TU Delft

Schiphol Group

Graduation Report

Self-Service Wheelchairs at the Departure Area of Schiphol Airport

Faculty of Industrial Design Engineering
Strategic Product Design

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April 2025

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PREFACE

Dear Reader,

This report concludes my Master's program in Strategic Product Design at the Faculty of Industrial Design Engineering at TU Delft.

To begin with, I would like to share that the past few months have been a very enjoyable and rewarding experience. In this foreword, I will briefly reflect on this period and take the opportunity to express my gratitude to those who contributed to it.

At Schiphol, I had the opportunity to start working directly in a real-world context. I am grateful for this, as I truly enjoyed designing while being immersed in the environment, observing, engaging, speaking to people, and listening, all within a dynamic setting like an airport. Being part of the team focused on passengers with reduced mobility was especially meaningful. Designing for accessibility, with real user needs at the center, was both valuable and inspiring.

First and foremost, I would like to thank my supervisory team. I really appreciated the collaboration and how both the TU Delft and Schiphol perspectives came together around one shared goal.

Sicco and Gonny, thank you for the calmness and opportunities. I truly appreciated how you supported me during the dynamic phases of the project. Thank you for guiding me creatively, and for helping me bring all those ideas and experiences together when I needed structure. Your patience and support were very helpful.

Lot and Femke, thank you for being not only my supervisors but also my mental support. I really enjoyed working closely with you and felt like a trusted colleague from the very beginning. The responsibility you gave me taught me a lot, and I'm grateful for that.

To the other members of the PRM and PSS teams, your expertise and teamwork taught me valuable lessons. I especially appreciated the co-creation sessions in the final phase. Thank you for your support and contribution.

To all the experts and stakeholders involved, especially the Klankbordgroep, thank you for your openness and insights. You inspired many of the ideas in this design process. I truly enjoyed the interviews, as well as the fun moments we shared.

Lastly, thank you to my family and friends, for your feedback, for helping me structure my thoughts, and for always encouraging and motivating me with your patience and inspiration throughout this process.

And of course, a heartfelt thank you to my grandma, for playing the lead role in my user research.

Enjoy reading!

Florien de Lange

EXECUTIVE SUMMARY

Schiphol Airport is facing a growing challenge: enabling independent mobility for Passengers with Reduced Mobility (PRM) in an environment where the number of passenger increases and ongoing staff becomes more limited. Every day, over 2,500 PRM passengers rely on assistance services, a number that continues to grow by 15–20% annually. At the same time, there is a clear shift in expectations: more and more PRM travelers are seeking autonomy, flexibility, and clarity in their journey. **This graduation project identifies this tension as an opportunity to introduce innovative mobility solutions at Schiphol Airport.**

The central question that emerged was: *How can a service be designed that enables PRM passengers with light mobility restrictions to use a wheelchair independently at Schiphol, and how can this service be communicated clearly and attractively?*

Following the Double Diamond design process, the project began by uncovering systemic barriers during the Discover phase: fragmented information, poorly located wheelchair stations, rigid assistance protocols, and a lack of autonomy for users wishing to travel independently. Furthermore, the current service landscape was found to fall short in meeting the diverse needs of users who vary in age, physical abilities, cultural background, and digital literacy.

In response, six design criteria were established during the Define phase to guide the solution: the service must support autonomy, provide complete and timely information, be universally accessible, integrate seamlessly into the airport infrastructure, be operationally reliable and well-managed, and remain adaptable to external developments such as new technologies or changing regulations.

These criteria led to the development of a service model that incorporates the organizational structure, the communication approach, and the strategic positioning of facilities into the design of two core elements: an interactive navigation tool and a network of Service Hubs. Together, these tools enable users to independently access mobility support, receive real-time information, and navigate the airport with confidence. Simultaneously, the model strengthens internal clarity around responsibilities, allows for scalability, and embeds the solution within the broader airport ecosystem. It is designed to be future-proof, providing space for external changes and growth in response to evolving technologies, policies, and user needs.

The proposed concept was validated through scenario testing and stakeholder collaboration. It proved not only feasible but also highly relevant to both passengers and the organization, forming a solid foundation for implementing a hybrid mobility strategy across the airport.

This project demonstrates how thoughtful, strategic design can support both operational efficiency and inclusive passenger experience. Schiphol takes a step forward in redefining airport accessibility, not as a luxury, but as a fundamental right for every traveler.

Glossary

RSG	Royal Schiphol Group
PRM	Passengers with Reduced Mobility
PSS	Passenger Services & Support
WCHR	Wheelchair Ramp
WCHS	Wheelchair Steps
WCHC	Wheelchair Cabin

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The first section of this report introduces the context, motivation, and structure behind the design challenge. It starts by outlining the growing demand for independent mobility among PRM passengers and Schiphol's ambition to support this through innovative services, such as autonomous wheelchairs. Chapter 1 explains the underlying trigger and urgency for developing a more self-sufficient mobility system. Chapter 2 translates this into a concrete design question, focusing on both service development and passenger communication. Chapter 3 outlines the broader project context, including the airport environment, the specific target group, and key stakeholders involved. Finally, Chapter 4 presents the design approach, which is based on the Double Diamond framework. It explains the phases followed in this project - Discover, Define, Develop, Deliver - and how they shaped the research, analysis, and concept development that follows in the rest of the report.

1. Trigger

This chapter outlines the reasoning behind this project. Schiphol addresses the rising demand for independent PRM mobility by testing autonomous solutions like the WHILL wheelchair. The goal of the project is to enhance autonomy, efficiency, and accessibility while reducing reliance on assistance services.

There is a Growing Need for Independent Mobility among PRM Passengers

The increasing need for independent mobility among passengers with reduced mobility (PRM) presents a valuable opportunity to elevate travel experiences in terms of accessibility. At Schiphol Airport, around 2,500 PRM passengers use the available assistance services daily, and this number is growing by 15-20% annually (Royal Schiphol Group, 2024). This growth is driven by factors such as improved accessibility and affordability of air travel, an aging population, and an increase in health-related mobility issues.

The evolving needs of PRM passengers push Schiphol to be progressive and develop innovative design solutions, challenging the airport to think beyond traditional assistance services. This not only enhances the passenger experience but also contributes to more efficient airport operations. Research indicates that PRM passengers positively perceive technology-driven solutions that enhance their independence, such as autonomous mobility aids. This trend highlights the need for Schiphol to adopt progressive and innovative mobility solutions that align with broader societal shifts toward technological accessibility.

Schiphol is balancing Efficiency, Accessibility and Compliance

As the demand for PRM assistance grows, Schiphol faces the challenge of balancing passenger needs with operational efficiency while meeting legal requirements. Traditional PRM assistance is labor-intensive, requiring significant human resources. To optimize capacity and maintain high accessibility standards, Schiphol must explore innovative approaches that integrate technology into the passenger experience. A key driver behind this research is Schiphol's list of PRM service improvement initiatives for 2024, developed based on compliance findings, customer journey research, and gemba walks. See figure 1. Initiative 3 is the specific one from this list that directly relate to this project. With PRM numbers rising and staff availability limited, Schiphol aims to reduce dependence on assistance services. The WHILL autonomous wheelchair pilot enables passengers to move independently from security to their gate, with potential for expansion.

Additionally, a wheelchair-sharing system is being explored by the PRM team, allowing passengers to borrow and return wheelchairs at designated locations. This research integrates these initiatives into a coherent autonomous mobility concept, ensuring clear communication to PRM passengers and enhancing their travel experience. By strategically deploying autonomous mobility solutions, Schiphol can enhance passenger autonomy while streamlining operational processes. This approach not only improves the travel experience for PRM passengers but also allows the airport to allocate resources more effectively, reducing strain on assistance staff and enhancing overall service efficiency.

Innovative Solutions are a Shared Goal

The introduction of autonomous mobility solutions offers a win-win scenario: PRM passengers gain more control over their travel, while Schiphol benefits from smoother operational workflows.

This research aims to contribute to the development of an autonomous wheelchair system that seamlessly integrates into Schiphol's existing infrastructure. By advancing the current developments, the project seeks to create a robust, scalable solution that supports PRM mobility from start to end of their journey. The ultimate goal is to enable PRM passengers to navigate Schiphol independently, reducing their reliance on assistance services and enhancing their overall airport experience.

	Improvement Initiatives PRM Service
1	Expansion of PRM facilities
2	PRM informed at departure
3	Promoting autonomy and more efficient resource allocation with use of innovative mobility solutions by focusing on what PRM passengers can do instead of what they cannot.
4	Optimization of boarding process
5	PRM informed at arrival
6	Optimization of disembarkation process:
7	Comfortable waiting areas

Figure 1: List of improvement initiatives for 2024

2. Question

This chapter bridges the initial client requirements to the first design challenge. It also outlines how the proposed solution aims to address the core trigger effectively.

Client Input

Schiphol, the client, requests an exploration of autonomous mobility solutions for PRM passengers, inspired by:

- **Self-driving wheelchairs (WHILL pilot)** as a first step towards autonomous mobility.
- **A wheelchair-sharing system**, ranging from simple to advanced shared mobility solutions.
- **Clear communication** about autonomous travel options for PRM passengers.
- **Passenger guidance and wayfinding** to ensure seamless integration of autonomous mobility.
- **Stakeholder collaboration**, including PRM service providers and technology suppliers.

The design challenge Schiphol formulated is twofold:

1. **Developing an autonomous wheelchair service**, ensuring a seamless and efficient experience for PRM passengers.
2. **Designing the communication strategy**, determining how the service is introduced and explained to passengers for usability and ease of adoption.

The goal of this graduation project is to assess how these initiatives can be integrated into a coherent autonomous travel concept, improving passenger independence while enabling Schiphol to allocate assistance services more efficiently.

Design Challenge

The design challenge that emerged from the client input and is presented in the Project Brief is as follows:

> "Design a service that integrates innovative wheelchair solutions to enable PRM passengers with light mobility restrictions to travel independently at Schiphol Airport, enhancing their overall experience and optimizing the allocation of assistance resources"

In Figure 2, a framework is presented that emphasizes the goal of designing a solution that effectively addresses a problem. The ultimate objective is to create lasting impact, continuously contributing to mitigating the root trigger of the issue. Since this trigger can vary in size and form, the framework is represented as a continuous cycle.

To sustain impact, the design challenge must be periodically reassessed and refined, ensuring that the solution evolves in response to changing conditions. By iterating and building upon the initial concept, the solution remains relevant and effective, continuously aligning with the core problem it aims to address.

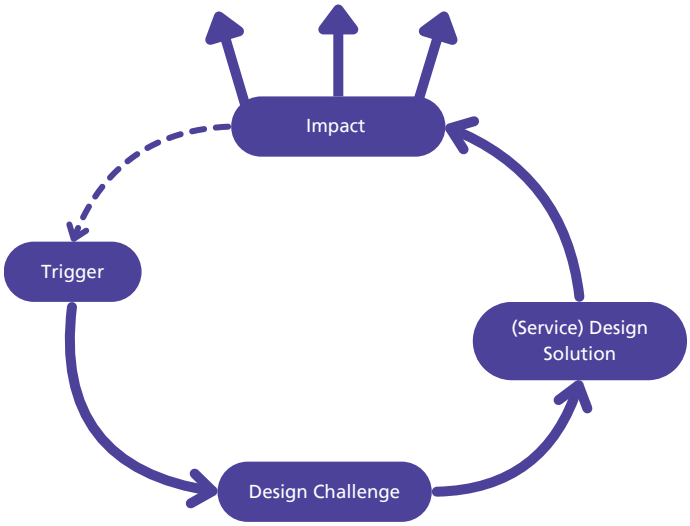


Figure 2: Impact Framework

3. Project Context

This chapter outlines the design context, target group, and key stakeholders. The focus is on wheelchair users (WCHR & WCHS) seeking independent mobility at Schiphol. Key stakeholders, including PRM passengers, assistance providers, airlines, and regulatory parties, play a crucial role. In the Discover section their impact will be further examined.

Amsterdam Airport Schiphol

The design context is Amsterdam Airport Schiphol, operated by the Royal Schiphol Group and the largest airport in the Netherlands. Schiphol is one of the busiest airports in Europe, handling around 66.8 million passengers in 2024, representing an average of 183,000 passengers per day (GTR Magazine, 2025).

Airports present a unique design challenge: they are not only a transit location where passengers move with time constraints, but also a complex operational environment operating 24/7. A passenger's experience within an airport is not just a matter of efficiency, but is partly shaped by the physical space, social interactions and expectations surrounding their journey (Bueno, 2020). Designing for this design context requires an approach that considers these variables to optimise both the functional and emotional aspects of the passenger experience.

Vision and Mission Schiphol Airport

Schiphol's design choices do not stand alone, but are directly linked to the airport's broader strategic direction. Schiphol's mission statement, **'Connecting your world'**, emphasises its role in connecting the Netherlands to the world, with innovation, sustainability and a high-quality passenger experience at its core. The vision of a future-proof airport thus forms the basis for both operational and spatial design decisions. For more explanation of Schiphol's vision and mission, Schiphol's Vision and Strategy report of 2025 is added. Click on figure 3.

The Independent wheelchair passenger

Introducing PRM passengers

PRM passengers include passengers who require physical, visual, auditory or cognitive support during their journey. This may include:

- **Wheelchair users** – Travellers (partially) dependent on a wheelchair for mobility.
- **Blind and visually impaired passengers** – Passengers with visual impairment who may need guidance at the airport.
- **Deaf and hard of hearing** – Passengers with a hearing impairment who may benefit from adapted means of communication.
- **DPNA (Disabled Passenger with Intellectual or Developmental Disabilities)** – Passengers with cognitive disabilities who may need additional support or guidance.

Introducing the Focus Group

This research focuses on wheelchair users within the PRM group, **specifically the WCHR and WCHS subgroups**, who want to travel independently at Schiphol Airport.

- **WCHR (Wheelchair Ramp):** Passengers who can walk short distances but require a wheelchair for longer distances.
- **WCHS (Wheelchair Steps):** Passengers who, like WCHR users, can walk short distances, but in addition cannot climb stairs or level differences independently.
- **WCHC (Wheelchair Cabin):** Passengers who are completely dependent on a wheelchair and cannot walk independently. These passengers carry their own wheelchair and thus do not use the self-service wheelchairs (outside the scope of this study).

Key Stakeholders

For a successful design process and implementation, it is essential to gain insight into the various stakeholders and their roles within the topic. These stakeholders can be clustered into six main categories: Users and Service Providers, Administrators and Regulators, Training and Quality Assurance, Infrastructure and Technology, Supervisors and Management, and Support and Information Provision.

Figure 4 provides an overview of the most relevant stakeholders categorized with explanations. In appendix 2 the complete stakeholder analysis is visualized, distinguishing their relevance to the organization, the target group, or both.

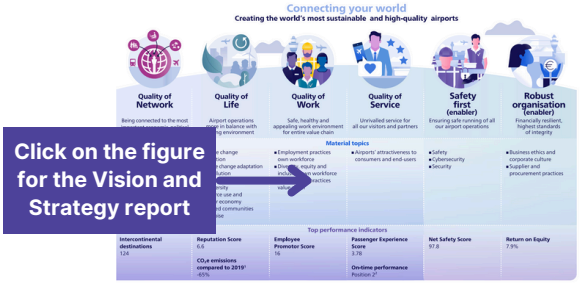


Figure 3: Schiphol's Vision and Strategy 2025 report

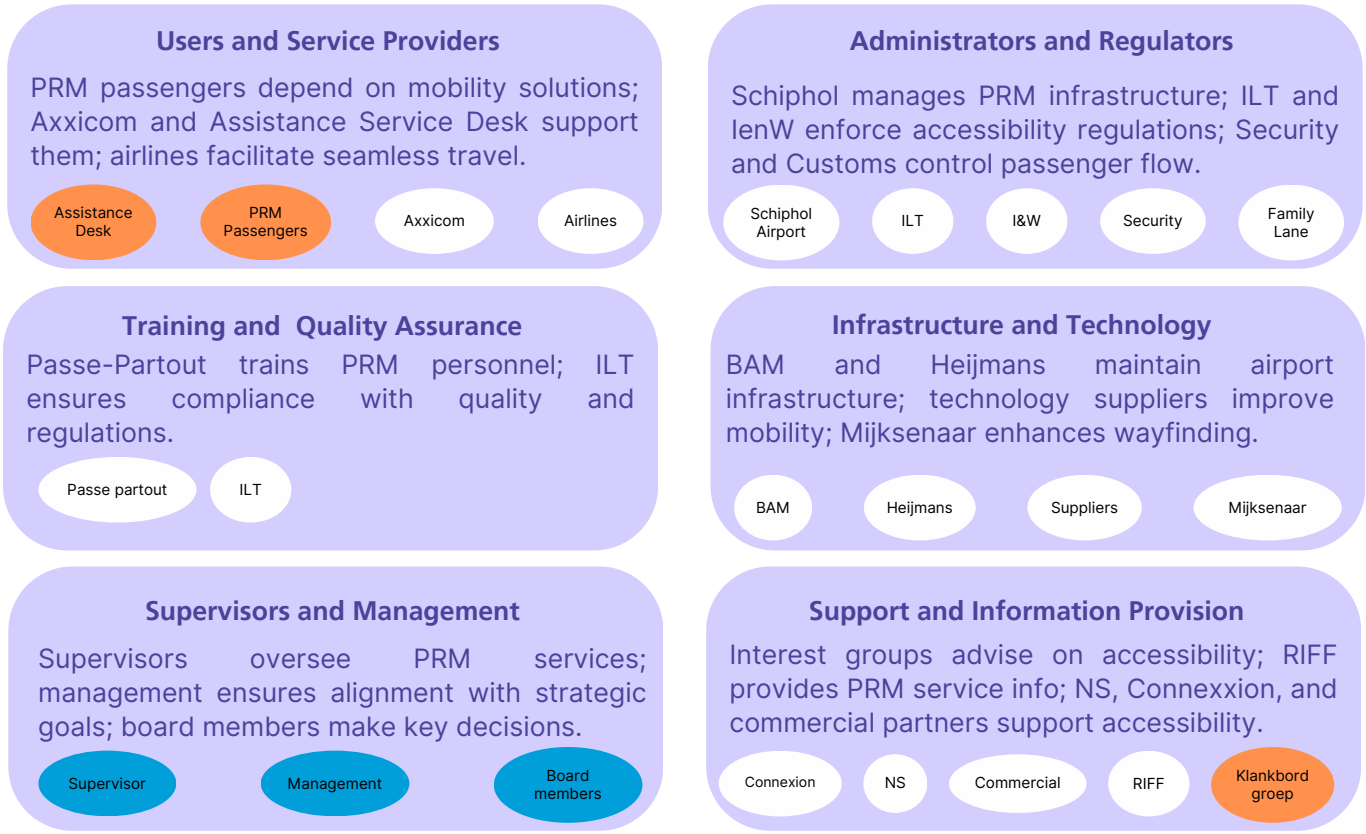


Figure 4: Stakeholders per Category

4. Project Approach

This chapter explains the project methodology used in this study. Additionally, a reading guide is provided to help navigate the report and understand its structure.

This project follows the **Double Diamond Model**, a structured, user-centered framework for design and innovation developed by the UK Design Council. It organizes the design process into four key phases: Discover, Define, Develop, and Deliver. This approach balances divergent thinking, which explores a broad range of possibilities, with convergent thinking, which narrows ideas into a clear and actionable solution, allowing for both broad exploration and focused decision-making.

While this framework served as a guiding structure, the design process was not strictly linear. In practice, the phases overlapped, and progress was iterative rather than sequential. New insights during development led to adjustments in earlier research conclusions, and some ideas started taking shape as early as the research phase.

Phase 1 - Discover

The Discover phase focuses on gaining a deep understanding of the problem space, user needs, and contextual factors influencing the design challenge. This phase involves extensive research, including literature studies, stakeholder engagement, and field observations, to uncover pain points, opportunities, and key design drivers.

Phase 2 - Define

In the Define phase, the findings from the Discover phase are synthesized into a structured design brief. This stage refines the core challenge, identifying patterns and prioritizing design criteria from insights, that will shape the next phases.

Phase 3 - Develop

The Develop phase is centered around concept generation, iteration, and prototyping. Different ideas are explored, tested, and refined through stakeholder feedback and user validation. This iterative process ensures that proposed solutions align with both user needs and operational constraints.

Phase 4 - Deliver

The Deliver phase finalizes and validates the developed solution, ensuring scalability, feasibility, and integration within the existing system. The chosen design is tested, refined, and evaluated against the design criteria, ensuring that it is both functional and sustainable.

To illustrate this dynamic and non-linear process, a Planning Matrix is included in Appendix 3. This matrix visually demonstrates how different activities were conducted across multiple phases of the Double Diamond, highlighting the iterative nature of the project.

Figure 5 illustrates how the Double Diamond framework structured the project, guiding both research and design decisions in the development of a functional and scalable PRM mobility solution. The framework not only shaped the process but also serves as a backbone for the report itself. Figure 5 shows how the chapters of this report correspond to the four phases of the Double Diamond framework.

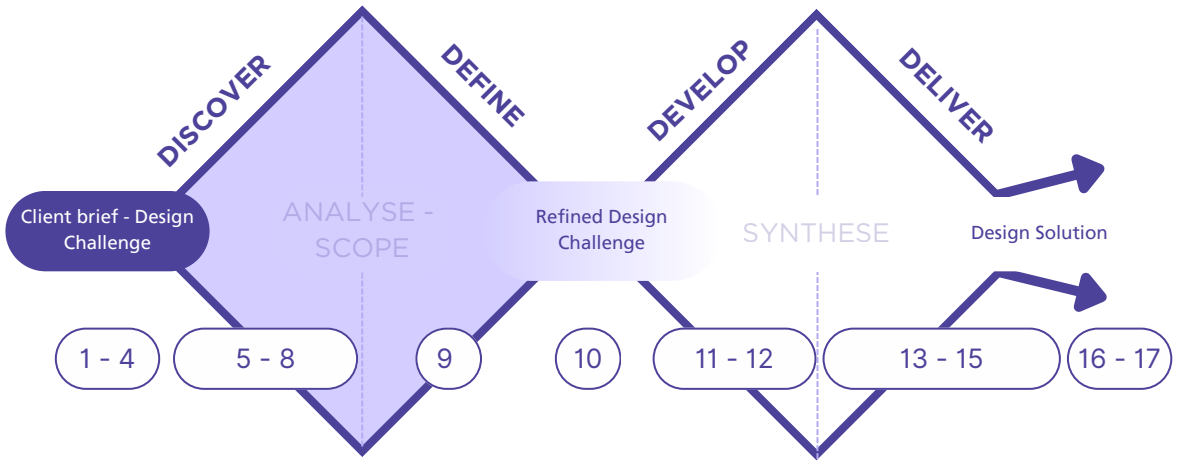


Figure 5: Double Diamond Model, Phases and Chapters included

Reading Guide

The Double Diamond method forms the structure of my project. To enhance readability and navigation, additional formatting and structuring elements have been applied throughout this report.

The report consists of 6 main sections, such as **Introduction**, based on the Double Diamond phases, each clearly indicated in the navigation bar at the bottom of the pages. These sections contain multiple chapters, each of which is introduced with a brief summary outlining its content.

Throughout the project, various research and design approaches have been applied. At the beginning of each analysis chapter, the research approach is introduced, while design chapters start with the design approach.

The first time a approach is described, it is explained in detail. In later sections, previously mentioned methods are referenced without extensive reintroduction.

At the end of each Discover chapter, key insights are summarized in an purple highlight box, as shown in Figure 6. Figure 6 also illustrates how footnotes, highlighted terms, and quotes are visually presented throughout the report to improve clarity.

Lastly, this report contains specialized terminology relevant to the topic. A glossary with definitions is provided on page 9 for reference.

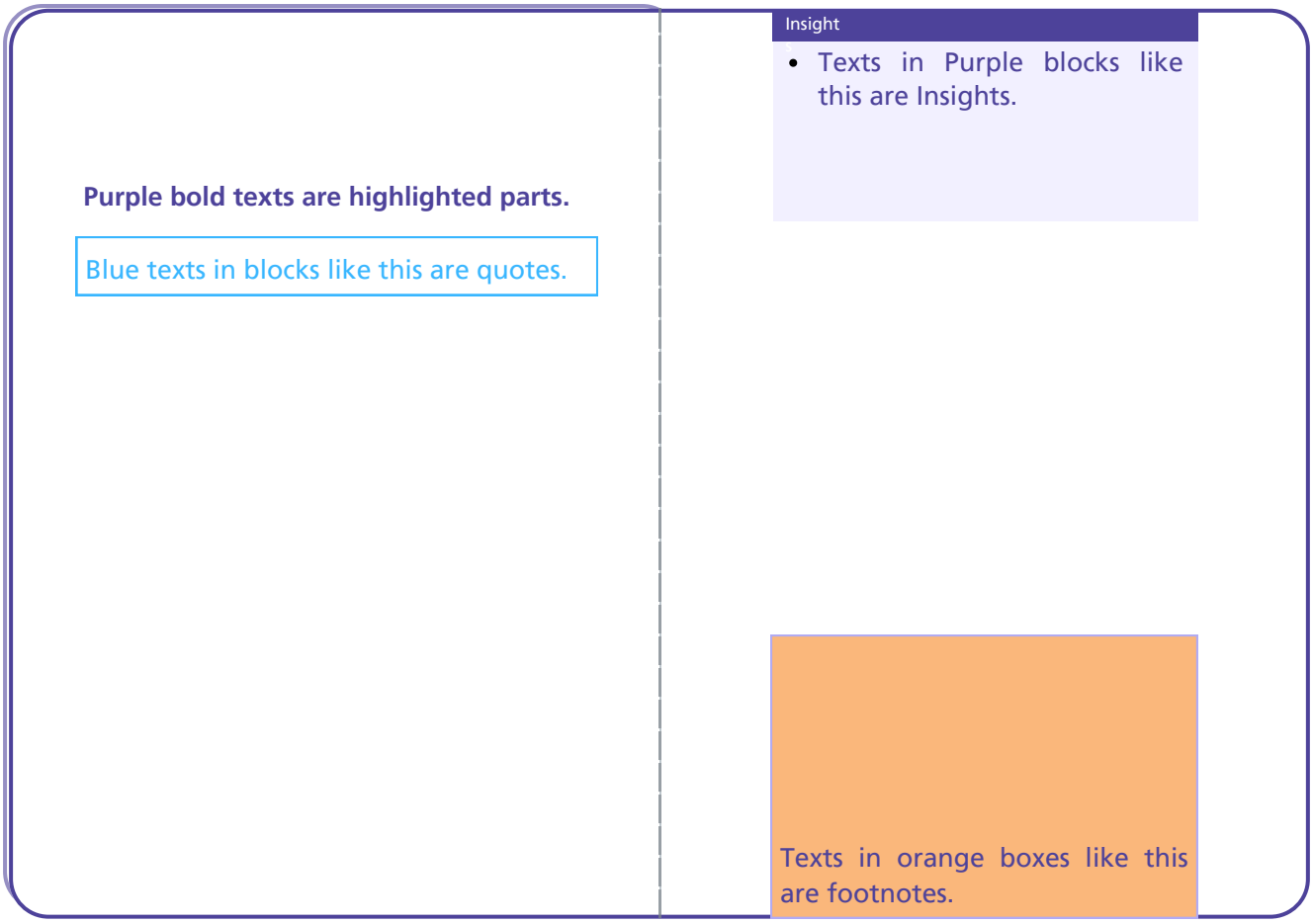


Figure 6: Structuring elements

Discover

5. Context Analysis
6. Behaviour Analysis
7. Design for Accessibility
8. Case Study at Schiphol

This section presents the Discover phase of the project, aimed at understanding the current situation, challenges, and needs for independent mobility for PRM (Passengers with Reduced Mobility) at Schiphol Airport. The research is divided into four parts: context analysis, behaviour research, a focus on accessibility, and a self-initiated pilot project. Using different methods, like literature review, interviews, observations, and real-world testing, legal frameworks, airport infrastructure, services at other airports, and new technologies are explored. Special attention is given to WCHR and WCHS passengers, who use wheelchairs of Schiphol, but want to travel independently. The research revealed several issues, such as unclear information, wheelchair stations that are hard to reach, and strict assistance procedures. At the same time, it uncovered opportunities for improvement through better design, smarter digital tools, and clearer communication. These insights shaped the next steps of the project: designing a more flexible and user-friendly service that supports autonomy and fits with future airport developments.

5. Context Analysis

This chapter explores the design process for an airport environment. It examines accessibility solutions at other airports, PRM approaches in different sectors, and relevant trends for future development. Additionally, technological advancements are analyzed to identify opportunities for enhancing independent mobility and operational efficiency.

Research Approach

Literature study

A literature study was conducted to gain an understanding of key considerations in airport design. It also provided insights into existing PRM wheelchair facilities at other airports and how PRM performance compares in different contexts, such as hotels and cruise ships. Lastly, literature was used for trend analysis and to further explore relevant technologies.

Desk Research and Observation study

Desk research was conducted to understand other contexts, including NS and the Efteling. Additionally, observational studies were used to identify trends.

Expert Interviews

Interviews and discussions were conducted with the PRM team and I&W to gain a deeper understanding of the legal context and with the team leader of the Irish Paralympic equestrian team to learn from the Paralympic games.

5.1. Designing for an Airport

Becoming a Passenger

The transition from traveller to passenger goes beyond a physical move from the check-in desk to the gate. Bueno (2021) describes this process as **becoming a passenger**, where the airport environment and interactions within it determine how a traveller feels, how quickly they act, and how stressful or smooth their journey is. Passengers often experience time pressure and stress while trying to catch their flight, making it crucial for airport design to minimize unnecessary delays and provide clear guidance to alleviate this stress.

Airport design can facilitate the process of becoming a passenger through smart spatial solutions and intuitive signage, allowing passengers to move safely and efficiently through the airport without unnecessary stress (Bueno, 2021). Signage and spatial organization directly influence how smoothly passengers find their way. Smart spatial solutions and intuitive wayfinding can enhance efficiency, reduce stress, and contribute to a more positive passenger experience.

This process includes not only the physical journey through terminals but also the perception and experience of passengers. Beyond navigation, waiting times also play a role in shaping the passenger experience. Many travellers use these moments to relax or mentally prepare for their journey. Well-designed waiting areas, with comfortable seating and calming environments, can support this process and contribute to a more pleasant airport experience.

Schiphol's Single-Terminal concept and Seamless Travel

Schiphol operates a single-terminal concept, where all facilities and departure halls are connected within one physical building. In aviation, this is often presented as a prerequisite to promote seamless travel.

However, Bueno (2021) argues that a completely frictionless journey does not necessarily deliver the best passenger experience. While efficiency and speed are important, an airport environment should also contribute to passenger autonomy and a sense of control.

Instead of solely focusing on speed and seamless movement, the airport should facilitate passenger autonomy and decision-making. Efficiency is crucial, but passengers should be given alternatives in how they navigate, rather than being restricted to a fixed route. Providing choices can enhance autonomy, reduce stress, and improve the overall experience.

An important aspect of seamless travel is therefore not only how fast a passenger can move, but also how intuitive the environment feels and how much autonomy passengers have when navigating through the airport. Thoughtful wayfinding, well-placed facilities, and flexible routes contribute to a smoother, yet more empowering, travel experience.

Autonomy and Airport Literacy

Another relevant insight from Bueno's research is that not all passengers have the same experience in an airport environment.

Their journey is influenced by their level of "**airport literacy**" - or, in other words, their knowledge of airport processes and spatial orientation.

- **Experienced passengers** tend to move quickly and purposefully through an airport. They are familiar with the process and need less support.
- **Less experienced passengers** may experience more stress and need clear signage and flexibility in routes.

This means that an airport design must cater to both groups. Schiphol can do this (and already partly does) by a logical layout of walking routes, landmarks and intuitive wayfinding, so that passengers with different levels of airport literacy can move around autonomously and comfortably.

By taking passenger stress, autonomy and airport literacy into account, an airport can function not only as an efficient transit location, but also as an environment where travellers feel safe, comfortable and in control.

The Continious Operation: An Airport Never Closes

An additional complexity in airport design is that airport operations can never be shut down. This means that infrastructural modifications, such as a new terminal or improvements in security processes, must happen while the airport remains

in operation. This requires design decisions that consider:

- Minimum disruption: Work should not interfere with passenger flows and operations.
- Design flexibility: Modular and adaptable structures allow for expansions without large-scale disruption.
- Sustainability and futureproofing: Schiphol must not only meet current demand, but also be prepared for future growth and changing regulations.

Insights

- **Clear and structured airport design** reduces stress and improves passenger experience.
- **Well-organized navigation** enhances autonomy and reduces reliance on assistance.
- A well-designed airport **balances efficiency with multiple navigation options** for passenger autonomy.
- Passengers' level of **airport literacy** influences how confidently they navigate the space.
- Providing **flexible navigation choices** reduces stress and enhances autonomy.
- Comfortable and calming **waiting areas** support passenger well-being and mental preparation.
- **Adaptive airport infrastructure** ensures continuous operation, minimal disruption, and future expansion.
- **Seamless** travel depends on **intuitive wayfinding, not** just **speed.**

5.2. Legal Context of PRM Accessibility

The accessibility of airport services for passengers with reduced mobility (PRM) is regulated at the European level through various laws and guidelines. These legal frameworks set minimum standards for assistance while also encouraging innovative mobility solutions to improve autonomy.

Regulations Ensuring PRM Rights

Regulation 1107/2006 (European Union, 2006) mandates that airports provide adequate assistance to PRM passengers at no extra cost, ensuring they can travel as independently as possible.

To further strengthen these rights, the 2024 Interpretative Guidelines (European Commission, 2024) emphasize the need for high-quality, seamless assistance that is tailored to individual needs. Key aspects include:

- **Accessible information** for PRM passengers.
- Continuous **training** for airport staff.
- **Cooperation with PRM passenger interest groups** to refine accessibility policies.

Schiphol has established the “Klankbordgroep”, where various PRM organizations provide input on accessibility initiatives, ensuring that PRM perspectives are actively integrated into airport policies. See figure 7. To better understand and connect with this interest groups, several meetings were held throughout the project. One of these was the "Flying with Autism" tour. These sessions are discussed in Appendix 11.

Figure 7: Klankbordgroep with Pieter van Oord

Advancing PRM Mobility Through Innovation

Beyond basic assistance, modern regulations encourage investment in autonomous mobility solutions.

