shows that insufficient cues for navigation severely hinder the accessibility of railway services (Doshi, 2026).

Figure 6: Transcripts from insight 4



2.2 Formulated accessibility requirements

We found that consultants had different needs and situations during their journeys due to their varying impairments, so we synthesized the findings into three user need statements using a needs-statement framework (Gibbons, 2019) (see Table 1). These correspond to different stages of the user journey and serve as the basis for developing the service concept.

Table 1: User need statements

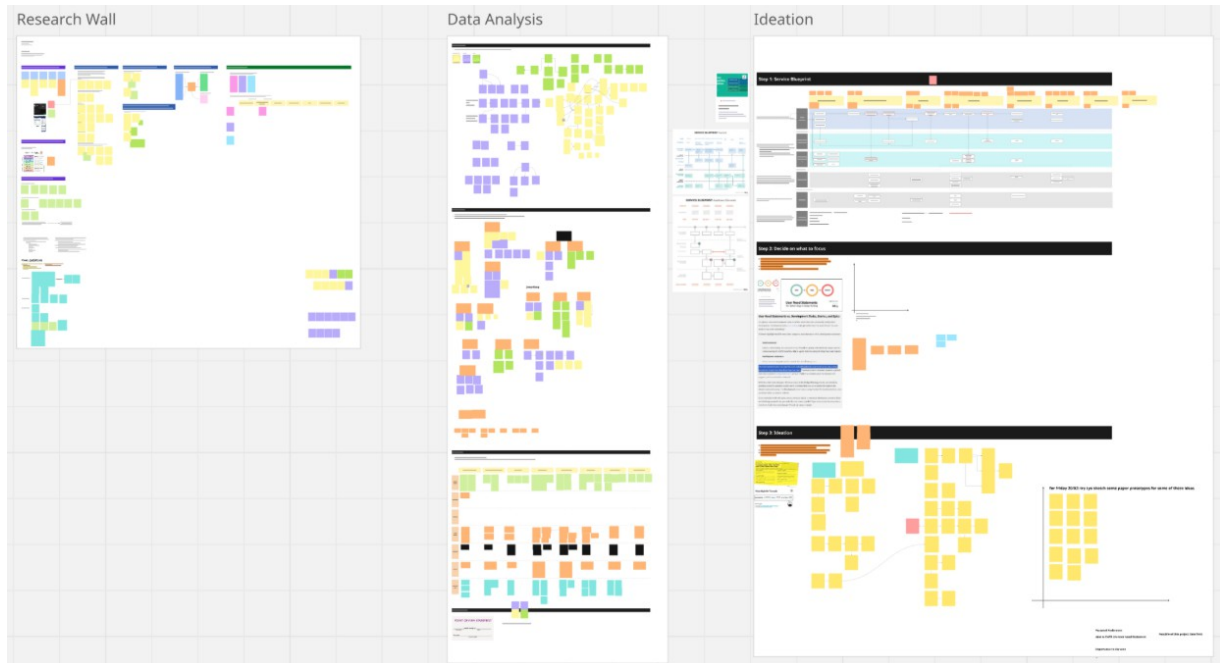
Need	Because
To understand their surroundings and orientation	Limited spatial cues make independent navigation difficult.
Clear and manageable information	Complex interfaces and financial transactions increase anxiety about making mistakes.
To easily access appropriate assistance based on their accessibility needs	Having to repeatedly request help and explain their situation reduces user confidence and control.

3 Design Iterations

3.1 Ideation, prioritisation, and design reasoning

This phase was developed with a service blueprint, which allowed us to collect various data emerging from previous phases and to visualise them in a more structured way (Gibbons, 2017).

Figure 7: Visual representation of service blueprint and design opportunities



Based on this information, paper prototypes were created to make it easier to evaluate the feasibility of the idea and the purpose. Similar concepts were combined, and we chose four ideas that could fit together to make a better app experience:

- Profile function
- A tool for assistants to improve their service
- Improved payment system
- Navigation tool

3.2 Initial Design Concept

The concept is an updated version of the SJ service, including new app features as well as service branches to make it more intuitive, less stressful, and more helpful during the journey. It consists of four main parts:

- The possibility for users to add preferences and needs to their profile, which are then saved and remembered for future use.
- A tool to improve assistants' work, connected to the user's preferences and aligned with the belief that the system needs to adapt to the user, and not vice versa.
- An updated payment page to increase buyer confidence.
- A new navigation system to help during the journey.

3.2.1 Memorization of users' needs (see Figures 8 and 9)

Figure 8: Initial profile preferences concept 1

The figure shows two mobile app screens for initial profile preferences. The left screen asks 'Do you have any seat requirements?' with checkboxes for 'Near the toilet', 'Near the door', and 'Near the window', followed by an 'Other' text input field. Below this, it asks 'Do you need assistance with the luggage?' with radio buttons for 'Yes' and 'No', and a 'Do you wish to specify something?' text input field. The right screen asks 'Which language would you like to speak?' with checkboxes for 'English' and 'Swedish'. Both screens have a green 'Continue' button at the bottom. Annotations include 'Addressing seat needs' pointing to the first screen and '“Assistants often don't speak the same language as me”' pointing to the second screen.

Addressing seat needs

Do you have any seat requirements?

- ☐ Near the toilet
- ☐ Near the door
- ☐ Near the window
- Other

Do you need assistance with the luggage?

☐ Yes

☐ No

Do you wish to specify something?

Continue

Which language would you like to speak?

☐ English

☐ Swedish

“Assistants often don't speak the same language as me”

Continue

Figure 9: Initial profile preferences concept 2

The figure shows two mobile app screens for initial profile preferences. The left screen asks 'Do you have any specific accessibility requirements?' with a text input field for '(Specific behaviors you find challenging, particular diagnoses, etc.)' and an example 'Ex. I don't like to be touched...'. Below this is a green 'Continue' button and a link 'Continue without filling'. The right screen asks 'Do you use any tech assistive tools?' with checkboxes for 'Wheelchair', 'Guide Dog', 'AAC Device', and 'White cane', followed by an 'Other' text input field. Both screens have a green 'Continue' button at the bottom. Annotations include 'Space for a detail, a diagnosis, a preference' pointing to the first screen and '“I can only select a wheelchair or I have to call”' pointing to the second screen.

Space for a detail, a diagnosis, a preference

Do you have any specific accessibility requirements?

(Specific behaviors you find challenging, particular diagnoses, etc.)

Ex. I don't like to be touched...

Continue

[Continue without filling](#)

Do you use any tech assistive tools?

☐ Wheelchair

☐ Guide Dog

☐ AAC Device

☐ White cane

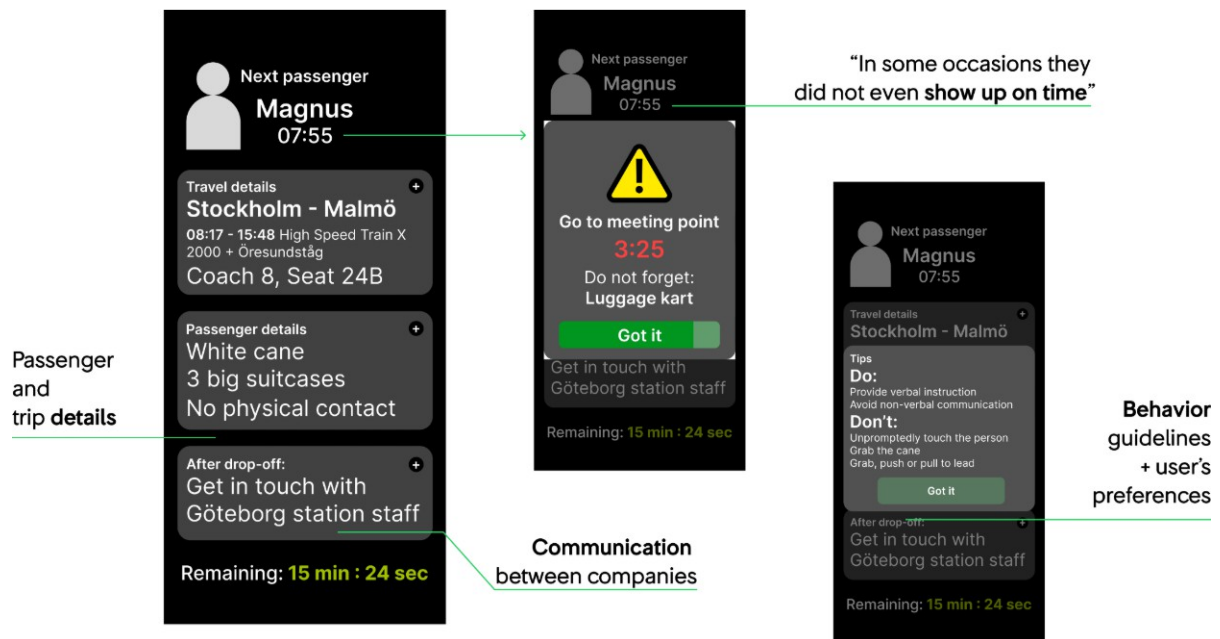
Other

“I can only select a wheelchair or I have to call”