- **The European Civil Aviation Conference (ECAC) guidelines** (ECAC, 2024) highlight the role of technology in enhancing PRM autonomy.
- **The European Accessibility Act (EU 2019/882)** (European Union, 2019) further reinforces the importance of accessible design and the deployment of mobility innovations.

These regulations align with Schiphol’s objectives to implement technological solutions, such as autonomous wheelchairs, to increase PRM independence and streamline assistance services.

Supervision and Inspection

In the Netherlands, PRM accessibility regulations are monitored by two key entities.

- **The Human Environment and Transport Inspectorate (ILT)** oversees the enforcement of Regulation 1107/2006 at Schiphol and other Dutch airports. ILT monitors:
  - **The quality of PRM assistance**, ensuring fairness and accessibility.
  - **Compliance with passenger rights,** including complaint resolution.

- **The Ministry of Infrastructure and Water Management (IenW)** plays a policy-making role, supporting:
  - The **transition towards autonomous** mobility solutions,
  - Financial and strategic **policy alignment** with European laws.

While ILT enforces strict compliance, it is also seen as an enabler of innovation, encouraging airports to explore new mobility solutions within the existing regulatory framework.

Insights

- European regulations ensure PRM passengers receive **free and fair assistance.**
- High-quality PRM service requires **accessible information, staff training, and collaboration with interest groups.**
- Regulatory frameworks **encourage** airports **to invest** in **autonomous mobility** solutions**.**
- Strict **supervision ensures compliance** but also drives **innovation** in PRM accessibility.
- **Collaboration** between regulatory instances and airports **is crucial** for policy alignment and implementation.

5.3. PRM Strategies at other Airports

Airports worldwide adopt different strategies for supporting passengers with reduced mobility (PRM). Some rely entirely on staff assistance, while others integrate technological innovations to enhance passenger independence. Analysis of various airports reveals **three dominant models**:

1. **Full Assistance Model** – PRM passengers rely entirely on staff support for mobility.
2. **Hybrid Model** – A combination of human assistance and technology, offering flexibility.
3. **Autonomous Model** – Technological self-reliance, minimizing the need for staff intervention.

A Hybrid Model Combines Autonomy and Assistance Effectively

Airports such as Heathrow and Charles de Gaulle operate a **full assistance model**, where dedicated staff or specialized services provide complete PRM support. While this ensures safety and reliability, it also results in long waiting times and reduced autonomy (Davies, 2020).

By contrast, JFK, LAX and Haneda focus on **technological autonomy**, implementing Jetweels and WHILL autonomous wheelchairs to reduce waiting times and allow PRM passengers to move independently. See figure 8. However, not all travelers feel comfortable using fully autonomous technology, meaning human assistance is still required in some cases (Future Travel Experience, 2020).

A hybrid approach, seen at Frankfurt and Dubai, combines human assistance with digital innovations such as real-time assistance apps and self-driving wheelchairs. This reduces staff dependency while maintaining flexibility, making it a balanced alternative (Frankfurt Airport, Dubai Accessibility). The comparison of different models suggests that a hybrid approach is the most effective. Offering passengers a choice between self-reliance and human support ensures both independence and accessibility.

Technology Enhances Efficiency, But Isn't Enough

Airports using smart mobility solutions have seen improvements in efficiency, but technology alone does not suffice. Frankfurt Airport's FRA SmartWay helps PRM passengers navigate terminals more easily, and JFK's Jetweels system enables self-reliant movement. However, some travelers struggle with digital solutions, reinforcing the need for hybrid models that offer both autonomy and personal assistance.

Real-Time Assistance Requests Increase Flexibility

Assistance request procedures impact PRM passenger satisfaction. Airports such as Charles de Gaulle require passengers to pre-book assistance 48 hours in advance, which can be problematic for unexpected needs (Easy CDG). In contrast, Frankfurt and Dubai allow on-demand assistance via mobile apps, reducing waiting times and increasing passenger control.

Airport Infrastructure Plays a Crucial Role

Beyond mobility services, physical airport infrastructure significantly affects PRM accessibility. Airports such as JFK and Heathrow improve mobility by strategically placing rest points, assistance stations, and moving walkways (Davies, 2020). Such features help passengers navigate large terminals with less reliance on assistance services.

Stronger Airport-Airline Collaboration Improves PRM Services

Seamless PRM support requires close coordination between airports and airlines. Charles de Gaulle and Frankfurt Airport have integrated PRM services between airlines and airport staff, ensuring faster assistance and a more consistent experience (Reduce Mobility EU, 2020). Centralized PRM management can further enhance efficiency.

Insights

- **A hybrid approach is the most effective**
- **Technology** improves efficiency but **cannot fully replace human** assistance
- **Real-time** assistance **requests** increase passenger **flexibility**
- Airport **infrastructure** plays a **crucial role** in PRM accessibility
- Strong **airport-airline collaboration** improves PRM services

A new transportation solution featuring autonomous driving technology

WHILL provides new indoor transportation solutions, featuring self-driving mobility and management systems for facility operators.
Our optimized service simultaneously provides customers with a smoother method of maneuverability by setting routes based on the facility environment and customer needs.

Passenger: Requires simply using a touch screen to select their destination. No actions are required while in motion.
Self-driving mobility device: Takes passengers to their destinations autonomously.

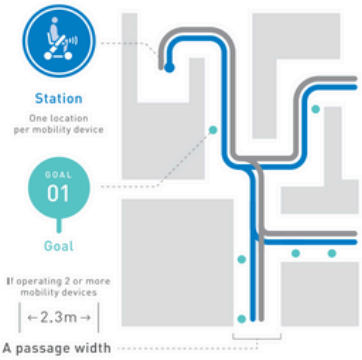
Passenger: The mobility devices do not need to be returned.
Self-driving mobility device: Detects when passengers exit the mobility device and triggers a countdown to automatically return to its original location.

Route settings

One boarding location can be set per mobility device, but there is no limit to the number of locations where users can be transported.
If operating more than two mobility devices, routes are set with enough clearance so that devices enroute to the destination and returning mobility may pass each other safely.

A passage width of at least 2.3meters is required if operating two or more mobility devices.

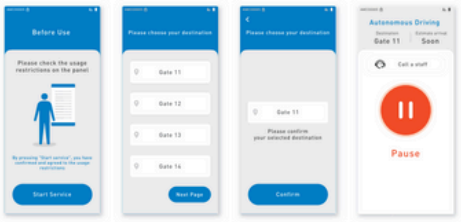
* Installation work and communication devices within facilities are not required.



Specifications

Load capacity (passenger)	136kg
Baggage weight restrictions	10kg
Speed	2.0-2.5km/h
Minimum turning radius	760mm
Size	1100×655×855mm
Battery	25.2V
Charging time	5h(time of service availability)

*The above are reference values



Operation panel

An easy-to-use and simple screen that enables first-time users to perform operations with ease. Supports multiple languages.
(Japanese, English, Chinese, Korean, Thai, Vietnamese, Dutch, French
*As of April 2023)

Remote management system for facility managers

WHILL's self-driving mobility service portal is a tool that maintains the mobility device conditions and location information, making operations run smoothly. Facility managers willl receive an ID and password.

Figuur 8: Zelfrijdende s wheelchair WHILL op Schiphol Airport (source: WHILL, 2023, whill.inc)

5.4. PRM Performance Across Sectors

Accessibility for PRM varies significantly across industries. While cruise tourism and music festivals have successfully implemented inclusive solutions, aviation and public transport still struggle with accessibility and efficiency. See figure 9 By analyzing different sectors, valuable lessons can be applied to airport environments.

Challenges in Aviation and Public Transport

Aviation and public transport face persistent accessibility issues, including long waiting times, bureaucratic assistance procedures, and inadequately trained personnel. Many PRM passengers must request assistance in advance, limiting their flexibility. Additionally, frequent complaints highlight malfunctioning mobility aids such as wheelchairs and lifts, further impacting the travel experience (Davies, 2020, p.150) (University of Leeds).

Inconsistent Accessibility in the Hospitality Industry

Hotels and restaurants show varied levels of PRM accessibility. While many hotels offer PRM-friendly rooms, these are often poorly implemented, with narrow passageways, inaccessible bathrooms, and insufficiently trained staff (Journey Able). The lack of standardized accessibility regulations leads to inconsistent service quality between accommodations. Similarly, restaurants frequently present barriers such as tight layouts, inaccessible toilets, and staff untrained in PRM support (Reduce Mobility EU, 2020).

Best Practices from Cruises and Festivals

Cruise ships have integrated PRM accessibility into their core design, offering wheelchair-friendly cabins, elevators, and well-trained personnel for direct assistance (Fly LAX). Likewise, music festivals have recently advanced accessibility efforts with dedicated wheelchair paths, raised viewing platforms, and real-time accessibility apps (Accessibility Expo). Unlike aviation, where PRM accessibility is often an afterthought, these industries embed accessibility measures into their infrastructure from the outset.

Insights

- **Technology is key to improving PRM services,** Real-time assistance apps and autonomous mobility solutions improve PRM accessibility.
- **Standardized PRM guidelines** reduce inconsistency and improve user satisfaction.
- Mandatory **PRM training** enhances staff competence and service quality.
- **On-demand assistance** increases flexibility and independence for PRM passengers.
- **A combination** of technology, trained personnel, and proactive accessibility measures **creates an inclusive PRM experience.**

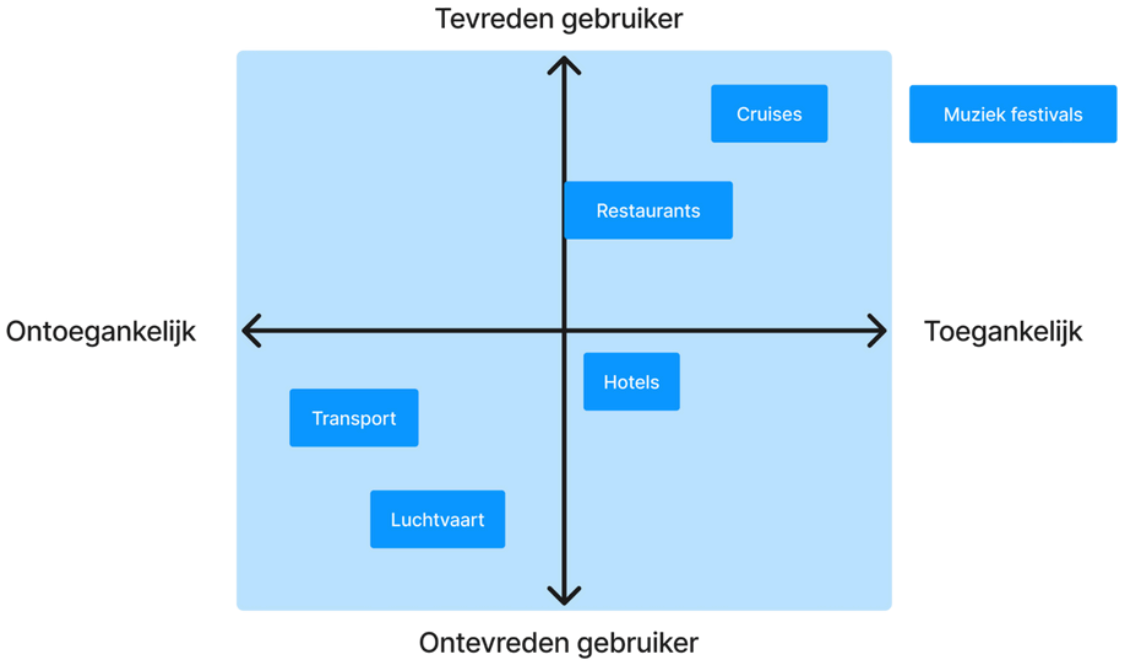


Figure 9: PRM Performance across sectors in Dutch

5.5. Lessons learned from the Paralympic Games

As part of this project, a case study on the Paris 2024 Paralympic Games was conducted to draw lessons for enhancing accessibility and autonomy for passengers with reduced mobility (PRM) at Schiphol Airport. The event provided a real-life example of large-scale accessible infrastructure, particularly relevant for the design of a self-service wheelchair system.

The Paralympic Games represent one of the most ambitious and large-scale efforts to make a city and event fully accessible. Unlike traditional environments, accessibility during the Games was implemented under high pressure and at city-wide scale. This makes it an ideal reference point for high-traffic, complex environments like airports, where similar principles can be applied to enhance autonomy and reduce reliance on assistance services.

Focus areas of the study

The research examined several key dimensions of accessibility during the Games:

- **Physical Infrastructure** – such as wheelchair-accessible buildings, public spaces, and the Paralympic Village.
- **Mobility Systems** – including accessible public transport (buses, trams), shared mobility options, and transfer points, see figure 10.
- **Information Provision** – the clarity and availability of signage, instructions, and real-time assistance.
- **User Experience** – personal experiences and perceptions of independence, dignity, and usability.
- **Organizational Approach** – how planning, coordination, and staff training supported accessibility.
- **Interview Insights** – firsthand reflections from the Irish Paralympic equestrian team leader, providing practical and emotional perspectives.

Emotional and Systemic Barriers

While the Games made major strides in accessibility, first-hand accounts revealed deeper, often overlooked challenges. The journey through Paris' public transport system highlighted how easily autonomy can break down, even in environments promoted as inclusive. Despite infrastructure upgrades, passengers still faced physical exhaustion, mental strain, and dependence on others due to inconsistent systems and last-mile friction points.

> "It's exhausting," Maille says. "Physically, because you're covering long distances in the hallways. Psychologically, because you have to pay attention to everyone, to everything, like the crowds, the traffic."

Moreover, what appears accessible on paper often falls short in real use. Unexpected obstacles like broken elevators, missing ramps, or unclear signage forced users to constantly adapt and at times surrender their independence.

> "I have to take the elevator and go down to the front desk. And that's where all autonomy ends for me because I need a rail agent's help," Maille sighs.

These experiences emphasize the importance of designing for dignity, continuity, and true independence, not just functional access.

A Note on Limitations: Incomplete Accessibility in Paris

The example in the previous paragraph serves as an important reminder: even in high-profile, accessibility-focused events, systemic gaps can still hinder true independence. While the Paralympic Games showcased numerous successful accessibility initiatives, not all aspects of the city were equally inclusive. A report from Euronews (2024) highlighted ongoing limitations in the public transportation system, particularly the metro, which remained largely inaccessible for many individuals with reduced mobility. For Schiphol and similar environments, it underlines the need for consistent, end-to-end accessibility beyond isolated improvements.

Key takeaways for Designing a Self-Service Wheelchair System

The analysis revealed that autonomy is only possible when all parts of the travel experience, from technology to human interaction, are carefully aligned. The following insights offer practical guidance for developing a self-service wheelchair solution at Schiphol.

Insights

- **Seamless Travel Chain,** Autonomy is disrupted when transitions between travel modes are poorly coordinated.
- **Ease of Use,** A self-service system must be intuitive, requiring little to no explanation or staff support.
- **Shared Mobility Solutions**, Paris' app-based wheelchair-sharing model allowed users more freedom at key access points.
- **Clarity and Consistency**, Confusing signage often undermined otherwise accessible infrastructure.
- **Emotional Design**, Independent movement is closely linked to feelings of dignity, confidence, and trust.
- **Dedicated Accessible Zones**, Fully integrated accessibility zones improved usability and reduced stress.
- **Staff Role,** Over-helping can reduce autonomy; well-trained staff know when to step back.
- **User-Centered Design,** Real user feedback is essential to ensure the solution fits actual needs.
- **Dependency Breakpoints,** Accessibility fails when users encounter unavoidable points where assistance is required, breaking the continuity of autonomous travel.
- **Psychological Load,** Mental strain from navigating unpredictable environments reduces user confidence and energy.
- **Accessibility Fatigue,** Constantly needing to ask for help or remain alert causes physical and emotional exhaustion.
- **Incomplete Accessibility,** Gaps between components of a "100% accessible" system undermine independence.
- **Last-Mile Breakdown,** Autonomy fails when key points (like elevators or bus ramps) require unavoidable assistance.
- **Event vs. System,** Short-term solutions must transition into lasting structural change to be truly inclusive.

Figure 10: Toyota Mobility Transport Paralympic Games Paris 2024 (source: Toyota, 2024, press.toyota.be)

5.6. Relevant Trends for Development

The accessibility and mobility of PRM passengers are shaped by various external factors that influence airport operations, service design, and technological advancements. To create a future-proof service, it is essential to anticipate and respond to these evolving trends. This analysis highlights the most relevant developments across demographic, economic, political, ecological, social, technological, and legal domains, which are shown in figure 11.

Anticipating Future Needs and Demands

Aging populations and increased international travel contribute to a growing demand for PRM-friendly services. Passengers require more adaptable, multilingual, and culturally sensitive solutions to accommodate diverse mobility needs. At the same time, economic trends, including labor shortages and fluctuating fuel prices, pressure airports to optimize PRM services while maintaining financial feasibility.

Regulatory and Political Pressures

Governments and international bodies continue to refine accessibility policies, requiring airports to comply with evolving regulations. The introduction of AI and robotic assistance must align with strict aviation security measures, making seamless integration a key challenge. Legal uncertainties surrounding autonomous PRM technologies, particularly in liability and data privacy, further complicate implementation.

Sustainability as a Driving Force

Environmental regulations push airports to adopt green mobility solutions, such as electric and hydrogen-powered transport. At the same time, energy-efficient technologies and smart infrastructure are becoming essential in reducing the environmental impact of PRM services. Sustainability measures also extend to designing infrastructure that minimizes disruption and allows for long-term adaptability.

Shifting Social Expectations

Passengers increasingly expect seamless, inclusive, and tech-enhanced PRM experiences. The acceptance of AI-assisted solutions is rising, with growing emphasis on neurodiversity and sensory-adaptive environments. Airports must go beyond physical accessibility to create spaces that cater to a broader spectrum of PRM passengers, including those with cognitive challenges.

Technological Innovations in PRM Mobility

AI, robotics, and IoT-driven solutions are revolutionizing PRM assistance. Self-driving wheelchairs, facial recognition, and digital wayfinding tools significantly enhance passenger autonomy. Automated customer service, such as chatbots and virtual assistants, further streamline assistance and reduce wait times. Airports that invest in these innovations can improve efficiency while meeting evolving passenger expectations.

By aligning PRM service development with these trends, airports can create an inclusive, efficient, and sustainable mobility ecosystem that enhances the passenger experience while ensuring operational feasibility.

Insights

- **Scalability and adaptability** are crucial to ensuring PRM services remain **future-proof** and responsive to evolving needs.
- **Regulatory alignment** is necessary for the successful integration of **AI-driven mobility** solutions within existing aviation security frameworks.
- **Sustainability efforts must be embedded** in PRM mobility planning to meet long-term environmental goals.
- Social inclusivity requires a **broader focus beyond mobility**, ensuring PRM passengers with cognitive and sensory challenges are also accommodated.
- Technology adoption must **prioritize usability**, balancing automation with human support to cater to diverse passenger preferences.

Demografic

- The aging population and increasing prevalence of chronic conditions are driving demand for more accessible PRM services.
- Globalization is increasing the need for multilingual and culturally sensitive PRM solutions.
- Changing travel behavior is leading to more international PRM journeys, requiring standardized services across borders.

Economic

- Passenger traffic continues to rise, with a 7% increase in 2024, increasing pressure on PRM services.
- Airports are investing in automation technologies such as self-driving wheelchairs and digital assistance tools.
- High implementation costs for PRM solutions require significant investment in infrastructure, staff training, and maintenance.
- Economic fluctuations, including fuel prices, labor costs, and tourism trends, influence the financial feasibility of PRM developments.

Political

- Stricter EU and national regulations are increasing accessibility requirements for PRM services.
- Airlines operating internationally must comply with multiple regulatory frameworks, making standardization more complex.
- New safety requirements for AI-driven mobility solutions must align with existing aviation security regulations.

Ecological

- Sustainability policies are driving the adoption of electric and hydrogen-powered PRM transport solutions.
- Energy-efficient technologies, such as smart lighting and climate control, are being integrated to reduce environmental impact.
- Stricter CO_2 reduction policies influence the selection of low-emission PRM transport modes.

Social

- Passengers expect inclusive, seamless, and digitally enhanced PRM experiences.
- There is growing acceptance of AI-assisted PRM services, with increasing reliance on automated support.
- Airports are expanding accessibility measures to support neurodiverse travelers, addressing sensory sensitivities and cognitive challenges.

Technological

- AI and robotics are transforming PRM assistance with self-driving wheelchairs, facial recognition, and AI-guided navigation.
- Wearable technology and IoT connectivity are enabling real-time assistance and improved communication.
- Digital wayfinding and augmented reality are enhancing PRM passenger navigation and independence.
- Automated customer service, including chatbots and virtual assistants, is reducing wait times and improving accessibility.

Legal

- EU accessibility laws, including Regulation 1107/2006, continue to evolve, imposing stricter requirements for PRM services.
- GDPR laws on AI and facial recognition are tightening, affecting data usage in PRM assistance tools.
- The legal framework for liability in autonomous PRM solutions is still developing, requiring new standards for accountability.

Figure 11: Summarized trends: DEPEST-L Trendanalysis

International Political Influence on Dutch Aviation Policy

Political decisions in countries such as the United States have a direct and indirect impact on Dutch aviation policy, especially in the areas of sustainability and inclusivity. The global nature of the aviation sector means that changes in foreign environmental regulations or accessibility standards can exert pressure on the Netherlands to adjust its policies. This creates both opportunities and challenges for the implementation of sustainable and inclusive mobility solutions at Schiphol and other Dutch airports.

One concrete example is the impact of American regulations on PRM services at Schiphol. American airlines operating in the Netherlands must comply with both U.S. and international regulations, which can result in inconsistent accessibility standards. The airline itself remains responsible for compliance with additional legal requirements beyond EU Regulation 1107/2006, including the costs of additional services or facility adjustments.

Moreover, broader U.S. political decisions on aviation and environmental policies can influence Dutch aviation strategy. A recent case is the debate on reducing flights at Schiphol, where American airlines and the U.S. government have exerted pressure to prevent flight reductions, fearing economic consequences and potential retaliatory measures (BNR, 2023).

These international regulatory dynamics emphasize the need for Dutch policymakers and aviation authorities to continuously monitor foreign legislation and geopolitical trends. Strategic alignment with international policies ensures that Dutch aviation remains competitive while adhering to evolving global standards in sustainability, accessibility, and operational efficiency.

Insights

- **Foreign political decisions shape Dutch aviation policy,** especially regarding sustainability and inclusivity.
- **American regulations create inconsistencies** in PRM services, requiring careful coordination at Dutch airports.
- **Airlines remain responsible for compliance** with additional legal requirements beyond EU regulations.
- **International pressure** influences Dutch airport policies, as seen in the debate on Schiphol's flight reductions.
- **Proactive monitoring** of global aviation policies **ensures adaptability** and alignment with evolving regulations.

5.7. Technological Explorations

To develop an efficient and accessible wheelchair self-service, it is essential to explore relevant technological innovations. By integrating unlock technologies, smart wayfinding, and autonomous wheelchairs, the service can remain future-proof and adaptable to evolving user needs. These technologies improve ease of use, independence, and operational efficiency, ensuring that the system aligns with both current and future airport environments.

Unlock Technologies for Wheelchairs

User-friendly unlock systems are essential for the seamless operation of a self-service wheelchair system. Several technologies offer keyless access, each with distinct advantages and limitations. The ideal unlock system should require minimal user effort and integrate with existing airport infrastructure. **NFC and QR codes** offer the best balance between accessibility, security, and ease of use. See figure 12 for an overview.

Smart Wayfinding and Navigation

Navigation in complex airport environments can be challenging for PRM passengers. The following technologies enhance real-time wayfinding and wheelchair tracking:

- **Indoor Positioning Systems (IPS):** Uses Wi-Fi, Bluetooth beacons, and Ultra-Wideband (UWB) to provide real-time navigation inside buildings, similar to hospital tracking systems.
- **Augmented Reality (AR) Navigation:** Overlays digital guidance on smartphones or smart glasses, like Google Live View.
- **RFID & BLE (Bluetooth Low Energy) Tracking:** Enables location tracking for wheelchairs and users, similar to Apple AirTag.
- **AI-driven Navigation:** Learns from crowd movements to optimize routes, reducing travel time and congestion.

A combination of IPS, AR, and BLE tracking could improve wheelchair availability and passenger autonomy, making airport navigation more intuitive and stress-free.

Autonomous Wheelchairs: Progress and Challenges

Autonomous wheelchairs promise greater independence for PRM passengers through AI-driven navigation and sensor-based obstacle detection. Key developments include:

- **LIDAR and camera-based sensors:** Used for obstacle detection, but struggle in poor lighting conditions.
- **AI & Machine Learning Integration:** Improves route planning and responsiveness.
- **Brain-Computer Interfaces (BCI):** Emerging technologies for hands-free wheelchair control.

Challenges remain, including high costs, regulatory barriers, and reliability in crowded airports. However, ongoing advancements in AI and sensor technology are expected to enhance autonomous mobility solutions.

Technology	Functionality	Advantages	Challenges
RFID (Radio Frequency Identification)	Uses a chip in a card or wristband that communicates with a scanner.	Fast and reliable. Widely used in hotels and access systems.	Requires users to carry a physical card.
NFC (Near Field Communication)	Unlocks via smartphone or contactless card (e.g., public transport card).	Seamless experience, no extra device needed.	Limited to users with NFC-enabled devices.
QR Code	Scans a unique QR code from a mobile app.	Cost-effective, easy to implement.	Requires smartphone with a camera.
Biometric Recognition	Uses fingerprint or facial recognition for security.	Highly secure and personalized.	Privacy concerns and high costs.

Figure 12: Unlock technologies

Additional Technological Innovations

Other cutting-edge technologies could further optimize wheelchair self-services:

- **IoT for Fleet Management:** Enables real-time monitoring of wheelchair availability and maintenance.
- **AI-based Assistance:** Voice-controlled digital assistants (e.g., Siri, Google Assistant) can support PRM passengers.
- **Sustainable Energy Solutions:** Electric wheelchairs with regenerative braking improve energy efficiency.

The successful implementation of these technologies depends on user accessibility, integration with airport systems, and cost-effectiveness.

Insights

- **NFC and QR codes** provide the most user-friendly and scalable unlock options for wheelchair access.
- **Smart wayfinding** solutions improve PRM independence, **with IPS, BLE tracking, and AR offering seamless navigation.**
- **AI-powered** navigation will enhance autonomous wheelchairs, but **reliability and costs remain challenges.**
- **IoT and AI-driven solutions** optimize fleet management and user assistance, reducing operational strain.
- **Sustainability should be considered** in wheelchair design, integrating efficient energy solutions for long-term use.

6. Behaviour Analysis

This chapter explores how PRM passengers behave and make decisions during their journey at Schiphol. Through interviews, observations, co-creation, and a test study, it reveals key needs, frustrations, and patterns. The findings help shape a more user-friendly, autonomous wheelchair service.

Research Approach

Design study
A short-term solution was developed early in the project, based on analysed behavioural insights. Due to fixed limitations, the research scope was narrower. This is further detailed in Chapter 8.

Cocreation
The PRM vision was developed through co-creation, using an interactive approach in which the vision was presented and iterated based on stakeholder feedback.

Stakeholder insights were also gathered through co-creation with the full PLPM team during a afternoon at the beach.

Action Research
A large part of this chapter is informed by the action study, in which test participants walked through the journey, were filmed during the process, and were later interviewed. The material was then analysed based on the video footage and interview recordings.

6.1 The Independent Wheelchair User

The focus of this research is on wheelchair users within the PRM group, specifically the WCHR and WCHS subgroups, who wish to travel independently at Schiphol Airport. These passengers have mobility impairments but maintain a strong desire for autonomy, which directly impacts their behaviour within the airport environment. See Appendix 4 for persona's of this focusgroup to get to know them a little bit better.

Key Characteristics
A defining feature of WCHR and WCHS passengers is their desire to **retain control over their journey**, despite needing mobility support. They do not want to rely entirely on assistance services but instead prefer flexible mobility solutions that allow them to navigate the airport on their own terms. Their main priorities include:

- **Comfort and convenience,** ensuring they can move seamlessly without excessive delays or complexity.
- **Predictability and clear information**, as an unclear or inconsistent process adds stress to their travel experience.
- **Flexibility in mobility aid usage,** allowing them to access and return a wheelchair without rigid procedures.

The group consists of both permanent and temporary wheelchair users, bringing a wide range of needs:

- **Permanent disabilities,** such as muscular disorders or joint problems.
- **Temporary mobility impairments,** due to injuries, surgeries, or other conditions.
- **Passengers with fatigue**, overstimulation, or limited walking endurance, who require occasional wheelchair use.

This diversity means that a one-size-fits-all approach does not work. While some passengers travel frequently for work or family visits, others fly occasionally for leisure. Despite these differences, they share a common need for an accessible and stress-free airport experience.

Airport Environment
For this group, accessibility is not just about physical infrastructure, but also about process efficiency and communication. The ability to easily locate, use, and return a wheelchair without unnecessary obstacles is critical. Any gaps in clear communication or lack of available resources can lead to uncertainty and discomfort, negatively impacting their journey.

Diversity Within the target Group

Although the target group shares the desire to independently use a self-service wheelchair, there are many differences within the group. Airports receive a wide range of visitors, varying in language, cultural background, age and technical skills with diverse needs and expectations. This calls for an accessible and intuitive self-service system that takes this diversity into account.

Cultural backgrounds can influence how people interact with technology or what preferences they have when using a self-service system. Cultural intelligence (CQ) plays an important role in this; a designer must be able to understand the needs of various target groups and develop universally comprehensible solutions (Moua, 2012). This is essential in airports, where travellers from different parts of the world come together and need clear communication and signage.

In addition, cultural preferences influence the way in which a space is experienced. Studies show that passengers have preferences for specific interior design features, such as lighting, use of colour and materials, depending on their cultural background (Hasanzade et al., 2022). Warm colours and natural light, for example, can be experienced as soothing, while certain colours can be emotionally charged in different cultures. This has implications for the design of spaces where wheelchairs are borrowed and used.

Age and physical abilities also play a role. Older travellers may have different requirements for comfort and support than younger users. With the ageing population, it is important to take this into account, as the perception of personal space and comfort varies by age group and culture (Kim et al., 2017). People with temporary mobility limitations, such as a broken leg, may have different expectations than people who are more frequently dependent on a wheelchair.

Technology offers new possibilities to bridge this diversity. Digital services and multilingual apps can contribute to a smoother user experience by informing travellers in their own language and helping them to navigate (Gu & Kim, 2016). A hybrid system that allows for both digital and physical interactions increase the accessibility and user-friendliness of the self-service process, as also follows from chapter 5.3, where learning points from other airports are mentioned.

By taking this variation within the target group into account, a self-service system can be developed that is widely accessible and effective for all users. Designing for diversity requires a combination of cultural intelligence, technological innovation and people-oriented design principles that respond to the diverse emotions, preferences and needs of travellers.

Vision and Mission PRM

As part of this thesis project, the vision regarding PRM service delivery was reviewed in collaboration with the Passenger Services & Support Team (PSS) (November 2024). A one-pager outlining the PRM vision for each travel step can be found in Appendix 5. These steps were defined by the PRM team.

Schiphol envisions a PRM service that is not just compliant with regulations, but truly passenger-centric, inclusive, and future-focused. The approach is based on two key principles:

- **Facilitating and Encouraging Autonomy**
  - PRM passengers should have the choice to travel as independently as possible. This is achieved through innovative technologies such as autonomous mobility systems, an improved assistance structure, and accessible information provision.
  - Schiphol recognizes that not all PRM passengers require full assistance, some prefer to navigate independently.

- **Providing Tailored Support Where Needed**
  - Assistance should be personalized rather than standardized.
  - Schiphol shifts from fixed procedures to a needs-based approach, ensuring that each passenger gets the right level of support.

Beyond enhancing the passenger experience, this shift towards autonomous mobility and tailored assistance also serves operational goals. It aims to reduce reliance on assistance staff, optimize resource allocation, and ensure that support is directed where it is needed most.

Collaboration with stakeholders

To achieve their goals, the PRM team indicates that they involve relevant stakeholders in different ways (Annual Plan 2025, PRM), as there is strong dependency to realize initiatives. The six most important stakeholders are shown in Figure 13, including how each stakeholder is kept engaged.

Future Outlook: Innovation and Accessibility

To realize this vision, Schiphol is actively exploring new mobility solutions that empower PRM passengers. Technology will play a key role in improving both autonomy and assistance quality, ensuring a seamless and dignified travel experience for all passengers. With this vision, Schiphol aims to set a new standard for accessible air travel, creating an environment that supports PRM passengers on their terms, while maintaining efficiency, quality, and inclusivity.

Vision and Mission Target Group

Independent travel means that the passenger does not make use of Schiphol's assistance service, whereby an employee accompanies them. Instead, they prefer to move around independently with the support of a self-service wheelchair system. This does not mean, however, that they cannot rely on friends or family as travel companions. The target group mainly consists of travellers who want to use a wheelchair together with their travel companions to navigate Schiphol independently.

The vision for this target group is to facilitate a seamless and independent travel experience, in which passengers retain full control over their own wheelchair use. Adapted facilities and procedures should enable them to experience the same degree of independence as other passengers. The core values of this vision are:

- **Full control over mobility:** Passengers should have the freedom to find their way at their own pace and without dependence on assistance services.
- **Adapted infrastructure and procedures:** The airport should be organised in such a way that wheelchair users can move around just as independently and efficiently as other passengers.
- **Integrated support:** Where necessary, aids should be offered without leading to unnecessary dependence on human personnel.
- **Accessible information and routes:** Schiphol should offer clear, well-marked and easily accessible routes, supported by digital and physical tools.