Continue

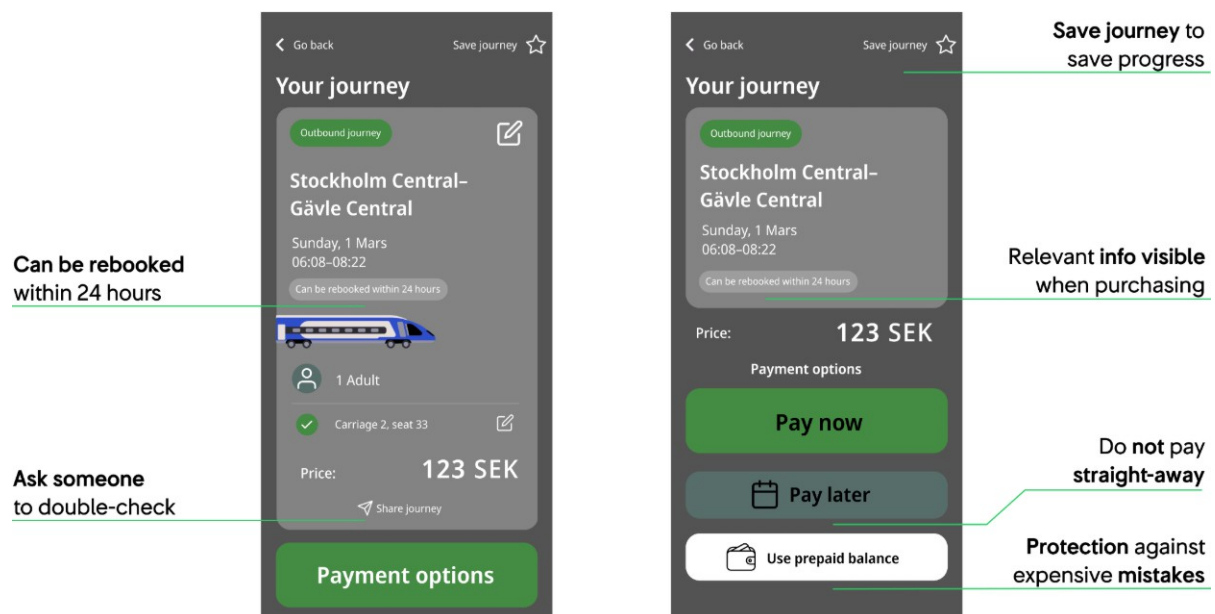
3.2.2 Tool for assistants (see Figure 10)

Figure 10: Initial assistant-side interface concept



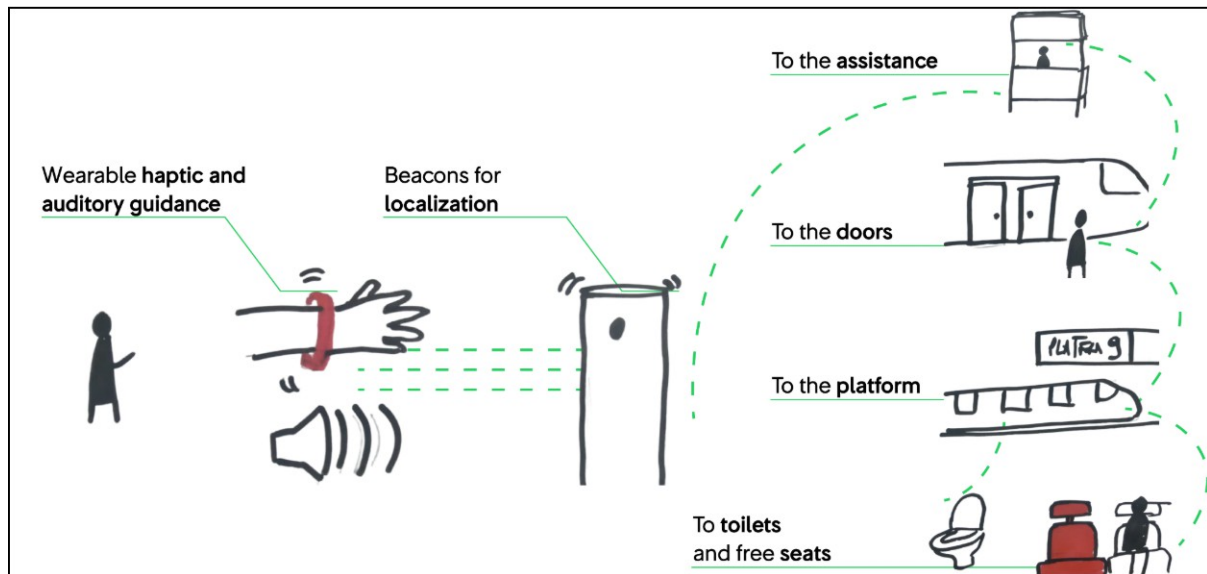
3.2.3 Updated payment interface (see Figure 11)

Figure 11: Initial payment page concept



3.2.4 Navigation system (see Figure 12)

Figure 12: Initial navigation system concept



3.2.5 Concept Overview

These proposals address multiple issues that were brought up during the consultations.

The inability to request specific assistance when purchasing tickets online has been addressed with the expanded profile section (see Figures 8 and 9), which reduces the need to repeatedly input the same information when booking and reduces the risk of misunderstanding with SJ staff.

The information memorized then becomes the foundation for the tool for SJ staff. This is conceived as a mobile app to guide assistants when doing their job, providing them with behavioral guidelines based on the user's impairment and personal preferences, clear travel instructions, and reminders. Enhancing the quality of human assistance rather than replacing it with purely technical solutions is crucial. Research indicates that personal interaction remains more effective for passengers with functional limitations, as it offers flexible support in unique and unpredictable situations (Rosenkvist et al., 2009).

The payment page (see Figure 11) displays information clearly at each step to avoid confusion. The "Save journey" feature was added to reduce the pressure of having to book immediately. Because the consultants mentioned preferring to book their tickets with somebody, the "Share journey" feature was added, allowing the recipient to double-check details of the ticket and purchase it for the user. This makes it possible for the user to book tickets independently, while still being able to have someone check their trip. Two new payment methods were also added: "Pay later" and "Use prepaid balance", which respectively allow users to postpone the payment or pay by drawing on a previously defined amount of money, decreasing the fear of making expensive mistakes.

The navigation system uses haptic and auditory feedback to help the user navigate through the station area and on the train (see Figure 12), enabling them to reach key points such as the assistance desk, the train doors, the right platform, or even a specific seat. Originally conceived for visually impaired users, this feature can prove useful for a diverse range of users.

4 Evaluation and Iteration

4.1 Evaluation approach

The evaluation phase involved the consultants and was carried out via Zoom interviews. Due to specific practical constraints, we could not perform an actual usability testing session on the prototypes, opting for a walkthrough of the concept and feedback collection from the consultants. To make the process as smooth as possible, we began by reviewing the issues each consultant raised during the first interview. Although we had come up with four ideas, we decided to present only one to each consultant, focusing on the one that best fit their reported needs. Two of the consultants mentioned feeling low self-confidence when buying tickets on the app, so we decided to present the design idea that addressed that issue. There was one consultant whom we had not met previously. We decided to include questions to get to know her better and gather

feedback on the navigation concept.

For the buyer-confidence design idea, we started by sharing a prototype, explaining the new features we had added and why. After the walkthrough, we moved on to the interview questions to get their evaluation of both the features and the interface.

For the navigation interview, precautions were taken to ensure the questions were easy to understand and to include daily life scenarios to provide the user with relatable, real-world context.

4.2 Key insights from the evaluation

The evaluation helped highlight both barriers and strengths of the proposed concepts.

As for the payment interface, one of the consultants stated that the option to “Pay later” could cause more anxiety due to the lack of clarity around it, forcing users to remember what they have already paid for and causing worry about when the payment is due. Another valuable insight provided by the consultants and also backed by literature (International Transport Forum, 2009; Stjernborg, 2019) concerned the way timetables and schedules are indicated: relying on numerical time only, for instance 08:53, could cause confusion for those who struggle with numbers. It was hence recommended to display time in the form of an analogue clock as well. Further confusion was generated by unclear icons. However, both consultants appreciated the feature enabling them to share their journey and the prepaid balance option, feeling reassured that they were not paying directly out of their bank account.

The consultant who evaluated the navigation concept noted that both auditory and haptic feedback could be overwhelming, and that there should be visual feedback on the screen indicating whether the user is facing the right direction. This insight highlighted the need for a simple approach, avoiding excessive feedback, while still providing a variety of options as suggested by relevant literature (Egard & Hansson, 2021). Moreover, we realised that what was originally conceived for the visually impaired could serve different user groups by activating and deactivating the most suitable feedback.