PRM Team - stakeholder engaging strategies

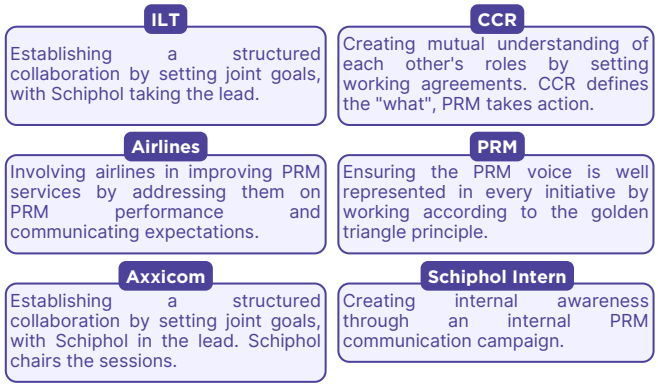


Figure 13: Stakeholder Engagement

Insights

- **PRM mobility** must be **flexible,** allowing independent navigation.
- PRM services must adapt to **different mobility needs.**
- Accessibility requires **clear processes and communication.**
- Self-service systems must be **intuitive and inclusive.**
- **Cultural intelligence** ensures **globally usable** designs.
- Design must consider **cultural differences** in **space** perception.
- Self-service must adapt to diverse **physical needs.**
- **Digital and physical** interaction improves accessibility.
- PRM assistance should be **flexible and user-driven.**
- Autonomous mobility reduces **staff reliance.**
- **Needs-based assistance** improves efficiency.
- **Innovation** enhances PRM autonomy and service quality.
- Adapted infrastructure ensures **equal mobility freedom.**
- **Wheelchair routes** must match airport efficiency.
- **Signage, wayfinding, and digital tools** support PRM users.

6.2 PRM Challenges and Needs

For passengers with reduced mobility (PRM), independent travel is a priority. Many PRM travelers rely on self-service solutions, such as wheelchair self-service stations and adapted walking routes, to navigate the airport without assistance. However, inefficient infrastructure, lack of information, and inaccessible technology often create frustration and barriers to seamless travel.

This chapter identifies key challenges and user needs, based on findings from the PRM Journey report (2024), focus group interviews, and field observations (2025). The challenges highlight the pain points PRM travelers face, while the identified needs emphasize the essential improvements required to enhance autonomy and accessibility. Figure 14 summarizes both.

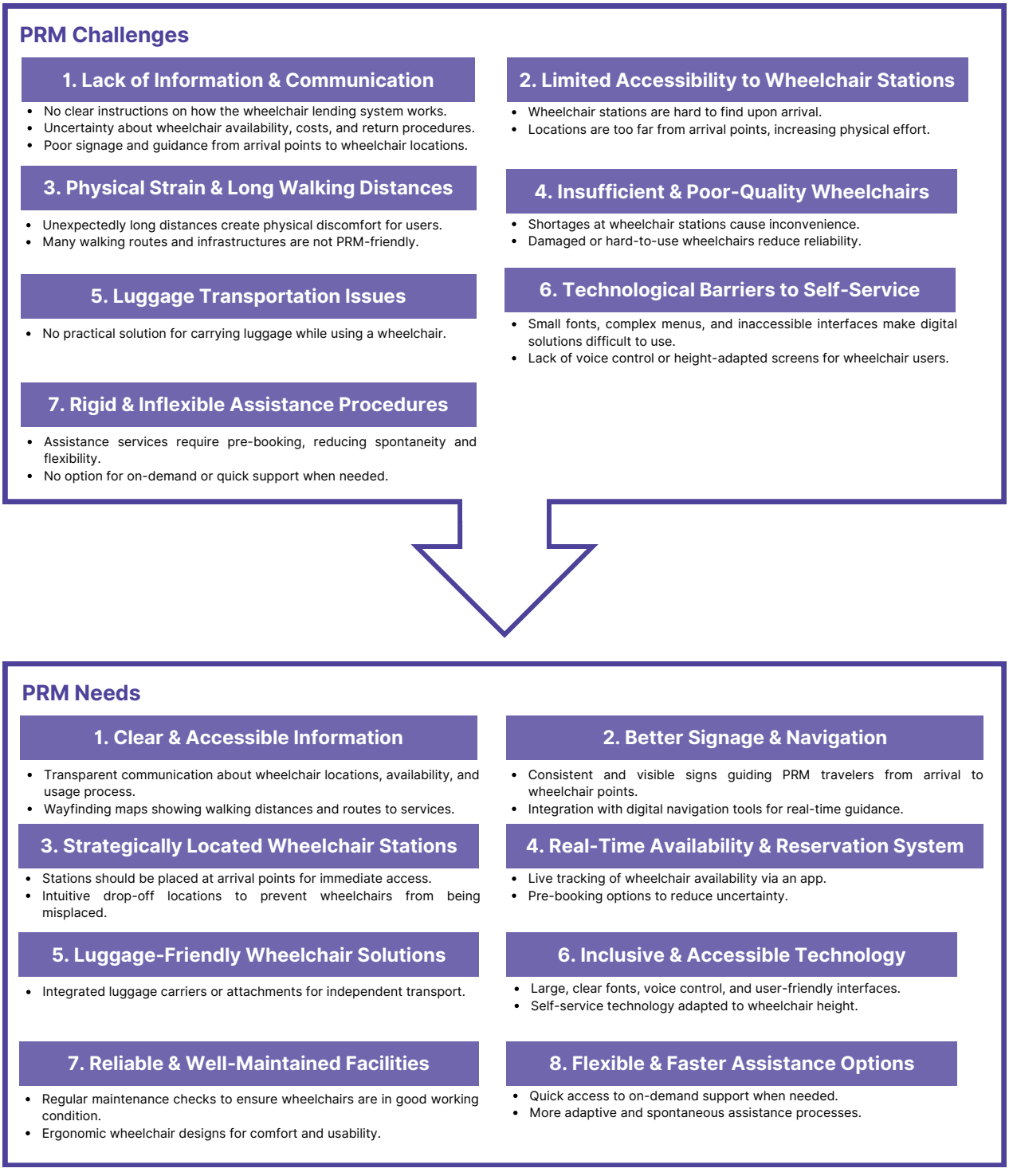


Figure 14: Challenges and Needs

Insights

- **Clear and on-time communication** is crucial to reduce uncertainty and stress.
- **Well-placed wheelchair stations** minimize walking effort and increase efficiency.
- **Real-time availability tracking** improves passenger control.
- **Integrated luggage solutions** enhance independent mobility.
- **Inclusive digital interfaces** must cater to all physical abilities.
- **Regular maintenance** ensures reliable wheelchair access.
- **More flexible assistance options** prevent unnecessary dependence on staff.

6.3 Passenger Journey

Figure 17 shows the current Passenger Journey. It shows which of the various steps independent wheelchair users currently go through, with a focus on the departure process from home to the gate. To fully understand this process, the option of assistance by Axxicom is also occasionally mentioned. Axxicom is the party responsible for the PRM assistance process at Schiphol, although this group falls outside the scope of this study.

The journey begins with a preparation phase that varies from person to person. Some passengers consult the Schiphol website in advance, while others rely on information upon arrival.

This is often the moment when they decide whether to request assistance from Axxicom or to use the available wheelchairs independently. Due to a lack of information about these independent facilities, many passengers still choose assistance, even if they would prefer to travel independently, like the man speaking in the next quote.

"Just give me that wheelchair"

A man who walks with a cane for support cannot manage the long distances at Schiphol but does not require further assistance. He only wants a wheelchair for those stretches, as his friends can push him.

After the pre-boarding procedure, passengers choose their means of transport to Schiphol, such as train, (shuttle) bus, car, taxi or kiss & ride. See figure 15 for the different arrival locations at Schiphol.

Figure 15: Different arrival locations at Schiphol

The official self-service locations are in front of check-in (Plaza, WTC Traverse, see figure 16) and after check-in at the Axxicom assistance lounges. These latter locations are poorly visible. Depending on their point of arrival, passengers will either pass a wheelchair self-service location (Plaza or WTC Traverse) or they will pass the service desk in the departure hall as their first touchpoint. So, there are two streams of passengers.

Because the availability of wheelchairs at Plaza and in the WTC Traverse is limited, the first stream of passengers, who should actually be walking past the service desk with a wheelchair, report to the service desk without a wheelchair. The second stream passes directly by the service desk and reports because they are looking for a wheelchair.

The service desk causes confusion. Independent wheelchair users do not have to go through this, but it happens anyway.

The service desk offers a choice of options: Have you already requested assistance and are coming to report, do you still want to request assistance or do you want to borrow a wheelchair independently? As a result of this choice of options, two possible situations arise: Some people will still request assistance due to stress and ignorance, even if they would prefer to travel independently, and others will not use a wheelchair on self-service, but will use wheelchairs from the service desks that are actually intended for assistance. This is because the service desk hands them out to help passengers quickly.

After the security check, they spend time in the lounges and then report to the gate, where they leave the wheelchair. Some passengers only look for a wheelchair in the lounges, but these are hardly available, forcing them to ask someone or use a wheelchair that is not actually intended for them.

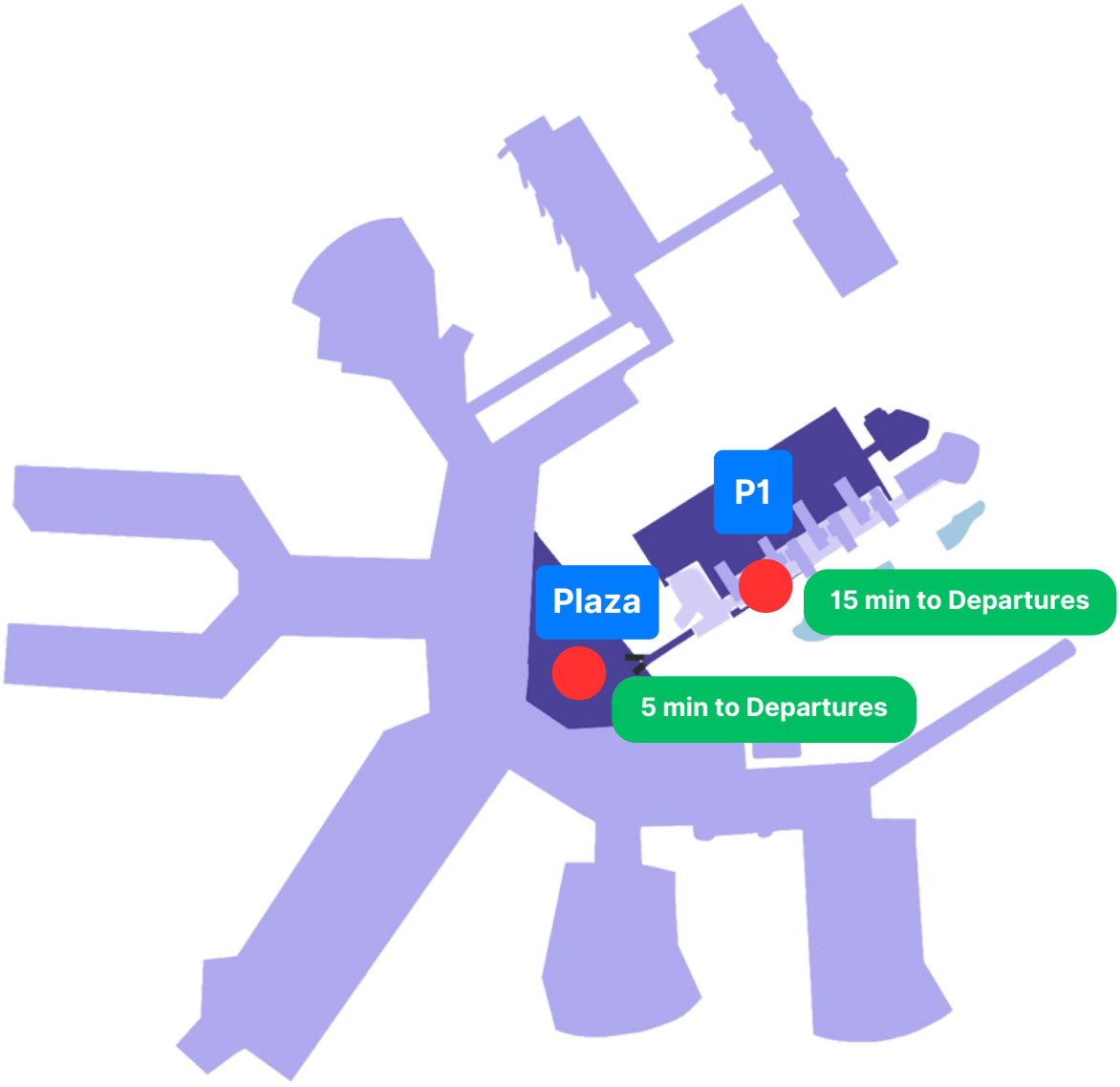


Figure 16: Wheelchair points at Plaza and WTC Traverse

Figure 17: Passenger Journey

6.4 Role of Key Stakeholders

Figure 18 visualises where stakeholders and their associated services appear throughout the current passenger journey. These findings directly inform the insights that are carried forward into the development of the final design.

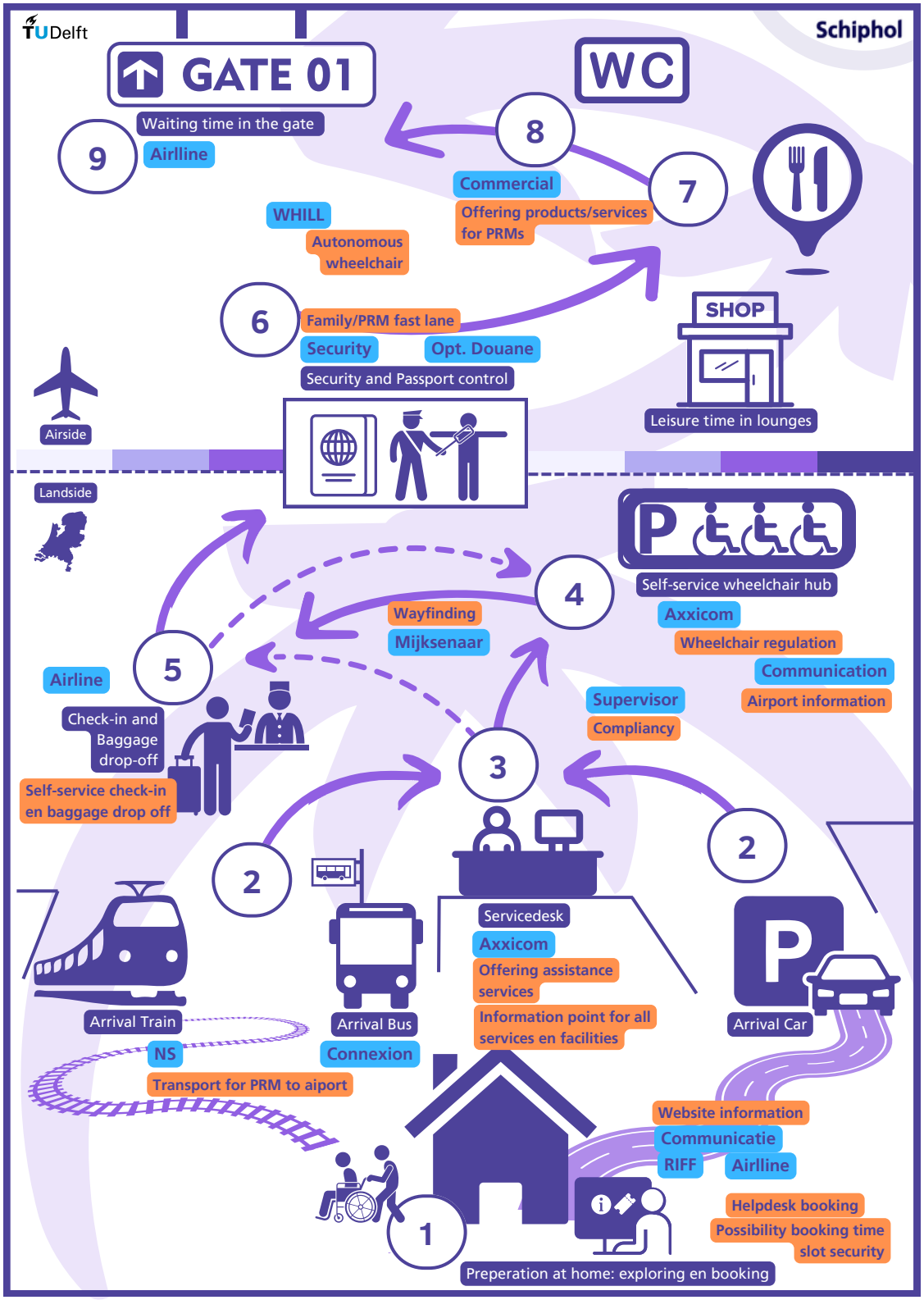


Figure 18: Stakeholders and services

7. Design for Accessibility

This chapter explores how accessibility must be an essential part of the design process from the very beginning. It highlights the importance of simple, intuitive, and inclusive design that reduces barriers and supports full independence for wheelchair users. Key examples and innovations show how thoughtful design can balance usability, technology, and user effort to create accessible mobility solutions for everyone.

Research Approach

Literature

Accessibility as a Driving Force

Real accessibility means designing a system in such a way that anyone can use it immediately, without additional tools or adjustments. For wheelchair users, this means that they should not be dependent on external assistance or special facilities, but should be able to participate in daily traffic independently and without obstacles.

Accessibility must be considered from the start of the design process, not as an afterthought. This principle is supported by the concept of Universal Design and guidelines such as the Web Content Accessibility Guidelines (WCAG), which state that a product should be usable by as many people as possible without additional modifications (World Wide Web Consortium [W3C], 2018). The Shift Left principle emphasises that accessibility must be integrated from the start of the design process to ensure functional and inclusive solutions (Bennett et al., 2018).

For wheelchair users at Schiphol, accessibility is not an extra luxury, but an absolute requirement. The wheelchair must be intuitive and easy to use without obstacles. A poorly designed product not only causes discomfort, but can also have direct consequences for the user's independence and mobility. That is why the design is focused on simplicity, reliability, and usability, without unnecessary barriers or complications.

A design that is easily accessible is not just a technical consideration, but an ethical one: it enables people to continue to function independently in an environment that many take for granted, but that can be a challenge for others (Story, Mueller & Mace, 1998).

Balancing Innovation and User Effort

Innovation in product and service design aims to improve the user experience, but paradoxically, it can also create new challenges for users. When innovative products require additional cognitive or motor skills, this can actually slow down adoption and cause resistance. A functional design should therefore not only be innovative, but above all, simplify interaction and minimise the effort required of the user.

The Limits of user Effort

Research shows that users can be reluctant to adopt new technologies if they involve a high learning curve. In a study on the adoption of innovative technologies, Sharma and Gandhi (2023) found that consumers often have doubts about the value in use, complexity, and risks, which leads to postponement or rejection of new technologies. This implies that a functional design should not require additional skills or mental effort unless the end user derives a direct benefit from it.

Another relevant study emphasises that a lack of skills is a serious obstacle to the adoption of ICT technologies, especially when users are confronted with unfamiliar interfaces or complicated procedures (Parmar, 2017). This underlines the importance of user-friendliness: a design that is functional should not be dependent on extra training or a long adaptation period.

When Innovation Works: Less Thinking, Not More Doing

However, innovation can also contribute to a simpler user experience, provided it reduces the cognitive burden on the user. A good example of this is the concept of technological assimilation, in which a product adapts to the user instead of the other way around.

In his research, Hinton (2016) distinguishes between technology adoption and technology assimilation: users may accept an innovation, but that does not mean it will be integrated into their daily routine. The success of a product therefore depends on whether it can be effortlessly incorporated into existing habits.

In addition, research shows that many users drop out of ICT developments when there is a gap between the design and their skills. Parmar (2017) argues that designs that place excessive demands on user skills, such as complicated apps or interfaces, form an obstacle to adoption. He therefore advocates for designs that utilise intuitive interactions, requiring less thought from the user.

Innovation cases: More Autonomy for Wheelchair Users

Enhancing accessibility for wheelchair users goes beyond providing assistance. It requires inclusive design solutions that promote autonomy and seamless mobility. True accessibility means that wheelchair users can navigate environments independently, without needing special adaptations or external help.

Innovations in transportation, infrastructure, and autonomous systems are eliminating barriers, making public spaces more inclusive. This section highlights key developments and future opportunities that enhance self-sufficiency for wheelchair users, useful as examples.

Level-Access Trains: Seamless Public Transport

Trains with level access allow wheelchair users to board independently, eliminating the need for ramps or assistance. Dutch railways (NS) are increasingly adopting step-free entry with new train models like SNG (Sprinter New Generation) and ICNG (Intercity New Generation).

Additionally, raised platforms at select stations create a seamless transition from platform to train, benefiting all passengers, including those with strollers, luggage, or mobility aids.

Automatic Doors & Spacious Entrances

Wide, automatic doors enhance accessibility by removing physical barriers for wheelchair users. International accessibility standards recommend a minimum width of 85 cm for accessible entrances. While many airports, hospitals, and public buildings implement sliding doors, some locations, like Schiphol Airport, use slow-rotating doors with delay buttons for better wheelchair access.

WeHelp: Robotic Assistance for Wheelchair Users

WeHelp is an AI-powered robotic assistant designed to support daily mobility tasks for wheelchair users. The system can:

- **Follow users** via visual tracking
- Be **controlled remotely** for complex tasks
- Use **speech recognition** to respond to voice commands

These features make WeHelp particularly valuable for users with limited hand function, providing greater independence in public spaces.

Future of Autonomous Wheelchairs

Autonomous wheelchairs are revolutionizing mobility, with technologies like AI-controlled navigation, obstacle detection, and real-time route planning. The WHILL autonomous wheelchair at Schiphol demonstrates how self-driving mobility solutions can enhance travel experiences for PRM passengers.

Research into haptic feedback navigation, obstacle avoidance, and smart integration with airport systems suggests that:

- Autonomous wheelchairs **reduce reliance** on **staff**
- **Integration with** smart airport **infrastructure** is necessary
- **User trust and safety concerns** must be addressed through testing and feedback

Insights

- Wheelchairs must be usable **without external assistance,** ensuring full independence.
- Accessibility must be **integrated from the start,** following Universal Design principles.
- The design should **prioritize simplicity, reliability, and ease of use,** removing barriers to mobility.
- Accessibility is an **ethical responsibility,** ensuring equal mobility for all users.
- The product should **not require** users to learn **complex skills** or place cognitive strain.
- **Reducing mental load** enhances usability, making interactions intuitive.
- New interactions must provide **clear value and** align with **natural user behavior.**

- Level-access transport **eliminates dependence on assistance** in public transit.
- **Automatic doors and wider entrances** remove physical barriers to accessibility.
- **Robotic assistance systems** provide new mobility solutions for wheelchair users.
- **Autonomous wheelchairs** enhance PRM independence, but require **trust-building** and infrastructure adaptation.
- **AI-driven navigation** and **obstacle detection** improve real-time wheelchair mobility.
- Airports **must integrate autonomous solutions** into existing digital and physical environments.

8. Case Study: Self-Service Wheelchairs at Departure

This chapter shares the case study of a self-service wheelchair system at Schiphol. It shows what was tested, what went wrong, and what insights were gained for future improvements.

Research Approach

Design Trigger

Triggered by the same accessibility challenges that initiated this broader design project, this short-term pilot aimed to provide an immediate, tangible improvement in self-service wheelchair access at Schiphol. It directly responded to Improvement Initiative 3 (see Figure 19), which strives to enhance passenger autonomy and visibility of existing mobility aids.

At the time of implementation, two visible wheelchair pick-up points already existed (at Plaza and the WTC-traverse, see figure 20 for the point at the traverse), along with three behind check-in used for Axxicom's assisted service. This pilot aimed to repurpose and expand these into usable self-service locations for independent wheelchair users.

Design and Develop Process

The development was divided into five key steps. See figure 23.

Defining Wheelchair Locations

Due to operational constraints, it was not possible to create entirely new locations. Instead, three existing storage areas were converted into public - facing loan stations (figure 21), one new location was added at a pre-approved site, and one row of luggage carts was replaced to make space, resulting in five total self-service hubs. See appendix 7 and the report on next page for additional information of the development of these locations and the user experience tests.

Figure 22: Wayfinding sketch

Improvement Initiatives PRM Service	
1	Expansion of PRM facilities
2	PRM informed at departure
3	**Promoting autonomy and more efficient resource allocation With use of innovative mobility solutions by focusing on what PRM passengers can do instead of what they cannot.**
4	Optimization of boarding process
5	PRM informed at arrival
6	Optimization of disembarkation process:
7	Comfortable waiting areas

Figure 19: Improvement initiatives

Figure 20: Pick-up point WTC-traverse

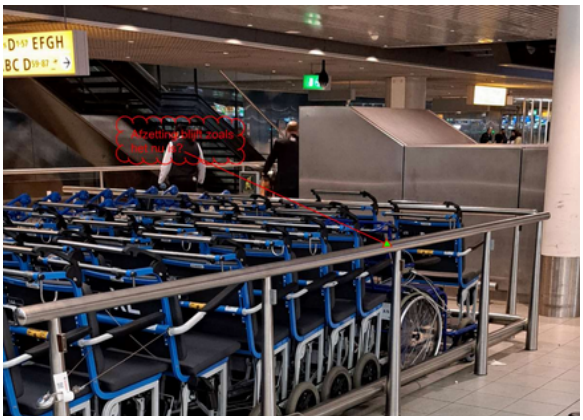


Figure 21: Work in progress

	Taak	Toelichting	Streefdatum	Status
Stap 1	Locaties leenrolstoelen	• Asba 2 en 4 hebben al een publieke locatie • Asba 1 voorstel voor publieke locatie	• 1 november	• Afgerond
Stap 2	Afbakening vak	• Middels hekken • In hekken kunnen banners	• BAM (plaza, WTC, Asba4): 12 maart • Heijmans (Asba 1/2, Aankomst 2): 1 april	• Bezig • Bezig
Stap 3	Communicatie/Zichtbaar maken leenmogelijkheid	• Blogpost op de website • Duidelijk dat de rolstoel geleend mag worden • Verzoek voor netjes terugplaatsen • Wensen van een fijne reis • Icm Mijksenaar: bebording en wayfinding naar de plekken toe	• Website: Af: 22 jan, live: 1 april • Wayfinding: 1 april	• Bezig • Opstart
Stap 4	Vormgeving vak	• Juiste vormgeving leidt tot gewenst gebruik	• 1 april	• Opstart
Stap 5	Process voorraad leenrolstoelen en onderhoud vakken	• Wie controleert voorraad en vult deze aan + verdwaalde rolstoelen terugplaatsen	• 1 april	• Nog niet opgestart

Figure 23: Key steps development locations

Designing Physical Boundaries

Research was conducted into suitable fencing types, including a review of existing structures at Schiphol. Initial designs were created in collaboration with main contractors BAM and Heijmans and submitted for approval. However, **a critical intervention occurred:** the chosen design was flagged by Schiphol's Safety Inspectorate (*Royal Halskoning*) due to security concerns (risk of concealed explosives). This led to a pivotal meeting with Schiphol Supervisor Don Murphy, where not only the fencing issue was resolved, but as a beneficial addition the broader project vision was introduced and positively received. A revised fence design was approved, better aligning with Schiphol's safety and aesthetic standards. This was an instructive moment about the values that govern airport infrastructure decisions.

Wayfinding and Communication

Physical signage was kept deliberately simple. In consultation with the Supervisor, a note like "Self-Service Wheelchairs" was chosen to appear on all signs. Additionally, replacing existing "Assistance" signs with new signs directing to the updated self-service locations was proposed. Online communication was developed together with the Schiphol communications team, though still in progress due to efforts to align messaging across multiple mobility initiatives (e.g. autonomous wheelchairs). A draft for a blog post was prepared (Appendix 7).

Designing the Layout

The internal arrangement of wheelchairs within the fenced areas was considered using behavioural observations, including user interaction with shopping carts (see case study report page 38, by clicking on figure 24). The goal was to maximise usability and reduce friction at the point of use.

Operational Planning and Regulation

Once the physical setup and communication tools were in place, the remaining challenge was inventory regulation. Axxicom, the assisted service provider, was made responsible for maintaining wheelchair availability across the new locations. A regulatory plan was co-developed, making use of existing tools such as GPS-based tracking and internal distribution planning. This would ensure real-time visibility and maintain consistent availability.

Click for the entire Case Study report

Figure 24: Case Study Report

Challenges and Learnings

The pilot revealed several structural and communication challenges that limited the effectiveness of the short-term wheelchair lending solution. While many passengers expressed a strong preference for independent mobility, they were often unable to act on it due to unclear or missing information. Wheelchair locations were poorly positioned or too far to reach independently - particularly for those arriving via group transport like tour buses. As a result, many users defaulted to requesting assistance despite their initial intent to remain self-reliant. The absence of real-time inventory insights and clear, user-focused communication further complicated navigation and operational regulation.

One of the most pressing challenges was the lack of flexibility in the short-term rollout. Ideal solutions, such as improved hub placement or custom infrastructure, were not feasible within the constraints. Despite this, key decisions - especially regarding locations - had to be made quickly and with limited data. This highlighted the importance of involving experience design or operations experts earlier in future projects.

Collaboration across stakeholders was essential, yet complex. Each party had its own timelines and priorities, making coordination demanding. Maintaining momentum and achieving shared ownership required considerable effort. A notable turning point occurred when existing fencing designs had to be changed due to updated safety protocols. This underscored how quickly priorities can shift in an airport environment, and how valuable it is to remain adaptable and responsive in real-world service design.

Reflection

This pilot served both as a quick win for passenger autonomy and as a live test of what it takes to activate change within a large, layered organisation. The experience highlighted the value of operational speed, but also reinforced the importance of deeper research and long-term planning. It created a foundation for the broader concept developed in this project, while surfacing practical, policy, and behavioural lessons that will inform its implementation.

Two sets of insights were developed: one based on the analysis done setting up the pilot, which also informed the broader research; and a second derived from the execution of the short-term project itself.

Insights from the Research within the Case Study

- **PRM passengers want to move independently** and flexibly, without relying on fixed procedures or staff.
- **Information** must be accessible **early (at home)** and remain **consistent** throughout the journey.
- Users are **intuitively looking** for **visual** guidance like maps or signage to navigate the airport.
- Interfaces and tools must be **simple, intuitive**, and **require no training** to use.
- Wheelchair locations must be **logical and physically accessible.**
- **Reliable digital systems** are essential for user trust and operational quality.
- The system should be **modular** to **accommodate future technologies** or regulations.
- Responsibility across teams must be clearly **defined** to ensure continuous service delivery.

Most Critial Insights from the Case Study

- **There is a mismatch between the desire for independence and the level of information provided.**

→ Many passengers want to act independently but lack the information to do so in time.

- **Without clear and timely communication, users cannot engage with the system as intended.**

→ Missed or delayed information blocks users from confidently using the self-service option.

- **Current infrastructure does not align with realistic passenger routes or arrival behaviours.**

→ Wheelchairs are not placed where passengers actually arrive or need them.

- **The walking distance to wheelchair hubs is often too far for independent users.**

→ Especially for PRM passengers, the current placement results in last-minute dependence on staff.

- **There is no data-driven regulation of inventory to ensure availability at the right place.**

→ Supply and demand are not connected in real-time, leading to inefficiencies in wheelchair distribution.

Define

9. Thematic Analysis
10. Refined Design Challenge

This section defines the design direction by translating research insights into clear criteria. Six key themes were identified, covering both user needs and airport challenges, such as autonomy, trust, and infrastructure. Based on these themes, six design criteria were developed to guide solution development. Together, they form a strong foundation for targeted, user-centered design. The focus is on improving access to self-service wheelchairs at departure - an essential step to enable independent travel for all PRM passenger types.

9. Thematic Analysis of Discover

This chapter brings together all research findings into six key themes that guide the design direction. These themes reflect both user needs and airport constraints, helping to structure insights into clear priorities. Each theme highlights what is essential for creating a better, more independent wheelchair service at Schiphol.

Throughout the analysis phase, a wide range of sources, including literature reviews, user research, observations, desk research, expert discussions, and comparative analyses, were used to gain insight into what is important when designing an accessible and functional PRM wheelchair self-service. To bring clarity and structure to these findings, all collected insights were carefully reviewed and, where overlap was found, merged into single, more concise statements.

These insights were then clustered into six overarching themes, each representing a core aspect that significantly influences the design direction of this project. For each theme, a key takeaway or conclusion was formulated, capturing the essence of the underlying findings. The resulting overview in figure 25 presents the six main insights that emerged from the research and together lay the foundation for the design strategy that follows.

To further clarify the origin of each insight, green and blue bullets indicate whether an insight primarily emerged from the passenger experience (green) or relates more to Schiphol's operational context (blue).

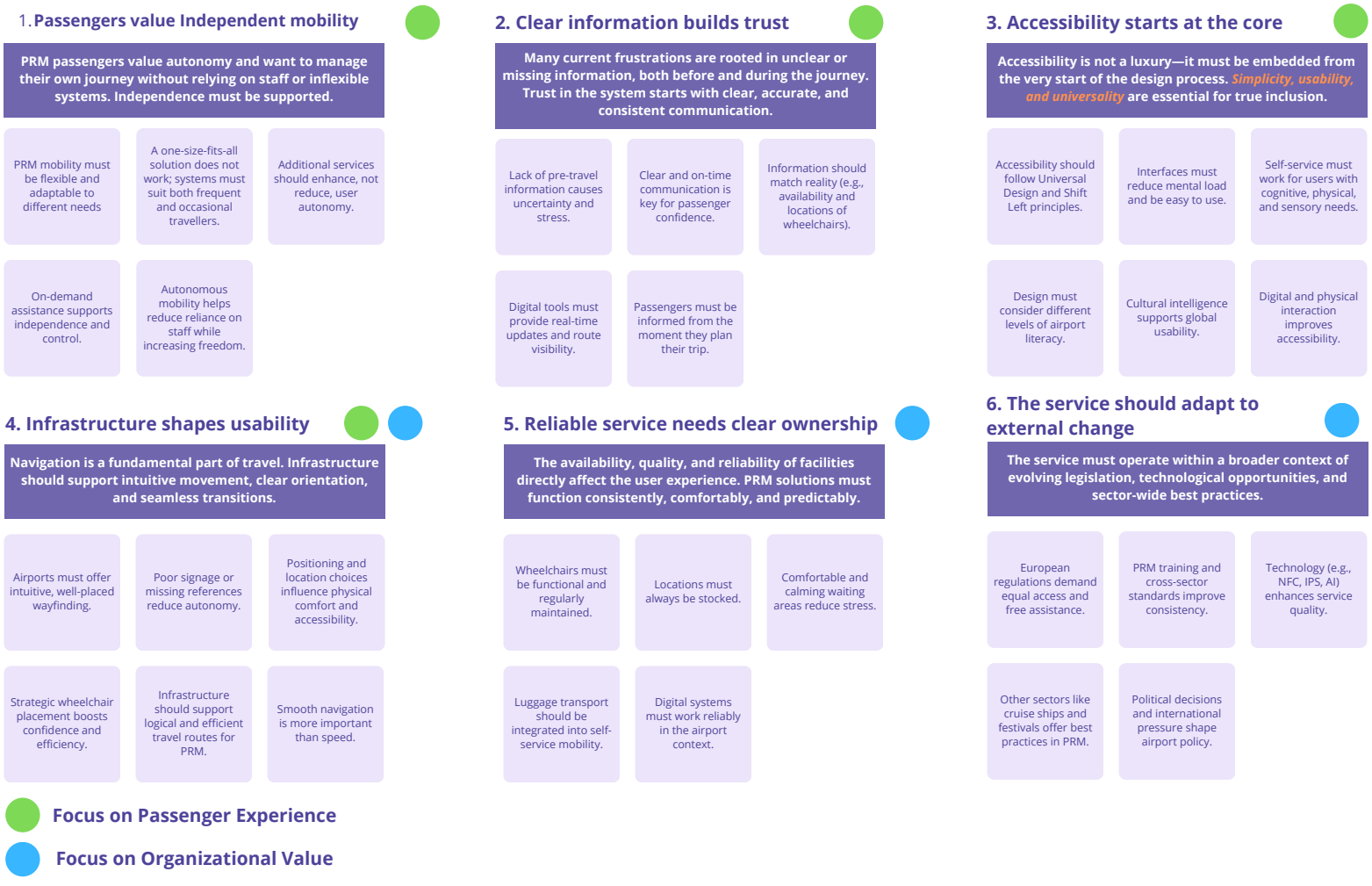


Figure 25: Insights clustered into themes

10. Refined Design Challenge

This chapter defines the core design focus: improving access to self-service wheelchairs at departure. It identifies this first step as crucial for enabling PRM passengers to travel independently. By targeting real barriers like unclear information and poor availability, the design aims to support autonomy for all user types - prepared, semi-prepared, and spontaneous.