5 Final Concept

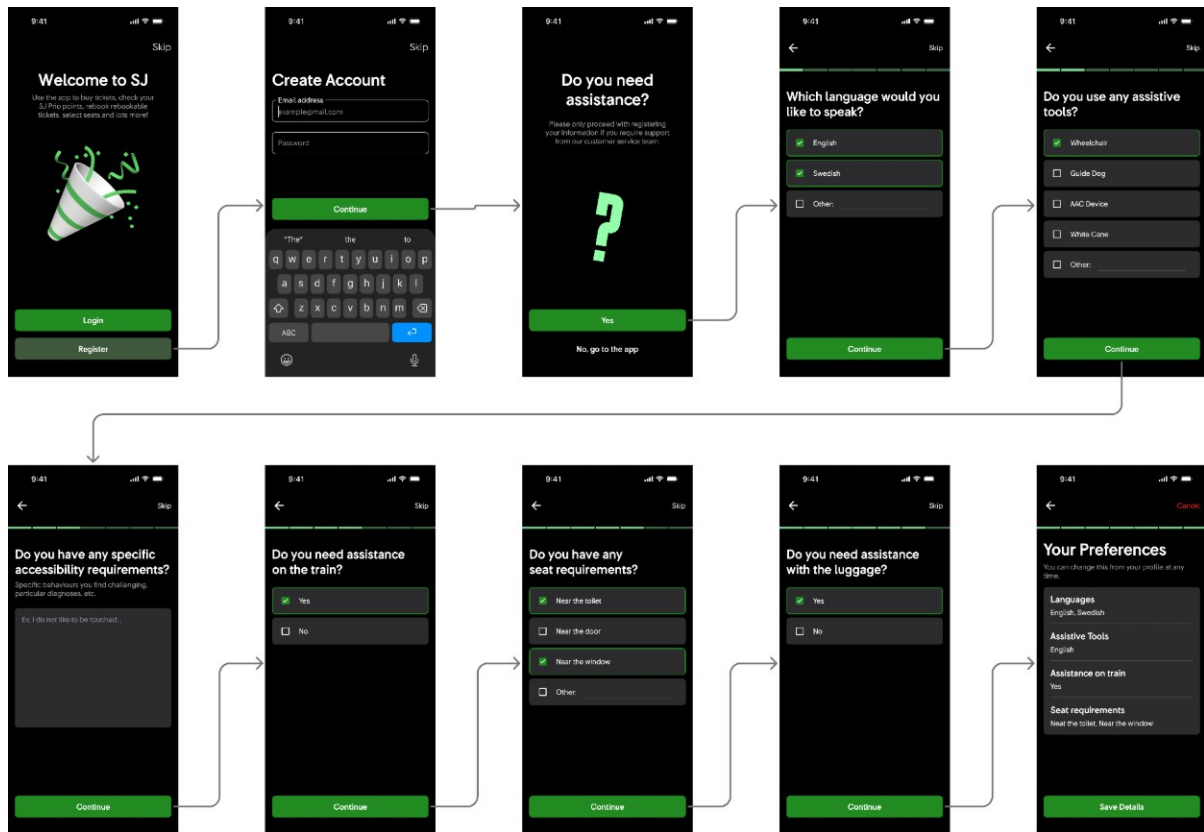
5.1 Final design concept

In light of these new insights, the concept was modified into the final service proposal.

5.1.1 User preferences during onboarding

The user can customize their information and needs, which are then saved into their profile, making the booking process faster and less complicated because information does not need to be entered manually, while ensuring the adoption of optimal measures by SJ and a consistent and prolonged assistance over time (Stjernborg, 2019). It includes data such as language preference, assistive tools used, specific requirements, assistance requirements, and seat requirements (see Figure 13). A progress bar on top keeps users informed at all times about the stage of the process, which is fundamental (Funktionsrätt Stockholms län, 2025).

Figure 13: User preferences during onboarding



5.1.2 Ticket payment page

The payment interface was changed to improve buyer confidence. Research shows that performing rapid, complex tasks creates excessive 'environmental pressure' that causes anxiety (Rosenkvist et al., 2009). By simplifying the interface and offering alternative payments, this redesign actively lowers this barrier.

Incorporating feedback from the second round of consultations, vague icons were removed for better clarity (see Figure 14). The "Pay later" option was also removed, as the consultants had confusion around what it entailed. Lastly, train timings are shown in both text and visual format (see Figure 15), meeting the needs of users particularly struggling with numbers.

Figure 14: Ticket payment pages

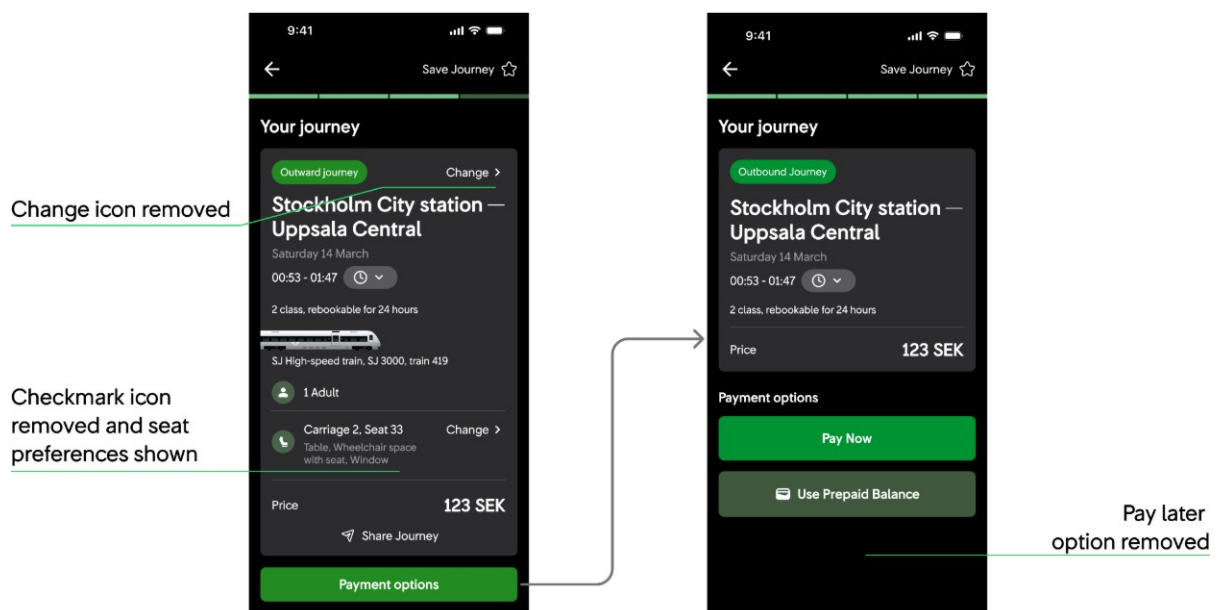
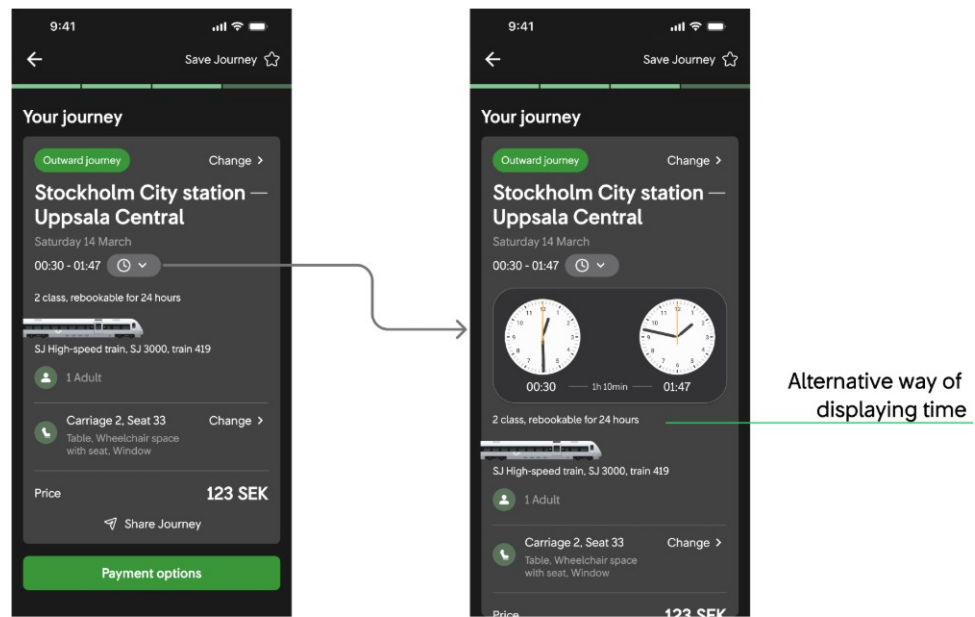