Providing access to self-service wheelchairs at Departure

The design focuses on the very first step of the journey: **providing accessible and reliable wheelchair access at departure.**

This moment often determines whether PRM passengers can travel independently at all — making it the most crucial starting point to support autonomy.

The collected insights from literature review, field research, focus groups, observations, and policy documents reveal a clear pattern: the accessibility and reliability of obtaining a wheelchair is often already problematic and the first step for PRM travelers at Schiphol. See appendix 9 for the problem analysis in more detail.

While Schiphol already offers wheelchairs and a self-service concept, its current implementation falls short. Wheelchairs are scattered, locations are poorly marked, systems are inaccessible, and there is a lack of clear information. As a result, travelers who wish to move independently become dependent on others, undermining their autonomy.

This issue is significant enough to influence travel decisions. Some passengers avoid Schiphol altogether or change their travel plans due to a lack of trust in the current system. A functional and dependable design that solves this first step has the potential to drastically improve accessibility and remove key barriers.

For this reason, my design focuses specifically on the process of obtaining a wheelchair for departures from Schiphol, a critical and underdeveloped phase in the broader PRM journey.

The design is functional in nature, aiming to make inclusive mobility accessible to a wider range of travelers. It is not about adding comfort or luxury, but about enabling autonomy. The solution should address real problems, be low-threshold and intuitive, and remain adaptable to future developments.

Segmentation within the focusgroup

The target group can be divided into three user types, as shown in figure 26, each with different needs regarding wheelchair access. The prepared traveller prefers to plan everything in advance, ideally including reservations. The semi-prepared traveller seeks basic information beforehand but relies on on-site guidance. The spontaneous traveller makes decisions on the spot, only upon arriving at the airport.

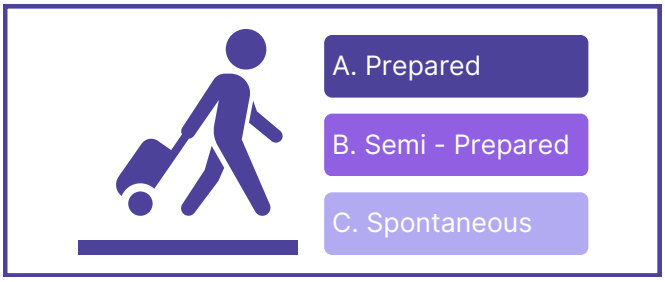


Figure 26: Three groups within target group

Design Criteria

Based on the research themes in chapter 9: *Thematic Analysis*, six criteria were developed that the solution must meet. These are shown in Figure 27 and are formulated as action-oriented statements.

A more detailed overview of these criteria, along with specific sub-criteria and how they were derived from the research themes, can be found in Appendix 8. This appendix highlights the key insights within each theme, reinforcing the rationale behind the selected design criteria.

1. Facilitate Autonomy

The system must offer full autonomy in accessing a wheelchair.

Independence is a core value. Users should never depend on staff or rigid procedures. The solution must accommodate diverse mobility needs and work intuitively without explanation or help.

2. Inform Comprehensively

Information must be available from the moment of travel planning and remain clear throughout the journey.

From the first moment of planning, users need access to accurate, up-to-date, and usable information, such as wheelchair locations, availability, and usage instructions.

3. Design Universally

The solution must be functional, simple, and universally usable.

Simplicity is a core value. The design should avoid mental or physical barriers and work for all users, regardless of age, language, impairment, or experience. Interfaces and interactions must be intuitive, clear, and require no additional mental effort.

4. Build Accessible Infrastructure

Wheelchair locations and infrastructure must be logical, efficient, and accessible.

Wheelchairs should be strategically placed in logical, recognizable locations. Wayfinding should be intuitive, routes seamless, and physical effort minimized.

5. Manage the Operation

The service must be reliable, well-managed, and clearly assign responsibilities.

The system must always function properly, and wheelchairs must be available. Digital systems must be flawless. A clear service model should define tasks, responsibilities, and cooperation between teams.

6. Adapt to Change

The design must be able to adapt to external trends, regulations, and technologies.

The solution must be modular and scalable. Innovations and policy updates must be easy to integrate. Think of evolving technologies, sustainability, and regulations, the service must grow and remain relevant.

Figure 27: Design Criteria, Facilitate Autonomy is the main goal

Develop

11. Design Components
12. Shaping the Concept

This section presents the development of the final design concept, based on the components and criteria defined in the previous phase. It translates research insights and strategic directions into concrete solutions, structured around three key design components: the information tool, the positioning strategy, and the service model. Together, these components aim to improve access to self-service wheelchairs at Schiphol by addressing critical user needs, such as clear wayfinding, reliable infrastructure, and intuitive service processes. The development process prioritises inclusivity, simplicity, and adaptability, ensuring the solution works across a range of physical and cognitive abilities and can evolve over time. While each component is explored separately, they are closely connected and function as one integrated system. Visualisations and design choices are explained in detail, showing how the concept supports autonomous travel for PRM passengers. The goal is a user-friendly, future-proof solution that aligns with real-world constraints and airport operations.

11. Design Components

This chapter outlines the steps of the passenger journey of the scope. It introduces three design tasks - information, infrastructure, and organization - based on six core criteria. These lead to three design components: an information tool, positioning strategy and service model. These form the foundation for building an accessible and flexible service system.

Design Approach

The design scope focuses on the first phase of the passenger journey: gaining access to a self-service wheelchair at Schiphol Airport. This phase consists of four chronological steps:

1. **Preparing the journey:** The passenger gathers information and makes travel-related decisions.
2. **Entering the airport:** The passenger arrives at the airport by car or public transport.
3. **Navigating to the wheelchair point:** The passenger locates a self-service wheelchair station.
4. **Unlocking the wheelchair for use:** The passenger activates the wheelchair for use.
5. **Use of the wheelchair:** shown in journey visual, out of scope.

These steps are visually represented in figure 28.

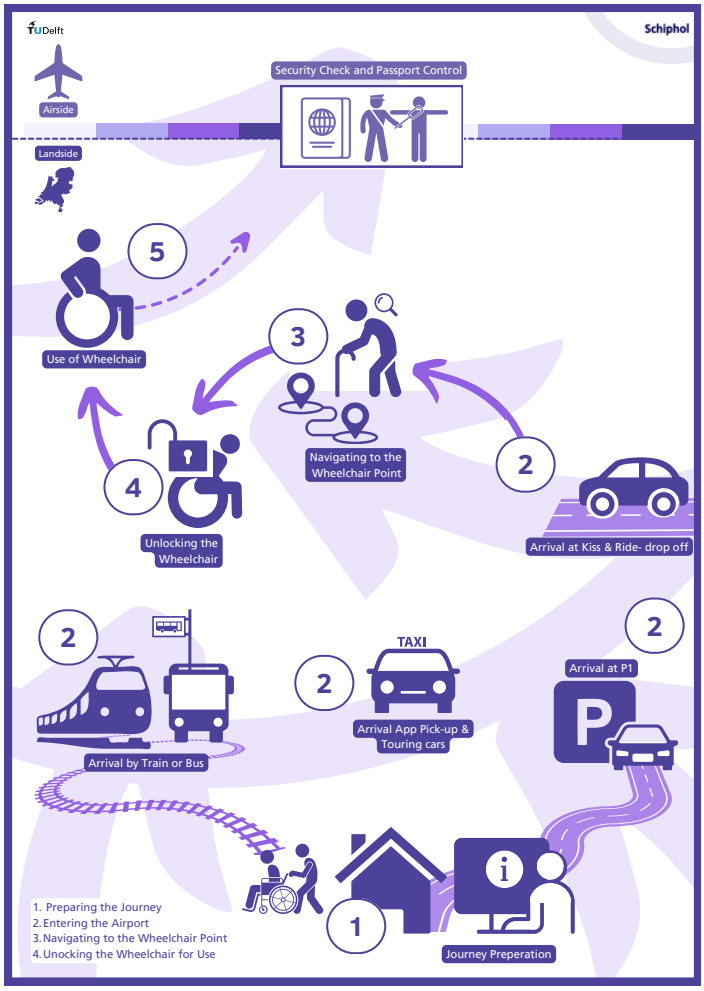


Figure 28: Passenger Journey Design Scope

Design Criteria Framework

The six design criteria, introduced in the Define phase, form the foundation for the final design of the wheelchair service system. These criteria do not all function on the same level; they serve different roles within the overall design logic.

Three of the criteria are overarching. They apply to the entire system and define the core values that every aspect of the service must reflect. These are:

- **Facilitate Autonomy:** The system must empower users to act independently. Every element of the design must contribute to full user autonomy, without reliance on staff or rigid procedures. Users should be able to navigate and use the system intuitively and without explanation.
- **Design Universally:** All components must be functional, intuitive, and accessible for all users, regardless of age, language, ability, or experience. Interfaces should avoid creating physical or mental barriers.
- **Adapt to Change:** The system must be modular and updatable, allowing new technologies, policies, or user needs to be integrated without requiring a complete redesign. This ensures long-term scalability and flexibility.

The other three criteria are actionable. They define key areas of the service that require targeted design interventions. These are:

- **Inform Comprehensively:** Users must be informed from the planning phase through to the end of their journey. A method of clear and accessible information delivery must be developed.
- **Build Accessible Infrastructure:** The physical placement and storage of wheelchairs must be carefully considered. Locations should be intuitive, recognizable, and seamlessly integrated into the user's journey.
- **Manage the Operation:** A reliable and clearly structured organizational system must be in place to manage the service. Responsibilities must be well-defined, and operations must run smoothly at all times.

These three criteria directly translate into three design domains, each of which becomes a design task in the next phase. Together, these components form the practical building blocks of the final system, embedded within the overarching principles that ensure cohesion and vision.

Figure 29 illustrates this distinction between the two groups of criteria: the overarching principles that guide the entire system, and the actionable criteria that lead directly to concrete design tasks.

Design Components

Following the distinction between the overarching and actionable criteria, the three **actionable design criteria** were translated into three **design tasks**. Each task is supported by a set of guiding **design questions** and directly forms the foundation for one of the **three core design components** of the final solution.

These components are developed to support the passenger across the key steps in their journey and ensure the wheelchair service is accessible, scalable, and future-proof. While each component addresses a specific design domain, the complete system must ultimately meet all six design criteria.

Figure 30, on the following page, visualizes how the actionable criteria were translated into design tasks and how these tasks form the building blocks of the final design. Various design directions for these components will be explored in the next chapter: Shaping the Concept.

Overarching criteria

1. Facilitate Autonomy

The system must offer full autonomy in accessing a wheelchair.

Independence is a core value. Users should never depend on staff or rigid procedures. The solution must accommodate diverse mobility needs and work intuitively without explanation or help.

3. Design Universally

The solution must be functional, simple, and universally usable.

Simplicity is a core value. The design should avoid mental or physical barriers and work for all users, regardless of age, language, impairment, or experience. Interfaces and interactions must be intuitive, clear, and require no additional mental effort.

6. Adapt to Change

The design must be able to adapt to external trends, regulations, and technologies.

The solution must be modular and scalable. Innovations and policy updates must be easy to integrate. Think of evolving technologies, sustainability, and regulations, the service must grow and remain relevant.

Actionable criteria to formulate design tasks from.

2. Inform Comprehensively

Information must be available from the moment of travel planning and remain clear throughout the journey.

From the first moment of planning, users need access to accurate, up-to-date, and usable information, such as wheelchair locations, availability, and usage instructions.

4. Build Accessible Infrastructure

Wheelchair locations and infrastructure must be logical, efficient, and accessible.

Wheelchairs should be strategically placed in logical, recognizable locations. Wayfinding should be intuitive, routes seamless, and physical effort minimized.

5. Manage the Operation

The service must be reliable, well-managed, and clearly assign responsibilities.

The system must always function properly, and wheelchairs must be available. Digital systems must be flawless. A clear service model should define tasks, responsibilities, and cooperation between teams.

Figure 29: Distinction between criteria

Overarching criteria

1. Facilitate Autonomy

The Design must contribute to full user independence

3. Design Universally

The Design should be accessible to all user

6. Adapt to Change

The Design should be Modular

- **Which** parts are independent?
- **How** are updates integrated?

Three actionable criteria that directly inform specific design components

2. Inform Comprehensively

Design an Information Tool

- **How** should the information be delivered?
- **What** information must be provided?
- **When** must information be available?
- **Where** can users access information?
- How is it kept accurate and consistent?

4. Build Accessible Infrastructure

Design a Positioning Strategy

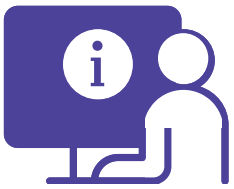
- **How** should the wheelchairs be positioned?
- **Where** should wheelchairs be placed?
- **How** should the passenger find the wheelchairs?
- **What** physical elements are needed?

5. Manage the Operation

Design a Service Model

- **What** processes are required?
- **Who** is responsible for what?
- **How** is availability guaranteed?
- **How** is maintanance handled?

Design Components



1. Information Tool

2. Positioning Strategy

3. Service Model

Figure 30: From criteria to Design Components

12. Shaping the Concept

In the previous chapter, three core components were introduced, together forming the basis for addressing all six design criteria. In this chapter, the focus shifts to the further development of these components and how they relate to one another. Each component is interdependent, and together they shape the foundation of the envisioned PRM self-service concept.

All three components will be discussed in this chapter, but with **varying levels of depth** based on the scope and priorities of this project. **The main focus lies on the development of Component 1: the Information Tool.** Component 2, the Positioning Strategy, presents a clear concept direction with key considerations for future development. Component 3, the Service Model, is addressed as a comprehensive and visualized service model, providing high-level recommendations for Schiphol to build on.

Design Approach

Iteration on Design Approach

In the initial phase, early ideas were generated through brainstorming, structured around the four chronological steps of the passenger journey (see Figure 28). Figure 31 and Appendix 10 contains early sketches from these sessions, including an initial concept proposal.

To create stronger coherence and a more direct link to the design criteria, the design components outlined in Chapter 11: *Design Components,* were later developed. These components provided a clearer structure and shifted the ideation approach: rather than ideating chronologically, the focus moved toward generating ideas per component.

This second round of ideation was shaped by:

- Earlier brainstorm material for the **information tool**
- Observations and interviews conducted at Schiphol Airport and in Rotterdam city centre for the **wheelchair positioning strategy**
- Research into service mapping methods for the **service model**

This iterative shift allowed for a more targeted and criteria-driven development of the concept. In this chapter, the design concepts for the three key components will be outlined. This marks the starting point for the further development of these concepts and detailing of the concept in the following stages.

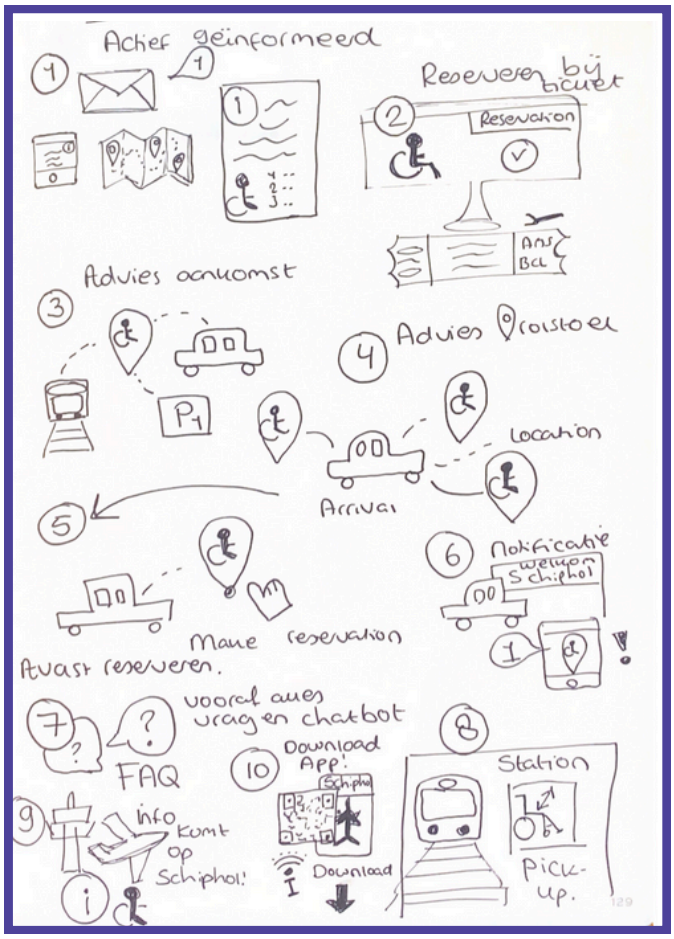


Figure 31: Design Components

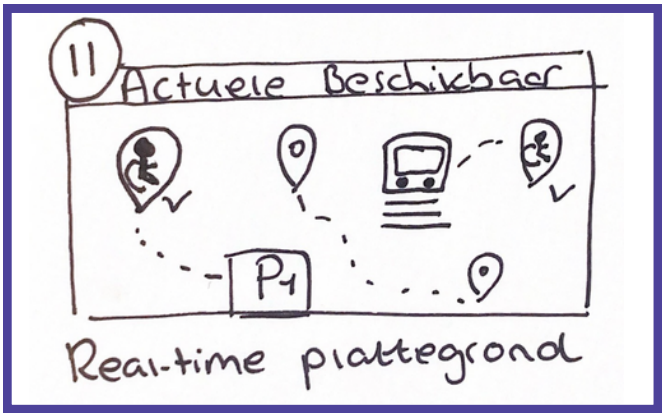


Figure 32: Design Components

- **How** should the information be delivered?
- **What** information must be provided?
- **When** must information be available?
- **Where** can users access information?
- How is it kept accurate and consistent?

Information Tool: Interactive Map

The proposed information tool takes the form of a real-time interactive map that guides passengers throughout their journey, from initial travel planning at home to navigating the airport environment. This design choice stems directly from Design Criterion 2: *Provide Complete Information*, which states that users must have access to accurate, up-to-date, and usable information, such as wheelchair locations, availability, and usage instructions, from the very first moment of trip planning.

Visual representation as universal design

A **visual representation** is the most universally accessible format in a diverse environment such as an international airport. Schiphol serves travellers from a wide range of cultural, linguistic, and cognitive backgrounds. A well-designed map provides intuitive guidance regardless of language or literacy level, and serves as a consistent visual reference throughout the journey. This aligns with Design Criterion 3: *Design Universally*.

During the user research phase, participants consistently expressed the need for a clear map when trying to locate self-service wheelchairs. In a large and unfamiliar environment, the first instinct is often to look for wayfinding tools. A digital or printed map supports this need, offering both orientation and reassurance. Research also supports the effectiveness of visual mapping in complex public spaces as a tool for reducing anxiety and increasing spatial understanding (e.g., Newman et al., 2010; Essense, 2024).

Consistency across the Journey

The interactive map functions as a **guiding element** throughout the entire passenger journey. Users first encounter it online, ideally integrated into Schiphol's website, when they search for accessibility information or plan their trip. This early exposure helps users build a mental model of the airport layout and wheelchair station locations.

Upon arrival at Schiphol, the same map interface is presented again, either via physical signage, kiosks, or digital displays, ensuring continuity and recognisability. The consistent use of this tool across all touchpoints reduces cognitive load and supports smoother navigation.

Availability and Access

The map should be:

- **Available online** via the Schiphol website or app, as this is where users typically begin their planning.
- **Physically accessible** on-site, placed prominently at key arrival points (e.g., parking areas, train-bus terminals, and entrances). See figure 33.

To further support inclusivity, the map could be equipped with audio functionality for visually impaired users. While this falls outside the scope of this current design phase, further research is recommended to explore integration with screen readers or spoken navigation.

Accuracy and reliability

To build trust, all information provided must be accurate and up-to-date. For instance, real-time availability of wheelchairs should reflect actual availability on-site. Ensuring this reliability will be a key point in the development of the service model, which defines who is responsible for maintaining this data and how it is kept consistent.

Figure 33: Information tool - navigating

- **How** should the wheelchairs be positioned?
- **Where** should wheelchairs be placed?
- **How** should the passenger find the wheelchairs?
- **What** physical elements are needed?

Wheelchair Positioning Strategy

The wheelchair positioning strategy is based on the principle that passengers should find a wheelchair **as close as possible to their arrival point**, while ensuring the setup is **operationally manageable for Schiphol**. Earlier concepts that suggested placing wheelchairs freely across the airport proved impractical and potentially unsafe, as confirmed in expert interviews (see Appendix 11). Therefore, the solution proposes grouping wheelchairs in clearly defined and manageable **Service Hubs.**

These hubs serve as central collection points not only for wheelchairs, but potentially also for other mobility-related resources, such as baggage carts and, in the future, autonomous vehicles. This aligns with Schiphol's ambition to combine rental services into a unified operational structure. The approach supports Design Criterion 6: *Adapt to Change*, as hubs can evolve into modular, multifunctional stations over time. For example, Service hubs could function as docking stations for autonomous wheelchairs or other innovations.

While this component focuses on defining the strategic direction, the technical and architectural realisation of the service hubs lies outside the scope of this project. However, for successful implementation, **five key aspects must be considered in further development, see figure 35.**

Figure 34: Moving to the servicehub

Service Hubs

1. Location of the Servicehubs

Placement should be informed by data on PRM passenger arrival points and usage patterns. Ideally, demand prediction is supported by passenger input. The **interactive map** (see previous paragraph: Information Tool) may assist by collecting this information during trip planning.

2. Management of Wheelchair Availability

Wheelchairs must be consistently available. This requires real-time inventory tracking and clear protocols for restocking, maintenance, and monitoring. Responsibilities must be defined within the **Service Model** (See next paragraph: Service Model).

3. Wheelchair Functionality

Operational reliability and ease of use are essential. Although technical design lies beyond this scope, the **service model** will show a suggestion for the performance as part of the broader service offering - including aspects such as how wheelchairs are unlocked and maintained.

4. Navigation to the Hubs

Both digital and physical navigation must clearly lead passengers to the nearest service hub. The interactive map must support this with intuitive wayfinding from every arrival point.

5. Hub Visibility and Physical Design

Service hubs must be easily recognisable, even without a phone or app. Physical signage and visual cues are essential to help passengers spot the hubs immediately upon arrival.

Figure 35: Five key aspects to consider for further development

Design a Service Model

- **What** processes are required?
- **Who** is responsible for what?
- **How** is availability guaranteed?
- **How** is maintanance handled?

The Overarching Service Model

As outlined in design criterion 5: *Manage the Operation*, the service must be reliable, well-managed, and clearly define responsibilities. The system must function seamlessly at all times, with guaranteed wheelchair availability, robust maintenance processes, and flawless digital support. To achieve this, it is essential to understand what supportive processes are required, who is responsible, and how operational collaboration is structured.

The sub-questions, repeated in this subtitle, further specify these needs by addressing, among others, how availability is ensured and how maintenance is managed over time. These operational components are critical and must be visualised in a clear and coherent way.

To do so, the service will be visualised using a model **inspired by the Service Blueprint methodology**. An example of this is shown in figure 36.

A service blueprint is particularly suitable for mapping services in complex environments like airports, where multiple actors, systems, and touchpoints interact. It enables both the passenger journey and the supporting operational processes to be shown in a single, coherent overview, connecting what the user sees (frontstage) with the underlying service infrastructure (backstage)

This model not only illustrates responsibilities and interactions, but also reveals potential pain points, dependencies, and critical handovers. As Essense (2024) states, service blueprints are highly effective for aligning teams and surfacing what is needed internally to deliver a seamless external experience.

More importantly, the service model forms the foundation of the overall design. All design components, such as information provision, infrastructure, and modularity, are connected through this structure. The effectiveness of the entire system relies on how well the service model is thought through and implemented.

Therefore, in this project, the service model is not only a way to visualise collaboration; **it is the strategic backbone of the concept.**

Strategic Backbone of the concept

To provide clarity and structure to the final outcome of this project, which, as previously described, consists of **three interrelated components developed at varying levels of depth** - an interactive service Model will be created. This map allows the reader to click on key elements such as actions, products, or involved parties (e.g., *"interactive map"*, *"reservation"*, *"the airline"*) to reveal short descriptions or visual representations.

Descriptions linked to actions primarily serve as recommendations or action points, while product-related elements may include concept visuals or brief functional explanations. This layered format supports a clearer understanding of how all components connect and where further development is required.

The following chapter, **Deliver,** is fully dedicated to how this vision has been translated into a tangible and visualised result.

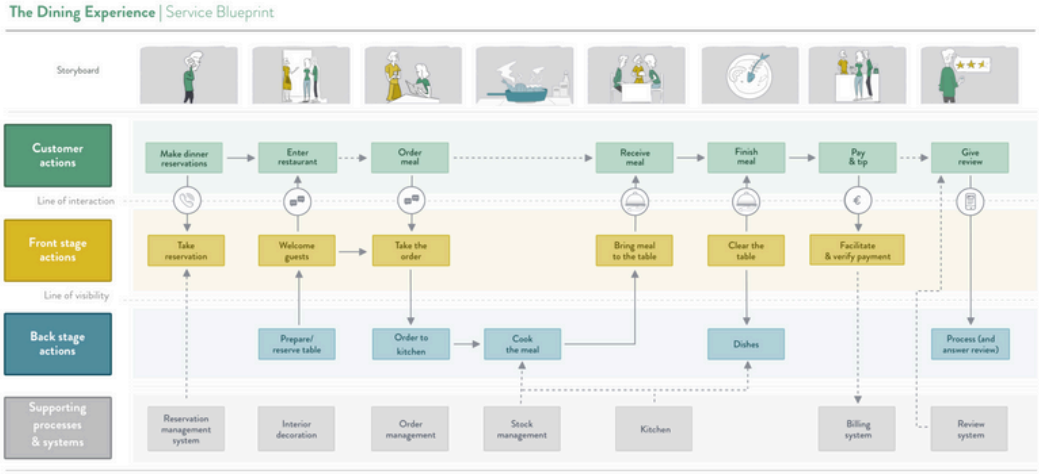


Figure 36. Service Blueprint framework - source: Essense, 2024

Deliver

13. The Concept
14. Innovation Example Case
15. Iteration for Implementation

This section, Deliver, presents the final concept, where all design components come together in a clear, visualised system. It shows how the service model, interactive map, and positioning strategy support both the passenger journey and background operations. Key features, like real-time wheelchair availability and visual guidance, are illustrated to demonstrate usability. The result is a clear and practical overview of the complete system that Schiphol can build on. One of the components, the information tool, has been developed in detail, while the other two are prepared with strategic directions to support further implementation.

13. The Self-Service Wheelchair Concept

This chapter presents the final outcomes of the three design components.
It begins with the Service Model, as this component ultimately brings together all elements of the system and illustrates how they interact in a cohesive structure. Following the Service Model, the interactive map is introduced as a tangible product design that directly supports the user experience. As previously stated, the Service Hub component will not be further developed within the scope of this project. The strategic choices and recommendations shared earlier in the Develop phase remain the final input for this part of the concept.

The Service Model as backbone of the final concept

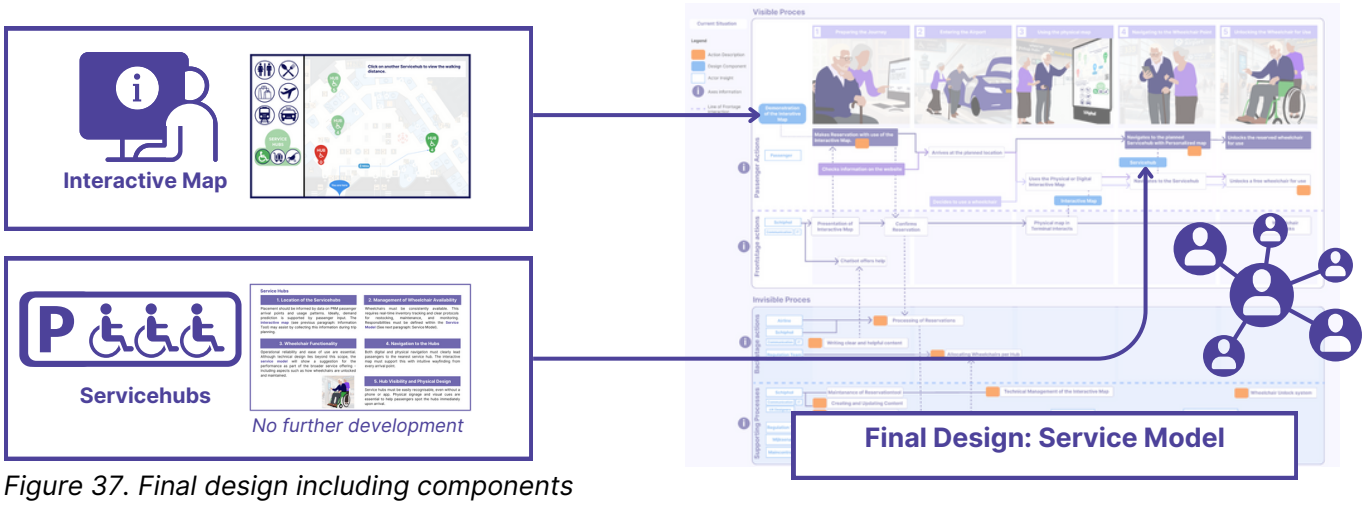


Figure 37. Final design including components

The design consists of one core component: **the Service Model,** where the two other components are integrated in: the Information Tool and a Wheelchair Positioning Strategy. See figure 37. Together, these components address the six design criteria introduced in the **Define** section, each derived from the key insights gathered during the research phase.

Design of the Interactive Service Model

From Booking to Wheelchair Use

Figure 38 on the next page presents the scenario the passenger goes through during the process. This corresponds to **the top row of the Service Model**, which outlines only the passenger actions in the form of a flow diagram. Within this overview, a distinction is made between the three types of travellers.

All elements that require organisation, and are therefore represented within the service model, contribute either directly or indirectly, visibly or invisibly, to enabling the passenger to complete their journey.

The challenge was to visualise this clearly and coherently within a single framework. An initial version of the service model can be found in Appendix 12. This version proved to be overwhelming. Based on feedback and testing, it became clear that the model was not immediately understandable. This was largely due to the high density of visible text and the introduction of new terms and stakeholders without sufficient explanation. The redesign of the model was therefore guided by the following goals:

- **A primary focus on the passenger journey**, with reduced emphasis on background processes
- **A reduction in the amount of visible text** within the visual interface
- **At the same time, providing necessary context and explanations** to support understanding

These goals shaped the development of the Interactive Service Model, shown in Figure 40.

The model serves two main purposes:

1. It functions as Design Component 3, **representing the organisational and operational structure** of the service.
2. It acts as the integrative layer, bringing together **all the design components,** so also the Information Tool and the Wheelchair Positioning Strategy, **within a single framework.**

On page 67, detailed guidance is provided on how to navigate and interpret the model.

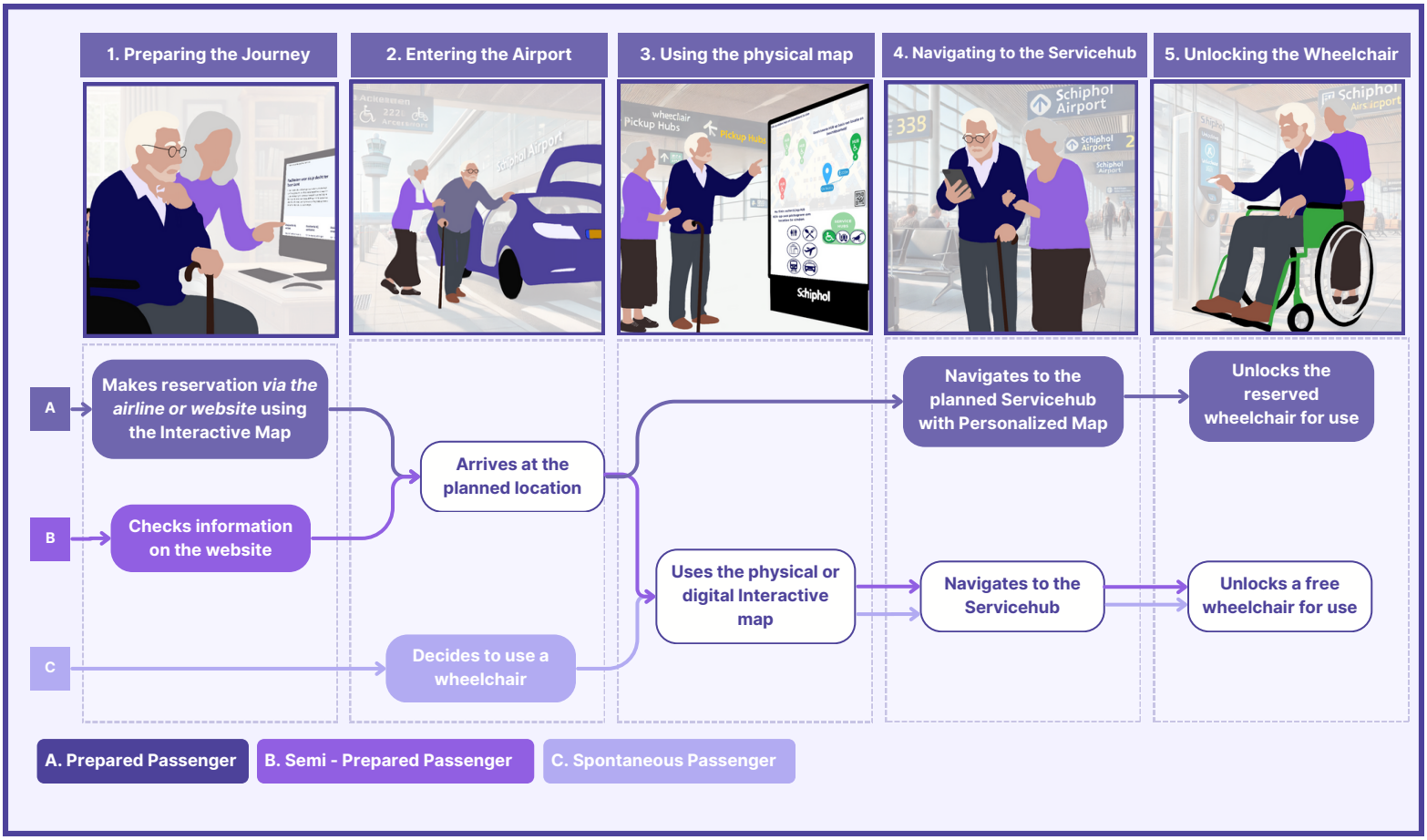


Figure 38. Passenger Journey Service Model

Four Layers of the Service Model

Before explaining how to navigate through the model, the four distinct layers are briefly introduced. Figure 38 is the first of those four.

Two of the layers are located in the visible upper section of the model, while the other two are part of the invisible background section below.

The visible layers, which are emphasized, include the passenger journey and the direct interactions experienced by the passenger. These interactions do not necessarily involve a human; they can also include digital interactions, such as information the passenger reads on the website.

The invisible layers represent everything that happens behind the scenes to enable the process. These are divided into background actions and supporting processes.

- **Background actions are real-time activities** that take place during the journey, such as restocking wheelchair hubs or the communication between the airline and Schiphol. Although passengers do not directly perceive these actions, they are crucial for ensuring the journey runs smoothly.
- **Supporting processes** are not tied to specific moments in the journey but are ongoing or take place intermittently. These include tasks such as placing signage, maintaining and updating systems, or repairing wheelchairs. These processes are represented as continuous lines without arrows or background boxes, highlighting their independence from specific passenger journey phases.

Click here to go to the Interactive Service Model

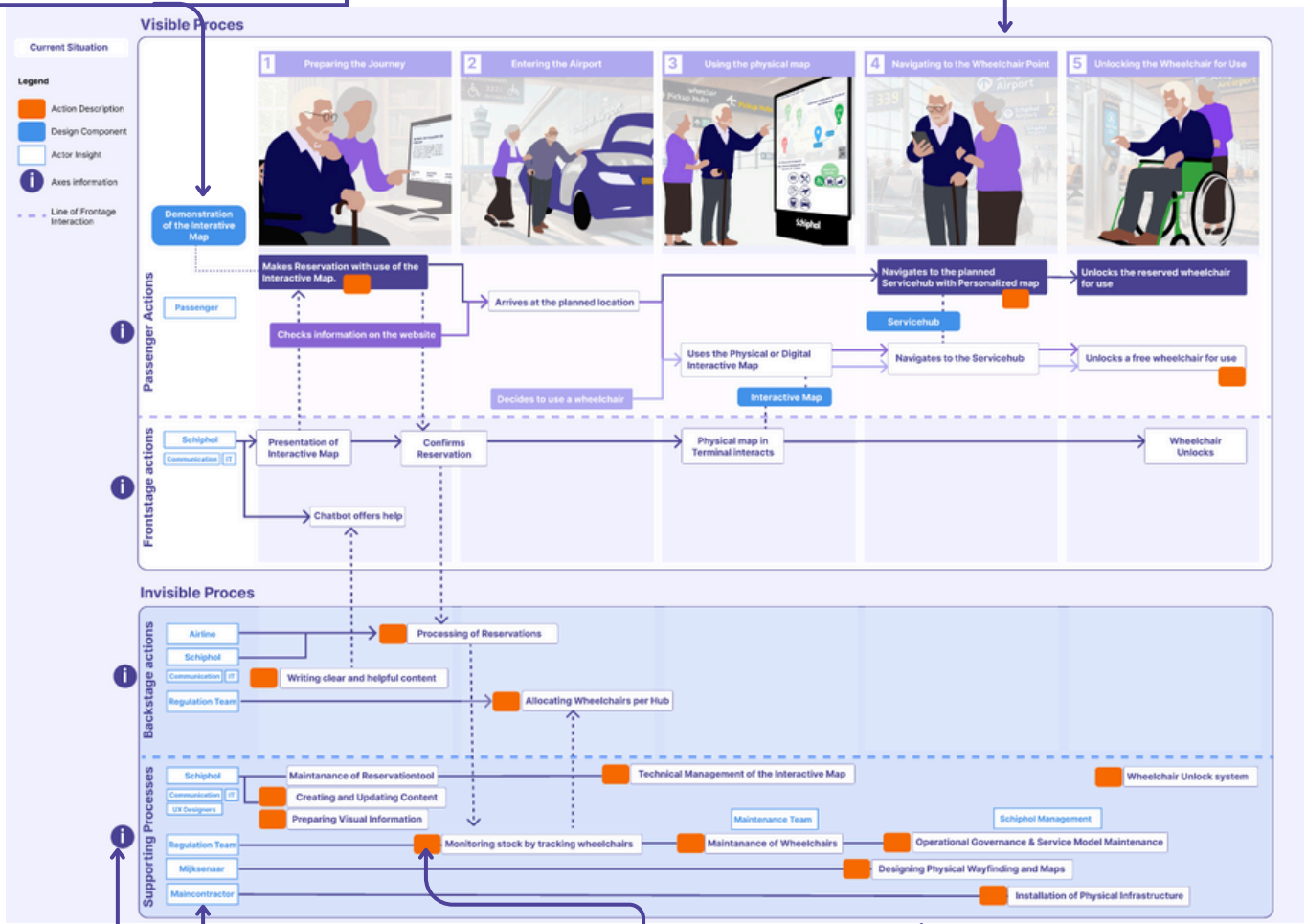
How to Navigate the Service Model

The interactive model is available by clicking on the orange bullet on the top of this page. You can click through the elements as described below to explore all aspects of the system. By clicking, overlays appear, such as in Figure 39, that provide additional explanations. It is also possible to navigate to the intereactive map in Appendix 14.

Figure 39: Overlays in Service Model

By clicking on the design components highlighted in blue, a demonstration of the Information Tool is provided, and the implementation steps for the Service Hub are explained.

The main focus lies on the top section, which outlines the passenger journey along with the direct actions of the actors the passenger interacts with.



Clicking the round blue info button provides an explanation of the different lanes in the model.

By clicking on the stakeholders, the corresponding actor is further explained.

By clicking on the orange blocks, the corresponding action is further explained.

The bottom section represents the organisational structure operating in the background. It has been kept intentionally compact. By clicking on the orange buttons, the underlying actions are further explained. This part serves as an implementation suggestion—a starting point for the organisation if they choose to move forward with activating the system.

Figure 40: Navigating through the Service Model

Design of the Information Tool

An initial version of the map, where the first ideas took shape, can be found in Appendix 13. Following further development, the information tool was refined into the interactive maps (online and physical) in figure 42.

By clicking on 'Demonstration of the Interactive Map' in the service model, see figure 41, the detailed concept of the interactive map becomes visible.

The information tool has been developed as an interactive map as well, accessible both online and physically on-site. This choice directly addresses Design Criteria 2: *Inform Comprehensively*, and Design Criteria 3: *Design Universally*, ensuring a consistent, accurate, and visually intuitive guide throughout the entire passenger journey. By using the same map across all touchpoints, from initial travel planning at home to navigation at Schiphol, the tool reduces cognitive load and enhances familiarity. As demonstrated in the Interactive Service Model, the map also supports the reservation process by visually linking arrival locations to service hubs and sharing the walking distance. See figure 43. This not only helps passengers orient themselves but subtly encourages them to plan their journey more consciously.

Due to its interactive nature, the map displays real-time wheelchair availability, making the information accurate and therefore more trustworthy. This reliability is essential for building passenger confidence and enabling informed decisions at every stage of the journey. The visual-first approach was chosen for its universal accessibility across languages and abilities, while future integration of audio features is recommended for further inclusivity.

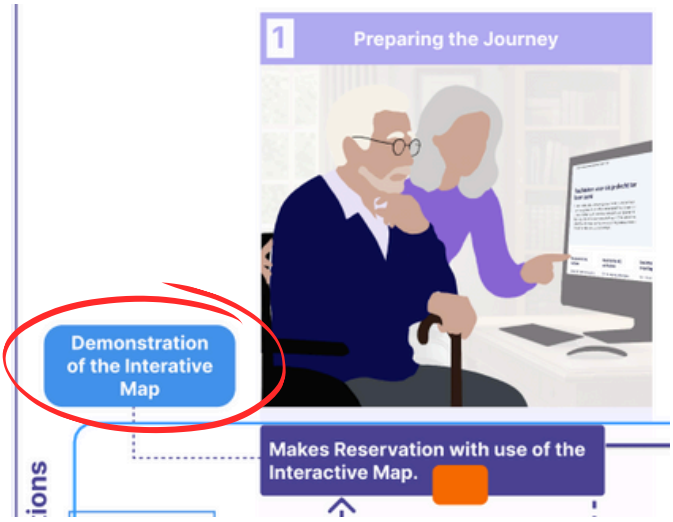


Figure 41: Demonstration Button

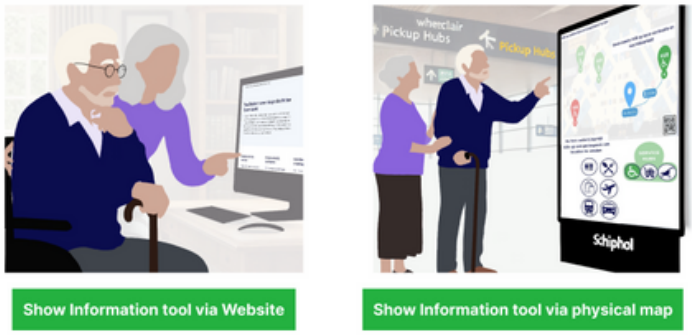
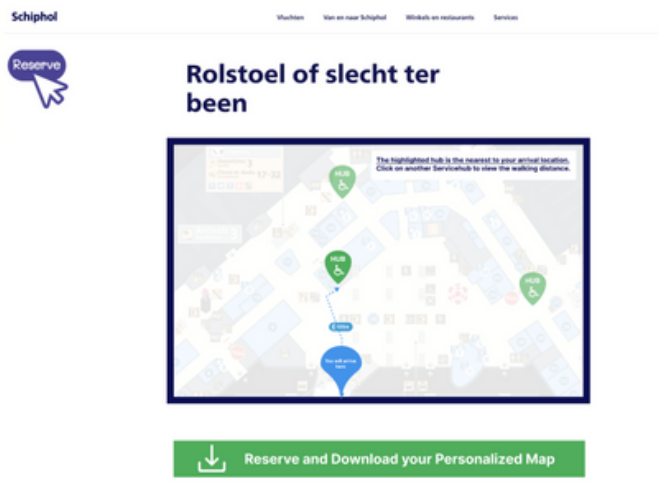


Figure 42: Interactive Maps

For elements such as the use of a personalized route guide or location-based advice, an explanation is provided within the demonstration in de Service Model to clarify the intent. Further development of these features currently falls outside the scope of this project.

Figure 43: Interactive Maps: walking distance



14. Innovation Example Case

This chapter illustrates the system's modularity, design Criterion 6: Adapt to Change, by exploring how the model would need to evolve if one key component were replaced. The example used is the transition from the current manual wheelchair to the autonomous WHILL wheelchair, a realistic scenario considering ongoing technological developments.

Testing modularity: How the system adapts to change

To explore the system's modularity and adaptability, this section illustrates how the existing process would need to change if an autonomous wheelchair (in this case the WHILL, figure 44) were introduced. This scenario serves as a validation of Design Criterion 6: *Adapt to Change*, by examining whether the design can integrate innovation without needing to be rebuilt from scratch.

Each phase of the current user journey is reviewed in figure 45, showing the impact of the WHILL implementation:

Figure 44: Implementing the WHILL

1. Preparing the Journey	2. Entering the Airport	3. Using the physical map	4. Navigating to the Servicehub	5. Unlocking the Wheelchair
				
Current				
The passenger makes a reservation via the interactive map and is assigned a fixed Servicehub.	Passenger travels to the assigned hub location to retrieve the wheelchair.	Passenger uses wayfinding or a personalized map to find the Servicehub.	The passenger follows signage to the hub to retrieve the reserved chair.	Unlocking happens via Schiphol's system (code or digital interaction).
With WHILL autonomous wheelchair				
• The passenger reserves a time and general location, not a fixed hub. • The WHILL navigates to the passenger's location automatically. • The interactive map needs to support dynamic location input and real-time WHILL availability.	• No need to walk to a hub. • WHILL arrives at or near the passenger's location. • Optional: add call points (e.g. kiosk or help pillar) in case the WHILL doesn't appear automatically.	• This navigation step becomes largely redundant. • Physical maps may no longer need to show hub locations, but could instead show WHILL call points or battery dock locations. • Opportunity to streamline wayfinding for WHILL interactions only.	• Navigation step is automated: the WHILL navigates itself to the user. • Physical signage pointing to hubs is possibly unnecessary, or replaced with signage to call stations if used.	• Unlocking is handled through the WHILL's own system. • Integration may be required between the reservation tool and WHILL's tech stack. • Schiphol's unlock infrastructure may be partially obsolete or repurposed for other services.
Backstage & Support System Impacts				
Maintenance Teams: May shift from operational (moving wheelchairs) to technical (monitoring autonomous functionality, software updates).	**Communication Needs:** Increased need for real-time tracking and reliability assurance, especially with autonomous systems.	**Hubs:** Function as charging docks only, requiring electrical infrastructure and monitoring tools, but no manual refilling.	**Wheelchair Stock Management:** Manual stock tracking and refilling hubs become irrelevant. WHILLs self-distribute.	

Figure 45: Implementation of the WHILL in an overview

Recommendations for Implementation

If Schiphol were to move forward with the implementation of autonomous wheelchairs like WHILL, the following steps to make within the service model are recommended:

- **Redesign the reservation interface** to allow flexible location selection and real-time matching with available WHILLs.
- **Establish docking & charging infrastructure** throughout the airport. These must be strategically located, monitored, and maintained.
- **Re-evaluate signage and physical maps.** Shift focus from static hub locations to dynamic interaction points (e.g. call pillars).
- **Integrate WHILL system** with Schiphol's backend to synchronize reservations, unlocks, and tracking.
- **Adjust staff roles and training,** with greater focus on technical maintenance and system monitoring rather than manual service tasks.
- **Pilot the WHILL service in one terminal before scaling,** use the results to refine the system integration strategy.

15. Iteration for Implementation

This chapter describes the test conducted at Schiphol to evaluate the functionality of the service model. The results are summarized, along with the resulting adjustments made to the design. The updated model was then validated through a user test with a participant. This validation confirmed the model's effectiveness and led to several recommendations, which are discussed further in the Evaluation section.

To ensure that this graduation project would be practically useful for Schiphol, a test was conducted with ten members of the Passenger Service and Support team. The goal was to evaluate the interactive model in terms of:

- **Content:** What information should the model provide, and how much?
- **Layout:** Is it clear and understandable?
- **Interaction:** Do users know where to click, what appears, and does it make sense?

The session started with a presentation of the model, followed by a guided brainstorming session. The goal of the session was explained, and participants were invited to provide feedback and ideas using post-it notes.

Test Results

The results of the session were summarized into the following three key insights:

Action points: Need for actionable guidance

The team would like to use the model as an implementation tool or user manual. To make this possible, they suggested adding concrete action points to the interactive elements, tailored to different levels of detail, from direct recommendations to suggestions for further exploration.

Visibility of all stakeholders

Since the model will be used by a project lead, it's important that all involved stakeholders remain visible throughout. This visibility supports understanding of the overall system and its interdependencies.

Figure 46: Brainstorm Questions

Importance of Modularity

The team also mentioned that many elements of the service are still under development. This confirmed the importance of modularity in the model. For example, service hubs are still being defined, and wayfinding is becoming more innovative and possibly interactive. The current model is useful in this context, as it allows space for ongoing developments and helps identify what needs to be done to bring the service to life.

Redesign

These insights have been incorporated into the interactive model. See Figure 47 for an example of the updated structure including action points. Go to appendix 15 or **click here** to navigate to the interactive map. Also the set-up of the Map is demonstrated here.

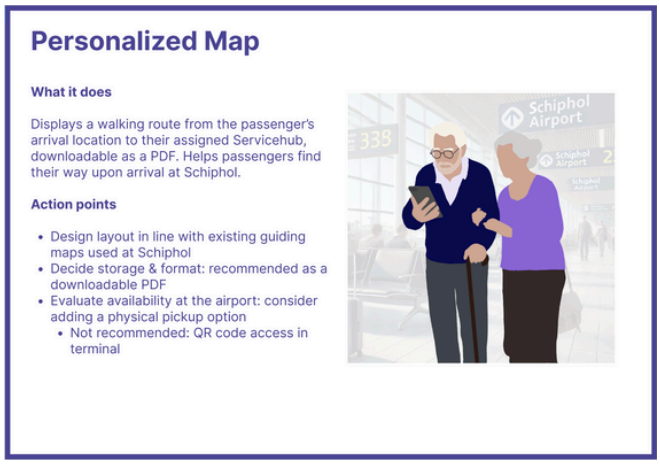


Figure 47: Implementation of Action Points

Figure 48: Set-up Brainstorm Session

Validation

To validate whether the model works as intended, a test user (figure 49) was asked to complete the following task:

"*Use this model to set up a wheelchair service at Schiphol.*"

With the model in front of her and post-its at hand, the test user instinctively wrote down what needed to be done per stakeholder. When a task was the responsibility of a single party, she formulated it as a direct assignment. In cases where collaboration was required, she noted that further coordination would be needed. This showed that the model was used as intended.

The next intuitive step of the user was to place these tasks on a timeline with specific durations. This proved too challenging for the test user, but it revealed a **valuable future improvement**: including time estimates per action could strengthen the model further and support more concrete planning.

Figure 49: User Interaction Test Final Concept

Evaluation

This final section brings together the main insights from the project and offers a critical evaluation of the design outcome and process. It revisits the initial challenge, now viewed through the lens of user testing, contextual experience, and reflection.

The Discussion outlines key limitations, formulates recommendations, and highlights how the proposed service model addresses the design trigger and contributes to broader impact.

The Conclusion distills the project's core contribution and final position within the wider context of inclusive mobility.
The Reflection looks back on the process, capturing key learnings and personal development, with attention to working in context and engaging directly with users.

16. Discussion

This chapter reflects on the outcomes of the project by addressing its limitations, offering recommendations for future development, and discussing the broader value of the proposed service model. The discussion connects the practical results of the design and testing process to the bigger picture of implementation at Schiphol and beyond.

16.1. Limitations

This section reflects on the key limitations identified during the project. While the proposed self-service wheelchair system demonstrates strong potential to improve autonomy and accessibility for PRM passengers at Schiphol, several critical factors must be acknowledged when moving from concept to implementation. These include dependencies between system components, limited user validation, and challenges related to stakeholder collaboration, organizational complexity, and rapid technological change. Understanding these limitations is essential to ensure the system's effectiveness, adaptability, and long-term success.

Scope of user testing: Service Model users instead of Service users

Testing of the final model was limited to a small group of internal users, specifically, those responsible for operating or managing the service. While these stakeholders provided valuable feedback on usability and implementation logic, the actual end users of the wheelchair service, PRM passengers, were not involved in testing the full system experience. Although their needs were central during the discovery phase, future iterations should include real-world validation with wheelchair users to ensure the service functions intuitively under actual conditions.

Single User Validation

The final design was validated through a single test case, which helped confirm the intended use of the model. However, one case is not enough to capture a broad range of user behaviors, preferences, and edge cases. Additional validation with diverse user profiles is needed to ensure robustness and inclusivity.

System Dependency on Full Implementation

The model is designed as an interdependent system in which all components, such as service hubs, unlock systems, and navigation tools, must work in harmony. Partial implementation (e.g., developing the hubs without an unlock system) could result in service breakdowns. For instance, if the map is not realized, passengers may not be able to locate the hubs; if unlock technology is missing, independence is lost. The concept only reaches its full potential if all parts are implemented cohesively.

Stakeholder Complexity

Although key internal stakeholders were involved, not all external actors, such as technology providers, airlines, or regulatory authorities, could participate in this phase. Yet, their collaboration is essential for successful integration, especially in areas like data sharing, legal compliance, and infrastructure changes. Early engagement of these partners is critical for scaling and implementation.

Organizational Complexity and Long-Term Feasibility

Implementing the full service requires significant investment, cross-departmental coordination, and long-term commitment. Without a clear owner to carry the plan forward, there is a risk of stagnation. Moreover, the nature of large infrastructural and technological implementations means that by the time the service is fully developed, user needs or technologies may have evolved again. Ensuring organizational alignment, resource availability, and future-proof planning are key preconditions for success.

Potential Researcher Bias

As this project was conducted primarily by a single researcher, there is a risk of interpretation bias in the analysis and synthesis of data. While efforts were made to reduce this, through frequent feedback sessions with supervisors and experts from Schiphol, the conclusions should still be viewed in light of this limitation.

Technological Development Pace

The rapid development of technologies in areas such as autonomous mobility, digital mapping, and smart infrastructure presents both an opportunity and a challenge. Although the model was designed to be adaptable, this adaptability depends on Schiphol's long-term commitment to ongoing investment and adjustment. Continuous effort, time, funding, and strategic alignment will be required to ensure the system evolves alongside technological advancements.

Limited Scope: Focus on Departure Phase Only

This project focused solely on the first step of the wheelchair service journey: departing from the Netherlands. As such, several crucial components were excluded from scope, including arrivals, transfers, in-terminal movement, and the return process at the gate or designated hub. These phases introduce additional complexity, particularly airside, where gate layouts and walking distances vary widely. Practical challenges such as baggage handling while using a wheelchair also remain unresolved. As was already identified during the research phase, see Figure 50, this issue was flagged early on as a significant barrier to passenger autonomy.

However, while these phases fall outside the current scope, the model developed in this project demonstrates how such processes can be structured. The model provides a clear framework for service design, one that is modular and extendable. It offers a foundation that can be expanded to include arrival and transfer journeys, showing not just a solution, but a method of designing solutions across different phases of the PRM passenger experience.

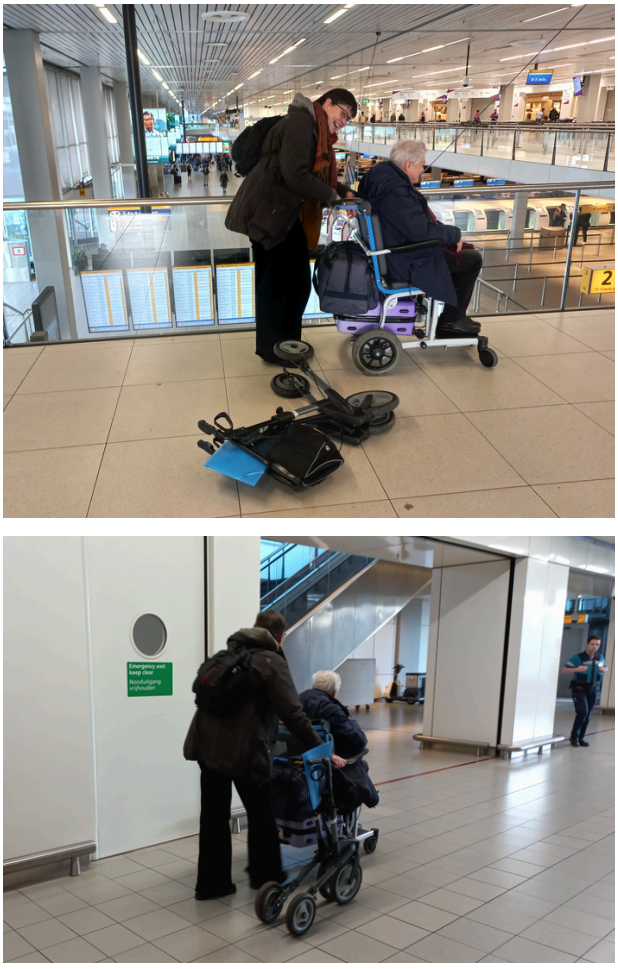


Figure 50: Problems with Baggage Handling during the PRM Journey with the self-service wheelchair

16.2. Recommendations

To support the development and future implementation of the self-service wheelchair system, this section outlines six key recommendations. Some focus on the further development of the service model itself, while others reflect on broader strategic or future-facing design directions for PRM support at Schiphol. Together, they provide suggestions for strengthening the concept, embedding it in its spatial and organizational context, and scaling it in line with long-term ambitions for accessibility and multimodal mobility.

Strategic Vision and Future Positioning

A sustainable PRM service requires a long-term framework to grow within.

Establish a Long-Term Vision for PRM Accessibility

One of the project's most fundamental observations is the absence of a long-term vision for PRM passengers, particularly those with reduced mobility. Services are often developed in response to current needs, but lack a broader guiding direction. Defining a future-oriented vision, looking ahead 30 to 40 years, can provide structure and ambition for all stakeholders. It enables Schiphol to build toward a more autonomous, inclusive mobility system over time, with the current concept serving as a modular stepping stone.

Explore Integration with Broader Shared Mobility and Multimodality

As shared and multimodal mobility continue to grow, Schiphol has the opportunity to integrate this service earlier in the passenger journey, for example, in partnership with NS (Dutch Railways) or other transport providers. This could allow PRM passengers to arrange wheelchair support before arriving at the airport, enhancing ease of travel and aligning Schiphol's PRM services with national mobility trends. This recommendation ties into the broader future role Schiphol can play as a hub in a connected mobility network.

Embedding the Service in a Changing Context

A flexible service must respond to the airport's evolving infrastructure and passengers flows.

Design for a Changing Context

The service had been designed with modularity and flexibility in mind, and this is critical in a dynamic environment like Schiphol. With upcoming projects such as the new terminal, it's vital to preserve and even enhance the system's scalability and adaptability. The physical infrastructure and service points must remain flexible, to be relocated or expanded without compromising the integrity of the system.

Integrate Arrival Strategy and Wheelchair Distribution

There is potential in aligning passenger arrival methods (e.g., train, Kiss & Ride, or airside gates) with the location of servicehubs. The current concept includes an initial strategy for hub placement, but further research could optimize this relationship. A tighter connection between arrival and wheelchair pick-up may reduce the number of required service points, improve user flow, and streamline operations.

Strengthening Implementation and Operations

To bring the model to life, it must be tested with the right users and structured with clear timelines.

Include End Users in Future Testing

While internal stakeholders were central to this phase, future iterations must involve PRM passengers directly in usability testing. This will validate assumptions, uncover practical barriers, and ensure that the service is truly accessible. Co-creation, scenario walkthroughs, and live environment testing are recommended methods for gathering meaningful input.

Translate the Model into an Actionable Timeline

The current model defines clear roles and responsibilities, but lacks a timeline for when actions must be executed and how long they will take. Developing a structured implementation roadmap is a crucial next step. Different parts of the model require different forms of action, some can be handed directly to contractors, others need additional research or policy decisions. A phased planning tool should be created to support rollout coordination across teams and timelines.

Expend the Model to Include Arrival

Transfer, and In-Terminal Movement The current concept represents only the first step in the wheelchair journey, departure from the landside area of Schiphol. Future work must explore how the service

can be extended to cover the full PRM experience, including arrivals, transfer connections, and returning the wheelchair at the appropriate gate or hub. Special attention should be given to airside logistics, where distances are greater and gate layouts more complex. Additionally, unresolved questions such as baggage handling while using a wheelchair must be addressed in collaboration with airlines and ground handlers. These aspects are essential to make the service fully operational and user-friendly.

16.3. Value

This project was initiated in response to Schiphol's twofold design challenge: to develop an autonomous wheelchair service for PRM passengers and to design a communication strategy that enables its adoption. The challenge arose from a growing demand for autonomy among PRM passengers and a need for operational efficiency. While wheelchairs were available, they were scattered, unregulated, and lacked a coherent system, offering neither passengers nor staff a reliable experience.

With PRM numbers on the rise, Schiphol needed a solution that would not only increase passenger independence, but also optimize the use of space, time, and staff. This project answers that need by designing **a comprehensive service model.** The model outlines how Schiphol can structure and implement self-service wheelchair support by integrating three essential design components:

- An information strategy
- A wheelchair positioning approach
- a supporting organizational structure

These components were derived from six core design criteria and together form a cohesive framework for delivering a reliable, scalable PRM service.

The solution effectively answers the design question through a criteria-based, systemic approach. It allows PRM passengers to prepare and navigate independently, while simultaneously improving internal operations by aligning infrastructure with natural passenger flows. This dual value, autonomy for the user and efficiency for Schiphol Airport, shows the strength of the service model.

Crucially, the project delivers more than a solution: it offers a **method for developing future services**. As illustrated in the project's impact model (see Figure 51), this design responds to a trigger that creates a challenge to design a valuable solution with **measurable long-term impact.** The model demonstrates how service components must be developed in harmony, communication, physical infrastructure, and organizational roles must align to create a valuable experience.

This is where the core value of the project lies: it serves as a **practical guide**. Not a finished system, but a blueprint that Schiphol can use to build out this service, and later **extend it to additional journey phases,** such as the journey to the gate and wheelchair use during transfers and arrivals. In each case, the same structure applies:

- clear information
- well-positioned wheelchairs
- strong collaboration between stakeholders

Ultimately, the ambition is a wheelchair service that feels effortless, for both the user and Schiphol. The confidence and clarity shown by the test participants offer a glimpse of this future: **happy PRM passengers supported by a smart, scalable service model.**

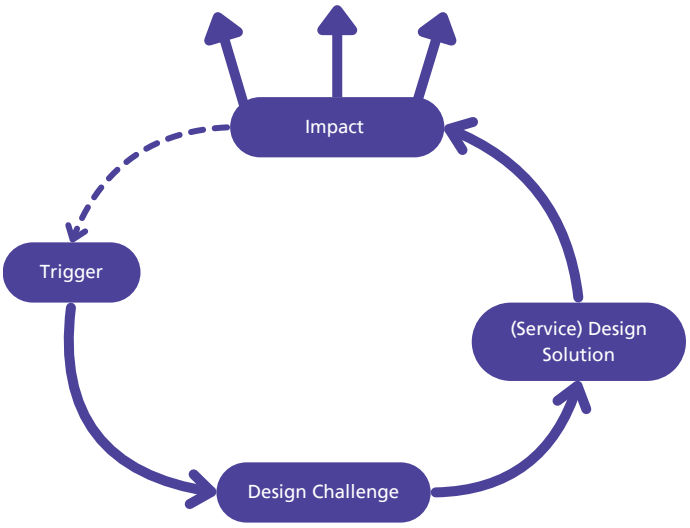


Figure 51: Impact Framework Graduation Report Florien

17. Conclusion

This chapter concludes the project's outcomes, linking the original design challenge to the developed solution. It reflects on the value of the final service model, the underlying design approach, and the potential impact for Schiphol and PRM passengers, today and in the future.

This graduation project was initiated in response to a growing opportunity at Schiphol: the ambition to offer more autonomy to passengers with reduced mobility (PRM), combined with the need to structure and scale a service that had been running informally. Wheelchairs were present, but lacked a guiding system, there was no coordinated information, clear positioning, or defined responsibility. This gap presented a **valuable design challenge.**

Research confirmed the urgency. Interviews and observations revealed that PRM passengers often struggle to move independently, and that existing support was fragmented and reactive. Earlier internal initiatives showed motivation, but lacked an integrated, passenger-focused approach. From these insights, six design criteria were developed: facilitating autonomy, designing universally, adapting to change, informing comprehensively, building accessible infrastructure, and managing operations.

These criteria shaped the final outcome: **a comprehensive service model that defines how Schiphol can implement and manage a reliable self-service wheelchair system.** This service model is the core design result. It integrates next to the organizational structure, two other key supporting components:

- **An information tool** to support passenger preparation and journey
- **A wheelchair positioning strategy** to align hubs with passenger flows and airport layout

Together, these three elements form a coherent and future-oriented system. The model enables clear stakeholder responsibilities, scalable infrastructure planning, and practical implementation pathways. Its modularity ensures that the service can evolve over time, whether through new technologies like autonomous wheelchairs, or changing spatial needs due to infrastructure developments such as the new terminal.

Beyond the current scope, the model also lays the groundwork for future expansion. Other travel phases, so arrival, transfer, or the following steps from departure, can follow the same approach: combining information provision, infrastructure design, and operational logic. This offers Schiphol a repeatable framework for service innovation.

This report acknowledges the limitations of the project, such as the scope being limited to departures, the dependency on future implementation partners, and the evolving nature of available technologies. Based on these limitations and the findings throughout the project, several recommendations have been made to Schiphol to guide future development. These include phased implementation, continuous user testing, interdepartmental coordination, and further exploration of autonomous technology integration.

In conclusion, this project delivers not just a service concept. It offers a method, a structured, human-centred way to turn complex mobility needs into clear, manageable and scalable solutions. It supports Schiphol's long-term vision of accessibility and autonomy for all, while also improving the efficiency and clarity of Schiphol's operations..