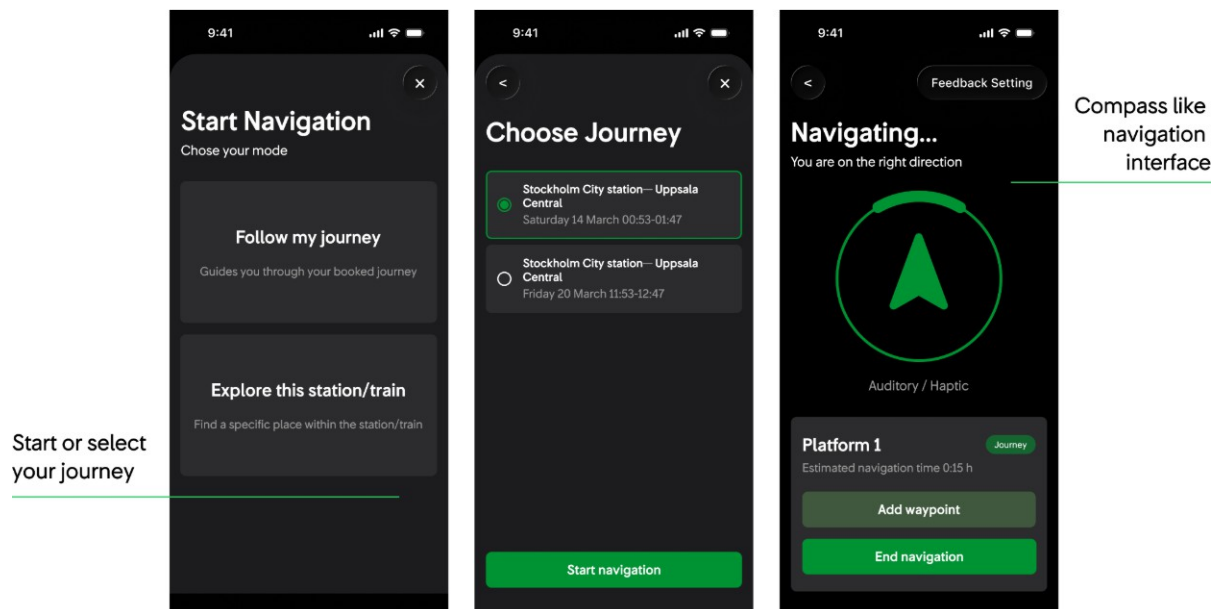
Figure 15: Alternative clock display



5.1.3 Navigation system

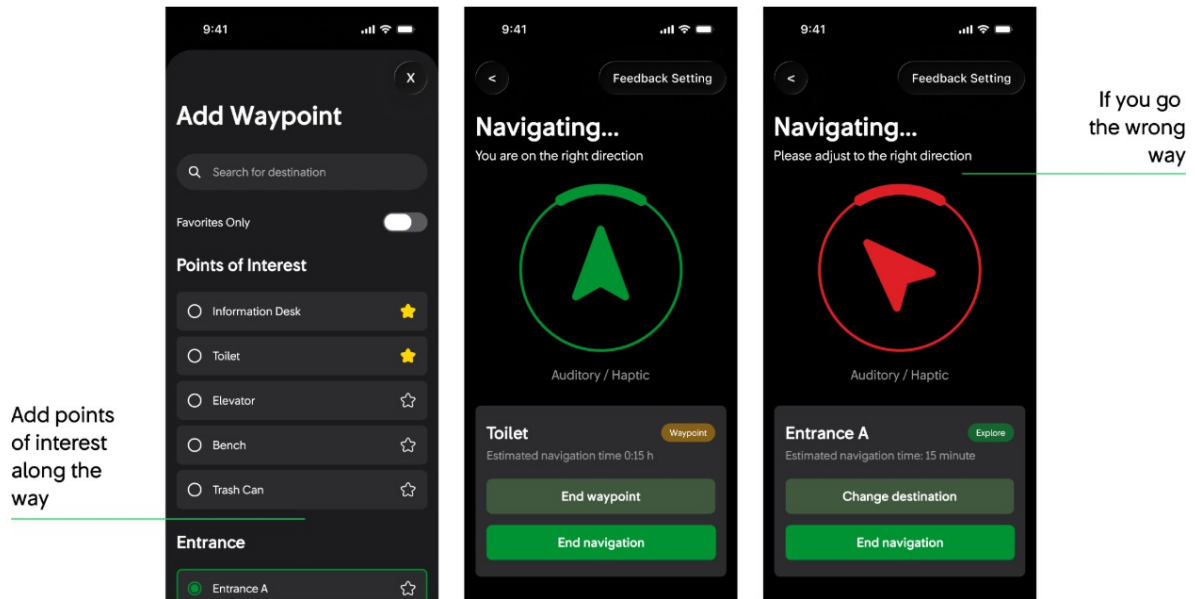
The navigation system was provided with an additional compass-like interface pointing in the right direction (see Figure 16).

Figure 16: Select and start journey interface



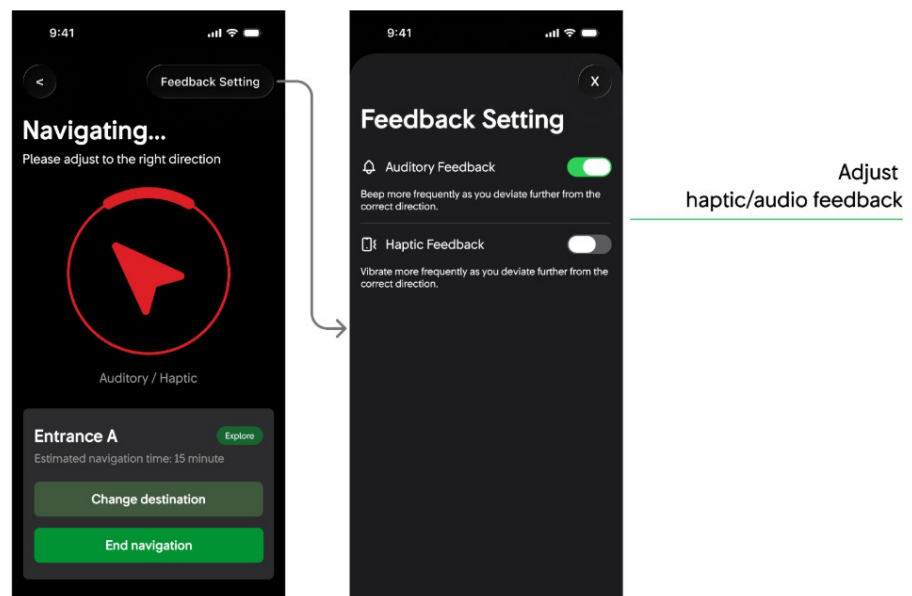
Users can also add points of interest they want to stop at along the way (see Figure 17).