Above all, it sets the foundation for a future in which PRM passengers can move confidently and independently through every part of their airport journey.

18. Reflection

This graduation project has been a valuable and multi-layered learning journey. The reflections below are divided into two parts: one focused on the process and content of the project itself, and one reflecting on my personal development as a designer throughout this experience.

Reflection on the Project

What worked well for me was that I was able to start directly in the **real-world context**. From the beginning, I was on-site at Schiphol, and I quickly realised that this way of working suited me. By experiencing, testing, observing, and talking to people, I gained insights much faster and deeper than through literature research alone. That involvement kept me motivated, especially because I sometimes felt the same frustrations as the users.

Looking back, I now see that the project actually turned into a kind of practical case study: a chance to implement something in the short term that could generate insights for a longer-term solution. In hindsight, that could have played a bigger role in shaping the structure of the project itself. If I had treated it as a case study from the start, I might have aligned my process and deliverables more closely to that setup.

Another thing that worked well was visualising my process. I kept logbooks and created lots of diagrams to maintain oversight. This helped me understand my choices and reflect throughout the project. It also helped me switch more easily between detail and bigger picture, something I found difficult at first, but improved at along the way.

I also noticed that I sometimes waited too long to make decisions. For example, I continued to develop all three design components in parallel, when it would have been stronger to choose a focus earlier on. Making decisions more quickly, scoping more clearly, is something I still want to get better at.

I also found it challenging to share things before they felt finished. I tend to research thoroughly before showing anything. But I've learned that sharing earlier, even if it's not perfect, actually leads to faster feedback, and that's really valuable. I'll definitely carry that insight with me into future projects.

Finally, I noticed that the Double Diamond framework didn't fully match the way I work. I often work iteratively, and I tend to discover insights while making, rather than only beforehand A method that allows more room for those kinds of cycles might suit me better. Something to explore further.

Personal Reflection

One thing I learned about myself during this project is that I enjoy working in real contexts, seeing, hearing, and experiencing things for myself. That gives me energy. And I found out that I learn a lot by doing. I want to continue seeking out work where I can observe, test, and have conversations directly with users.

I also discovered how much I enjoy learning while working. During the project, I read Hoe makkelijk kun je het maken? by Jasper van Kuijk, and was able to apply the insights right away. I really enjoyed combining theory and practice, and it showed me how important it is to make time to dive into design knowledge, not just before a project, but also during it.

Creating structure was something I grew in, but it also took effort. Especially at the start of meetings or project phases, I had to remind myself to ask: *what is the goal of this moment?* Preparing well helped me stay focused, without losing my creativity. This remains a point of attention for me, I need to keep creating structure and push myself to stay purposeful.

My communication improved, especially early on. Later in the project, it became a bit harder, especially during writing phases or moments of higher stress. Keeping a logbook with to-dos, short reflections, and checking in with the supervisory team helped me get back on track.

I also learned a lot about how I deal with feedback. I'm very open to it, but I sometimes dive too deep into a single comment. I've now learned to break feedback into concrete actions, or to simply ask for clarification to avoid misinterpretation. That really helps me stay focused.

Another thing that stuck with me: everyone has their own process. Mine ended up feeling like a big, practical case, fast-moving, embedded, and at times a bit messy, but full of learning moments. I found it rewarding to figure out how to turn such a complex experience into a clear and structured story.

Finally, **I'm incredibly happy with my choice of graduation environment.** Schiphol is a complex, but extremely valuable place to learn. I had the space to work on my project, and I learned how difficult it is to truly launch a service. I was surprised to find how much I enjoyed overseeing the process, and how much of a difference good information provision and physical coordination can make in a smooth experience. That often turned out to be the bottleneck. It inspired me to learn more about how to help people, like PRM passengers, move through complex systems in the best possible way.

With great enthusiasm, I'm going to start my first position at Mijksenaar, a design firm specialised in wayfinding. Thanks to this graduation project, I now have a clearer sense of what I enjoy and value in design: *helping people move through complex environments with ease and independence*. That insight might just be the most valuable outcome of this entire journey.

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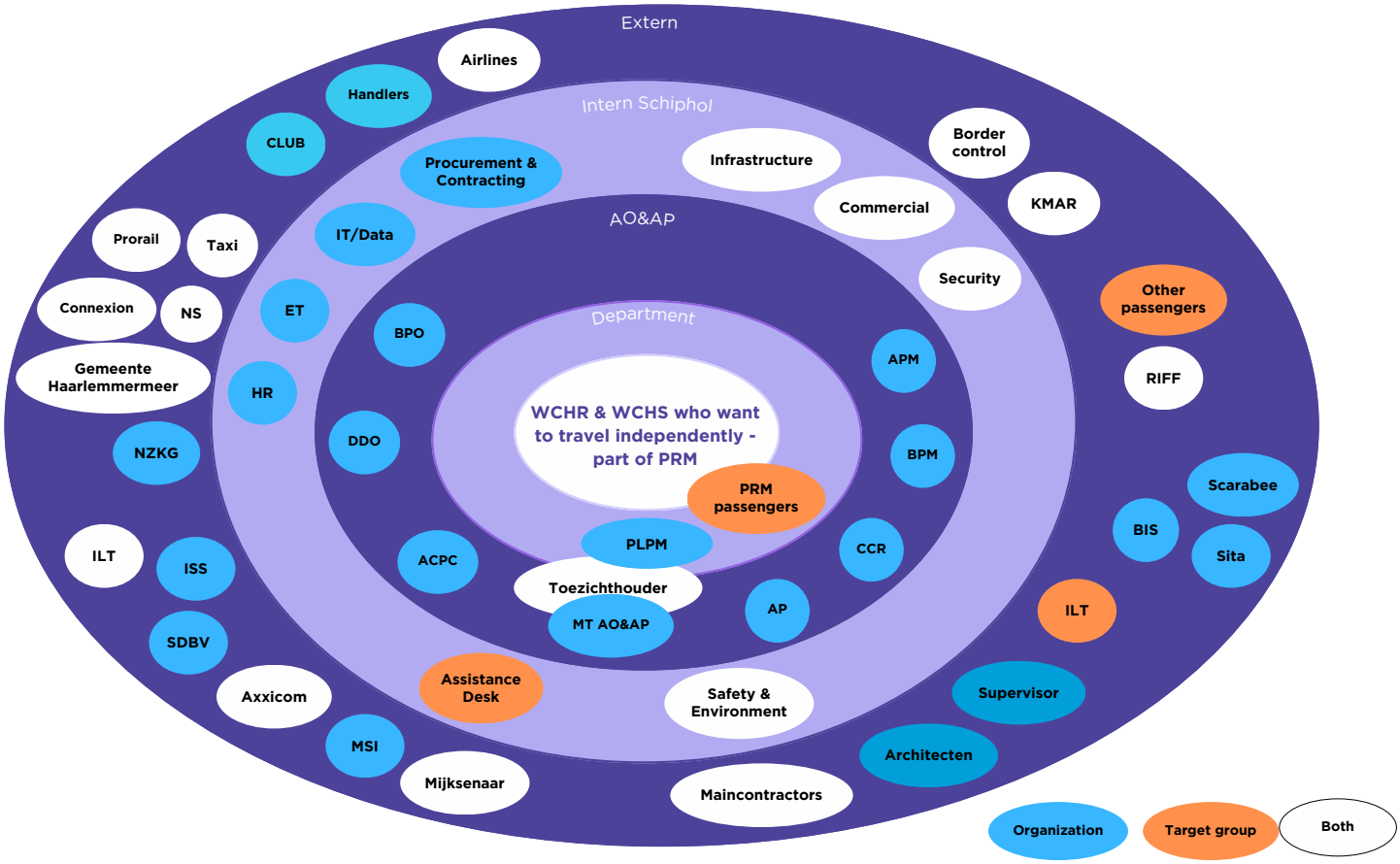
Appendices

1. Coachmeetings and working documents

2. Stakeholder Analysis



3. Planning Matrix

PROJECT PROCESS MATRIX: TOPIC & ACTIVITIES PER PHASE

	Thema's/Rapport	Oriënteren/Discover W1 W2 W3 W4	Define W5 W6 W7 W8	Develop W9 W10 W11 W12	Deliver W13 W14 W15 W16	Overig W17 W18 W19 W20
BACKGROUND AND ARGUMENTATION	Schiphol & PRM	Onderzoek Company Schiphol. Definiëren PRM en project focus PRM	Onderzoekje over "gebruik" vertalen naar context van Schiphol			
	Relevantie onderzoek	Beschrijven aanleiding onderzoek en belangen		Testen ontwerp aan belangen		
	Stakeholders	Overzicht stakeholders en functie	Sp. doelgroep onderzoek en snijdende services vaststellen	Vaststellen stakeholders in de toekomst		
	Situatie & context	Huidige situatie Schiphol, andere Airports en sectoren	Huidige PRM journey opzetten focus zelfstandig reizen obv auto ethnographic research			
	Gebruikerservaringen	Uitdagingen en frustraties van gebruikers onderzoeken door rapporten en eerder onderzoek	Uitdagingen en frustraties vaststellen mbv overzichten en Persona's	Uitdagingen en frustraties voorspellen tijdens ontwerpfase	Combineren met gebruikersbehoeften als argumentatie voor Design	
	Technologie		Vaststellen welke technologie relevant is en vergelijkbare diensten gebruiken			
	Autonoom reizen		Definiëren wat autonoom reizen in deze context betekent	Ontwerp testen aan definitie		
	Trends	Trendanalyse, focus op mobility		dieper: Toegnkl. en inclusiviteit		
	Toekomstvisie		Visie Schiphol en PRM onderzoeken en definiëren	Def. in visie van inclusiviteit, autonoom en toegankelijkheid		

Afgerond | Voor nu afgerond | Grootste focus op dit moment | Mee bezig | Nog niet aan begonnen | (Nog) niet aan de orde

		W1 W2 W3	W4 W5 W6	W7 W8 W9 W10	W11 W12 W13	
DESIGN	Concept design H1 (Afwijkende planning)	Onderzoek obv bovenstaande Background punten. Opzet stappenplan ontwerpen Pilot	Vaststellen requirements obv frustraties&behoeften, uitdenken locaties en hekwerk, indienen modificaties	Begeleiden uitvoering modificaties, Ontwerp Journey en invullen locaties en inhoud bebording en wayfinding aan de hand van behoeftenonderzoek. Inrichten regulatie en **opzetten concept**	Testen en documenteren van testresultaten (go's en belemmeringen) --> tijdens ontwerp en testfase H1 feedback verzamelen: requirements eind ontwerp	
		W1 W2 W3 W4	W5 W6 W7 W8	W9 W10 W11 W12	W13 W14 W15 W16	W17 W18 W19 W20
	Ideation	Collage maken van verschillende rolstoelen+functie	Opzet ontwerpplan en methoden Eind design	Opzetten van verschillende conceptdesigns --> 10-5-3-2-1-.	Documentation Concepten	
	Concept Design	Eerste ideeën op een dumpplek neerzetten		Beslissing maken verschillende concept designs, uitwerking gekozen concept Design	Visualisation en documentation eind design	
FUNCTIONAL REQUIREMENTS	Gebruikersbehoeften	Gebruikersonderzoek Background + "Gebruik" in het algmeen onderzoeken	Behoeften onderzoek a.d.h.v. frustraties&uitdagingen, interviews en interactieve workshop stakeholders • Wayfinding CH1 op basis van deze behoeften	Ontwerp Journey en invullen "locaties" behoeften en belangen, testen tijdens ontwerpen		
	Product specificaties	Specificeren wat functie zegt, hoe het ontstaat en hoe het het ontwerp beïnvloedt.	Requirements specificaties opzetten a.d.v. interactieve workshop stakeholders **en adhv pilot test H1** • Opzet workshop, doel + invulling/werkvorm	Specificaties testen en vaststellen voor eindontwerp		
	Service specificaties	Hoe formuleer je functies in service ontwerp?	Requirements vaststellen a.d.h.v. interactieve workshop	Specificaties testen en vaststellen voor eindontwerp		
	Context fit	Wetgeving en leiderschap onderzoeken Schiphol	Omliggende services in kaart brengen		Invloed van omliggende services op schiphol behandelen	
	Kostenplaatje			Bijhouden tijdens keuzes tijdens concept ontwikkeling	Uitwerken volledig kostenplaatje	
	Implementation steps				Uitzetten eisen en stappen implementatie	

4. Persona's

Tessa

Zelfstandig Doorzetter Georganiseerd
Empathisch Praktisch ingesteld

- 51 jaar oud
- Getrouwd
- volwassen kinderen, wonen zelfstandig
- Projectmanager Duurzaamheid en Milieu
- Spierziekte
- **WCHS: <100m, geen opstap**

"De mobiliteitsbeperking zie ik als een praktische uitdaging, geen obstakel"

"Ik wil onafhankelijk blijven, zelfs op een drukke luchthaven. Ik hoef geen assistentie, alleen een rolstoel waarmee ik zelfstandig en comfortabel mijn weg kan vinden."

"DE ACTIEVE EN ZELFSTANDIGE REIZIGER"

Tessa is een actieve, zelfstandige professional met een passie voor reizen. Ondanks haar mobiliteitsbeperkingen door een spierziekte wil ze onafhankelijk blijven, vooral tijdens het reizen. In het dagelijks leven gebruikt ze een wandelstok en soms een rollator voor extra steun. Ze werkt als projectmanager bij een non-profitorganisatie en reist regelmatig voor haar werk. Tessa streeft ernaar haar mobiliteit zo zelfstandig mogelijk te behouden en zoekt oplossingen die haar autonomie bevorderen, zoals zelfstandig te gebruiken rolstoelen op Schiphol.

UITDAGINGEN

- Gebrek aan duidelijke informatie gebruik rolstoelen
- Onzekerheid beschikbaarheid rolstoelen
- Omgang extra stress als tijdsdruk, zoals tijdens security

PIJNPUNTEN EN FRUSTRATIES

- **Gebrek aan Informatie en onrust over beschikbaarheid:** Op de website en tijdens het boekingsproces is beschikbaarheid en locatie zelf te gebruiken rolstoelen onduidelijk
- **Complexe Assistentie-aanvraag:** Bij assistentieaanvragen moet ze aangeven dat ze hulp nodig heeft, terwijl ze alleen een hulpmiddel wil lenen, zonder begeleiding.
- **Stress door Terugbrenglocatie:** ongemak, omdat ze niet weet waar ze de rolstoel precies moest achterlaten. Creëert onrust, vooral bij tijdsdruk.

HOBBY'S EN INTERESSES

- Reizen
- Culturen ontdekken
- Lezen
- Buitenshuis
- Tijd spenderen met vrienden en familie

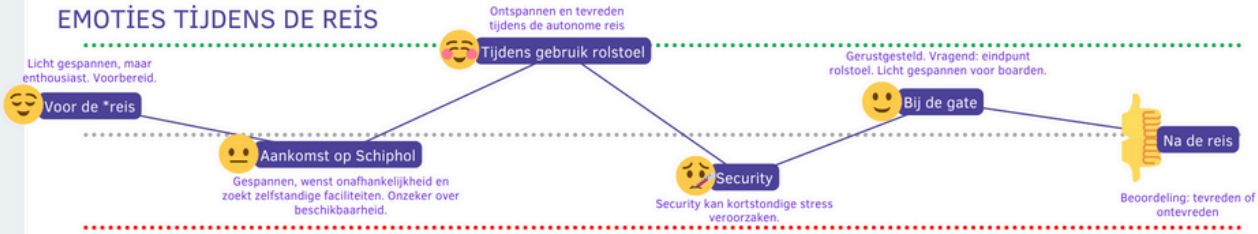
MOTIVATIES EN DOELEN

- Reismobiliteitskeuze onafhankelijk van beperking
- Onafhankelijk zijn van mensenlijke assistentie, waardoor comfortabel en stressvrij
- Zelfstandigheid en flexibiliteit, eigen keuzes over activiteiten op de luchthaven
- Overzicht over organisatie van hulp en faciliteiten

BEHOEFTEN EN WENSEN

- Comfort en autonomie
- Duidelijke informatie vooraf: rust en zekerheid dat ze zelfstandig de luchthaven kan doorlopen.
- Duidelijke wayfinding: gemakkelijk te vinden rolstoelen
- Efficiënte procedures bij security: voorspelbaar en soepel proces, waarbij ze bij voorkeur niet uit haar rolstoel hoeft te stappen als het niet nodig is.
- Flexibiliteit bij inleveren van rolstoelen: dicht bij de gate

EMOTIES TIJDENS DE REIS



*De reis is de reis die op Schiphol gemaakt wordt: Van aankomst op Schiphol naar de gate waar vandaan het vliegtuig vertrekt

Marieke

Positief ingesteld Behulpzaam Doorzetter
Zorgzaam Geduldig

- 46 jaar oud
- Ongehuwd
- Hecht netwerk aan vrienden en familie
- Basisschool Onderwijzeres
- Spasme in benen
- **WCHR: <100m lopen**

"Ik wil zelf de controle hebben en mijn reis zonder gedoe beginnen. Een beetje steun is fijn, maar ik wil vooral zelfstandig mijn weg vinden."

"DE OPTIMISTISCHE REIZIGER MET ROLLATOR"

Marieke is een energieke, optimistische vrouw van 38 jaar die ondanks haar fysieke beperkingen geniet van het leven. Door een aandoening aan haar benen en gewrichten kan ze niet lange afstanden lopen zonder hulpmiddel. In haar dagelijks leven gebruikt ze een rollator, waarmee ze zichzelf redelijk goed kan redden. Marieke heeft een grote vriendengroep, is sociaal en geniet van nieuwe ervaringen en reizen. Ze is avontuurlijk ingesteld en wil niet dat haar mobiliteitsbeperking haar enthousiasme of onafhankelijkheid beperkt. Marieke reist regelmatig om vrienden en familie te bezoeken of om nieuwe plekken te ontdekken, waarbij ze de voorkeur geeft aan zelfstandigheid.

UITDAGINGEN

- Navigeren naar rolstoelstations
- Inleveren van de rolstoel bij de gate als dit niet goed aangegeven is
- Voorbereiden met informatie vooraf die soms lastig te vinden is op de website

PIJNPUNTEN EN FRUSTRATIES

- Onzekerheid over de beschikbaarheid: frustratie dat er geen garantie is op een rolstoel, waardoor er mogelijk alsnog assistentie nodig is
- Onduidelijke inleverpunten: specifiek bij de gate
- Beperkt gevoel van vrijheid: gebrek aan informatie vooraf en duidelijke wayfinding beperkt haar zelfstandigheid, waardoor reisenthousiasme vermindert

HOBBY'S EN INTERESSES

- Reizen en nieuwe plekken ontdeken
- Lezen
- Creativiteit
- Natuur en buitenzijn

MOTIVATIES EN DOELEN

- **Zelfstandig reizen**, onafhankelijk van assistentie, juist op hectische plekken als Schiphol Airport
- **Vertrouwen** op een soepel en duidelijk **systeem voor rolstoelen** op Schiphol
- **Zorgeloos** van begin tot eind de luchthaven doorkomen, met **minimale hulp**

BEHOEFTEN EN WENSEN

- Toegang tot betrouwbare, **zelfstandig te gebruiken mobiliteitsopties** bij aankomst en vertrek
- Duidelijke **wayfinding** en **instructies vooraf**, zodat ze de rolstoelen snel kan vinden
- Zorgeloze **inleveroptie** bij de gate, zonder lange loopafstanden

EMOTIES TIJDENS DE JOURNEY

- **Voor de reis:** Enthousiast, licht gespannen over de beschikbaarheid van de faciliteiten
- **Op Schiphol:** Gestrest bij aankomst als ze niet direct weet waar de rolstoelen zijn, spanning zakt zodra ze de middelen gevonden heeft
- **Tijdens gebruik:** Opgelucht en blij. Geniet van onafhankelijkheid terwijl ze door de luchthaven navigeert.
- **Bij de gate:** Onduidelijkheid over de inleverlocatie van de rolstoel creëert onzekerheid en onrust.

5. Vision Development

Visie- 02

- PRM, december 2024
- To do: Aanpassen, specifiek maken voor Autonoom Reizen door WCHR en WCHS

Visie PRM, december 2024

9. Gate en Boarden

Het boardingproces is **waardig** worden doorlopen door iedere passagier. Er is een **naadloze overdracht** van ondersteuning en gedurende het hele proces is er **duidelijkheid over persoonlijke hulpmiddelen.**

7. Dwell time

Er zijn **passende faciliteiten** en **verblijfsruimtes** beschikbaar en publieke ontspanningsfaciliteiten zijn **zelfstandig toegankelijk** voor iedere passagier

6. Security- en grensproces

Iedere passagier **wordt in staat gesteld** het Security- en Grenproces **waardig** te doorlopen

5. Check-in

Schiphol **faciliteert autonomie** en biedt daarnaast ondersteuning afgestemd op de behoefte van de passagier

2. Ontvangst op Schiphol

Iedere passagier met assistentiebehoefte kan **ontvangen of gebracht** worden naar een **fysieke plek** waar de **ondersteuning op maat** start. De passagier kan dit ook (vooraf) **digitaal regelen**

1. Thuis oriënteren en voorbereiden

Een **compleet** en **toegankelijk** overzicht van **alle beschikbare faciliteiten** en **assistentiemogelijkheden** stelt **iedere passagier** in staat zich **tot in detail** voor te bereiden op de reisstappen. De passagier vindt hier ook een overzicht van **alle aangevraagde en bevestigde assistentie.**

Visie PRM

Gehele proces van oriënteren thuis tot aan de gate.

De visie voor PRM-reizigers op Schiphol is om een toegankelijk, waardig en soepel reisproces te bieden, waarin autonomie wordt gefaciliteerd, ondersteuning op maat beschikbaar is, en alle voorzieningen naadloos aansluiten op de behoeften van de passagier.

Visie WCHR en WCHS met autonome reisbehoefte

Gehele proces van oriënteren thuis tot aan de gate.

Het faciliteren van een waardige en zelfstandige reiservaring, waarin passagiers **volledige controle** behouden over hun eigen rolstoelgebruik en door aangepaste **faciliteiten** en **procedures dezelfde mate van zelfstandigheid ervaren als reguliere passagiers**. Ondersteuning is geïntegreerd in de infrastructuur en processen, zodat menselijke betrokkenheid in principe **alleen plaatsvindt waar dit ook voor andere passagiers gebruikelijk is**. Schiphol biedt **duidelijke informatie**, **toegankelijke routes** en **naadloos afgestemde voorzieningen** om deze passagiers in staat te stellen **onafhankelijk, efficiënt en comfortabel door de luchthaven te reizen.**

1 Thuis oriënteren en voorbereiden

Kernbehoefte PRM: informeren, zekerheid bieden
De PRM heeft een **grotere informatie behoefte** voor de reis begint en zoekt **zekerheid** over het meenemen van hulpmiddelen en de beschikbare ondersteuning

Een **compleet** en **toegankelijk** overzicht van **alle beschikbare faciliteiten** en **assistentiemogelijkheden** stelt **iedere passagier** in staat zich **tot in detail** voor te bereiden op de reisstappen. De passagier vindt hier ook een overzicht van **alle aangevraagde en bevestigde assistentie.**

- **Compleet**: de passagier kan op één, door Schiphol gefaciliteerde plek alle informatie vinden
- **Toegankelijk**: de informatie is bereikbaar en begrijpelijk voor iedere passagier, ongeacht zintuiglijke of cognitieve beperkingen
- **Alle beschikbare faciliteiten**: alle voorzieningen en middelen die er op het Schipholterrein worden geboden, waar je zelfstandig gebruik van kunt maken
- **Alle beschikbare assistentiemogelijkheden**: alle opties die worden geboden door Schiphol, Axxicom en airlines/afhandelaren om een op maat gestelde ondersteuning te bieden
- **Iedere passagier:** ongeacht fysieke, zintuigelijke of cognitieve beperkingen

  ***Denk overbodig. Iedere passagier = iedere passagier.**
- **Tot in detail:** een uiteenzetting van hoe elke reisstap er uit ziet, welke keuzes hierin beschikbaar zijn en wat er is toegestaan wat betreft hulpmiddelen
- **En bevestigde assistentie:** De passagier kan niet alleen vinden wat er mogelijk is en wanneer en hoe dit geboekt moet worden, maar vindt hier ook de boekingbevestiging van de aangevraagde assistentie

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: informatie en planning
De passagiers hebben toegang tot duidelijke informatie over rolstoelvriendelijke routes, faciliteiten en procedures om hun reis goed voor te bereiden.

Een **compleet** en **toegankelijk** overzicht van **rolstoelvriendelijke routes, faciliteiten**, en **assistentiemogelijkheden** stelt de passagier in staat om **zelfstandig** en **in detail** hun reis voor te bereiden. Informatie over het meenemen en gebruik van eigen hulpmiddelen, als een stok of rollator, is helder en eenvoudig te vinden.

2 Ontvangst op Schiphol

Kernbehoefte PRM: Duidelijkheid, maatwerk
De PRM wil **duidelijkheid** en **bevestiging** over of de realiteit overeenkomt met de voorbereiding.

Iedere passagier met assistentiebehoefte kan **ontvangen of gebracht worden** naar **een fysieke plek** waar **de ondersteuning op maat** start. De passagier kan dit ook (vooraf) **digitaal regelen**

- **Iedere passagier met assistentiebehoefte = iedere passagier met assistentiebehoefte!**
- **Ontvangen of gebracht:** de passagier heeft de keuze om zelfstandig (of met eigen ondersteuning) naar het centrale punt te komen of om vanaf het eindpunt van het brengende vervoer opgehaald te worden.
- **Ondersteuning op maat:** maatwerk om te voldoen aan de behoefte van de passagier, waarin **zelfstandigheid optimaal wordt gefaciliteerd.**
- **Digitaal regelen:** de passagier kan voor vertrek via een Schiphol omgeving een "assistentie intake" doen en hiermee vooraf de reis op diens behoefte afstemmen. De passagier gaat vervolgens naar de afgesproken startlocatie en hoeft niet meer naar een assistentiebalie.

  ***Of gaat direct naar de plek waar een hulpmiddel te halen is**

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: Toegankelijkheid en eenvoud
De passagiers moeten eenvoudig en zelfstandig de luchthaven kunnen betreden, met directe toegang tot rolstoelvriendelijke voorzieningen.

Passagiers kunnen **eenvoudig** en **zelfstandig** een leenrolstoel ophalen en **direct starten met hun reis** door de luchthaven. Ondersteuning of begeleiding is **optioneel** en sluit naadloos aan op hun **zelfstandige reiswens**.

5 Check-in

Kernbehoefte PRM: Zelfredzaamheid
De PRM behoefte verschilt tussen het proces met eigen ondersteuning (bijv vrienden/familie) doorlopen, of ondersteunt door Schiphol.

Schiphol **faciliteert autonomie** en biedt daarnaast ondersteuning afgestemd op de behoefte van de passagier.

- **Faciliteert autonomie:** het check-in gebied is toegankelijk voor passagiers en hun wegbrengers, waardoor een passagier met ondersteuningsbehoefte de keuze heeft in hoe het proces doorlopen wordt.

  ***Hier mis ik de self service opties, die maken het ook zelfredzaam**

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: Zelfstandigheid, fysieke ontspanning
Zelfstandig inchecken wordt mogelijk gemaakt via rolstoeltoegankelijke balies en gebruiksvriendelijke self-service opties.

De check-in verloopt vlot en **zelfstandig** door het gebruik van **rolstoeltoegankelijke balies** en **gebruiksvriendelijke self-service oplossingen**, zonder extra stappen voor deze passagiers.

6 Security- en Grensproces

Kernbehoefte PRM: waardigheid, maatwerk
De rij voor het security- en grensproces is stressvol en kost veel energie voor veel PRM's. Daarnaast zijn de lanes niet altijd uitgerust met passende oplossingen voor de PRM behoefte.

iedere passagier **wordt in staat gesteld** het Security- en Grensproces **waardig** te doorlopen.

Wordt in staat gesteld ... waardig: er zijn variaties op het reguliere proces die passagiers met aanvullende ondersteuningsbehoefte in staat stellen het proces respectvol te voltooien.

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: Soepele doorstroom
Beveiliging en grensprocedures zijn afgestemd op eigen rolstoelgebruik, zonder extra handmatige assistentie nodig te maken.

Het security- en grensproces is ingericht op **zelfstandige doorgang** voor passagiers in een leenrolstoel, met **efficiënte en aangepaste procedures waar nodig** voor comfort en eenvoud, zonder extra menselijke assistentie nodig te maken.

7 Dwell time

Kernbehoefte PRM: toegankelijkheid
De PRM kan niet altijd hetzelfde gebruik maken van ontspanningsmogelijkheden

Er zijn **passende faciliteiten** en **verblijfruimtes** beschikbaar en publieke ontspanningsfaciliteiten zijn **zelfstandig toegankelijk** voor iedere passagier*

*Wegens de veiligheid voor personeel en passagier zijn er grenzen aan de gelijkheid die gefaciliteerd kan worden aan passagiers.

Passende faciliteiten: er zijn voorzieningen en middelen die aansluiten bij de behoeftes van passagiers, waar zelfstandig gebruik gemaakt van kan worden

Passende verblijfruimes: er zijn fysieke ruimtes die aansluiten bij de behoeftes van de passagiers, indien nodig met toezicht

Zelfstandig: het gebruik van ontspanningsfaciliteiten behoort niet tot de ondersteuning die door de luchthaven processen aangeboden wordt. Daarom wordt zelfredzaamheid in en om deze faciliteiten gefaciliteerd.

Toegankelijk: De publieke ontspanningsfaciliteiten zoals zichtplaatsen en F&B moeten fysiek toegankelijk zijn en het personeel moet getraind zijn om aan te kunnen sluiten bij de behoefte van de passagier.

Iedere passagier: ongeacht fysieke, zintuigelijke of cognitieve beperkingen

***Denk overbodig. Iedere passagier = iedere passagier.**

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: Comfort, plezier en autonomie
De passagiers hebben toegang tot rolstoelvriendelijke zitruimtes, ontspanningsfaciliteiten en duidelijke bewegwijzering.

Passagiers kunnen gebruikmaken van toegankelijke en comfortabele **verblijfsruimtes** en **dezelfde ontspanningsfaciliteiten als elke andere passagier.** Bewegwijzering en digitale hulpmiddelen ondersteunen een soepele, **zelfstandige navigatie**

9 Gate en boarden

Kernbehoefte PRM: waardigheid, duidelijkheid, naadloos
De PRM kan waardig plek nemen in het vliegtuig en ervaart zo min mogelijk van de overdracht van zorg tussen Schiphol en de airline. Tijdens dit proces is er duidelijkheid over het vervoeren van eventuele hulpmiddelen.

Het boardingproces kan **waardig** worden doorlopen door iedere passagier. Er is een **naadloze overdracht** van ondersteuning en gedurende het hele proces is er **duidelijkheid over persoonlijke hulpmiddelen.**

Waardig: er zijn voorzieningen en middelen om iedere passagier waardig in de vliegtuigstoel te krijgen

Naadloze overdracht: de passagier ervaart minimale hinder van de overdracht van ondersteuning van Schiphol naar de airline. Dit betekent dat er wordt samengewerkt en dat informatie wordt gedeeld.

Duidelijkheid over persoonlijke hulpmiddelen: de passagier heeft ten alle tijden duidelijkheid over 1) of persoonlijke hulpmiddelen mee aan boord mogen 2) hoe persoonlijke hupmiddelen vervoerd worden en 3) waar de persoonlijke hulpmiddelen op dat moment zijn

Visie WCHR en WCHS met autonome reisbehoefte

Kernbehoefte PRM: Onafhankellijkheid
Het boardingproces ondersteunt zelfstandig instappen, met passende voorzieningen voor korte loopafstanden.

Het boardingproces maakt zelfstandig instappen mogelijk, met ondersteuning **via aangepaste voorzieningen en processen waar nodig,** zonder extra afhankelijkheid van menselijke assistentie.

Visie WCHR en WCHS met autonome reisbehoefte

- To do: Itereren, korter en bondiger, toelichten relevante onderdelen in de zin.

9. Gate en Boarden

Het boardingproces maakt zelfstandig instappen mogelijk, met ondersteuning **via aangepaste voorzieningen en processen waar nodig,** zonder extra afhankelijkheid van menselijke assistentie.

7. Dwell time

Passagiers kunnen gebruikmaken van toegankelijke en comfortabele **verblijfsruimtes** en **dezelfde ontspanningsfaciliteiten als elke andere passagier.** Bewegwijzering en digitale hulpmiddelen ondersteunen een soepele, **zelfstandige navigatie**

6. Security- en grensproces

Het security- en grensproces is ingericht op **zelfstandige doorgang** voor passagiers in een leenrolstoel, met **efficiënte en aangepaste procedures waar nodig** voor comfort en eenvoud, zonder extra menselijke assistentie nodig te maken.

5. Check-in

De check-in verloopt vlot en **zelfstandig** door het gebruik van **rolstoeltoegankelijke balies** en **gebruiksvriendelijke self-service oplossingen**, zonder extra stappen voor deze passagiers.

2. Ontvangst op Schiphol

Passagiers kunnen **eenvoudig** en **zelfstandig** een leenrolstoel ophalen en **direct starten met hun reis** door de luchthaven. Ondersteuning of begeleiding is **optioneel** en sluit naadloos aan op hun **zelfstandige reiswens**.

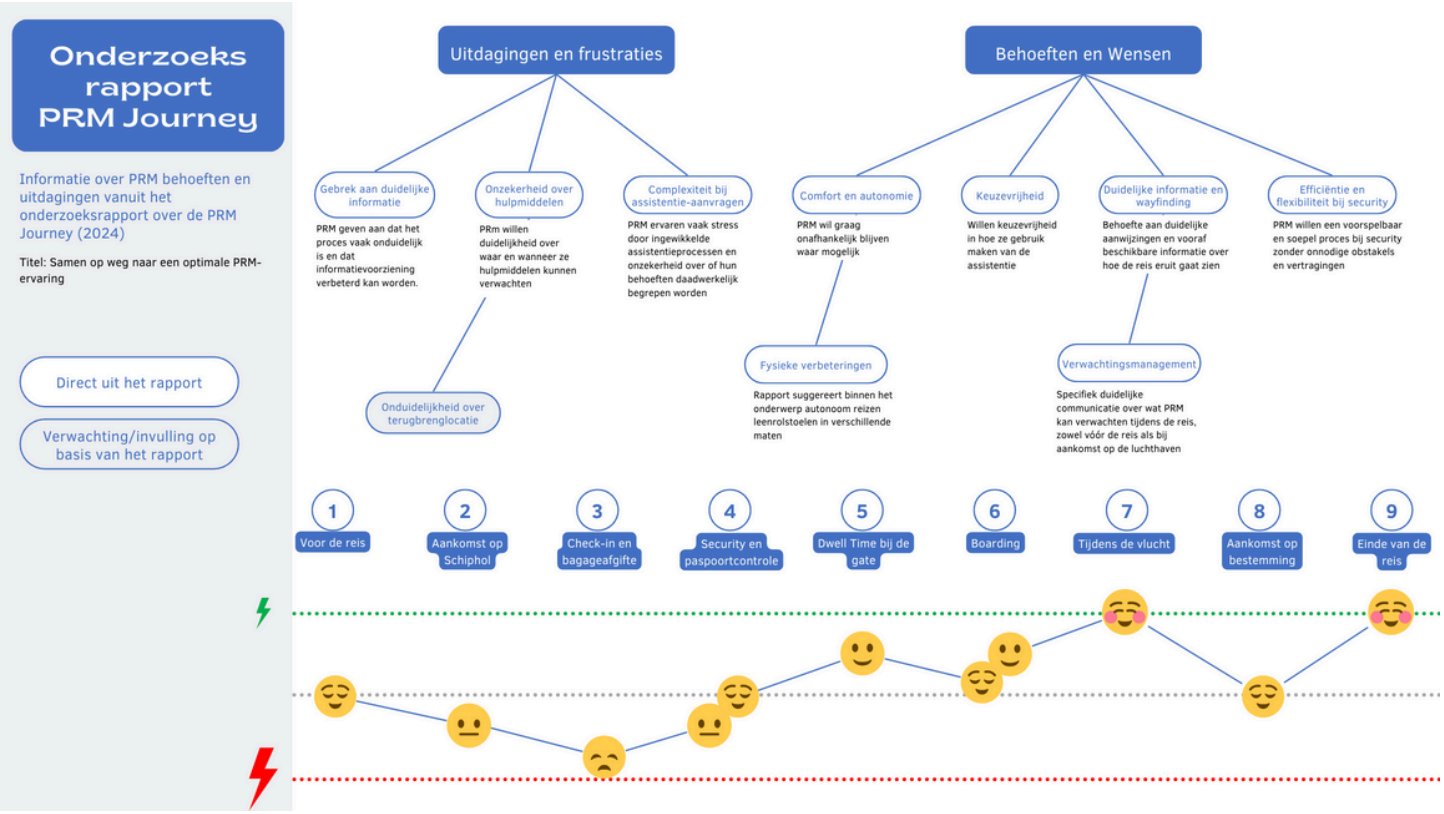
1. Thuis oriënteren en voorbereiden

Een **compleet** en **toegankelijk** overzicht van **rolstoelvriendelijke routes, faciliteiten**, en **assistentiemogelijkheden** stelt de passagier in staat om **zelfstandig** en **in detail** hun reis voor te bereiden. Informatie over het meenemen en gebruik van eigen hulpmiddelen, als een stok of rollator, is helder en eenvoudig te vinden.

6. Arrival Research

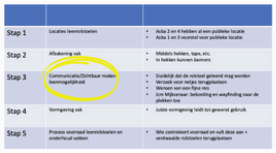
- Op het figuur links staan de mogelijke aankomstlocaties en -middelen van PRM weergegeven
- Hudige rolstoelgebruikers kunnen momenteel een rolstoel pakken bij de rode stippen.
- * Kiss & Ride is een etage hoger, bij de vertrekhallen, dus deze PRM pakken geen rolstoel op Plaza of in de WTC traverse

7. Additional information to Case Study



Click for entire report

PRM Journey: communicatie



Wie heeft **wanneer** en op **welke locatie** behoefte aan **welke** informatie?

Thema	Vraag	Actie	Volgorde
Wie	Wie gebruiken de dienst?	• AFGEROND **Persona** doelgroep WCHR en WCHS met autonome reisbehoeften	2
Wat	Welke informatie willen ze weten?	• AGEROND **Behoeften onderzoek** - Overzicht creëren en verwerken in persona • OPEN **Hoe via communicatie** de behoeften beantwoorden - welke boodschap en welk middel?	1 5
Wanneer	Wanneer (op welke momenten in de journey) is er behoefte aan deze informatie?	• AFGEROND **PRM Journey** Leenrolstoelen opstellen en invullen a.d.h.v. behoeften onderzoek	3
Waar	Op welke locaties in de journey zijn deze momenten van informatie?	• OPEN PRM Journey Leenrolstoelen opstellen en invullen a.d.h.v. behoeften onderzoek en **kennis/ervaring Mijksenaar (wayfinding)**	4

Relevantie goede communicatie
- PRM: Overzicht over en begeleiding tijdens je reis
- Schiphol: stukje wetgeving, blijven voldoen aan het aanbieden van assistentie en voorkomen van de misinterpretatie dat er weigering van assistentie is.

Gericht op de reiziger met een aanwezige zelfstandigheidswens

Inzoomslag informatievoorziening vooraf: **Welke zoektermen** gebruiken **reizigers met een mobiliteitsbeperking** voor informatie over zelfstandig gebruik van hulpmiddelen op Schiphol, en hoe kan gerichte website-informatie **zelfstandigheid stimuleren**?

ONGOING

Gericht op de potentiële zelfstandige reiziger

Modificatieformulier

Vul dit formulier zo compleet mogelijk in. Denk daarbij ook aan het meesturen van plattegronden en bij voorkeur ook foto's van de huidige situatie of de gewenste asset. Stuur het ingevulde formulier naar: **Asm_modificatie@schiphol.nl**. De accountmanager zal de scope doornemen op volledigheid van de funtionele scope.

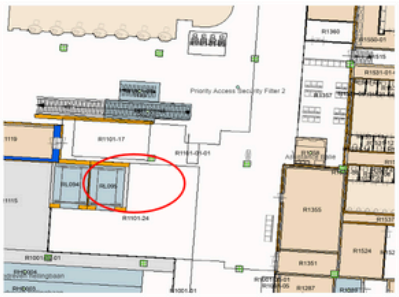
Naam aanpassingsverzoek:	Afbakening rolstoel opstelvakken (Axxicom)
Datum aanvraag:	10-10-2024
Naam proceseigenaar:	Femke van Veen
Naam contactpersoon:	Florien de Lange
Afdeling conform Assetmanagent:	A/O/PLPM/PSS
Kostenplaats:	21605

Wat is de achtergrond en functionele vraag van het aanpassingsverzoek?	Graag zouden we afbakening door verschillende soorten hekken plaatsen op verschillende locaties. Het doel is om rolstoelen netjes op te stellen. Verschillende hekwerken zijn: - hekken waar reclameborden in te plaatsen zijn (vb: zoals in aankomsthal, zie figuur 1) - lage stalen balken - hoge stalen hekken
Wat is de gewenste oplossing?	Assistentiebalie Axxicom vertrekhal 1: 1x lage stalen balk en 1 x hoog stalen hek Assistentiebalie Axxicom vertrekhal 2: 1x hoog stalen hek Assistentiebalie Axxicom vertrekhal 4: 1x lage stalen balk Rolstoel opstelvak (nieuw) aankomsthal 2: 2x hek waar reclameborden in te plaatsen is Rolstoel opstelvak Schiphol plaza: 1x hek waar reclamebord in te plaatsen is Rolstoel opstelvak WTC gang: 1x hek waar reclamebord in te plaatsen is
Wat is de gewenste opleverdatum? Met welke urgentie (hoog-midden-laag) wil je contact met de MC?	Zo spoedig mogelijk
Zijn er afhankelijkheden bekend? (denk bijvoorbeeld aan andere projecten, naastgelegen ruimten of andere klanten)	Axxicom voor opslag rolstoelen SDBV voor karrenregulatie
Wat is de locatie/ het locatienummer en welk type assets betreft het?	Rolstoel opstelvak/karrenvak assistentiebalie Axxicom vertrekhal 1: R1001 Rolstoel opstelvak assistentiebalie Axxicom vertrekhal 2: R1101-24 Rolstoel opstelvak assistentiebalie Axxicom vertrekhal 4: R1101-15 Rolstoel opstelvak (nieuw) aankomsthal 2: aankomsthal 2 Rolstoel opstelvak Schiphol plaza: naast de lift van perron 3/4 - R0801-18 Rolstoel opstelvak WTC gang: einde eerste rolband WTC gang, bekeken va
Overige opmerkingen:	

Plattegronden

GEEF DE PLATTEGROND VAN DE RUIMTE MET EEN STUKJE OMGEVING (bijvoorbeeld uit SGIS) WEER

GEEF IN DE RUIMTE AAN WAAR DE AANPASSING ZICH BEVIND

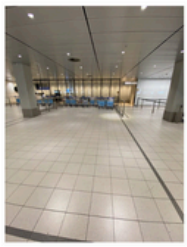


Ingediende modificatie

Foto's

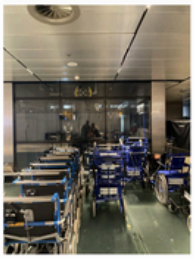
GEEF HIER FOTO'S VAN DE SITUATIE ZODAT OMGEVING LOCATIE INZICHTELIJK IS. EVENTUEEL IN DE FOTO LOCATIE AANGEVEN

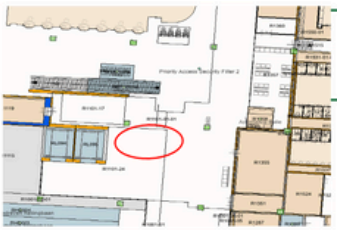
Assistentiebalie Axxicom vetrek 1



Figuur 1: vb hek met reclamebord

Assistentiebalie Axxicom vetrek 2



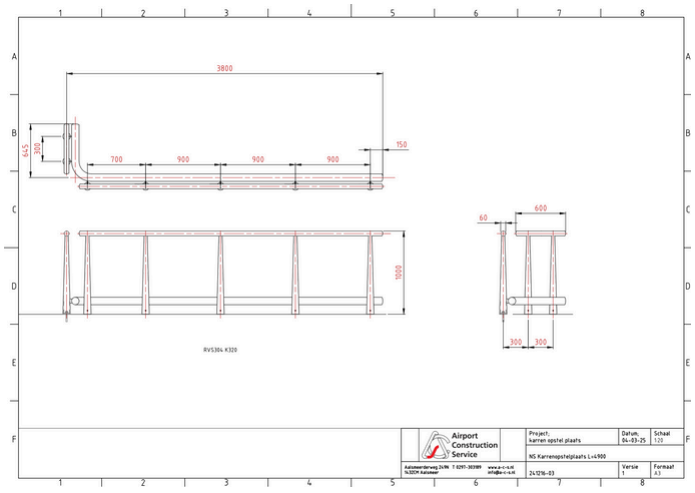


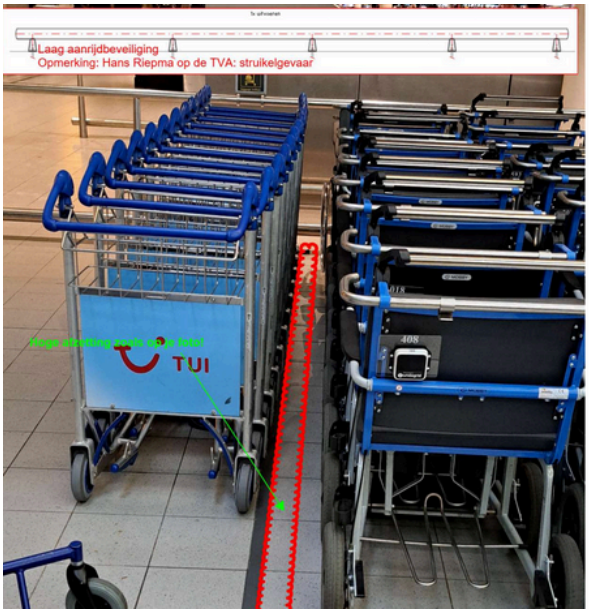
Assistentiebalie Axxicom vertrek 4

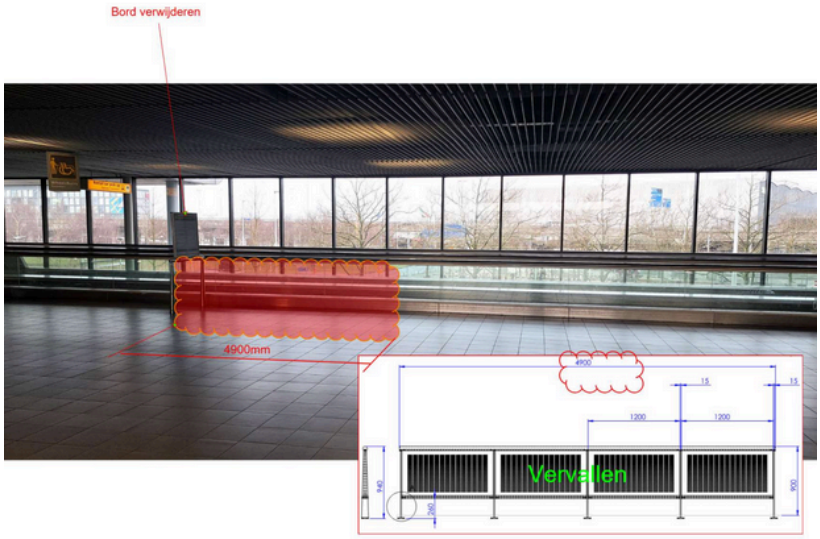
Schiphol Plaza - boven spoor 3/4

Traverse WTC

Aankomst 2







Uitwerking opstelvakken

Blog leenrolstoel

Wil je een rolstoel lenen op Schiphol? Dat kan!

Vliegen is een geweldig avontuur, maar om in het vliegtuig te komen moet je vaak langere stukken lopen op de luchthaven of sta je veel te wachten. Gelukkig heeft Schiphol voor iedereen die wat minder lang kan staan of minder ver kan lopen een leenrolstoel beschikbaar. En die rolstoel mag je gewoon zelfstandig gebruiken én je hoeft je er ook niet voor aan te melden. Hoe het werkt, lees je in dit blog.

[Foto Leenrolstoelen]

Leenrolstoel zonder assistentie
De leenrolstoelen zijn gratis te gebruiken en je hoeft je er niet voor aan te melden. Je vindt de leenrolstoelen op Schiphol Plaza, in de vertrekhal of op weg van parkeerplaats P1 naar de vertrekhal. De rolstoel kan je gebruiken tot aan de gate waar je vlucht vertrekt. Je mag er dus mee door de securitycontrole. Zie je geen rolstoelen staan of zijn alle rolstoelen in gebruik? Ga dan naar de assistentiedesk in de vertrekhal. De assistentie wijst je dan naar een beschikbare leenrolstoel.

[Foto's locaties leenrolstoelen]

Zelfrijdende rolstoel gebruiken
De leenrolstoelen die voor de security- en paspoortcontrole staan, zul je met spierkracht moeten voortbewegen. Eenmaal door de paspoortcontrole kan je overstappen in een zelfrijdende rolstoel. Dit werkt heel eenvoudig: je hoeft alleen maar je gatenummer aan te geven en de rolstoel rijdt je automatisch naar de juiste plek. Ben je bij je gate? Dan stap je uit de rolstoel, die zelf terugrijdt naar het beginpunt. Je vindt de zelfrijdende rolstoelen in Lounge 2 naast de Bubbles bar en in Lounge 3 tegenover House of Tulips. Zoek op 'Self-driving Service' op de plattegrond van Schiphol.

[Foto/video zelfrijdende rolstoel]

Wel een rolstoel met assistentie nodig?
Voor de leenrolstoel hoef je geen assistentie aan te vragen, maar mocht je het toch prettig vinden dat een assistant je begeleidt naar je vliegtuig, dan kan je op Schiphol ter plekke assistentie aanvragen. Je kan dit doen via de assistentiedesk in de vertrekhal of via een van de belpalen met het assistentie logo. Weet je al bij het boeken van je ticket dat je assistentie nodig hebt? Vraag dit dan meteen aan bij je luchtvaartmaatschappij.

Lees hier meer over assistentie aanvragen >

Commented [LF1]: gratis en zelfstandig (zonder assistentie). Dit moet hieruit blijken.

Commented [LF2]: reserveren, het staat al los van assistentie

Commented [LF3R2]: Aanmelden hoort bij assistentie en reserveren hoort bij een rolstoel (maar reservren hoeft dus niet)

Commented [LF4]: plattegrond locaties

Commented [LF5]: balie

Commented [LF6R5]: Nederlands: assistentiebalie, Engels: assistance desk

Commented [LF7]: daar (bij de genoemde balie). Assistentie eruit laten om verwarring te voorkomen

Commented [LF8]: Het moet meer blijken dat het twee opties zijn. Nu lijkt het alsof je moet overstappen na security op de WHILL.

Commented [LF9]: Deze zin ook bij het kopje Leenrolstoel zonder assistentie, maar dan in de juiste termen daar

Commented [LF10]: vraag je geen assistentie aan. "Het gebruik van de leenrolstoel valt niet onder assistentie/geen vorm van", maar oocht je het toch prettig vinden...

Commented [LF11]: Dit willen we eigenlijk niet. juist wijzen op dat ze dan vooraf assistentie aanvragen. Ter plekke kan, maar is het laatste redmiddel. Belangrijk dat het in een lijn is met de tekst onder de link

8. Thematic Analysis

1. Passengers value Independent mobility

PRM passengers value autonomy and want to manage their own journey without relying on staff or inflexible systems. Independence must be supported.

- PRM mobility must be flexible and adaptable to different needs
- A one-size-fits-all solution does not work; systems must suit both frequent and occasional travellers.
- Additional services should enhance, not reduce, user autonomy.
- On-demand assistance supports independence and control.
- Autonomous mobility helps reduce reliance on staff while increasing freedom.

2. Clear information builds trust

Many current frustrations are rooted in unclear or missing information, both before and during the journey. Trust in the system starts with clear, accurate, and consistent communication.

- Lack of pre-travel information causes uncertainty and stress.
- Clear and on-time communication is key for passenger confidence.
- Information should match reality (e.g., availability and locations of wheelchairs).
- Digital tools must provide real-time updates and route visibility.
- Passengers must be informed from the moment they plan their trip.

4. Infrastructure shapes usability

Navigation is a fundamental part of travel. Infrastructure should support intuitive movement, clear orientation, and seamless transitions.

- Airports must offer intuitive, well-placed wayfinding.
- Poor signage or missing references reduce autonomy.
- Positioning and location choices influence physical comfort and accessibility.
- Strategic wheelchair placement boosts confidence and efficiency.
- Infrastructure should support logical and efficient travel routes for PRM.
- Smooth navigation is more important than speed.

5. Reliable service needs clear ownership

The availability, quality, and reliability of facilities directly affect the user experience. PRM solutions must function consistently, comfortably, and predictably.

- Wheelchairs must be functional and regularly maintained.
- Locations must always be stocked.
- Comfortable and calming waiting areas reduce stress.
- Luggage transport should be integrated into self-service mobility.
- Digital systems must work reliably in the airport context.

3. Accessibility starts at the core

Accessibility is not a luxury—it must be embedded from the very start of the design process. *Simplicity, usability, and universality* are essential for true inclusion.

- Accessibility should follow Universal Design and Shift Left principles.
- Interfaces must reduce mental load and be easy to use.
- Self-service must work for users with cognitive, physical, and sensory needs.
- Design must consider different levels of airport literacy.
- Cultural intelligence supports global usability.
- Digital and physical interaction improves accessibility.

6. The service should adapt to cxternal change

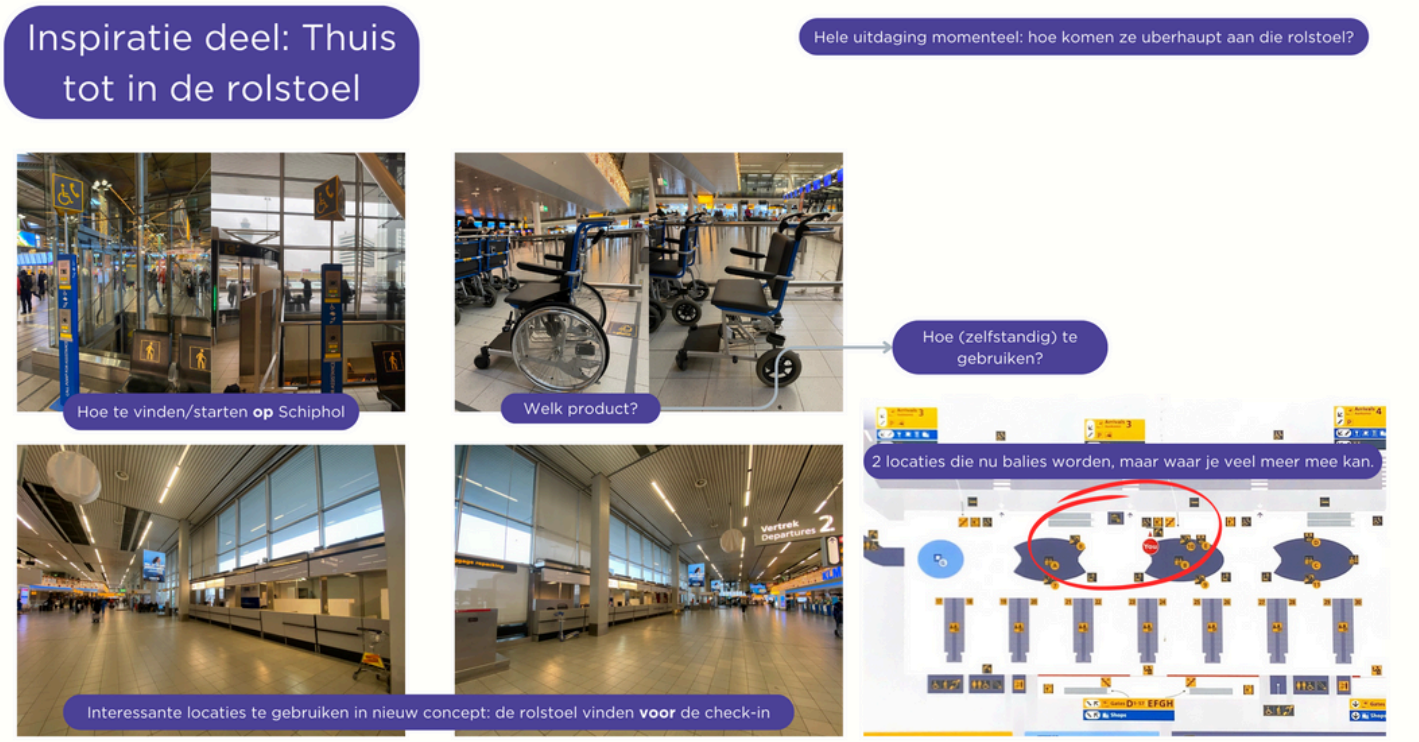
The service must operate within a broader context of evolving legislation, technological opportunities, and sector-wide best practices.

- European regulations demand equal access and free assistance.
- PRM training and cross-sector standards improve consistency.
- Technology (e.g., NFC, IPS, AI) enhances service quality.
- Other sectors like cruise ships and festivals offer best practices in PRM.
- Political decisions and international pressure shape airport policy.

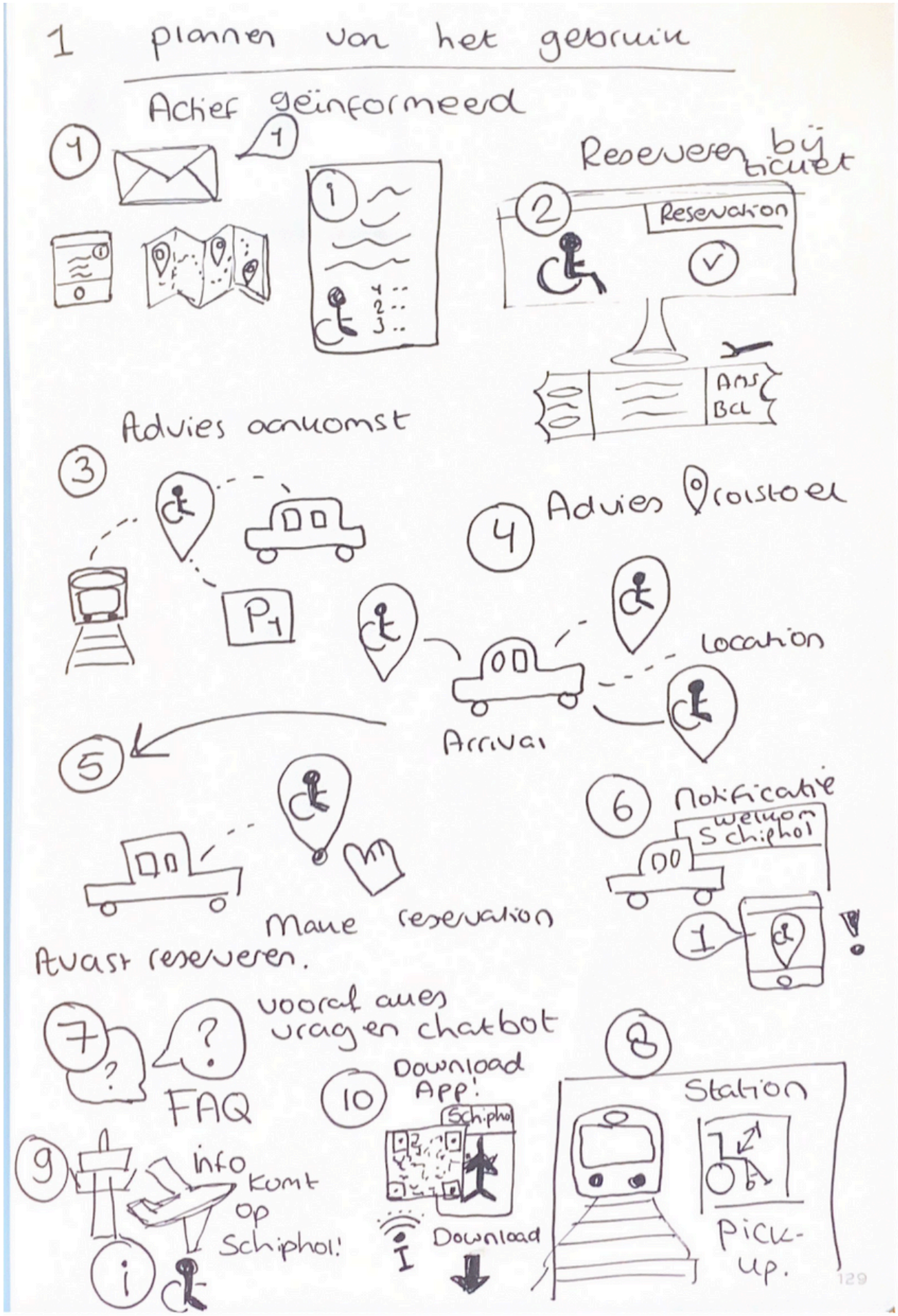
Focus on Passenger Experience

Focus on Organizational Value

9. Exploring the Problem



10. Sketches Ideation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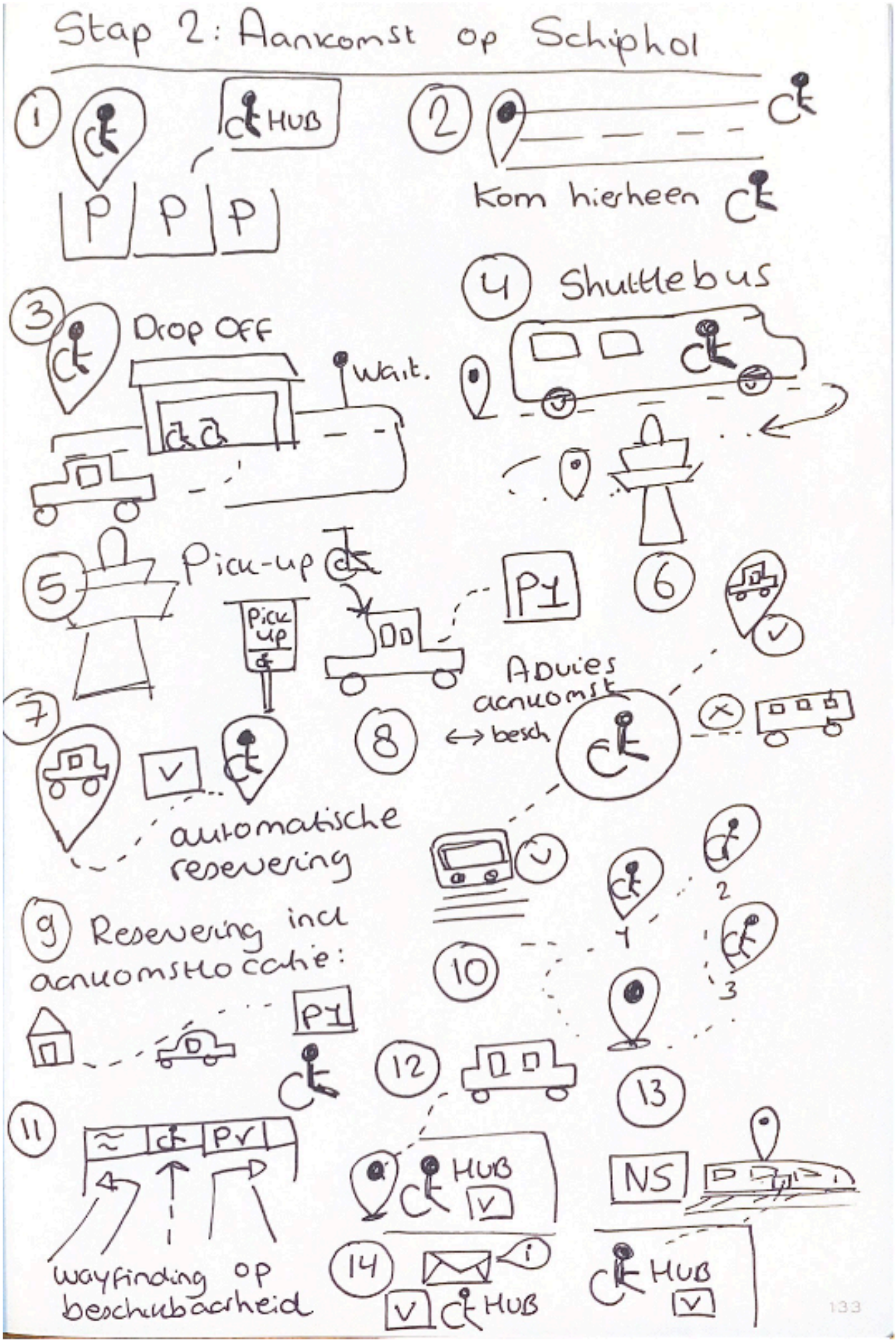
Stap 2: Aankomst op Schiphol
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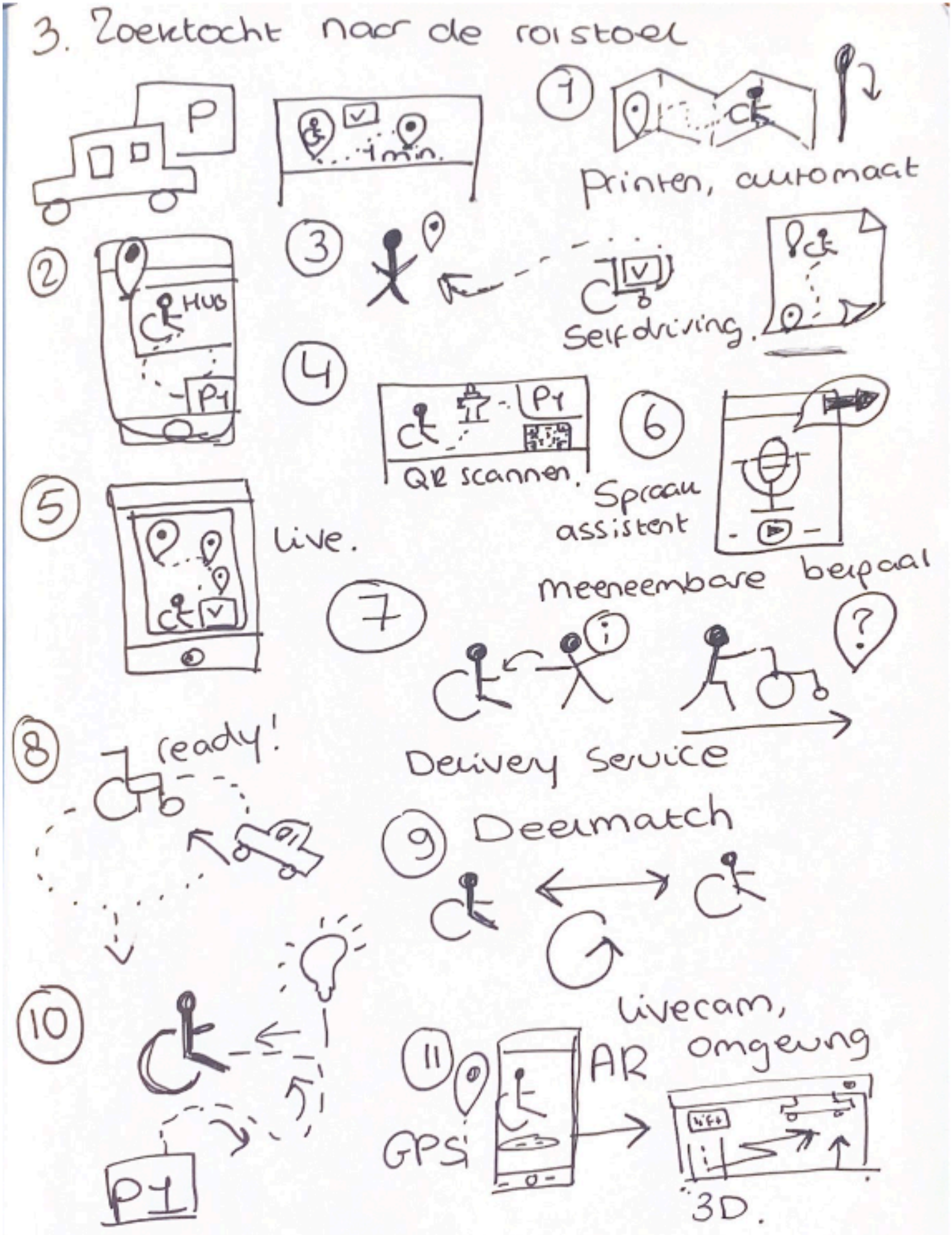
HUB
133


3. Zoektocht naar de rolstoel
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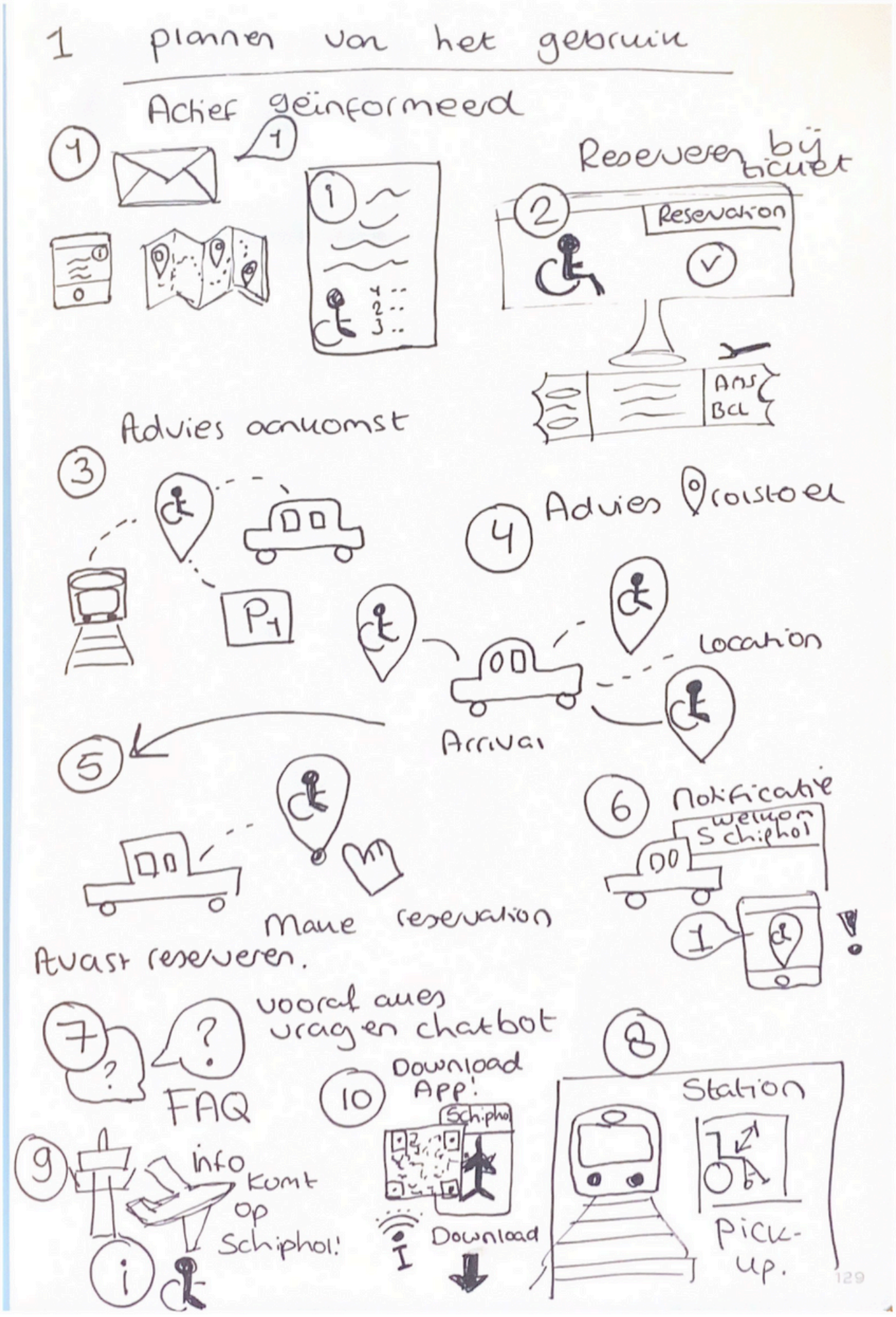
1 plannen van het gebruik
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Advies aankomst
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Advies rolstoel
location
Arrival
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Make reservation
Ruim van tevoren reserveren.
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vooral alles vragen chatbot
8
Station
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Schiphol
Download
9
info komt op Schiphol!
i
Pick-up.