Figure 17: Add waypoint



Moreover, haptic and audio feedback are available options and can be switched on or off to make personalization possible (see Figure 18).

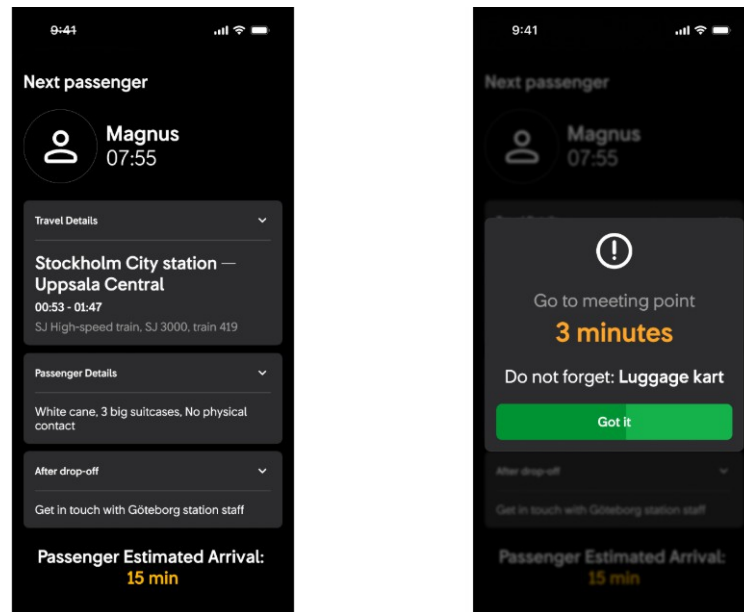
Figure 18: Toggle audio/haptic feedback



5.1.4 Assistant system

The assistant-side pages remained substantially unchanged, besides general graphical improvements, as it was not shown to the consultants (see Figure 19).

Figure 19: Assistant pages



5.2 Trade-offs, limitations, and unresolved challenges

Despite the attempt to ground the design on real user needs and relevant literature, the final outcome presents some limitations and unexplored aspects that would need more iterations.

The proposed navigation system requires installing hardware at train stations, such as beacons. Given the number of train stations in Sweden and the associated financial and time costs, the system presents significant implementation challenges. To overcome this infrastructure barrier in future iterations, we could further investigate infrastructure-free localization approaches among the existing solutions (GoodMaps, 2026; Ren et al., 2023). For example, the Route-Nav app demonstrates the feasibility of achieving seamless indoor-outdoor localization without relying on external hardware (Ren et al., 2023).

The tool for assistants remains, as of yet, a rather assumption-based concept, since evaluating the internal organization of SJ would have required extensive stakeholder involvement, which was not feasible within the project's limited timeframe.

Finally, the profile preferences concept suffers from a lack of feedback from the consultants. With limited consultation sessions, we chose to focus on evaluating the navigation and payment touchpoints instead. However, its design is grounded on insights from the consultants or from relevant literature.

5.3 Next steps

The next steps of the design process would be to conduct further consultations with user testing of the service concept. To move further toward Universal Design, testing with a more diverse group would also be an important step toward ensuring accessibility.

6 Conclusion

Throughout this project, key insights emerged at each stage, shaping the final design. Consultations with accessibility experts proved far more revealing: interviewees shared a common anxiety of making mistakes during ticket booking, particularly around financial transactions. They also reported inconsistent assistance, insufficient station navigation cues, and a lack of online options for requesting support. These insights were clustered into user need statements, which directly informed the final concept.

Our proposed concepts addressed different points in the user journey, mainly by redesigning the ticket payment flow to actively build buyer confidence. This means introducing a “Share journey” feature, allowing a trusted person to review a ticket, and a prepaid balance payment option to reduce anxiety. These changes are relatively low-cost, technically feasible, and grounded in directly expressed user needs. Similarly, the profile preferences feature links to other parts of the service and reduces the burden on users

of having to enter the same information repeatedly. The proposed navigation system concept relies on installing physical hardware across stations, which entails cost and infrastructure challenges. Meanwhile, the profile preferences feature received no consultant feedback, and the assistant-facing interface remains largely untested and underexplored. Moreover, it is an attempt to solve a problem that would likely need major

structural interventions, for instance by providing better training to staff.

More broadly, the consultation pool was small and did not include sufficient diversity to validate universal design claims. Further testing with a wider range of users would be essential before any concept moves toward implementation.

7 Acknowledgment

This work was conducted at KTH Royal Institute of Technology as part of the course DM2624 Human Centered Technology for Disabilities. We would like to thank our supervisor, Sofia Strömqvist, and all teachers for their supervision and constructive feedback throughout the project.

We would also like to give special recognition to the consultants who participated in the research. Their firsthand accounts of navigating public transport services were central to the outcomes of this project. Their time and willingness to share their experiences are deeply appreciated.

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