11. Expert Interviews

Action Research: Karen and Marianne:

Summary – Test Day Action Research Karen and Marianne

As part of this research, a test day was conducted starting in Leiderdorp and continuing at Schiphol Airport. The goal was to explore the user experience of passengers with reduced mobility (PRM) and identify friction points in their journey — from departure to arrival at the terminal.

Participants received preparatory instructions in advance, in line with a briefing provided beforehand. Following the field experience, semi-structured interviews were conducted to reflect on the process. Interview questions are available upon request.

Key Findings:

1. Desire for Certainty and Pre-Trip Clarity
2. Participants expressed a preference for having all necessary information arranged beforehand, such as parking locations, wheelchair pickup points, and assistance options. This desire stemmed from a need for security and clarity in what to expect, especially when traveling with someone requiring mobility support.
3. Parking Frustrations and Accessibility
4. Although signage to P1 was initially clear, once on-site, participants found it difficult to navigate. The relevant entrance for proximity to the traverse level was unclear, and accessible parking spaces were either limited or not meaningfully close to assistance points. This led to frustration, uncertainty, and logistical challenges when handling both a vehicle and a wheelchair user.
5. Wayfinding Gaps
6. Upon entering the terminal, signage toward wheelchair facilities or assistance points was minimal or missing altogether. Participants were unsure where to find a wheelchair, whether they were permitted to use those they found, and if assistance was nearby. Plattegronds (maps) and directional cues were either lacking or poorly timed in their placement.
7. Wheelchair Availability and Visibility
8. Several wheelchairs were found in non-designated areas, without clear markings indicating public use. This created confusion and hesitation about whether they could be used. Participants emphasized the need for clearly marked loaner wheelchairs and consistent placement at expected locations.
9. Emotional Experience
10. Although participants began the day with trust in the system, unclear information and wayfinding quickly led to feelings of frustration, uncertainty, and stress. Particularly for those unfamiliar with the airport environment or traveling alone, the lack of guidance diminished confidence and self-reliance.
11. Recommendations for Improvement
    - Provide clearer pre-arrival information on where and how to access PRM facilities.
    - Improve signage, especially within and around P1 and the traverse level.
    - Establish designated drop-off areas or wider parking spots for PRM passengers.
    - Label public-use wheelchairs clearly and ensure their availability is visible and reliable.
    - Explore lightweight digital systems to reserve, track, or unlock wheelchairs.










We gaan op reis!

TU Delft Schiphol

Lieve Oma en Karen,

Wat ontzettend leuk dat jullie meedoen aan mijn onderzoek!

Jullie gaan terug in de tijd.. Terug naar dat onvergetelijke moeder-dochter uitje naar Griekenland! 🇬🇷 Een reis die na al die jaren nog steeds wordt besproken. Dit jaar maken jullie samen weer zo'n bijzondere reis, en ik mag met jullie meekijken hoe deze ervaring verloopt.

📍 **Praktische informatie:**
Om deze vlucht te "halen" worden jullie tussen 12:00 en 13:00 uur verwacht bij de incheckbalie. Lekker optijd 😉. We spreken om 10.30 af in Leiderdorp.

Doel van het onderzoek:
Een intuïtieve, aangename en efficiënte ervaring
Het onderzoek heeft twee belangrijke subdoelen:

- Inzicht krijgen in jullie ervaringen tijdens het doorlopen van het proces.
  - Welke uitdagingen en frustraties komen naar boven?
  - Wat vinden jullie juist prettig aan hoe het nu werkt?
- Creatieve en innovatieve ideeën opdoen om het proces te verbeteren!
  - Hoe kan het in de toekomst makkelijker, sneller of prettiger?

We doorlopen 7 stappen in de reis:

- Plannen van het gebruik (thuis, voorbereiding reis)
- Aankomst op Schiphol met vervoermiddel (auto, trein, taxi, bus)
- Verlaten van het voertuig en de eerste stappen richting de terminal
- Van voertuig naar de rolstoel (waar en hoe wordt deze gevonden?)
- Unlocken van de rolstoel (hoe werkt dit en hoe voelt dit?)
- Gebruik van de rolstoel (navigeren, bagage, toegankelijkheid)
- Terugbrengen/einde gebruik van de rolstoel

We zullen de stappen achter elkaar doorlopen zonder tussendoor te evalueren. Achteraf bespreken we uitgebreid hoe jullie dit hebben ervaren!

Wat verwacht ik van jullie?

Tijdens de reis: Denk hardop! 💡

- Waar denken jullie aan? Welke keuzes maken jullie? En belangrijk: Wat voelen en ervaren jullie?

Ik observeer en stel af en toe een vraag om het proces beter te begrijpen, niet om iets te sturen.

Na Afloop: Gezellig lunchen!

- Tijdens de lunch bespreken we de hele journey en reflecteren we op jullie ervaringen.

Ik stel jullie interviewvragen en samen kunnen we vrijuit ideeën delen over hoe het beter kan in de toekomst.

Wat moeten jullie voorbereiden en meenemen?

Bereid je voor zoals je dat normaal zou doen voor een reis!

- Denk aan alles wat je van tevoren zou regelen of uitzoeken
- Pak een (lege) koffer, zodat we het proces realistisch kunnen doorlopen
- Kies hoe jullie naar Schiphol reizen en waar jullie eventueel parkeren.
-

✨ Alvast heel erg bedankt dat jullie meedoen! Ik kijk er enorm naar uit en zie jullie morgen! 😊

Liefs, Florien

KL 1957 naar

Athens

Datum	Vertrektijd	Vertrekhal	Check-in balies	Nieuwe gate
4 feb	20:55	1	6-8	D86

Interview WHILL Alexander and Els

Summary – Test Day Action Research Karen and Marianne

On the first day of my internship, I joined Els and Alexander from the advisory group to test the WHILL autonomous wheelchair. Alexander experiences lung-related limitations, while Els lives with a muscular condition. Together, we explored how the WHILL functioned in practice and gathered their feedback on the concept of autonomous mobility. This session provided valuable insights into their perspectives and expectations regarding independent travel.

Opslag & Beveiliging

Vaste houder voor wandelstok: Een veilige plek waar een wandelstok kan worden opgeborgen om te voorkomen dat de gebruiker moet balanceren met tas en stok.

Opbergmogelijkheid tijdens het rijden: De rolstoel moet een opbergmogelijkheid hebben waar de passagier tijdens het rijden zelf bij kan.

Bagagevak met diefstalpreventie: Een afgesloten klep op het bagagevak of andere voorzieningen om diefstal te voorkomen.

Besturing

Spraakbesturing voor slechtzienden: De rolstoel moet voorzien zijn van spraakbesturing zodat slechtzienden deze gemakkelijk kunnen gebruiken.

Navigatie

Oproepen van de rolstoel: Oproepen van de rolstoel naar een locatie.

Tegenhouden van de rolstoel: Lege rijdende rolstoel die je tegenkomt kunnen remmen en gebruiken.

Gate wijziging: Bij gate wijziging kan de rolstoel naar de nieuwe gate rijden.

Toegankelijkheid

Liftgebruik: De rolstoel moet eenvoudig toegang tot liften hebben, zodat gebruikers alle gebieden kunnen bereiken.

Pauzestop en toiletbezoek: Het moet snel en gemakkelijk zijn om een pauzestop in te lassen voor een toiletbezoek.

Beschikbaarheid

Tijdslimiet van de rolstoel beschikbaarheid: De beschikbaarheid van de rolstoel van 8.00 tot 17.00 uur is te beperkt. Langere beschikbaarheid is gewenst.

Alternatieve assistentie bij lange wachttijden: Bij een lange wachttijd voor een terugkerende rolstoel moet er een duidelijk instructiebord zijn met een telefoonnummer dat men kan bellen voor assistentie/een andere rolstoel.

Veiligheid

Noodknop voor noodgevallen: Een stopknop of noodvoorziening moet beschikbaar zijn in de rolstoel voor onvoorziene omstandigheden.

Waarschuwingtekst: Ook aan de voorkant een signalering om andere mensen te laten weten dat de rolstoel zelf rijdt.

Onverstaanbaarheid tijdens omroepen op de luchthaven: De rolstoel ("step aside") is moeilijk te verstaan tijdens de omroepen op de luchthaven.

Verlengde tijd voor ouderen om af te stappen: De huidige 30 seconden om van de stoel af te stappen bij de gate is mogelijk te kort voor ouderen, wat paniek kan veroorzaken.

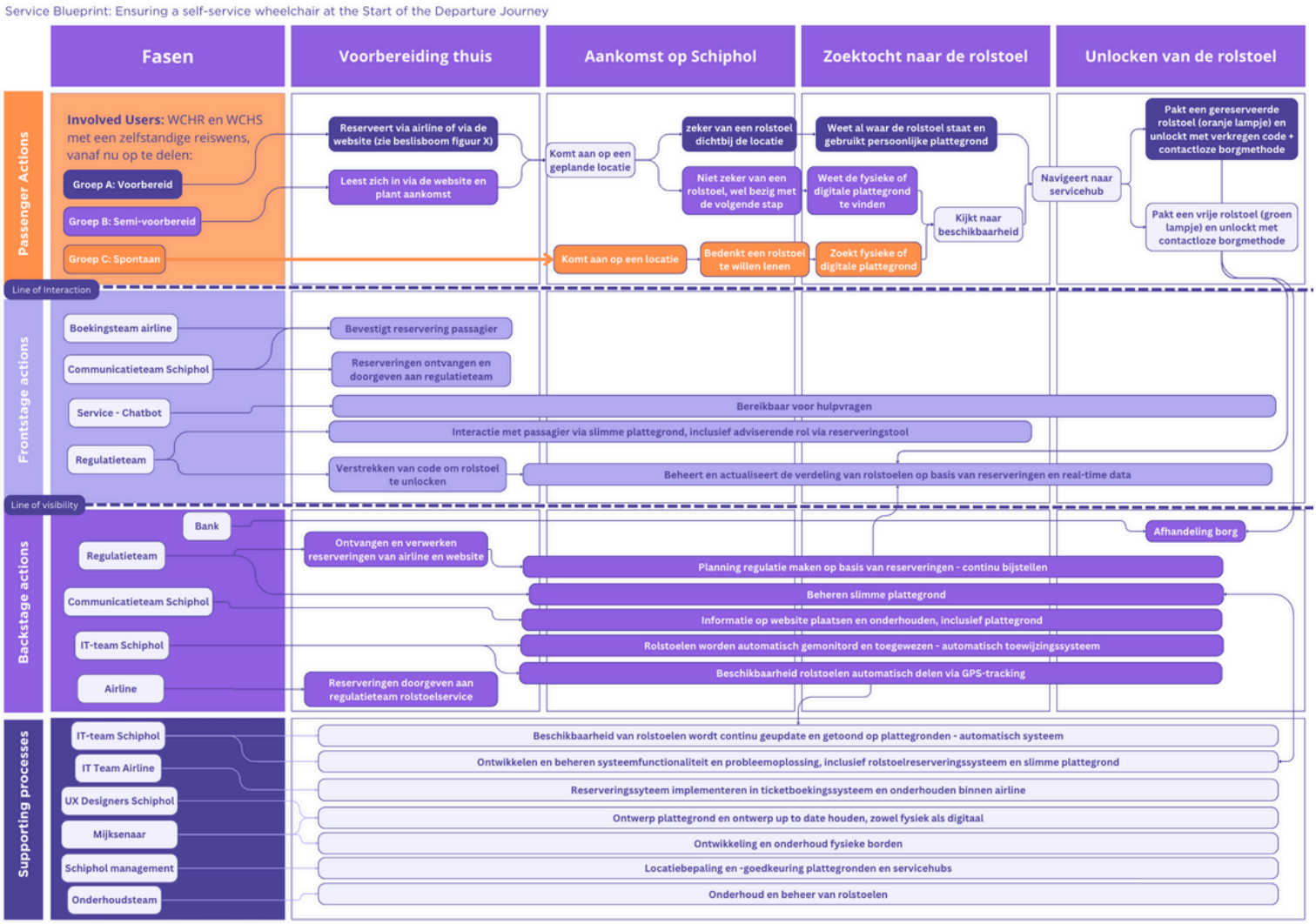
Interview Klankbordgroep

Sessions with the Klankbordgroep

Several interviews were conducted with members of the advisory group, each representing different perspectives within the PRM (Passengers with Reduced Mobility) community. Two participants had cognitive impairments due to brain-related conditions, one focused on air travel with autism, and another represented various advocacy organizations. These sessions provided a broad view of the diverse needs within the PRM target group, with a strong emphasis on the desire for low-stimulus, sensory-friendly travel experiences.

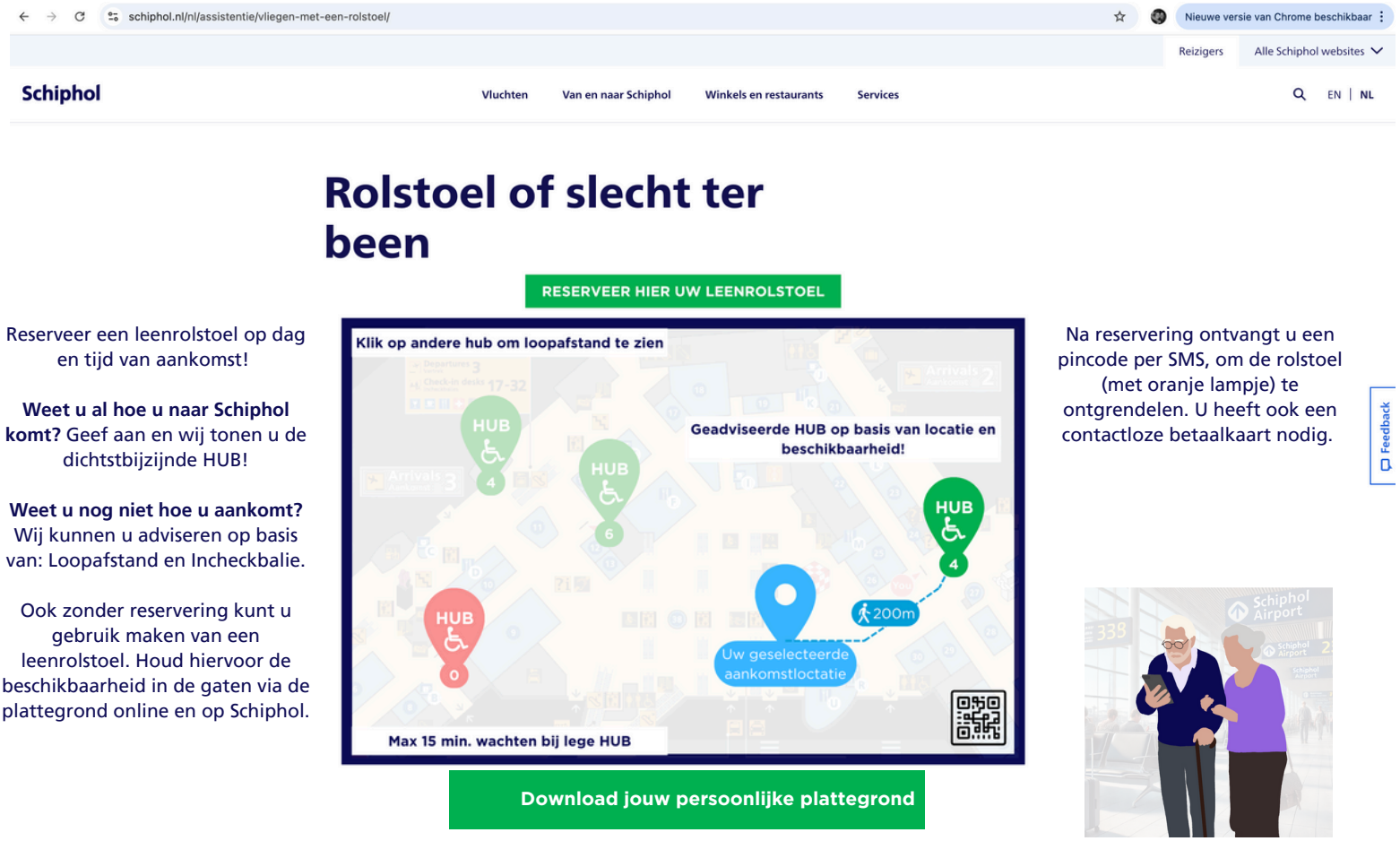
During these conversations, I explored in depth the topic of autonomous mobility and gained valuable understanding and empathy for the lived experiences of this user group. Attached are the transcripts of the session with Pieter van Oord and the field visit where I participated in the 'Flying with Autism' initiative.

12. First version Service Model

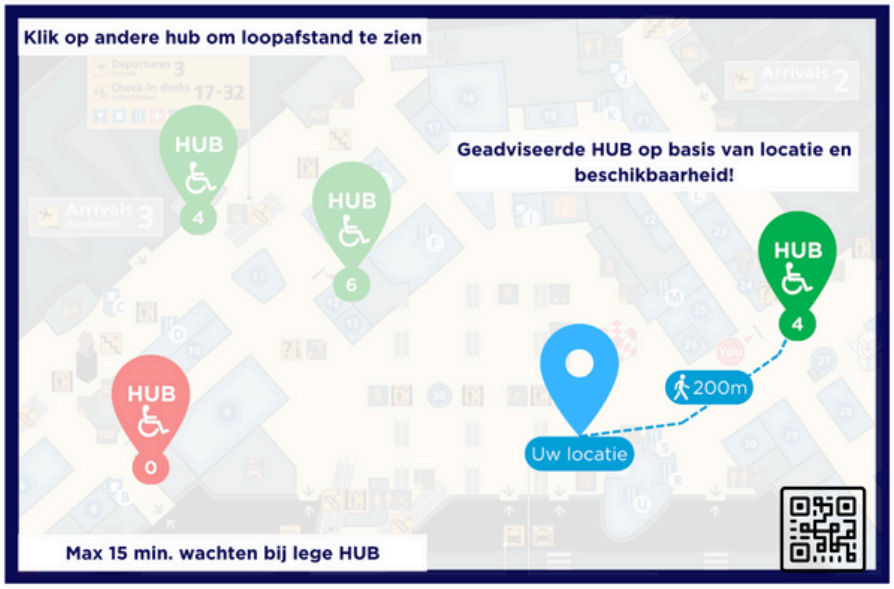


13. First thoughts Information Tool

Design an Information Tool



Een slimme plattegrond als centrale gids - digitaal en fysiek



Scan QR code om jouw persoonlijke plattegrond te downloaden

What

Digitale en fysieke plattegrond, waar de acutele beschikbaarheid van de rolstoelen op te vinden is.

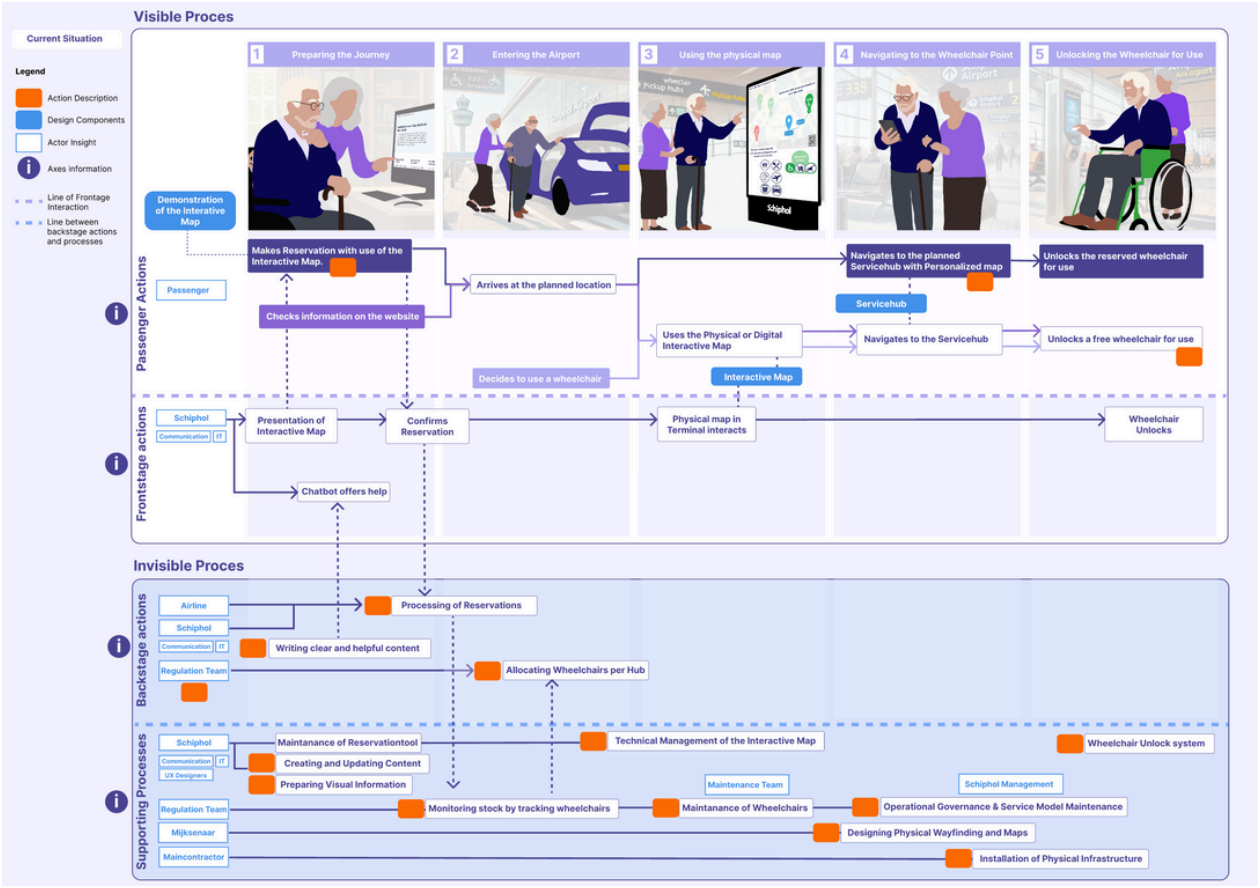
Why

- Visuele **houvast**: **één centrale gids** vanaf het begin van de journey, komt terug op alle punten
- **Real-time** beschikbaarheid
- Naar behoefte en afhankelijk van reizigersgroep fysiek of digitaal
  - **Reiziger A**: digitaal (en fysiek)
  - **Reiziger C**: Fysiek (en digitaal)
- Integreren Schipholbreed: alles komt samen op deze plattegrond
- Verhoogt zelfredzaamheid

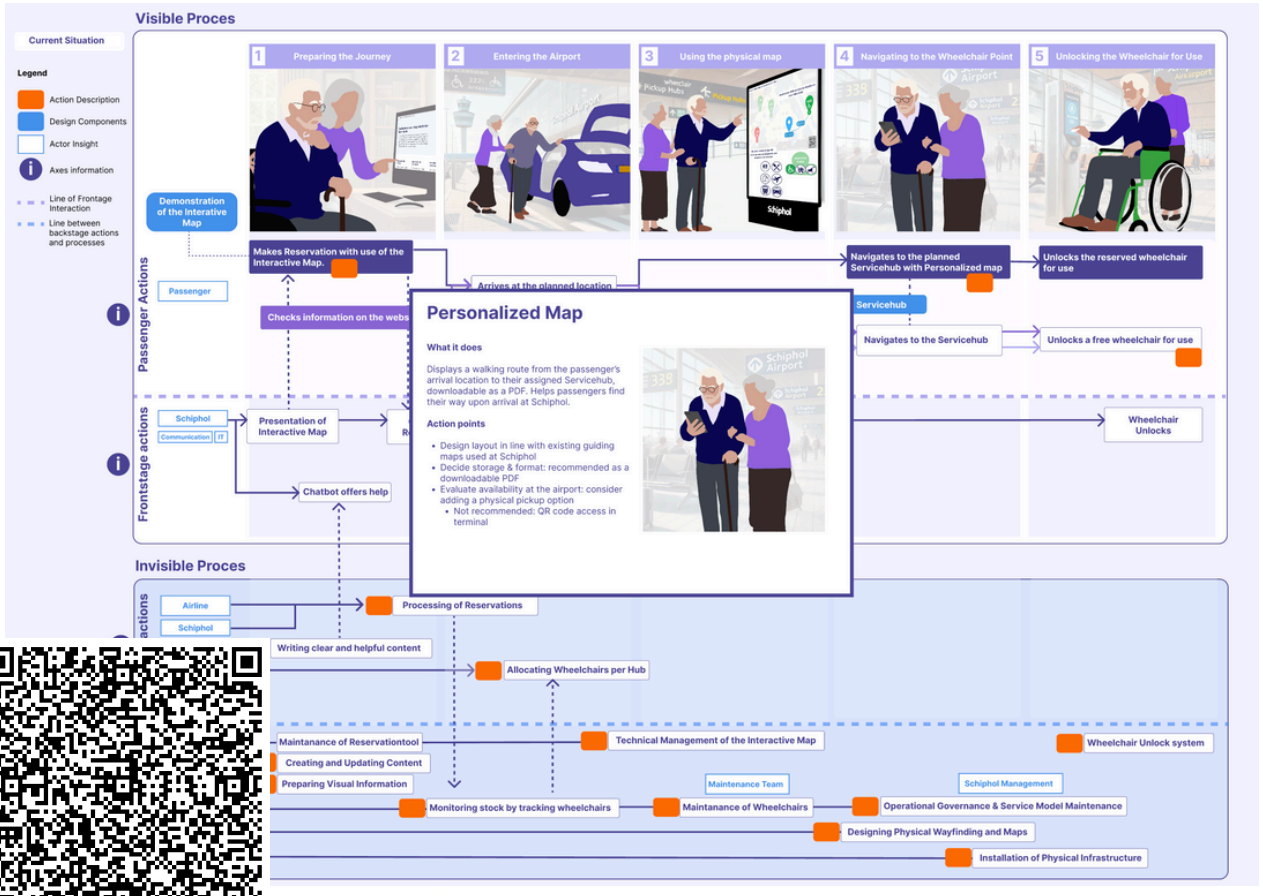
A. Voorbereid | C. Spontaan

DISCOVER DEFINE DEVELOP DELIVER
ANALYSE SYNTHESE

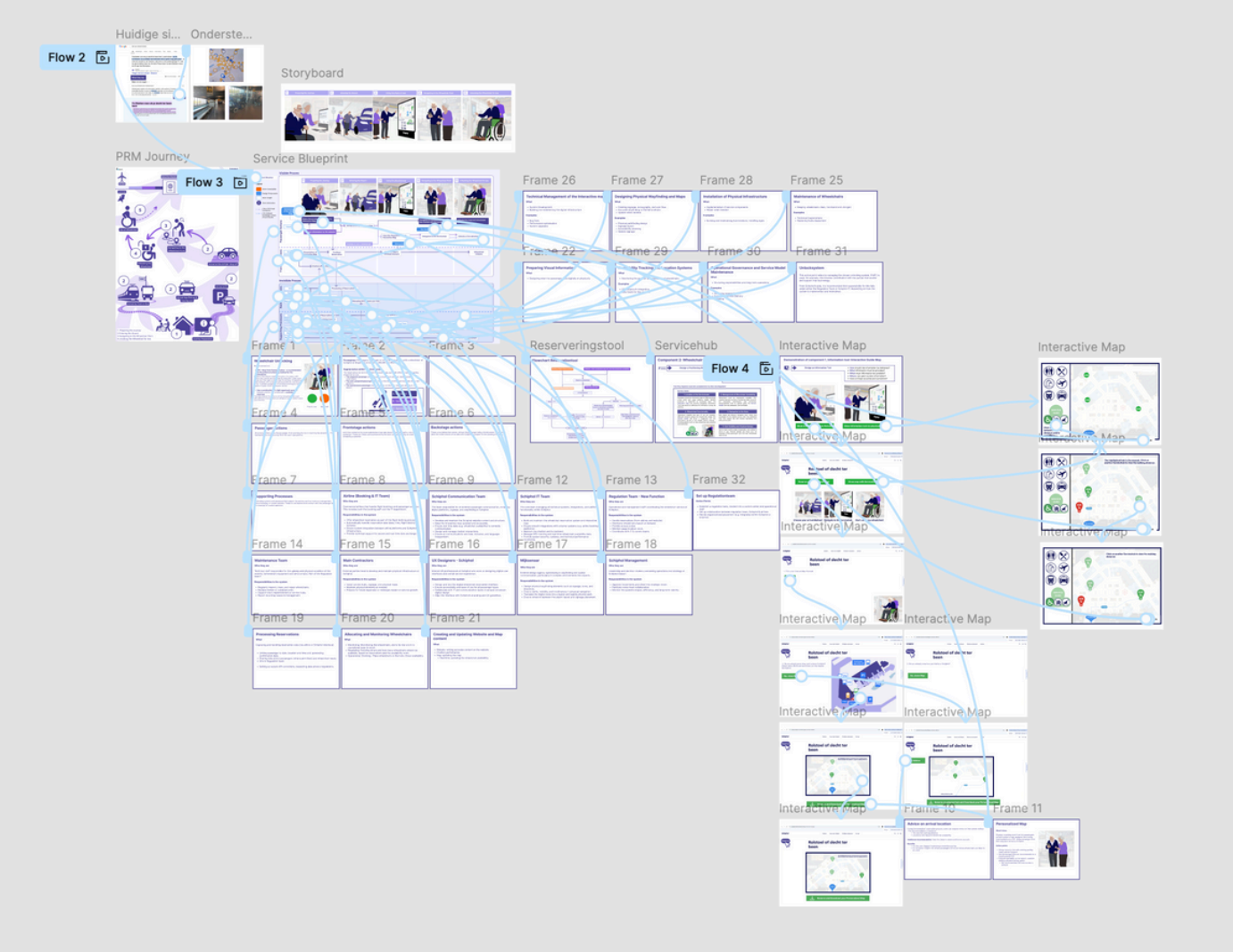
14. Second version Service Model



15. Service Model after Iteration for Implementation



Flow of the Service Model



Thankyou.